

**APPROPRIATE ENTREPRENEURIAL DEVELOPMENT PATHS FOR
HOMESTEAD FOOD GARDENING AND SMALLHOLDER IRRIGATION
CROP FARMING IN KWAZULU-NATAL PROVINCE**

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by

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EXECUTIVE SUMMARY

Background and motivation

In South Africa, most irrigation schemes are found where the incidence of rural poverty is the highest. For that reason, smallholder irrigation presents opportunities for reducing rural poverty through enabling farmers to produce multiple times a year, boosting productivity, raising income and enhancing rural employment creation and food security among rural households. However, the sector faces various challenges that have undermined its potential. Available evidence shows that smallholder irrigation, both in schemes and homestead food gardening, is performing below expectation. The sector is failing to support and make any meaningful contribution to rural livelihoods.

Under-performance of the existing smallholder irrigation crop production is of a serious concern to farmers who depend on them for their livelihoods and to the government of South Africa that has made massive investment in their development. Homestead irrigated food production, in particular, is in poor condition as it is not properly maintained to increase productivity and the timing of water supply is also unreliable. The wide gap between actual and desirable performance threatens the sustainability of the homestead irrigation crop production (Van Auerbeke, 2008). This state of affairs necessitates proper institutional reforms and comprehensive plans for implementation, starting from micro-level (plotholders level) so that productivity can be improved and livelihoods enhanced. Moreover, genuine participatory governance of the irrigation crop production at the micro level can yield benefits in terms of both efficiency and equity, by giving the water users a sense of ownership, by allocating their livelihood assets (resources) according to people's demand and by utilizing their skills, indigenous knowledge and other resources.

The country's long-term vision as stipulated in the National Development Plan Vision 2030 and other policy and strategy documents indicate the need to improve employment opportunities and economic livelihoods of rural communities through expanding the area under irrigation and increasing smallholder farmer participation in high value markets. In the program of action of the Presidency announced during 2010, Outcome 7 envisages vibrant, equitable and sustainable rural communities with food security for all. It is hoped that Output 4 will deliver improved employment opportunities and economic livelihoods. This includes a rising percentage of smallholder farmers

producing for market sales and an increased number of jobs in agro-processing. The last area of focus mentioned involves support for the establishment of new small businesses and related additional job creation. In this regard priority attention should, therefore, be given to encouraging existing and new farming businesses to be undertaken on smallholder irrigation schemes.

Project objectives

Given this background, the purpose of this study was to first take stock of the resource endowments/incentives and how these can be utilised to enhance the performance of smallholder irrigation. It also intended to assess the opportunities, challenges and prevailing constraints for expanding land under crop irrigation activities and determine strategies for unlocking the bottlenecks and improving productive use of irrigation water in smallholder agriculture. Ultimately, the study aimed to propose differentiated entrepreneurial development pathways for enhancing the contribution of the sector to the achievement of the national development objectives.

The general objective of the study has been to review and evaluate appropriate development paths for expansion from homestead food gardening to smallholder irrigation farming, increased water use productivity of crop production and improved livelihoods on selected smallholder irrigation schemes. To this end, the following specific objectives were pursued:

- To evaluate natural, physical and financial assets with specific attention to irrigation farming potential;
- To evaluate human and social assets with particular attention to entrepreneurial spirit and management capabilities within incentives of secure land tenure, water use rights and leadership in organisational structures;
- To determine sources of livelihoods and opportunities to improve contribution by farming within available food value chains;
- To determine the aspirations and goals of farmers to expand irrigation crop production from homestead food gardens to irrigation plots and/or from one to more than one irrigation plot; and
- To formulate and test appropriate development paths for establishing sustainable farming businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes.

Literature synthesis

The literature reviewed and the synthesis thereof has resulted in an in-depth understanding of the key imperatives in the context of KwaZulu-Natal such as sustainable rural livelihoods, opportunities and challenges in taking advantage of the premises of wealth at the bottom of the pyramid, expanding food gardening, psychological capital and farmers' entrepreneurial spirit. It also examined the principles and applications of water use productivity, security and scarcity in the context of irrigation farming in South Africa. Integration of these concepts/issues led to the development of a holistic conceptual model for the study. This gave a better understanding of the challenges holding up rural people from transitioning from homestead food gardens/subsistence farming to small-scale commercial farming and beyond.

The conceptual bases for the design, analysis and interpretations of the results in this research project will be drawn from the body of work including the sustainable rural livelihoods approach (Scoones, 1998; Carney *et al.*, 1999; De Satgé and Holloway, 2002; Ellis and Freeman, 2005); entitlement theory (Sen, 1981); behavioural economics (Simon, 1955; Tversky and Kahneman, 1974; Dawney and Shah, 2005; Ariely, 2008; Etzioni, 2011; Wilkinson and Klaes, 2012; Baddeley, 2017), psychological capital (Luthans, 2004; Luthans *et al.*, 2007, Luthans *et al.*, 2015; Luthans *et al.*, 2010; Simons and Buitendach, 2013); wealth at the bottom of the pyramid (Prahalad and Hammond, 2002; London, 2009); rural entrepreneurship, innovation & farmer entrepreneurial spirit (McElwee, 2006; 2008; Drucker, 1985; Kirzner, 1973); complexity economics (Arthur, 1999); and access to small-scale irrigation water, water scarcity and water use security (Yokwe, 2009; Young and Loomis, 2014; Senyolo *et al.*, 2014). Integrating all of these concepts/issues and developing a holistic conceptual model that guides the research is found critical to lay out the mechanisms and understand the challenges holding up rural people for managing transition from homestead food gardens to small-scale farming, then to small-scale commercial farming and beyond.

The research process and case studies

The research process was structured in various stages, namely (i) contextualization and establishing facts, (ii) exploratory survey, (iii) primary data collection from sample households/communities, (iv) data analysis, and (v) preparation of development pathways for typologies of farmers and validation. The research approach was participatory ensuring intensive

engagement of the research team with the rural communities and other relevant stakeholders in and around the irrigation schemes. The qualitative research activities that the team went through prior to the household survey included organisational mapping, focus group discussions, key informant interviews and questionnaire surveys. Input-output data were collected through weekly plot visits to address the recall problem.

The research was conducted in and around four irrigation schemes in KwaZulu-Natal (Makhathini, Ndumo-B, Tugela Ferry and Bululwane). Stratified random sampling was used to select the participants and a total of 674 smallholder farmers were interviewed (342 scheme irrigators, 99 independent homestead food gardeners, 68 independent irrigators, 76 community food gardeners and 89 non-irrigators). The total number of farmers interviewed per area are: Makhathini – 265, Tugela Ferry – 160, Bululwane – 137 and Ndumo-B – 112. The total number of focus group discussion conducted with farmers was 21 (Ndumo-B – 4, Makhathini – 8, Bululwane – 4 and Tugela Ferry – 5).

Recognizing the importance of understanding farmers' decisions and behaviour to agricultural and rural development, the study took a psychological and behavioural economics perspective to provide the road map to realize the returns on investment in the smallholder irrigation sector. Several qualitative and quantitative methods of data analysis were used, i.e. descriptive statistics, multivariate statistics (principal component analysis and cluster analysis), regression analysis (e.g. least squares regression, general linear model, double hurdle, mixed logit, Tobit, Heckman and ordered logit models) and thematic content analysis.

Assets for homestead food gardening and smallholder irrigation farming

The study started off by evaluating smallholder natural, physical and financial capital endowment in the four study areas. Accordingly, these endowments in the rural areas include land, water, irrigation infrastructure and farming equipment, storage facilities, financial capital and the credit options (especially the informal ones such as '*mashonisas*'). The different forms of capital complement and reinforce each other, i.e. access to one form facilitates access to another or enhances the productive use of the other. The findings suggested that more intervention is required to enhance access and better utilise the available capital assets and increase the competitiveness of smallholders. For instance, access to credit is mostly limited to informal loans at high interest rates and there is little or no credit accessible to smallholders through commercial banks or value chain

financing. The institutional arrangements need to be transformed for natural, physical and financial capital assets to be accessible and secured so that they contribute to meaningful rural livelihoods.

Farmers reported to have inadequate and poor-quality land and poverty of tenure security. From this study it is not clear what benefits privatization of individual land title would bring to improve productivity or investments in land when commons are governed collectively and effectively. This is especially the case as smallholders were not willing to use their land as collateral and also did not have production credit records or proof of income which is required by banks to get production credit. Therefore, customary tenure system was found to be appropriate in this study as it was inclusive, ensured sustainability of land and accountability of leadership. The communal land tenure policy was found to be consistent with what was happening at local level. Therefore, the study recommends that the roles and responsibilities of scheme committees be reflected in both the communal land tenure policy and the national water resource strategy as a body that is responsible for land and water in the irrigation schemes. Agency control tenure systems need to be more inclusive in decision-making as it affects smallholder production. Going forward, a provincial body of scheme committees is needed whereby smallholders will capacitate each other to collectively address the challenges they face related to water, land and markets. This body would also need to be represented in the policy formulation and can aid in policy implementation.

Access to water in and around the schemes is affected by high cost of water, limited access to irrigation equipment at plot level (e.g. sprinklers and pipes) and poor maintenance of irrigation infrastructure (e.g. pumps and canals). Recurrent drought is also reducing water availability. Generally, the state of physical infrastructure in the four areas, including roads, is rather poor. Ownership or access to other key physical assets such as transport, storage facilities and other agricultural equipment is also low.

When agriculture and other livelihoods fail, smallholder farmers depend mainly on social grants to survive. Findings show that rural household income is dominated by social grants (on average about 62 percent) distantly followed by crop income (22%), remittances (10%), casual employment (3%), permanent employment (2%) and arts and crafts (1%). For that reason, smallholders take farming as a supplement or ‘top-up’, not the main income source. This has profound policy and farm level ramifications. First of all, it destroys the incentive to identify ways and means of farming productively or investing in the farm. It negatively affects psychological

capital and mindset. Farmers' response to any policy intervention, among other things, depends on the importance of the income source to their livelihoods, i.e. the more important the income source affected by the policy, the more responsive farmers are expected to be. If two-thirds of smallholder income is unearned, i.e. most of their living is coming through no effort, not in their hands, how can one expect them to be self-confident let alone entrepreneurial? How can incentives work? How can one expect them to put effort into a livelihood strategy that is not the source of most of their living? How can we expect them to consider themselves as farmers, mobilize resources and exert the necessary effort? How can we make them believe that their own destiny is in their own hands?

Overall, the study has shown why it is of critical importance to take the mindset and human behaviour as the locus of interventions to improve the performance of smallholder irrigation schemes. The evaluation of the human and social assets focused on the extent to which smallholders (in and out of the schemes) in South Africa can run farming as a business and also the extent to which endowment in these assets, including psychological capital, enhance on-farm entrepreneurship and water use productivity. The concept of psychological capital was introduced to incorporate the farmers' key asset, their mindset and its impact on their capacity to make use of available opportunities despite the prevailing constraints. Transformation of the smallholder mindset is important for the success of the entrepreneurial development pathways. However, changing mindsets is complicated as the behaviour is entrenched over time and it is a process that requires a collective effort from all stakeholders, particularly those in education, extension and social security. Changing mindsets has to be a long-term objective targeting the youth in the rural areas so that they can be part of the rural economy, agriculture or otherwise.

Smallholders' entitlement to the other forms of capital (natural, physical and financial) determines the effectiveness of their entrepreneurial spirit and management capabilities. Thus, the incentives/disincentives introduced by the water and land rights issues affect the human, social and psychological drivers. Social and psychological endowments are enhanced if bottlenecks associated with these entrenched institutional issues are unlocked. Intervention strategies must be holistic, taking into account the important synergies and complementarities of the various forms of capital.

The major sources of information and training are government extension services, fellow farmers, social groups and local non-governmental organisations. Farmer-to-farmer sharing of information

signified the importance of social networks and relations in improving production and entrepreneurial capabilities of smallholder farmers. However, more than a third of the smallholders find it difficult to access information. Moreover, access to information alone is not enough if they have a limited capacity to process and utilise that information.

Entrepreneurial spirit, collective action and psychological capital

The results suggest that the on-farm entrepreneurship index generated was dominated by motivated farmers who perceived their farms as a means of making a profit and ambitious farmers who also understand how to motivate people. Gender, farming experience, education level, psychological capital, participation in scheme irrigation, main occupation and irrigation scheme distance from homestead statistically and significantly explained on-farm entrepreneurship competencies. Scheme irrigators were found to have the lowest levels of entrepreneurial competency. Capital endowment of any kind is not effective in isolation. Thus, government's exclusive focus on infrastructural investment, with no due consideration of the human and social dimensions of collective management of the schemes, has to be revisited. With male farmers being more entrepreneurially skilled than female farmers, entrepreneurial skills training needs to target women.

Better-educated farmers were found to have lower levels of on-farm entrepreneurship skills probably because the younger generation, often better educated, had very little interest in farming as a career. Therefore, government investment in smallholder irrigation for rural poverty reduction should continue but the sector has to be made more appealing for the youth. Improving the information communication technology infrastructure in the rural areas and enhancing the role of this technology in agriculture could be one of the focus areas of the intervention package. Going forward this is an issue the team will explore further through a new Water Research Commission project. Both organisational (functional) and human-centred aspects of sustainability of smallholder irrigations schemes have to be the key area of focus to improve their governance.

To address agricultural and rural development challenges, national policies often identify entrepreneurship as an appropriate intervention strategy for improving the performance of smallholder irrigation. However, to unlock entrepreneurship, a better understanding is required regarding smallholder farmer behaviour *vis a vis* the relevance/application of the concept of entrepreneurship to their context, their aspirations and heterogeneity.

The validity and applicability of the mainstream concept of entrepreneurship to the context of smallholder agriculture has not been examined in the literature. Such an analysis is important because it initiates discussions around what should change in policies and strategies for enhancing sustainable rural development through interventions that can unlock on-farm entrepreneurship. According to the findings, smallholders do not conform to the mainstream definition of entrepreneurship which is mainly the result of neoclassical economics paradigm. This does not, however, mean that such farmers cannot be entrepreneurial, but it highlights the need for redefining the concept to suit their context. The farmers' mindset is the maker and breaker of their entrepreneurial spirit. Embracing indigenous knowledge, the multipurpose nature of smallholder farming and heterogeneity and an enabling environment are the other important factors to cultivate on-farm entrepreneurship in the smallholder sector. To improve the performance of smallholder irrigation and unlock entrepreneurial spirit, a paradigm shift is required, putting smallholder behaviour at the centre for which the concept of psychological capital and behavioural economics are expected to play an important part.

Most smallholders exhibit tendencies synonymous with low entrepreneurial spirit. A considerable number lack confidence in farming and thus do not view smallholder farming as profitable in the long term. They are also not endowed with a business mindset. They also do not consider farming as a business, but a way of life and a significant proportion would not be in farming if they had other options. Most do not distinguish farm from family operations implying that one cannot tell if the farm is making a profit or loss. Only a few keep records, albeit inconsistently.

The key rural development challenges that have locked the entrepreneurial spirit include the poverty of the quality of services rendered to farmers (mainly training and agricultural extension), the poverty of cooperative governance, and issues related to access to water/land/finance/markets. Regarding credit, easy consumption credit at high cost is depleting rural livelihoods and making rural people vulnerable. Regarding market access, marketable surplus from irrigation farming is not earning farmers the income they deserve due to lack of profitable markets, high transaction costs and lack of norms of reciprocity, middlemen retaining most of the profit margin and farmers' failure to consistently supply the desired quality of homogeneous produce.

There is an inclination towards individualism by some farmers and lack of appreciation of the benefits of collective action. This is mainly the result of farmers' bad experiences with

cooperatives which has resulted in negative perceptions. Lack of transparency and nepotism in the cooperative leadership in the past have made most members lose faith in this organisation. For most farmers, becoming a cooperative member is driven by the desire to receive support from the government, not recognising the benefits of working together. However, the existing collective action arrangements offer smallholders better opportunities for market access (both input and output) and collective irrigation scheme management. Regarding market access, the key challenge is poor relations characterised by low levels of trust among the different players and lack of norms of reciprocity. The other challenge is the poor smallholder reputation when it comes to meeting their market obligation (in terms of volumes and quality of produce). There is also the lack of leadership in local organisations which affects the management of conflicts and collective action, rendering some of the organisations ineffective. Participating in scheme management as a committee member is voluntary and there are no proper incentives to encourage participation. The business plans for the schemes do not specify a plan for the formal transfer of ownership and management of the schemes after the government has invested in the infrastructure. When any part of the irrigation infrastructure breaks, farmers are expecting government to do the maintenance, rather than collectively taking over management and maintenance responsibilities.

Understanding the livelihood dimensions of different types of smallholders enables the assessment of the sources of livelihoods and opportunities for improving farming within available food value chains. Smallholder irrigation offers a better chance to run small farms as businesses and cultivating of certain crops that would have otherwise been impossible under rainfed conditions. For homestead and community food gardeners, farming is mainly a source of food and to a lesser extent income. For scheme and independent irrigators, farming is relatively more of a business, contributing to considerable income to the household. There are a few opportunities for earning off-farm income through temporary employment (mostly in the schemes). For smallholder irrigators in the target communities, farming is a key component of rural livelihoods and it is possible to enhance its contribution further.

The range of crops that farmers grow is widely diversified but cabbage, green maize and beans are the most important in terms of income generation. Organised and networked farmers have a stronger voice in price negotiations in the input and output markets resulting in reduced cost and increased profits. There is a market for cabbages even locally although the potential for earning more is in high value markets. Hawkers/van traders play an important role in the marketing of

agricultural produce. However, this comes at a cost to smallholders through lower farm gate prices. The transaction cost of participation in high-value markets is high due to lack of information and high transport costs. Furthermore, smallholder participation in markets is at the tail end only as producers of primary agricultural products. All farmers produce are sold raw. They do not process any produce and nor does any company exist to process and add value to the local primary agricultural produce. No manufacturing plants exist in the rural areas to process farmers' produce. It is, therefore, critical that development pathways engage value-adding rural enterprises and link farmers with high value markets, to which public-private partnerships will become critical. Crop quality and standards together with value-addition will enhance the competitive advantage of farmers in the market. Branding will also be important in marketing, especially if the products are organic and produced through a process that is more sustainable.

The potential to transform homestead food gardening and smallholder irrigation farming is complicated by the heterogeneity of smallholder farmers. Smallholders in and around the irrigation schemes have diverse attributes in terms of their resource endowments, objectives in farming, constraints, opportunities and mindsets. Future on-farm entrepreneurial development paths should be pursued based on the nature of the development domains (farmer typology) as each type of farmer would require different packages of technology, farming practices and other factors of production.

Expansion of farming activities is a preferred roadmap by most smallholder farmers, particularly scheme and independent irrigators. Relatively, few homestead food gardeners and more so community food gardeners are sceptical about the whole idea and hence have little interest. However, these could be individuals who follow a “wait-and-see” strategy and never show interest in something the first time they are told about it, or they might be those farmers who believe they cannot cope up with the demands of collective management of irrigation schemes and hence would rather remain with their small gardens.

Due to the heterogeneity and complexity of smallholder farming systems, smallholder entrepreneurial spirit and goals and aspirations to expand naturally vary which complicates the formulation and implementation of development pathways. This reinforces the need for understanding the complexity and heterogeneity of the system and designing tailor-made responses for the respective farmer typologies. For expansion to happen, aspiration and willingness to expand

are not enough. Both farmers' willingness and ability to expand are the key aspects that need to be understood. For expansion to happen, willingness must be accompanied by the necessary resources, managerial capacity and conducive institutional and policy framework. There is also a need for a mindset change so that the smallholders believe in themselves and are able to withstand the pressures of being a small farm business entrepreneur in a constantly changing environment. Empirical results show that factors that affect smallholder aspirations to expand land under irrigation farming in Makhathini and Ndumo-B are psychological capital endowment, access to credit, access to markets, social networks and land tenure security. Those that determine their ability to expand include market access, asset ownership and experiences in addressing local/social conflict. For Bululwane and Tugela Ferry, three key factors were found significant in influencing farmers' willingness and ability to expand, i.e. age, gender and household size. These factors, together with others identified through discussions with key stakeholders (e.g. water scarcity and inadequate irrigable land), present inherent challenges, endowments (such as access to land, water, markets, credit and other assets) as well as conditions for success (such as land tenure security, willing and able mindset, cooperation, collective action and collective governance of common resources) that will trigger expansion and entrepreneurship development.

The integration of positive psychological capital to the sustainable livelihoods framework is one of the unique features of this study compared to studies in the past. The findings show the role of positive psychological capital in taking advantage of opportunities, facing constraints, mobilizing/managing other resources. Farmers who are endowed with positive psychological capital (confident, hopeful, optimistic and resilient) were found to be more persistent and productive despite prevailing constraints and challenges (such as markets access). However, the results indicated that the majority of smallholder farmers had less confidence in themselves because, among other factors, over time, they have developed a dependency syndrome that government has to do everything for them.

Comparison between the different farmers showed that homestead food gardeners are poorly endowed with psychological capital compared to the other types of smallholder irrigators. For all farmers, there were three important aspects related to psychological capital that were found to reduce the interest and hence participation in expanding irrigated crop farming. These are resilience or capacity to absorb the impact of shocks, willingness and ability to take risk and capacity to delineate goals in farming. Also, even though farmers have positive psychological

capital, they still lack the skills and resources that they would need to strive in the whole value chain. It is clear from the findings that, owing to their poverty, most smallholders are not willing to incur the opportunity cost in the short-term to enjoy benefits in the long-term. They make short-term survival maximizing decisions at the expense of long-term profit and wealth creation. However, for them to establish successful farming businesses, they should be willing to forego immediate benefits for achieving sustained and long-term benefits in the future. The fact that farming is also not a preferred activity for making a living for a large segment of the smallholder population is in itself an inherent problem with multi-dimensional implications. This can be partly attributed to the unintended impact of unearned income on the effort smallholders put on earned income sources including farming and repeated failure of smallholder farming, especially rainfed. This means at any given time the smallholder might abandon farming if any better opportunity comes up and this is more pronounced among the younger segment of the population.

Scarcity of water remains one of the biggest threats to the expansion of smallholder irrigation farming activities. Current institutional set-up governing water sharing and management arrangements fails to support expanded irrigation activity in the target communities. Due to these institutional failures, farmers are equally divided over the issue of individual or collective irrigation farming. Lack of cooperation, i.e. lack of adherence to agreed cooperative rules and regulations, is cited as the major problem. Water disconnections due to failure by one or a few members to pay for water affect every member of the cooperative.

Currently available land in the four schemes would not be able to meet the expansion potential of farming activities in and around the irrigation schemes. This entails the need to invest in the expansion of the current schemes or identification of other sites for such development. Expansion of smallholder irrigation demands an investment in farming technology (including inputs and improved crop varieties) and equipment and hired labour, for which financial resources will remain critical. If expanding smallholder irrigation farming succeeds, it will also result in increased crop production and more marketable surplus. If this is not matched with improved market access and proper distribution channels, farmers might be worse off due to low farm gate prices. Farmers, like any other business people, need to make a profit to invest and expand the farm. Unless that happens, smallholder agriculture will not be attractive to the youth. Even though young people hold the greatest opportunities for expansion and growing the smallholder agriculture sector, they

will remain sceptical until they see the current farmers making a decent living from smallholder agriculture.

Development pathways

To develop appropriate entrepreneurial development pathways meant to establish sustainable businesses among smallholders engaged in irrigation, it was found imperative to develop and define the different typologies of farmers in the four irrigation schemes. The typologies were stratified and defined based on their asset base portfolios (including psychological capital) and entrepreneurial spirit to inform the respective development domains. Based on their asset portfolios, six farmer typologies were identified among smallholder irrigators. These are risk taking and opportunistic farmers (25.8%), ambitious, optimistic but social grant reliant farmers (24.2%), young and educated (19.7%), farmers with access to information but limited access to credit (9.7%), risk-taking and opportunistic but with limited access to credit (7.4%) and mixed farming and physical capital endowed (3.1%). Synchronizing their entrepreneurial spirit with features of an entrepreneurship that the literature suggests, two broad categories of smallholder farmers were identified, i.e. those with high (38%) and low (62%) entrepreneurial spirit. Smallholders with high entrepreneurial spirit were competitive, market-oriented and have positive attitude towards business planning. They also were responsible, able to manage their own affairs and cooperative. Smallholders with low entrepreneurial spirit are risk averse, reactive in the way they deal with problems, poorly endowed with social capital and do not have a positive attitude towards information seeking. They are also afraid of failure and do not view failure as a learning curve.

The study shows that agricultural policies and interventions targeting smallholder farmers in irrigation have to account for their heterogeneity and the complexity of their farming system. It affirms that the “one size fits all” approach does not work and technologies, extension services, farm management practices, innovations and development pathways should be context-specific and speak to the heterogeneity. The research demonstrated that heterogeneity in the smallholder irrigation sector happens at two levels, i.e. the farmer (psychological capital endowment, market access, collective action and access to credit) and geographic area or what can be called the spatial dimension of heterogeneity. At the farmer level, complexities are inherent due to differences in resource endowment and the ability of the farmers to identify and utilise available opportunities. Spatial differences in agricultural potential, livelihood assets, institutions and infrastructure that

enhance (or otherwise) market access will impact on the potential growth of the smallholder irrigation sector in each area. These aspects cannot be ignored when designing and implementing policies and interventions targeted at smallholder irrigators. However, accounting for this heterogeneity is a double-edged sword. On one side it complicates tailor-made policy formulation and on the other side, if there is capacity, it makes the portfolio of policies and strategies impactful and relevant. Due to its importance, the study also recommends the recognition and nurturing of psychological capital as a key livelihood asset.

Smallholders and their context do not conform to the common neoclassical and mainstream concept of entrepreneurship. However, this does not mean they cannot be entrepreneurial. It only highlights the need to redefine the concept to make it relevant in their context. The missing link is contextual relevance. The study demonstrated that not all smallholder irrigators have the potential to be successful on-farm entrepreneurs and this forms the basis for the development of the different entrepreneurship development pathways. Certainly, interest/willingness, capability and commitment are key in the whole process and farmers not keen and who are content with their *status quo* cannot be forced to participate in the on-farm entrepreneurship development programme. Government and its partners should be able to identify interested farmers with high entrepreneurial spirit for the programme. This is not to say that those not interested in expanding their smallholder irrigation activities should be ignored but depending on who they are, their current level of production and land use rights, among other factors, can also be targeted.

Interrogating the proposed development pathways showed that propositions and recommendations by the research team matched well with most of the challenges, propositions and preferences of the respective smallholder typologies. The exercise allowed triangulation of the fitness of the empirical research findings with the reality on the ground, thereby enhancing the appropriateness and relevance of the recommendations. Some of the suggested solutions by farmers are feasible in the short-run while others are feasible in the long run as they require more resources and time. There were also challenges that they thought had no solutions such as theft because it is difficult to monitor or prosecute, especially when it involves people from their communities. From the focus group discussions, it was clear that government and other stakeholders need to work very closely with the farmers. However, interventions by either government or other stakeholders must not promote a dependency syndrome but must target for collective solutions whereby farmers are also fully involved in their implementation.

There is a gap between academic discourse on policy and political action. In the study areas, there is too much research (going on and/or completed) and too little action. As a result, there is research fatigue and resistance from most farmers to respond to interview questions. The ‘knowledge-action gap’ is mainly the result of lack of collective engagement between the researchers and policy makers. No one owns implementation of the recommendations of the research. No one accounts for it and takes responsibility to make sure that it happens. When research is done exclusively for academic purposes, many respondents find it time wasting to participate which, in turn, affects the relationship going forward. Most of the researchers who collected information from the farmers before had never given feedback to the farmers, demonstrating how their results and the recommendations therein will help improve their livelihoods. This has obviously made farmers sceptical about participating in research. The research community has failed farmers in changing the knowledge stock to action, the so-called science policy disconnect. Researchers are mainly concerned about scientific integrity of their research and there is no political commitment on implementation. There is sheer lack of collective engagement of local people, researchers and implementers in developing research proposal, conducting the research, developing the recommendation and implementing the proposed solutions.

Policy and management recommendations

Overall, the study suggests smallholders are the way they are and finding it difficult to come out of the poverty trap not only because of their inherent features but also largely because of market/institutional/government failures and the poverty of the services they receive. To reverse this reality on the ground, the recommendations and policy implications of the study for consideration by the collective role players include:

- There is a need for collective action by all the relevant role players with a shared agenda and action plan. The various role player activities and processes need to be coordinated, synchronised and integrated and it is required to engage them all, along the value chain of developing and implementing the interventions. There is a need to create a collective platform so that the relevant stakeholders can be part of understanding the problem, developing the solutions and implementing them, with a deliberate focus on how to improve conversion of scientific knowledge to policy with rural development impacts. All the role players need to feel that the research and development project activities add value

to all the collective role players involved. The remaining challenge, though, is who should initiate the collective action and how can it be managed and materialized.

- It is also important to build public-private partnerships around farmer development initiatives. The private sector should become an integral part of developing smallholder producers through, for example, local procurement of their products and services and offering input and credit schemes for smallholder entrepreneurs. To address the market access challenge for smallholders, there is a need to explore avenues of enhancing farmers' bargaining power through collective marketing, collective production scheduling and contract farming. Farmers need to organize themselves to benefit from their own produce and tap into profitable markets.
- Mutual beneficial working relationships should be developed based on trust among farmers and other role players in the farm product value chain. To this end, it is critical to develop strategies that enhance smallholders' linkages with high value markets for key crops such as green maize, cabbage, beans, tomatoes, chillies and green peppers.
- There is a need to recognise that entrepreneurial activity is a continuous process rather than once-off individual event and entrepreneurship is a continuum, not a 'Yes or No' concept. As such, there is a need to measure smallholder entrepreneurship participation levels across a range of phases. Key imperatives to improve the relevance and applicability of the entrepreneurship concept to smallholders: integration of psychological capital and behavioural economics to explain on-farm entrepreneurship, fostering an environment that cultivates positive psychological capital and entrepreneurial spirit and embracing heterogeneity and complexity of the smallholder farming system. There is a need to design strategies (e.g. experience sharing platforms with successful farmers and rewarding excellence in sustainable farming) for developing and improving positive psychological capital and enhancing entrepreneurial spirit among smallholders.
 - Key issues that should be given attention in future efforts to enhance the entrepreneurial spirit and nurture positive psychological capital:
 - As dependency mindset is the result of many years of surviving on unearned income, changing smallholder farmers' mindset will take time; it starts with changing their income structure to make them earn most of their living;

- Concerned collective efforts to change the household income structure and increase earned income by smallholders – make them own their own living – make them believe in themselves and their endowments; and
 - Government and other stakeholders can only create an enabling environment and provide seed funding and seed support – in the long-term, smallholders must handle their farming activities in their own hands collectively or individually. Government and other role players should not be handing out resources whenever there is a gap.
- In the quest for improving the performance of smallholder agriculture, a paradigm shift is required to which the concept of psychological capital and lessons from behavioural economics are found to be of special relevance. This reinforces the need for recognizing, embracing and nurturing indigenous knowledge.
- The public focus must not be on handouts but on creating the incentives (land tenure security, water use rights, market access, access to credit and information and leadership in cooperatives) opening up opportunities and addressing the institutional/organisational bottlenecks necessary to boost the social and psychological endowments and unlocking rural entrepreneurial spirit and management capabilities in the context of smallholder irrigation.
- Leverage existing mechanisms (Micro Agricultural Financial Institutions of South Africa, Comprehensive Agricultural Support Programme, AgriBEE Fund, Small Enterprise Development Agency Funds, National Youth Development Agency Grant, Revolving Credit Fund, among others) including informal systems (e.g. stokvels) for financing smallholder farming so that they effectively support the sector.
- There is a need for a rational, integrated approach to the management of different forms of capital endowments to ensure profitability and competitiveness of entrepreneurs in smallholder farming.
- Government, through the Department of Agriculture Forestry and Fisheries, and its strategic partners should support farmers with skills training in improved agriculture production techniques (including integrated pest management), irrigation water management and business and entrepreneurial skills. Farmers need to be trained on the role and importance of record keeping, distinguishing family and farm operations and collective

action organisations. The government should invest more on the mentorship programmes for smallholder farmers to learn from the more experienced and entrepreneurial fellow farmers or large-scale commercial producers.

- There is a need to provide demand-driven extension services for each type of farmer that embraces technological developments (e.g. information and communication technologies) to remain effective and relevant. The extension support including value addition should focus on improving the quality of produce supplied to the market.
- Agricultural extension approaches need to target developing the psychological capital and entrepreneurial spirit of smallholders and supporting cooperatives deliver their mandate effectively. Furthermore, policies should assist in creating an environment that nurtures farmer entrepreneurial spirit that is supportive of smallholder entrepreneurs. This includes, but is not limited to, encouraging and incentivizing own effort rather than a culture of dependency.
- Young people must be given priority when planning future irrigation schemes and there must be proper incentive schemes targeted specifically for them. To change their attitudes towards farming, policies should deliberately create conditions that develop entrepreneurial spirit from a young age and encourage youth involvement in farming, not only as workers but also as owners of farming businesses. Young people should receive necessary training and exposure to be able to participate meaningfully in the whole value chain.
- There is a need to reform the social grant program. It is time to ask “What needs to change to address the unintended consequences of the social grant program that act as disincentives to entrepreneurship? Is there a need to redesign the social grant program? If so, how? Is increasing the number of social grant beneficiaries (currently taking 12% of government budget and 17 billion Rand) really a success story? Should it continue to be the major income source for smallholders? Can economic activities target those who are not in the program? Is there a room to make it in-kind?” These are questions that the government has to ask going forward.
- To enhance the role of collective action organisations, in consultation with cooperatives and farmer groups, the government should negotiate and enter into partnerships with

agricultural input suppliers and major markets for crop produce to facilitate access to inputs and reduce high transaction costs of marketing crop products beyond the local markets.

- The priority areas for improving access to agricultural credit and markets include value chain financing, reforming the existing government credit schemes and the integration of smallholder irrigation within existing value chain development initiatives. To better make use of irrigation schemes and enhance the role of the smallholder irrigation sector, there is a need to enable smallholders to achieve their aspirations through improving access to physical capital assets, addressing land security concerns and supporting institutions that promote social interaction and learning.
- The transparency, accountability and management capacity in the governance and operations of collective action organisations (especially cooperatives) should be improved through a deliberate focus on building trust and effective local organisations and governance structures.
- Water distribution infrastructure in all schemes should be regularly maintained and repaired through a collective scheme management structure to avoid loss of water and pressure along the system and ensure availability of water to all blocks of farmers. The government should find institutional mechanisms of transferring ownership and responsibility of the collective management and maintenance of the schemes. Investments in infrastructure and equipment (water pumps, water meters, pipes and sprinklers and canal systems) that increase water access, utilisation and efficiency are important in expanding irrigation farming operations. For those farmers far away from the schemes, there is a need to put in place water harvesting strategies.
- Conduct land audit to match currently available land and land required for expansion to identify the land gap and also initiate dialogue among the key players (government, tribal authorities and farmers) regarding land allocation challenges. There is a need to consultatively engage traditional leaders to facilitate rural land reform and allocation of unused land to pave the way for legally leasing and transferring to farmers who can productively use it.
- Gender mainstreaming in smallholder irrigation programmes is critical since most of those involved are women whose participation in economic empowerment activities is affected by the failure of programs to account for gender.

Future research directions

The following are the knowledge gaps identified for future research based on field work experiences of the team and literature reviewed:

- Qualitative research should be conducted to examine the social or psychological foundations of entrepreneurial mindsets. This will help build a solid understanding of smallholders and possible strategies for unlocking their entrepreneurial spirit;
- There is need to develop a behavioural/psychological entrepreneurship index. This can be the basis for assessing the level of entrepreneurship spirit among smallholder farmers;
- The stated preferences approach to measuring psychological capital employed in the study is limited in that it depends on how truthful farmers are in their answers. Farmers' self-rating of their psychological capital endowment could well result in inflated figures as the questions are hypothetical. For improved results, future research should develop a revealed preference-based entrepreneurship index/psychological capital index, working with a psychologist/behavioural specialist;
- More understanding is needed on household farm income vis-a-vis total household income. Future research should use census data to explain farm income as a proportion of total household income for smallholders in South Africa. There is also a need to link the level of on-farm entrepreneurial spirit among smallholders and their psychological capital endowment with the proportion of earned income. The argument is that those smallholders who earn the larger portion of their income are expected to be more entrepreneurial. Future studies should also link diversification strategies and the extent to which farmers utilise their resources at their full capacity with the proportion of earned income;
- Examine the role of crop and livestock integration on the productive use of irrigation water and on unlocking the on-farm entrepreneurship spirit;
- Explore further the impact of consumption credit on rural household welfare and the possibility of regulating informal organisations offering this credit. The major question is how to incentivize these organisations to shift focus to the provision of affordable production credit;
- Research is needed to test young people's attitudes towards farming and their level of entrepreneurial spirit to ensure that irrigation expansion programs by government become

a success. To this extent, future studies should use psychological capital and behavioural economics principles to help understand what influences the involvement of young people in agriculture;

- Given the heterogeneity of smallholders, there is need to characterise the ‘typologies of smallholder entrepreneurs’ and use this information to inform policies and interventions for transforming smallholder agriculture;
- Furthermore, given the changing climate, farming cannot be done as usual and it will remain necessary to adapt. There will be a need to examine the costs and benefits to smallholders of undertaking “climate smart agriculture”; and
- Further studies will be required on how psychological capital impacts water productivity of smallholder farmers to get more insights relevant for farmers, government and other stakeholders in the smallholder irrigation sector.

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LIST OF ACRONYMS

AgriBEE	Broad Based Black Economic Empowerment Framework for Agriculture
ARC	Agricultural Research Council
CA	Cluster Analysis
CAWMA	Comprehensive Assessment of Water Management in Agriculture
DAEA	Department of Agriculture and Environmental Affairs
DAFF	Department of Agriculture, Forestry and Fisheries (national)
DARD	Department of Agriculture and Rural Development
DFID	Department of International Development
NDA	National Department of Agriculture
DRDLR	Department of Rural Development and Land Reform (national)
DWA	Department of Water Affairs* (national)
DWS	Department of Water and Sanitation* (national)
ET	Evapotranspiration
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FGDs	Focus Group Discussions
GDP	Gross Domestic Product
GEM	Global Entrepreneurship Monitor
GM	Gross Margin
IDC	Industrial Development Corporation
IDP	Integrated Development Framework
IMT	Irrigation Management Transfer
KMO	Kaiser-Meyer-Olkin
KZN	KwaZulu-Natal
LAN 28	Limestone Ammonium Nitrate
LRAD	Land Redistribution for Agricultural Development
MAFISA	Micro Agricultural Financial Institutions of South Africa
MAP	Mono Ammonium Phosphate
MSLF	Modified Sustainable Livelihoods Framework
NARI	National Agricultural Research Institute

NDP	National Development Plan
NEF	National Empowerment Fund
NEPAD	New Partnership for Africa's Development
NGOs	Non-Governmental Organisations
NGP	National Growth Plan
NPC	National Planning Commission
NWA	National Water Act (of 1998)
NWRS-2	National Water Resource Strategy-2
NYDA	National Youth Development Agency
PC	Principal Component
PCA	Principal Components Analysis
PDAEA	Provincial Department of Agriculture and Environmental Affairs
PDARD	Provincial Department of Agriculture and Rural Development
PRA	Participatory Rural Appraisal
PsyCap	Psychological Capital
PTO	Permission to Occupy
RASET	Radical Agrarian Socio-Economic Transformation Programme
RCF	Revolving Credit Fund
SDGs	Sustainable Development Goals
SEDA	Small Enterprise Development Agency
SEFA	Small Enterprise Finance Agency
SEI	South African Environment Institute
SISs	Smallholder Irrigation Schemes
SLAG	Settlement/Land Acquisition Grant
SLF	Sustainable Livelihoods Framework
UNESCO-WWAP	United Nations Educational, Scientific and Cultural Organisation – World Water Assessment Programme
UNICEF	United Nations Children's Fund
US	United States
USDA	United States Department of Agriculture
WHO	World Health Organisation

WRC	Water Research Commission, South Africa
WUAs	Water User Associations
WUE	Water Use Efficiency

*DWA is now known as DWS

1 INTRODUCTION

1.1 Background

Of the developing world's three billion rural people, over two-thirds reside on small farms of less than two hectares; there are nearly 450 million smallholder farmers (Hazell and Rahman, 2014). These people include half of the world's undernourished people (Hazell *et al.*, 2007). The Census of Commercial Agriculture (2008) reflects a 31% decline in the number of farmers since 1993 in South Africa, resulting in the industry being left with fewer than 40,000 medium and large scale commercial farms. Based on data from South Africa Statistics labour force survey (2001 to 2007), Aliber and Hart (2009) noted that some 4 million people from over 2.5 million households, mostly residing in poor communities, are engaged in smallholder agriculture as a means of supplementing household food supplies. Thus, stimulating agricultural growth is "vital for stimulating growth in other parts of the economy" and smallholders are at the core of this strategy (World Bank, 2007).

Smallholder farmers are mostly subsistence producers and are often characterised as forming part of the rural poor. The emphasis is often on commonalities rather than differences in assets, income or investments. Frequently neglected in the literature are the dynamics of change and the underlying processes which clarify why some producers are more commercially orientated than others. Smallholder farmers are faced with unequal access to natural resources, infrastructures like storage facilities and rural roads, credit, the right technology, knowledge and skills and markets. Low levels of human capital are witnessed mostly in terms of nutritional, health and educational inadequacies (Thamaga-Chitja and Morojele, 2014).

In a considerable number of cases, rural poverty is caused by worsening access to natural resources which in particular include land and water. The sustainable development goals also require a reduction in poverty levels. Land and irrigation water are assets and their availability increases or reduces household capacity to produce income in combination with other assets. Irrigation schemes have particular importance in increasing agricultural production, productivity and enhancing social and economic development for poor countries. In South Africa, most smallholder irrigation schemes are found where the incidence of poverty is the highest (Van Averbeke *et al.*, 2011). Thus, smallholder irrigation schemes present an attractive opportunity for the development of local livelihoods. Where conditions are favourable irrigation schemes can raise the income of those farmers with access to irrigated land. Water management in agriculture may boost productivity and income by providing adequate water

throughout the growing season, thus contributing to higher yield, making water available and accessible, and providing a more secure supply of fodder for livestock. It also reduces the production risk and the need for farm output diversification, thereby encouraging farmers to gain the benefits of greater specialisation and commercialisation.

In the program of action of the Presidency announced during 2010, Outcome 7 envisages vibrant, equitable and sustainable rural communities with food security for all. It is expected that Output 4 will deliver improved employment opportunities and economic livelihoods. This includes a rising percentage of smallholder farmers producing for market sales and an increased number of jobs in agro-processing. Among the measures proposed, support for the establishment of new small businesses and related additional job creation is a key. In this regard, priority attention should, therefore, be given to encouraging existing and new farming businesses to be undertaken on smallholder irrigation schemes. The available evidence indicates that natural and human resources on most if not all smallholder irrigation schemes in South Africa are utilised far below potential. Given the semi-arid circumstances and potential impact of climate change, increasing emphasis must be placed on higher efficiency of water use under irrigation. For this purpose, ways must be found to enable more productive farming practices, more competitive and profitable farming on irrigation schemes. This, in turn, requires that an assessment be made of the goals and aspirations of current and potential farmers to improve the economic performance of farming enterprises (WRC, 2014).

Smallholder farmers have different sources of livelihoods which include both earned income (crop farming, livestock production, temporary employment, arts and culture) and unearned income (social grants and remittances). However, among these, social grants are their major source of livelihood (Sinyolo *et al.*, 2017). Hence, it is high time to understand the possible unintended consequences and disincentives linked to welfare policies such as social grants. To show the way forward, research should be carried out which is based on real situations on existing irrigation schemes where solutions are practically achievable. This can be done by involving farmers and potential beneficiaries on irrigation schemes in the research. Since it is acknowledged that the situation on all smallholder irrigation schemes is complex and diverse, it is imperative to follow a holistic approach incorporating the natural, human, social, physical, financial and psychological capital (PsyCap) endowments presently available or potentially accessible.

Since South Africa is among the water scarce countries and the agricultural sector utilises more than 50% of the available water resources (Fanadzo *et al.*, 2010), water resources management

and development are becoming central to sustainable livelihoods, agricultural growth, employment generation and poverty reduction. However, the below optimal performance of the existing smallholder irrigation crop production is of serious concern to farmers, the government of South Africa and other rural development stakeholders. Homestead irrigated crop production, in particular, is in poor condition and it is not properly maintained to increase productivity, while the timing of water supply is unreliable. The wide gap between actual and desirable performance threatens the sustainability of homestead irrigation crop production (Van Averbeke, 2008). This state of affairs necessitates proper institutional reforms and comprehensive plans for implementation, starting from micro-level (plot holder's level) so that productivity can be improved and livelihoods enhanced.

The rest of this chapter is structured as follows: Section 1.2 provides the state of irrigation schemes in South Africa, with a special reference to KwaZulu-Natal (KZN) Province. Section 1.3 describes the research and development problems of the study. This is followed by the research and development objectives in Section 1.4. The project outputs and expected outcomes and envisaged impact are contained in Section 1.5. Finally, the closing section provides a brief outline of the structure of the project report.

1.2 The state of irrigation schemes in KwaZulu-Natal Province

The agricultural potential of, its diverse topography, climate and soil virtually make this province a 'world-in-one', yet its potential is under-utilised (Joubert, 2012). The provincial government has taken smallholder irrigation schemes (SISs) as key strategic areas of interventions to address poverty, food insecurity and joblessness in rural areas. SISs are taken as strategic investment portfolios to address ever increasing water scarcity in the KZN province. Thus, the province massively invested in capital expenditures to SISs (Joubert, 2012). Similar to the national situation, most SISs are found where the incidence of poverty is the highest and hence the schemes present a big opportunity for enhancing rural livelihoods.

According to Van Averbeke *et al.* (2011), in 2010, there were 35 operational schemes in the province, covering an area of 6621 ha with the total number of 6174 participants. Most schemes in the province need maintenance of equipment and infrastructure. For instance, in Tugela Ferry, siltation, cracks, leaks and dysfunctional holding dams, the outcomes of inadequate maintenance and repair work since the 1960s, are the major problems (Cousins, 2013).

In KwaZulu-Natal, some 40% of schemes were based on sugarcane production which has a ready market (Bembridge, 2000). Hence, the sugarcane schemes tended to be more successful than other schemes, due mainly to better support services and a readily available market (Bembridge, 2000).

South Africa is an arid country with limited water resources. To address the water constraint in the agriculture sector, the emphasis by the government has been on the creation of large and medium scale irrigation schemes, with inadequate devolution of the ownership and management of the schemes to local community members. Regarding small-scale farms, the most successful ones are those which developed from farmers' own initiatives. SISs are supposed to be collectively managed, controlled and maintained by farmers who are the users. SISs are easiest where a farmer has independent access to a water source (FAO, 1997). However, that is not the case for almost all SISs in South Africa, where more use by one farmer would mean less availability to the other(s) and water use by one would mean water use insecurity by the other.

SISs are common interventions in South Africa to halt rural food insecurity, poverty and unemployment and lastly to address the past issues of agricultural inequalities amongst the black communities (Gomo, 2010). In many instances, the marketable surpluses that these farmers produce do not get marketed profitably due to lack of access to profitable markets. This study will inform policy/decision makers on the role of small-scale irrigation schemes to unlock rural entrepreneurship and enhance farmers' capacity to support their livelihoods.

SISs refer to schemes used by a group of farmers irrigating together and sharing the same water source and supply line. Irrigators are allocated plots within the irrigation command area and there is individual control of irrigation and farming activities by each farmer in his/her plot. The plot sizes are small and normally range between 0.1 and 2 ha (Svubure *et al.*, 2011). South African SISs can be defined as multi-farmer irrigation projects larger than 5 ha in size that were established in the resource poor areas by black people or agencies assisting their development (Van Averbeke, 2008). Over the years, many SISs have been established in South Africa to enable poor people in the rural areas gain access to productive land and increase production in the different regions of the country. In the South African context, smallholder farmers are often black farmers most of whom reside in the former homelands (Fanadzo, 2012).

Over the years, many SISs have been initiated in South Africa. Van Averbeke *et al.* (2011) elaborate that in South Africa SISs become highly significant because the majority of them are

found in areas where poverty is prevalent. About 79% of the SISs are located in KwaZulu-Natal, Eastern Cape and Limpopo Provinces (Fanadzo, 2012). In these poor regions, where most SISs are found, they play a crucial role in the development of local livelihoods.

SISs were developed in the former homeland areas of South Africa during the apartheid era, mostly for enhancing community food supply. The parastatal entities that used to support them have gradually collapsed from the early 1990s. These schemes are now facing serious problems and an uncertain future, owing to low yields, deteriorating infrastructures, limited access to services, weak and unclear institutions regarding access to water and land and lack of support (Perret *et al.*, 2003). The complexity of the institutional challenges and the lack of attention to address them remains to be a recurrent problem in the smallholder irrigation sector (Bembridge, 2000 and Backeberg, 2003).

SISs represent assets or resources that need to be managed collectively by the users. They can be used to increase and diversify the livelihood activities of plant production, resulting in improved livelihood outcomes, either directly in the form of food or income for plotters, or indirectly by providing full or partial livelihoods to people who provide goods and services in support of irrigated agriculture on these schemes (Oni *et al.*, 2011).

According to Van Averbeké *et al.* (2011), there were 302 SISs in South Africa in 2010 with the command area of 47,667 ha. However, out of these, not all of them were functioning in 2010 and not all the functioning schemes were fully effective. Some authors (e.g. Van Averbeké *et al.*, 1998; Bembridge, 2000 and Fanadzo *et al.*, 2010) argue that because of their failure to meet the anticipated productivity and economic gain, the development objectives of SISs remain largely unfulfilled.

Most of the schemes have collapsed or are utilised well below their potential. This is also the case in KwaZulu-Natal (see Chapter 7). Irrigation infrastructure was generally in a poor state of repair and either partially or completely non-functional (Bembridge, 2000). Considerable infrastructural investments have been made by the government to improve the state of SISs. However, the situation still has not improved much. Smallholder irrigation farming has shown very little change in the number of farmers actively participating in commercial agricultural markets and it has failed to make meaningful contribution to poverty reduction, food security and employment creation. Oni *et al.* (2011) indicated that recent assessments of the impact of SISs on the smallholder farming sector have all come to the conclusion that the success of smallholder irrigation has been limited. The causes of poor performance of SISs in terms of

productivity and economic impact are complex and diverse. They include socio-economic, institutional, management-related, technical (water reliability, reticulation problems and deterioration of physical infrastructure), political, climatic and design factors, as well as lack of farmer participation in the management of the schemes (Bembridge, 2000). The other factors include (Oni *et al.*, 2011) limited knowledge of crop production among smallholders; ineffective extension and mechanization services; lack of reliable markets and effective credit services; and the predominance of subsistence-oriented farming. The absence of effective institutional mechanisms to collectively manage the SISs is the key challenge that has resulted in the failure of most SISs. The how question still needs to be carefully and contextually examined.

The primary goal of establishing these schemes was to improve rural livelihoods through sustainable crop production for food security and poverty alleviation (FAO, 2001). However, because of poor performance, the development objectives of SISs remain largely unfulfilled (Yokwe, 2009; Fanadzo *et al.*, 2010 a,b). As such, the benefits of irrigation have not been realised in the South African smallholder sector. The inability of these schemes to bring about the expected social and economic development needs to be examined contextually to inform future policy decisions.

There is an exclusive focus on financial investment to improve irrigation infrastructure, with little attention to the human capital (to effectively utilise, collectively manage and maintain the infrastructure). No clear plan of action on the transfer of ownership (Fanadzo, 2012). The absence of well-articulated business plans is a common constraint. According to Perret (2001), for instance, many schemes in Limpopo had been inactive for a long time. This is a result of poor planning and design, inappropriate management structures, lack of technical knowledge, insecure land tenure, political interference, the absence of opportunities for farmers to participate in decision-making and ‘dependency syndrome’.

The management of smallholder irrigation schemes in South Africa has generally been highly authoritarian and top down (Cousins, 2013; Denison *et al.*, 2015). Fanadzo (2012) identifies weak institutional and organisational arrangements, poor technical skills of farmers and poor crop management practices as the major factors leading to underperformance of most SISs. Accordingly, human (capacity) and social (institutional) resource problems were at the heart of the poor performance of SISs in South Africa, exacerbated by a top-down approach which created a high level of dependency among farmers and failure to manage the schemes on their

own. Financial constraints and abrupt withdrawal of management and finance have also led to the collapse of most schemes (Bembridge, 2000).

The success of SISs will depend on integration between technology, management, participants and the socio-economic factors (Bembridge, 2000). All studies agree on the role of institutional support and enabling environment in South Africa. Security of land tenure and market access are critical issues for the success of any rural development interventions including SISs. There is also a need to address issues of conflict resolution, farmer training, greater farmer participation and better training of extension workers. Beneficiaries are often dissatisfied about scheme management, lack of farmer participation in scheme management and maintenance, institutional support services (including extension, training, research, markets, credit, farm inputs, mechanization services and land tenure) (Bembridge, 2000).

In South Africa, most SISs are found where the incidence of rural poverty is the highest and hence they present an attractive opportunity for the development of local livelihoods. Where conditions are favourable irrigation schemes can raise the income of those farmers with access to irrigable land. The evidence from Tugela Ferry and other irrigation schemes show that where they have access to fertile plots, irrigation water and markets, smallholder farmers can be highly productive and earn reasonable returns (Mnkeni *et al.*, 2010; Cousins, 2013). From a case study in Zanyokwe irrigation scheme, Eastern Cape, Fanadzo *et al.* (2010a) have concluded that crop productivity is constrained by poor management of basic practices such as weed, fertiliser and water management as well as late planting, low plant populations and use of inappropriate varieties.

The transfer of the responsibility of managing, operating and maintaining irrigation schemes from the government to the farmers, has been referred to as the irrigation management transfer (IMT) (Van Averbeke, 2008). The central aim of the IMT alteration process is to improve the performance of the schemes through handing over of the ownership and collective management responsibilities to the farmers (Fanadzo, 2012; Van Averbeke, 2012). The process also includes the formation of water users associations and development of local management institutions (Perret, 2002). South Africa initiated IMT in government SISs located in former homeland areas and most transfer operators are still unsure about how to design and implement the process (Perret, 2002). The process of SISs rehabilitation and modernisation is a complex activity (Bembridge, 2000), due, among other things, to context specificity of the potentials, challenges and constraints.

Devolution of management and ownership of the schemes to the local community is a key to the success of irrigation schemes in KZN. For instance, the majority of the Bululwane scheme beneficiaries felt the management of the scheme should, over time, be taken over by themselves (Bembridge, 2000). The business plan (which was never developed) of all SISs should have provisions for step-by-step withdrawal of government management and cost recovery so that the users can own and manage the schemes on their own. However, abrupt withdrawal of management and finance can also lead to the collapse of irrigation schemes (Bembridge, 2000).

Lack of up to date and accurate information that reflects the current status of SISs on the ground in KZN is a huge problem. Bembridge (2000) has also encountered this problem in Northern Province. Despite many efforts, the team was not able to solicit this from the KZN Provincial Department of Agriculture and Rural Development (PDARD). No section in the Department is willing and able to collate this information for potential users. No section in the Department recognises the role of this information for research and development purposes. Given this stumbling block, the only imprecise information available is a database compiled by the KZN PDARD in October 2013. Accordingly, there are 49 irrigation schemes in the province, with a total capacity to irrigate 10,657 hectares.

About 41 of these schemes require some kind of service including sealing dams, construction of main and infield furrows, irrigation equipment maintenance, installation of electricity, fencing, canal and pipeline cleaning and repairs, sluice gate and intake repairs and installation of pumps/pipes and sprinklers. They also need the rehabilitation of pumps/pipes/sprinklers, installation of scheme electricity supply, in-field pump improvement, intake structure and irrigation canals, rehabilitation of irrigation infrastructure, weir construction and sprinkler irrigation equipment maintenance.

In some instances, there is a need to do bush clearing, upgrading the roads and land preparation for the schemes to be used. This shows lack of proper business plans before the schemes are established. The poverty of planning in the development and construction of the schemes without proper business plans is the reasons for most schemes not functioning. It is not uncommon to find an irrigation scheme with no farmers or no markets or no suitable agro-ecology where farming can be done profitably.

Lack of capacity to use the schemes to their full capacity is a common phenomenon in KZN. For instance, for the Bululwane Irrigation Scheme, approximately 80% of the 345 ha was not being utilised in 2000 due to lack of motivation, lack of resources and support services

(Bembridge, 2000). This was also the case for Thukela estate in 2000 which was irrigating only about 30% of the productive area. Currently, none of the schemes in the province are operating at their full capacity. About half of the schemes are not currently operational for a variety of reasons including, among others,

- delays in undertaking the required procurement, maintenance and rehabilitation,
- pipe/pump/canals broken/stolen,
- non- or malfunctioning drip irrigation and tunnels,
- absence of agreed rules on how to collectively manage, use and pay the running costs; social conflict, and
- problem of electricity connection.

In sum, the paradox that needs to be addressed is that KZN province continues to invest on SISs and at the same time most of the schemes continue to fail. This is the harsh reality on the ground. Wide ranging research has been done to provide evidence on the failure of most of the schemes. However, there is very little research done on “how to make the schemes work?” and so is little known about the potential of collective action institutions and rotational management. That is why this project is focusing on the challenges and opportunities of SISs to unlock and show the pathways to move from homestead food gardening to smallholder irrigation farming and enhance rural entrepreneurship and livelihoods.

1.3 Research and development problems

Since South Africa is among the water scarce countries (Fanadzo *et al.*, 2010), water resources management and development will remain central to sustainable livelihoods, agricultural growth, employment generation and poverty reduction. As noted in the background and Chapter 6 of this report, most of the SISs are under-performing and future research has to look beyond the reasons to make the schemes contribute to the South African rural development agenda. The wide gap between actual and desirable performance (Van Averbeké, 2008) calls for institutional innovations to bring participatory governance to the SISs.

This project will make a deliberate attempt to generate policy-relevant information on how to improve the state of homestead food gardening and smallholder irrigation farmers in South Africa, the policy and institutional arrangements surrounding them and factors closely associated with success as well as failures. This systematic analysis will be done in KZN with

the selection of four irrigation schemes to be used for a case study, household survey and in-depth analysis.

In Asia, irrigation was the most important component of the green revolution (Van Averbeké *et al.*, 2011). The South African government has, therefore, invested millions of Rand on various SISs throughout the country. The success of these schemes, however, has been very limited (Van Averbeké *et al.*, 2011) as the institutional and human dimensions of the schemes have not received adequate attention as the engineering and physical aspects. There is a need to invest not just on the physical capital but also on people and institutions (collective management). Van Averbeké (2013) also confirms that plottolders have failed to collectively manage and maintain canal irrigation schemes in the Vhembe district of Limpopo province. Ways to support the institutions and organisations of smallholder irrigation scheme communities need to be investigated more thoroughly (Van Averbeké *et al.*, 2011). This project will, among other things, focus on the failure of the users to manage the schemes on a sustainable basis.

Many of the studies have pointed out that farmers with less than 1.5 hectares of land hardly benefit from the schemes (Van Averbeké *et al.*, 2011). These farmers will not be able to have a marketable surplus due to additional production constraints to run a profitable farm out of this land. Land tenure security is another inherent policy problem that complicates the matter. Even though they manage to produce extra for the market, there will still be a market access issue. According to Backeberg and Sanewe (2010), efforts have been made to empower subsistence farmers to become the suppliers of local and international markets. However, these markets are still being dominated by the commercial white farmers. The stumbling blocks that prevent smallholder farmers from participating in commercial agri-food chains (e.g. continuous supply is a requirement) are the stringent requirements of commercial agri-food chains, the small-scale operations of smallholder farmers, insecure property rights, lack of access to credit, poor conditions of physical infrastructure, lack of trust among the value chain role players, transaction costs and lack of support services (Jordaan *et al.*, 2014). Commercialisation of smallholder agriculture through value-chain development requires the spirit of entrepreneurship and does not hinge on formal education but involves being equipped with skills in (Rukuni, 2011):

- Seeing opportunities where others do not and taking advantage of those opportunities;
- Having the courage to act;
- Having the courage to do things that have never been done before, i.e. taking risk; and

- Having the courage and willingness to be innovative and creative. According to Drucker (1985), innovation is the tool or instrument used by entrepreneurs to exploit change as an opportunity.

One of the puzzling questions in Africa is why the continent has not developed innovative and locally appropriate means of smallholder irrigation that supplements rainfed agriculture (Rukuni, 2011). In the context of South Africa, there is a need to understand the challenges of making smallholder farming more entrepreneurial oriented to run it as a business. There is very little research and development (R&D) done to unleash rural entrepreneurial education and enhance entrepreneurial skills amongst farmers. Only recently, some studies (e.g. Díaz-Pichardo *et al.*, 2012; Knudson *et al.*, 2004; McElwee, 2006; McElwee, 2008; McElwee, 2005; and Vesala *et al.*, 2007) have started to examine the challenges and opportunities of considering farmers as rural entrepreneurs. This scanty literature also highlights the challenges of running small-scale farming as a business. Rural entrepreneurship and the role of SISs to unlock the entrepreneurial spirit will be one of the research agenda for this project.

Since limited research has been published on the role of irrigation schemes in unlocking farm/rural entrepreneurship in South Africa, this knowledge is expected to contribute to policy making to improve the livelihoods of the smallholder irrigators. In this regard, it is imperative to develop detailed farm business plans accounting for heterogeneity of farmers and using farmer typologies. This project aims to generate information on the opportunities and challenges in using irrigation schemes as effective rural development interventions in South Africa. One of the outcomes will be development and validation or testing of a business development plan for entrepreneurial development in the smallholder irrigation scheme sector.

South Africa's National Development Plan (NDP) Vision 2030 strategy for rural economy hinges on the potential role of agriculture in creating jobs, employment and increasing food security among rural households (National Planning Commission, 2011). The multiple effects of this growth in the rural economy are expected to be felt in the broader economy through reduced unemployment, reversal of rural to urban migration, the emergence of rural-based industries, increased food security and reduced dependency of rural people on social grants, among other effects. If smallholder irrigation agriculture is the target sector for the achievement of transformation in rural livelihoods, it is important to first understand livelihood sources of smallholder farmers currently practicing small-scale irrigation in and outside of formal irrigation schemes.

However, several studies have shown that the role of agriculture in South African rural livelihoods is diminishing (Bradstock, 2006; Backeberg and Sanewe, 2010; Daniels *et al.*, 2013) as households shift to other non-farm sources such as public transfers (social grants), wage income and remittances. This phenomenon, now termed the deagrarianization of the South African rural economy, shows a shift in community preferences towards a more cash-based lifestyle (Bradstock, 2006). Daniels *et al.* (2013) found evidence of deagrarianization in rural South Africa. Their study was different from other studies in that it used panel data to show shifts in livelihoods of rural people. They observed low levels of employment in agriculture and increasing reliance on social grants. Backeberg and Sanewe (2010) state that smallholder farming contributes between 10-30% of household income in South Africa's rural households while Bryceson (2002) found that farming contributes between 20-40% of rural household income in South Africa. The figures might slightly differ and other researchers might argue that the values are undermined (Shackleton *et al.*, 2010) but the reality is that unearned income (social grants) is more important to rural South Africans compared to farming. This is mainly because of the aging rural population structure in South Africa (Manona, 1999). If these findings are similar across all smallholder irrigation farming communities, there will be a need to rethink policy strategies for transformation of smallholder agriculture. In this regard, this study will assess the extent of the contribution of farming to livelihoods of farmers in the context of SISs.

The major constraints to rural livelihoods in rural South Africa include inadequate access to productive resources, limited market information and market access, the price of inputs, availability of inputs, cost of transport and natural capital constraints (land degradation and depletion of resources) (Mpandeli and Maponya, 2014). Other factors such as climate change and water scarcity also adversely threaten rural livelihoods (Benhin, 2008). High levels of poverty affect smallholder farmers' ability to acquire productive resources while lack of participation in high value markets means farmers cannot benefit from higher output prices for their produce. Farmers' failure to participate in markets is attributed to high transaction costs, in particular, high transport cost due to inadequate road infrastructure.

The individual farmer is also affected by her/his access to livelihood assets, which come in the form of different types of capital and capabilities. Assets and capabilities are closely linked to household livelihood security. For example, an individual farmer may have some assets to engage in various activities but not the capability to combine and use them fully. On the other hand, he/she may have capabilities but not assets. Therefore, it is imperative to scrutinize the

range of assets and entitlements which different farmers have access to as key factors which influence to engage in various activities. This will help identify the capabilities that enable farmers to make the best use of their asset base and the factors that limit people's ability to participate in new ventures and diversify their activities. The external factors such as natural disasters, global trends and seasonal changes also create uncertainty.

1.4 Research and development objectives

The purpose of this research is to review and synthesize the stock of knowledge and evaluate appropriate development paths for expansion from homestead food gardening to smallholder irrigation farming, increased water use productivity of crop production and improved livelihoods on selected smallholder irrigation schemes. To this end, the following specific objectives have been pursued:

1. To evaluate natural, physical and financial assets with specific attention to irrigation farming potential.
2. To evaluate human and social assets with particular attention to entrepreneurial spirit and management capabilities within incentives of secure land tenure, water use rights and leadership in organisational structures.
3. To determine sources of livelihoods and opportunities to improve contribution by farming within available food value chains.
4. To determine the aspirations and goals of farmers to expand irrigation crop production from homestead food gardens to irrigation plots and/or from one to more than one irrigation plot.
5. To formulate and test appropriate development paths for establishing sustainable farming businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes.

As best practice entrepreneurship requires a commitment of the right groups and organisations to participate in these opportunities and the incentives to motivate them, this research project will enable the addressing of questions such as:

- a. Who would be the likely homestead irrigated crop producers to drive breakthrough solutions?
- b. Who will be the entrepreneurs and how will they cooperate, leverage and empower smallholders of the study areas in a fair and efficient way? For instance, is it through individual entrepreneurs or co-operative farms? This requires triggering a wave of

transactions by identifying incentives (such as access to suitable land, water and financing) as well as conditions for success (such as cooperation).

Another research project with the same set of objectives has been conducted in Eastern Cape Province and it is documented in another WRC report (see Obi *et al.*, 2016).

1.5 The structure of the project report

The report is organised into 11 chapters. Chapter 1 sets the scene by providing an overview of the state of irrigation schemes in South Africa, the research and development problems that the study focuses, research and development objectives and expected outcomes and impact. Chapter 2 presents a detailed literature review of key research issues. These include smallholder agriculture in South Africa, homestead food gardening, smallholder irrigation, water security, land tenure security, smallholder heterogeneity and entrepreneurship in South Africa, among others.

Chapter 3 details the research methodology starting by outlining the conceptual framework employed in the study, empirical methods of data collection and data analysis and methods of disseminating the research findings. Chapter 4 gives a description and justification of the smallholder irrigation schemes selected for the study. It focuses on how the study areas were selected and then the biophysical description of the irrigation schemes.

Chapter 5 provides an evaluation of the natural, physical and financial assets of the four selected irrigation schemes. It begins by providing an overview of the common pool resource endowments in and around the schemes and then an evaluation of these assets per irrigation scheme. Chapter 6 presents an evaluation of the remaining livelihood assets, i.e. the human, social and positive psychological assets. It also evaluates the entrepreneurial spirit of the smallholder farmers in and around the irrigation scheme. Chapter 7 presents an analysis of the sources of livelihoods and opportunities to improve contribution by farming within available food value chains. It outlines a conceptual framework which links livelihoods, food value chains and irrigation schemes before presenting results and discussions of the sources, constraints and opportunities to rural livelihoods in and around the schemes.

Chapter 8 explains the aspirations and goals of farmers to expand irrigation crop production. It focuses on farmers' willingness and capacity to expand crop irrigation farming, factors affecting farmers' aspirations and ability to achieve their aspirations and opportunities and challenges for expanding crop irrigation farming operations in and around the schemes.

Chapter 9 presents the proposed entrepreneurial development pathways for the different types of farmers. The pathways are also discussed in the context of the development domain for each area. Chapter 10 presents the results of the evaluation and testing of the proposed development pathways formulated for each farmer typology. It identifies policy synergies and conflicts and discusses their policy implications in the transformation of homestead food gardening and smallholder irrigation in South Africa. Chapter 11 provides the conclusions, policy/management recommendations of the study and future research direction.

2 REVIEW OF LITERATURE

2.1 Introduction

In a considerable number of cases, rural poverty is caused by worsening access to natural resources which in particular include land and irrigation water. Land and irrigation water are assets and their availability or lack of it increases or reduces household capacity to produce income in combination with other assets. Irrigated agriculture in South Africa is under renewed attention in relation to enhancing food security and reduction of poverty, as a driver in agricultural development and for transformation of subsistence production. Irrigation is defined as human intervention to modify the spatial or temporal distribution of water occurring in natural channels, depressions, drainage ways, or aquifers and to manipulate all or part of this water to improve crop growth (Small and Svendsen, 1992). Irrigation has the potential of social and economic development for poor countries through improving agricultural production and productivity.

In South Africa, smallholder irrigation schemes present an attractive opportunity for the development of local livelihoods. Where conditions are favourable, irrigation schemes can raise the income of those farmers with access to irrigated land. Water control in agriculture may boost productivity and income by providing adequate water throughout the growing season. It thus contributes to higher yields by eliminating water deficits and reducing the effects of drought especially in areas where rainfall is inadequate and highly variable. Water control in agriculture also ensures the availability of a cheaper and more secure supply of fodder for livestock and reducing production risk and the need for farm output diversification. This encourages farmers to gain the benefits of greater specialisation and commercialisation.

As noted in Chapter 1, the government of South Africa policy direction is focused on the development of sustainable rural communities and improved employment opportunities and economic livelihoods. In this regard, priority attention should, therefore, be given to encouraging existing and new farming businesses to be undertaken on smallholder irrigation schemes. The Sustainable Development Goals (SDGs) also require reduction in poverty levels and empowerment of women. The available evidence indicates that natural and human resources on most, if not all, smallholder irrigation schemes in South Africa, are utilised far below potential (Bembridge, 2000). Given the semi-arid circumstances and potential impact of climate change, increasing emphasis must be placed on higher efficiency of water use under irrigation. As stated before, this will involve higher crop production and better product quality,

which allows negotiating higher prices and improve operating margins (WRC, 2014). For this purpose, ways must be found to enable more productive farming practices, more competitive and profitable farming on irrigation schemes. This, in turn, requires that an assessment is made of the goals and aspirations of current and potential farmers, in particular women, to improve the economic performance of farming enterprises.

Typically, most attention is given to “push factors” such as infrastructure and subsidies on inputs, while “pull factors” such as incentives linked to secure land tenure and empowerment through knowledge, skills, access to markets and finance are neglected. A report on “Review of experiences of establishing emerging farmers in South Africa” (FAO, 2009). Backeberg and Sanewe, 2010 states that, internationally, smallholder farmers should be free to exchange landholdings amongst themselves by sale, lease or sharecropping arrangements. Information for South Africa indicates, however, that the size of the landholding on irrigation schemes does not tend to change. Rather, members of households seek additional sources of livelihoods outside farming. Better understanding is, therefore, required to explain this phenomenon and the possible unintended consequences and disincentives linked to welfare policies such as social grants. The majority of these irrigation schemes are located on land administered by traditional authorities. While land use rights are generally perceived to be secure, certainly from the point of view of men as head of the family, land exchanges under leasing are limited and market sales of plots of land are impossible. While there is evidence that about 60% of households are in fact headed by women, with land cultivation and food production also being undertaken by women, these women lack incentives for productive and sustainable use of land since use rights cannot be transferred to or held by them. This means that heads of households and/or farmers cannot raise capital to finance operational expenses and equipment because commercial banks and the Land Bank cannot use land as collateral.

To show the way forward, research should be carried out which is based on real situations on existing irrigation schemes where solutions are practically achievable. This can be done by involving farmers and potential beneficiaries on irrigation schemes in the research effort. It will thereby contribute to moving away from *ad hoc* solutions provided by research outputs and policy inputs. Since it is acknowledged that the situation on all smallholder irrigation schemes is complex and diverse, it is advisable to follow a holistic approach incorporating the natural, human, social, physical and financial assets presently available or potentially accessible.

The purpose of this chapter is to review the relevant literature and set the scene for the empirical chapters that follow. It provides an overview of the smallholder agricultural sector in South Africa and a brief history of homestead food gardening. It also discusses literature on smallholder irrigation, water-related concepts, heterogeneity among smallholder farmers, aspirations and irrigation expansion, on-farm entrepreneurship, entrepreneurial development in smallholder agriculture and agricultural-related policies and institutional frameworks in South Africa.

2.2 Overview of the smallholder agricultural sector in South Africa

In South Africa, the agricultural practice can be grouped into three categories, small-scale, emerging farmers and medium to large-scale farming. When defining farming practice, the land alone is not adequate for classifying whether a farmer is a small-scale or a large-scale farmer. Classification should also be based on the general character of the business, with labour supply as the principal factor (Carver, 1911). Smallholder farmers are those who are mainly located in rural areas where agriculture is the main activity to alleviate poverty and they are challenged by a number of constraints to increase productivity (Kirsten and Van Zyl, 1998). Smallholder farmers differ by individual characteristics, the size of the farm system and proportion of crops sold, household expenditure patterns, distribution of factors of production between food crops and cash crops and off-farm activities. These differences make these farmers have different levels of contributions in different forms towards the South African economy (Machingura, 2007).

Smallholder farmers face many challenges like drought, pests and crop diseases, scarce arable land with water, market availability, old age, low level of education, limited availability of quality infrastructure like good roads within the schemes and good cellphone network connections and limited access to quality inputs. Due to these challenges, the contribution of agriculture to total household income is low and in South Africa social grants are the major contributor. There remain challenges in output market information, right to use and exclude others from land, land transferability and access to irrigation equipment.

According to Poulton *et al.* (2010), smallholder farmers enjoy low labour cost which has competitive advantage over large commercial farms in the form of low supervision and transaction cost. This is because they are able to substitute cheap labour for hired labour and lumpy capital equipment (such as for land preparation, planting, weeding and harvesting) using motivated family labour. However, these benefits are insignificant due to small-scale farm size

which leads to high transaction cost for almost all non-labour transactions such as accessing capital, market and technical support, output markets, etc. Table 2.1 below shows the main sources of the distinction between small-scale and large-scale farming.

Table 2.1. Comparison of small-scale and large-scale farms

Characteristics	Small Farms	Large Farms
Unskilled labour supervision, motivation, etc.	✓	
Local knowledge	✓	
Skilled labour		✓
Market knowledge		✓
Technical knowledge		✓
Inputs purchase		✓
Finance and capital		✓
Output markets		✓
Product traceability and quality assurance		✓
Risk management		✓

Source: Poulton *et al.* (2010)

The majority of smallholder farmers rely on family labour with women mostly involved in the production. They either produce for household consumption or for informal markets if there is a surplus, due to high transaction costs to access formal markets (Machingura, 2007). Furthermore, smallholder farmers have access to both on-farm and off-farm income. On-farm income is procured from the sale of their agricultural products while off-farm income is from wages and off-farm employment and grants from social welfare. Tollens (2006) refers to smallholder farmers as net buyers of food because their production is insufficient to meet their household needs. This permeates their poverty and vulnerability over time.

On the other side, large-scale farmers receive many critical services through telephones with market intermediaries while the same cannot be said for smallholder farmers as they have to walk miles in search of market information (Poulton *et al.*, 2010). Product quality constrains their ability to access high valued markets because demand for goods has become more sophisticated with greater importance being placed on quality and safety attributes because of rising income of consumers (Louw *et al.*, 2008). Access to market information is increasingly important to assure product traceability. To meet market quality requirements, specific inputs such as high variety seeds and fertilizer are vital to producing good quality products. Smallholder farmers do not have an advantage over these services and their products are usually of poor quality. According to Louw *et al.* (2008), Baloyi (2010) and Poulton *et al.* (2010), economies of scale is largely observed in agro-processing and export markets while smallholder farmers do not have such comparative advantages. Poulton *et al.* (2010:1414)

noted that “not only do smallholder producers lack market power but they also suffer from limited political voice, as a result of their limited education, limited economic power and geographic dispersion”. This leads to the inability to put pressure on public sector service providers to effectively deliver services.

2.3 Homestead food gardening: history and characteristics

Homestead food gardening was previously considered women’s activities but perceptions have changed due to the prevailing harsh socio-economic conditions. Gardening activities are now an important source of family food and income. It is also likely that informal irrigation sites would grow in importance due to the dietary nutritional requirements needed to mitigate the effects of the HIV/AIDS pandemic (Svubure *et al.*, 2011).

African countries are net food importers, with between 25% and 50% of food consumed in sub-Saharan Africa being imported. Household food access is the ability to acquire sufficient quality and quantities of food to meet all household members’ nutritional requirements. Individuals have sufficient access to food when they have adequate income or other resources to purchase levels of appropriate foods needed to maintain consumption of an adequate diet/nutrition level. There is a growing recognition that one of the major factors affecting availability of food at the household level in rural areas of Africa is access to homestead food gardens.

To understand the basis of homestead food gardening, it is important to review its history and understand its evolution. Private, domestic food gardens in residential areas represent substantial element of green space in many areas of the world (Gaston *et al.*, 2005; Mathieu *et al.*, 2007.). A homestead food garden can be defined as the combination of organised planted vegetation, usually with a complex procedure and planned to produce natural products for household or market (Kumar and Nair, 2006). Different plant species in a homestead food garden can range from less than five to more than 100 (Vogl and Vogl-Lukasser, 2004). If homestead food gardens are managed properly, they can be used for both money-making or survival purposes and can supply from only a few to more than 100 products. Homestead food gardening is not only important for exploring the human-environment linkage but also to potentially improve the livelihoods of people through improved management systems. According to Millat-e-Mustafa *et al.* (1996), Uddin *et al.* (2002) and Ahmed and Rahman (2004), homestead food gardens can act as a safety net in provision of alternative livelihood opportunities for the people during periods of frustration such as bad crop year.

Keller (2003) defines homestead food gardening as an area around the home where vegetables, annual and perennial plants and fruits are grown to meet family consumption requirements. Those homestead food gardens that produce one to two varieties of vegetables and are scattered and seasonal are considered as simple homestead food gardens, whereas those that have three to four varieties but are not productive throughout the year are considered improved. Finally, those that produce at least three varieties of vegetables throughout the year are considered as developed.

2.3.1 The history and value of homestead food gardening

During the early settlement period in the US, people's survival was based on their ability to cultivate their own food although producing an adequate amount was a challenge. Many struggled to flourish because of lack of food. Those who managed to survive did so by incorporating the now famous gardening triad corn, beans and squash which were the first cultivated crops by the Native Americans (Becker 1984; De Wolf, 1992).

In the eighteenth century, the character of homestead food gardening changed due to the increase in population of the colonies. Growing occupational and residential specialisation meant that gardening was no longer a required activity of the entire population. Still on that note many individuals continued with homestead food gardening for self-provision. Some people decided to engage in homestead food gardening more as a hobby and for relaxation than as a way to feed themselves (Leighton, 1976).

The need and function of the homestead food garden continued to evolve into the nineteenth century, with technological development and urbanization being a critical force of change and mass production of home preservation material (Becker, 1984) and the emergence of firms specializing in seed saving developed an impact on the character and scale of what was possible in homestead food gardening (Tucker, 1993). The declining necessity of the homestead food garden as means of survival strategy suggested that more people who engage in homestead food gardening used it for entertainment and leisure activity (Tice, 1984). For the urban community, it was suggested that homestead food gardening enabled them to psychologically escape the hectic urban life for few moments by using it as an opportunity to show off their leisure time by growing exotic and expensive varieties of crops and plants (Tice, 1984). The increasing efficiency of market farming and space limitation of urban landscapes for homestead food gardening was gradually becoming unnecessary in the urban landscape (Becker, 1984). Food retail businesses grew during this period and destroyed the importance of homestead food

gardening as markets, trading posts and grocery stores began to develop in urban and rural communities (Baker and Izard, 1991).

As we entered the twentieth century, the practice of homestead food gardening further declined with additional technological advance and even greater level of urbanization. Between 1910 and 1920 many people realized that they do not have enough time, space or desire to maintain homestead food gardens and therefore the art of homestead food gardening started to fade (Lynd and Lynd, 1929).

While the twentieth century witnessed a decrease in homestead food gardening, there was a resurrection during two historical moments, called ‘War gardens’ during the World War I and ‘Victory gardens’ during the World War II, which is when the homestead food garden started to reappear due to the food crises. The United States Department of Agriculture (USDA) claims that during the World War II, more than 20 million families planted a victory garden in 1943 (USDA, 2011). Bentley (1998) also indicated that these gardens functioned as a symbolic expression of patriotism and helped build community structures where they were planted. The US government encouraged the promotion of household gardening during the war periods (Miller, 2004), assuming that the urban population no longer knew how to grow fruits and vegetables (Cole, 1993). Other levels of government including municipalities supported use of gardens throughout the country (Miller, 2004).

2.3.2 Characteristics and functions of homestead food gardening

With a focus mainly on edible crops, homestead food gardens contribute to sustain basic household needs without generating environmental degradation (Nair, 2001; Watson and Eyzaguirre, 2002). Research on ecological functions of homestead food gardens found out that it improves nutrient cycling (Kumar and Nair, 2004). The economic function of homestead food gardening suggests that it is efficient and energy flows in cash (Cai *et al.*, 2004) and contributes to food security through the generation of products for household consumption. It also contributes to household cash income through the commercialisation of surplus fruits and vegetables (Wezel and Bender, 2003). Wide range of products from trees and herbaceous plants cultivated in homestead food gardens offer diversity to the diet for rural households. According to Shillington (2008), homestead food gardening provides an important space for social relations and contributes positively to household health (Finerman and Sackett, 2003). Other functions of homestead food gardening are that it contributes to community development (Saldivar-Tanaka and Krasny, 2004) and impact on social skills, food choice and nutritional

knowledge of food gardeners. It can be concluded that homestead food gardening provides numerous benefits to the ecological, economic and social environment.

Owners use various forms of plants management strategies in homestead food gardening activities (Thomas and Van Damme, 2010). Plant management can be categorized into two main groups, namely, cultivated and tolerated. Cultivated crops or species are managed and cared for by people during their lifecycle (Van den Eynden, 2004). They are sown as seeds then increased by means of stem, root cutting and transplanted from natural habitats (Thomas and Van Damme, 2010). Tolerated are those that are intentionally spared during land clearing activities since they are useful to the household. Such species are maintained and protected in homestead food gardens and some of these can be found growing in the wild.

Francis and Hester (1990) describe homestead food gardens as places which have distinct meaning. They are powerful settings for human life. There has been increased interest in examining the role of homestead food gardens, gardening practices, memories of past gardens and the gardening experience itself (Kiesling and Manning, 2010). Three major themes emerge from the literature in this regard: food gardens and well-being, food gardens and memories and food gardens and identity.

Homestead food gardens have established the connection between gardening and psychological well-being (Kuo and Taylor, 2004). Connection and access to nature has potential benefits for both physical and mental health (Frumkin, 2003), stress and cognitive functioning (Wells and Evans, 2003). In poor communities, the process of planting and observing plants grow to maturity provides significant calming relief from the concerns and challenges of daily living (Alanen, 1990). Homestead food gardens can ease psychological strain.

According to Thompson (2005), gardens are containers of memory, past landscapes, trees and plants (Francis, 1995). Certain plants carry special meaning and they are transferrable from home to home (Bhatti and Church, 2001). In some communities in England, ethnic minority groups took pleasure in growing fruit producing plants, such as olives and grapes, from their countries of origin (Rishbeth, 2004). For immigrants from war torn nations, such as the Hmong from Laos, growing familiar fruits and vegetables, while enjoyable, was also touched with sadness, a recap of the land and lives they had lost forever.

Homestead food gardens can express personal, social, cultural and environmental identities (Kiesling and Manning, 2010). At the personal level, gardens can replicate an individual's creativity, originality, planting preference and gardening styles (Clayton, 2007). Homestead

food gardens can express the gardener's relationship with the environment, e.g. through the creation of an organic garden and the non-use of chemical fertilizers and pesticides (Kiesling and Manning, 2010). Although a few researchers have made important contributions, research on homestead food gardens is largely incomplete.

2.3.3 Selected country experiences with homestead food gardening

2.3.3.1 Homestead food gardening in Philippines

Philippines is one of the countries which is experiencing serious deficiencies of micronutrients, especially with Iron and Vitamin A (Soemantri *et al.*, 1985). Such deficiency causes increased morbidity and mortality, encourage growth deficit and reduce work productivity and economic input (World Health Organisation, 1995). The Fifth National Nutrition Survey conducted in 1998 by the Food and Nutrition Research Institute (FNRI) of the government of the Philippines demonstrated that the prevalence of vitamin A deficiency was 8.2% amongst children aged 6 months to 5 years and 7.1% amongst pregnant women (Department of Health, 2001).

Three strategies were later developed to control these deficiencies: horticultural activities combined with health and education, protection of food products and distribution high dose micronutrients supplements (Vitamin A capsules and Iron tablets) (Darnton-Hill, 1997). The government focused on food protection, but the program did not cover the whole eligible population because of inconsistent supply (dela Cuadra, 2002). Households faced with the crisis of increasing food prices may opt to change the quantity, quality and diversity of their daily food consumption.

Even though previous studies concluded that fortification and supplementation were cost effective for controlling Vitamin A in the Philippines (Solon *et al.*, 1979), recent studies revealed that the burden on the government budget to sustain on-going program is very high (Fielder *et al.*, 2000). Vegetable are regarded as the most economically efficient source of micro nutrients (Ali and Tsou, 2002). Due to the dietary deficiencies in Philippines, diet improvement practices through homestead food gardening were developed (De Pee *et al.*, 1998). Homestead food gardening is among the approaches recognised to increase production and consumption of Vitamin A-rich foods and it also has the potential to provide multiple nutrients (Chakravarty, 2000). However there have been few research papers done to examine the dietary improvements through homestead food gardening in Philippines (Bayani, 2000).

2.3.3.2 Homestead food gardening in India

FAO (2000) found out that about 230 different plant species are sheltering in 60 homestead food gardens in Asian villages. Some of these traditional vegetable species have not been considered in modern society and yet were noted for good nutrition and medicinal purposes. A study of homestead food gardening in humid Southern Kerela State of India demonstrated the increase in revenue from women's household food gardens contributing to improved child nutrition. In Southern India, men stopped homestead food gardening and women took over because it involves fetching water, which is regarded as women's activity and unsuitable for men. Marketing of homestead food garden produce also is seen as women's job as it is believed that it provides women with a chance to leave the house and socialize (Pacey, 1978).

2.3.3.3 Homestead food gardening in Zimbabwe

Agriculture is the main source of income for most rural people in Zimbabwe. The use of homestead food gardens varies as some use them for subsistence and others for commercial purposes (Vogl *et al.*, 2004). In the rural homestead food gardens, gardeners usually grow medicinal plants, vegetables and fruits (Kumar and Nair, 2004). The features of homestead food gardens are year-round production of food, decreasing production failure due to diversity of species, increased resource productivity over time and alternative production (Senanayake *et al.*, 2009). Homestead food gardens can serve as source of cash and food for rural communities.

Even though there has been little research done about homestead food gardening in Zimbabwe, Maroyi (2013) looked at the use and management of homestead food garden plants in Zvishavane District. Surveyed households in it district possessed fenced homestead food gardens adjacent to the homestead (71%) or next to the river (29%). Homestead food gardens were clearly defined by wooden fence or barbed wire. Cultivation was mainly done in an area of 154-520 m². Most people (93%) relied on bucket irrigation while only 9.7% had drip irrigation as the source of water (Maroyi, 2013). The majority of households are educated up to secondary level and most homestead food gardens are led by women since they remain at home while men are engaged in different jobs.

2.3.3.4 Attitude towards homestead food gardening in Botswana

Pacey (1978) states that during hunger season, fresh homestead food gardening vegetables can be cultivated so that the whole diet in the family could be better balanced. A number of developments in the vegetable industry and economy have resulted in high cost of energy and

labour has contributed to an increased interest in homestead food gardening. Due to price variations vegetables are becoming too expensive; hence, homestead food gardening can be used as means to supply families with these products and improve diet and provide additional tax-free income. Collum (1995) noted that fresh home vegetables have the upper hand in quality than those sold in the market and are readily available when needed.

In Botswana, homestead food gardening is popular in Mochudi, an area situated at the outskirts of Gaborone city where most husbands work as employed (ALDEP, 1982). Majority of women remains at home while their husbands are working. This is of great disadvantage to them since most unmarried women do not have access to land for farming resulting into high levels of poverty. Despite all the challenges, women are still projected to provide food for their families. The solution to this expectation was to engage in homestead food gardening (ALDEP, 1982).

2.3.3.5 Homestead food gardening in South Africa

South Africa's constitution entrenches the right to adequate nutrition for all and it has devised a National Integrated Food Security Strategy (De Klerk *et al.*, 2004). The link between homestead food gardens and nutrition seems obvious and the promotion of vegetable gardening is often undertaken on nutritional grounds (Webb, 2000). Homestead food gardens are significant in promoting adequate nutrition for as part of a comprehensive strategy for households coping with HIV/ AIDS and for all households, particularly those in low income communities (Stimie *et al.*, 2010). In South Africa, there is a homestead food security policy and "Zero Hunger" strategy that aims to reduce poverty and inequality amongst the masses of the South African people, for which homestead food gardens have a key role to play. Despite the prevailing challenges, there is a tremendous potential for each and every family in South Africa to have one garden (Joemat-Pettersson, 2012).

Community food gardening plays a role in giving individuals opportunity to develop a full range of entrepreneurial and farming skills on a small scale. It is unique in the opportunity it can provide the poorest of the poor people to improve their standard of living (Fanadzo *et al.*, 2010b). Homestead food gardens are promoted in some developing countries with the aim of addressing food scarcity problems in vulnerable areas (Karaan and Mohamed, 1998; Moskow, 1999). To the extent that food insecurity is a problem in South Africa, homestead food gardens play a crucial role in trying to reduce the problem (Altman *et al.*, 2009). In recognition of the role of homestead food gardens to rural food security, poverty reduction and job creation, the

KZN PDARD launched a campaign in 2009 called “one home one garden”. Food gardens also have gender dimensions.

2.3.4 Gender and homestead food gardening

Women are economically, socially and emotionally dependent on their husbands. Thus, many women do not have independent decision-making powers. At the same time, however, they are key players in caring of those who are sick since they are the most reliable sources in caring and supporting their families. Thus, interventions like homestead food gardening and educating women reduce their dependence on men (Friedman *et al.*, 2006). A study has been conducted in the KZN province on rural women empowerment through water use security and agricultural skills training which is documented in another WRC report (see Oladele and Mudhara, 2016). Francis (2002) states that in South Africa, frugal populations are also highly stratified with income and asset distribution tilted by class, gender and ethnic identity. This stratification is bound up with inequalities of voice and power. Altman *et al.* (2009) suggest that there is a high prevalence of women engaged in subsistence agriculture in South Africa and that the gender-specific constraints that they face are under-researched.

According to Du Plessis and Lekganyae (2012), since becoming involved with the homestead food gardening, women in South Africa feel empowered by programs directed at improving their literacy levels and strategies aimed at poverty alleviation. Some of those involved in the homestead food garden projects indicated that it had freed them from the chains of poverty and deprivation.

The homestead food gardens addressed aspects of structural powerlessness for women because they were able to take some food home to their children and at times even helped them obtain a small income from selling produce (Du Plessis and Lekganyae, 2012). Furthermore, women possessed power in the redistribution of vegetables taken from gardens to their homes. In other words, they controlled the allocation of these additional resources in their domestic spheres. They gained a small victory over the delineation of priorities and of laying claim on what they have produced.

Participation of women in the homestead food garden projects empowered women in terms of greater food security for their households, increased quantity and quality of foodstuffs available for household consumption, savings in the food budget and modest income generation (Du Plessis and Lekganyae, 2012). There is evidence that food gardens are implemented in some developing countries with the aim of addressing food scarcity problems in vulnerable areas

(Karaan and Mohamed, 1998). South Africa has a large number of households which are food insecure and such interventions play a crucial role in trying to reduce the problem (Altman and Jacobs, 2009). Hence, Du Plessis and Lekganyae (2012) state that policy interventions to promote the reduction of poverty in South Africa should consider the role of food gardens in rural and urban areas to change risk environments for the better. This should include equitable access to land, extension services and markets. Moreover, as the United Nations' Sustainable Development Goals emphasize poverty reduction, the promotion of gender equity and sustained research and support for developmental interventions such as homestead food gardens are required.

2.4 Smallholder irrigation

In sub-Saharan Africa, smallholder irrigation is strategically recognised as the future of smallholder farming and one of the means to address rural poverty, food insecurity and rising youth unemployment. Support for this sector has become more important now than ever before due, among other factors, to the pressure from climate change. The growing water scarcity resulting from the adverse impacts of climate change threatens the lives of approximately 13.2 million South Africans (Chipfupa, 2018) and a quarter of the world's population (World Bank, 2007). Smallholder irrigation is also highly valued in South Africa because it forms part of the strategies meant to address inequalities created by many years of a repressive and unjust apartheid system.

Irrigation has long played a key role in feeding expanding populations and is undoubtedly destined to still play a greater role in the future. It not only raises the yields of specific crops, but it also prolongs the effective crop-growing period in areas with dry seasons, thus permitting multiple cropping (two or three and sometimes four, crops per year) where only a single crop could be grown otherwise. With the security provided by irrigation, additional inputs needed to intensify production further (pest control, fertilizers, improved varieties and better tillage) become economically feasible. Irrigation reduces the risk of these expensive inputs being wasted by crop failure resulting from lack of water (Oni *et al.*, 2011).

A smallholder irrigation scheme refers to a group of farmers irrigating together and sharing the same water source and supply line. Irrigators are allocated plots within the irrigation command area and there is individual control of irrigation and farming activities by each farmer in his/her plot. The plot sizes are small and normally range between 0.1 and 2 ha. Such irrigation schemes are considered as formal in the smallholder farming sector (Svubure *et al.*, 2011).

SISs were developed in the former homeland areas of South Africa during the apartheid era, mostly for community food supply purposes. The parastatal entities that used to support them have gradually collapsed from the early 1990s. These schemes are now facing serious problems and an uncertain future, owing to low yields, deteriorating infrastructures, limited access to services, weak and unclear institutions regarding access to water and land and lack of support (Perret *et al.*, 2003). SISs represent assets or resources that can be used to increase and diversify the livelihood activity of plant production, resulting in improved livelihood outcomes. This is either directly in the form of food or income for plottolders, or indirectly by providing full or partial livelihoods to people who provide goods and services in support of irrigated agriculture on these schemes (Oni *et al.*, 2011).

In South Africa, about 1.3 million ha of land is under irrigation for both subsistence and commercial agriculture. Irrigation schemes in South Africa can be categorized into:

- 1) Bureaucratically managed small-scale schemes in which farming is carried out on behalf of farmers by the government or its agencies.
- 2) Community or garden schemes which are usually very small in sizes and are maintained by community users with the main objective of subsistence farming. Community food gardeners share similar infrastructure for water supply where small dams are usually used for water supply.
- 3) Corporation financed schemes in which government provides support from infrastructure down to farmgate while farmers only contribute toward a subsidized water fee and do operational service and management decisions.
- 4) Large estate schemes which are managed by agents with the objective of maximizing the use of resources through the production of high-value crops such as tea, coffee, etc. (Bembridge, 2000; Perret, 2002).
- 5) The other significant group of smallholder farmers are independent irrigators. They have a private water supply such as own borehole and their primary objective is to make a living out of farming where it is usually considered as an additional source of income. Independent irrigators are usually not supported through funds but use their own or family capital accumulated over a period of time. Moreover, there is a lack of support on specialised technical advice on cropping and irrigation management which reduces their overall productivity. According to Delgado (1999), independent irrigators can be differentiated on the basis that they buy their own inputs and sell produce independently wherever they choose.

In South Africa, it is estimated that about two-thirds of small irrigation schemes are dedicated to food plots where about 200,000 to 230,000 rural black people gain livelihoods partly on such schemes (Perret, 2002). In irrigation schemes, sprinkler irrigation technology is widely used on about 53% of the area, flood irrigation on 28.5% and micro and drip irrigation on about 18.5% of the area. Homestead and community food gardeners use low efficient technologies such as bucket system, hosepipes, flood irrigation, due to low maintenance cost. As noted in Chapter 1, the country's most recent era of SISs development is the one known as the IMT and revitalization era which began in the 1990s and is currently underway (Van Averbek, 2008; Fanadzo, 2012). Who are smallholder irrigation farmers?

The term smallholder is often defined and used in an inconsistent manner referring, *inter alia* to producers who sell products for cash as a supplement to other sources of income, to those who regularly market a surplus after their consumption needs have been met and to those who are small-scale commercial farmers with primary focus on production for the market (Cousins, 2013). In South Africa, the term smallholder or small-scale irrigation¹ is mainly used when referring to irrigated agriculture practiced by black people (Van Averbek and Mohamed, 2006). On the other hand, Gomo (2010) explains that the terms smallholder, small-scale, subsistence, communal and emerging farmers have been loosely used to mean the same thing although they have different connotations (Fanadzo, 2012). Machethe *et al.* (2004) state that there are different terms to describe smallholder farmers which include small-scale farmers, peasant farmers, food deficit farmers, household food insecure farmers, land reform beneficiaries and emerging farmers.

Farming as with small enterprises in general is inherently risky and the simple reproduction of rural household is by no means assured. Producers have to contend with both risks and opportunities arising from their conditions of access to land, credit and markets, their relationship with powerful groups such as landowners or agro-processing companies, the vagaries of nature, relative prices within markets for inputs, outputs and consumer goods and state policies. Within capitalism, small productive enterprises based on family labour power are best understood as petty commodity producers. Such producers combine the class places of capital and labour within the enterprise: they own the means of production, unlike landless workers and are in these sense capitalists but they also use their own labour power, unlike capitalists who hire workers. However, some may hire in occasional labour for specific

¹¹ In this report, the term smallholder irrigation and small-scale irrigation are used interchangeably to mean the same thing.

purposes. Some produce a substantial surplus over and above the amount needed to secure their simple reproduction and can reinvest all or part of this surplus in extending the material base of production unit (through cultivating more cropping land, intensifying land use through irrigation or the application of higher levels of fertilizer) (Cousins, 2013).

2.4.1 Types of irrigation systems common in South Africa

Irrigation is the controlled application of water for agricultural purposes through manmade systems to supply water requirements not satisfied by rainfall. According to Van Averbeké (2008), irrigation scheme refers to diversion of water by multiple holdings from one area into a relatively small area where they share water resources with the aim of enhancing available water for crops. The techniques of diverting the water include use of gravity through canals or pipes and lifting water through the use of pumps for application in the fields (FAO, 2001).

Irrigation is the major user of water in South Africa. Irrigated agriculture generally depends on engineered structures and field layouts to make the best possible economic and technical use of water that has been pumped or stored, usually at considerable cost. The full range of irrigation systems is found on various schemes across South Africa, namely, flood, sprinkler, center pivot and micro and drip irrigation, with sprinkler irrigation being the most common. Small-scale vegetable irrigation farming plays a significant role in rural and urban areas in South Africa where an estimated 150 000 growers participate on community food gardening projects and an unknown number grow food in homestead food gardens (Muchara, 2011).

Irrigation schemes are classified as traditional and modern. Modern irrigation systems serve the same purpose as those of traditional systems. Apart from the differences in their technological advancement, they are designed with the aim of securing smallholder sustainability and productivity. Traditional irrigation schemes were developed in different parts of the world by communities as an intervention to climatic challenges. Irrigation schemes can be classified on the basis of their structure into two groups: river diversion and dam construction. Others distinguish between intensive vs. extensive, yet other divisions can be made as productive vs. protective irrigation systems (Crosby *et al.*, 2000; Barker and Molle 2002; Mutiro and Lautze, 2015). The following are types that can be identified drawing from the literature:

- Surface irrigation – Water is distributed over and across land by gravity, no mechanical pump involved.

- Localized irrigation – Water is distributed under low pressure through a piped network and applied to each plant.
- Drip irrigation – A type of localized irrigation in which drops of water are delivered at or near the root of plants, evaporation and run-off are minimised in this type of irrigation.
- Sprinkler irrigation – Water is distributed by overhead high-pressure sprinklers from a central location in the field or from sprinkler on moving platforms.
- Center pivot irrigation – Water is distributed by a system of sprinklers that move on wheel towers in a circular pattern. This system is common in flat areas.
- Lateral move irrigation – Water is distributed through a series of pipes, each with a wheel and a set of sprinklers which are rotated either by hand or with a purpose built mechanism. The sprinkles move a certain distance across the field and then need to have water hose connected for the next distance. This system tends to be less expensive but requires more labour than others.
- Sub irrigation – Water is distributed across land by raising the water table through a system of pumping stations, canals, gates and ditches. This type of irrigation is most effective in areas with high water tables.
- Manual irrigation – Water is distributed across land through manual labour and watering cans and this system is very labour intensive.

In addition, USAID (2013) describes irrigation methods as:

- Flood irrigation – The application of irrigation water where the entire surface of soil is covered by ponded water.
- Furrow irrigation – A partial surface flooding method or irrigation normally used with clean tilled crops where water is applied in furrows or rows of sufficient capacity to contain the designed irrigation system.
- Gravity irrigation – Irrigation in which the water is not pumped but flows and is distributed by gravity.
- Rotational irrigation – A system by which irrigators receive an allocated quantity of water not at a continuous rate but at some intervals.
- Supplemental irrigation – Irrigation to ensure increased crop production in areas where rainfall supplies most of the moisture needed.

- Surface irrigation – Irrigation where soil surface is used as a conduct, as in furrow and border irrigation as opposed to sprinkler irrigation or sub-irrigation.

Irrigation structures can also be divided into different scales based on their irrigating potential, namely, smallholder irrigation scheme, medium irrigation scheme and large-scale irrigation scheme (Kyei-Baffour and Ofori, 2006). The most common irrigation method found on schemes is the sprinkler irrigation followed by the flood, center pivot micro and drip irrigation. An indigenous flood irrigation system of short furrows is widely used and very popular because of its manageability and maintainability without sophisticated equipment. Small basin irrigation is used for trellised row crops such as tomatoes. Similar systems are used widely in other African countries (Fanadzo, 2012).

Smallholder irrigators in South Africa have been categorized into four groups: homestead food gardeners, community food gardeners, farmers on irrigation scheme and independent irrigators (De Lange, 1994; Fanadzo *et al.*, 2010). Homestead food gardening and farmers in schemes have been described in detail in sections 2.3 and 2.4, respectively. Community food gardens are similar to irrigation schemes in that a group of farmers share infrastructure for water supply. These irrigated food plots constitute one of the biggest success stories in agricultural development in South Africa and their success is in sharp contrast to the problems of many of the sophisticated top-down managed larger irrigation schemes. It is estimated that at least 150 000 growers participate on community food gardening projects in South Africa and unknown number grow food in homestead food gardens. Community food gardening plays a role in giving individuals opportunity to develop virtually a full range of entrepreneurial and farming skills on small enterprise. It is a unique opportunity which can provide the poorest of poor people to improve their standard of living (Fanadzo *et al.*, 2010).

Different types of irrigation technologies are used on community food gardens. Most are irrigated using the bucket system, directly from rivers and springs or from earth furrows. Some of the food gardens have pumping equipment and water is pumped either into a reservoir or directly into a distribution network of pipes and tap stands. Sometimes hosepipes are used with tap stand system. Furrow irrigation is also used (Fanadzo *et al.*, 2010a).

Independent irrigation farmers are those not participating on an irrigation scheme or in a food gardening group. They have a private water supply such as through pumping directly from a river or on a borehole. Most independent farmers earn their living from farming even though others consider farming as an additional source of income. Independent farmers usually start

their irrigation enterprise using their own capital and their enterprises can be from small vegetable or fruit tree plot to large commercial units. The products include maize, sunflower, wheat, lucerne, vegetables, citrus, cotton, sugar cane, fruits and ground nuts (Fanadzo *et al.*, 2010a).

2.4.2 The contribution of smallholder irrigation to rural livelihoods

Irrigation schemes have one or more of the following objectives: increasing in economic return to the implementer, increasing in agricultural intensification and thus enhancing production and productivity, securing self-sufficiency in food production and maintaining food security, providing opportunity for optimal allocation and utilisation of resources, generating employment to the rural poor and making use of available labour resource and maximizing welfare of the community.

Studies have revealed that reliable and sustainable irrigation water can result in vast improvements in agricultural production and assure the economic vitality of the region. Many people have been depending on irrigation for their agricultural production in order to provide the basis for their societal needs and enhance food security. Since irrigation is the controlled application of water for agricultural purposes through manmade systems to supply water requirements not satisfied by rainfall, crop irrigation is vital throughout the world to provide the world's ever-growing populations with enough food (USG, 2013). Agriculture is predominantly dependent on natural rainfall. Irrigated agriculture on fairly limited scale is a recent phenomenon and was necessitated largely by the seasonally and unreliability of natural rainfall (Kyei-Baffour and Ofori, 2006).

There seems to be a general consensus that improving agriculture and enhancing agricultural productivity through irrigation will remain the key strategy for rural poverty alleviation in most of the low-income countries, where the majority of the rural poor depend directly or indirectly on agriculture (Fanadzo, 2012). Smallholder irrigation involves the diversion of water from one area into a relatively small area through canals or pipes for the purpose of supplementing water available for crops (FAO, 2001). Irrigation offers the potential to move to year-round cropping, generating higher annual yields from a single plot and allows farmers to diversify and plant alternative cash or food crops. For best results irrigation should be combined with other measures to improve crop diversity, crop yield, soil erosion, support for market access and the development of crop and seed banks (Kilpatrick, 2011).

Irrigation has historically been a major factor for increasing crop productivity; it raises the productivity of land directly by providing sufficient water supply to raise the yield per hectare per crop and by allowing a second crop to be grown during the dry season when yields are potentially higher (Ali, 2010). Irrigation development in the past started as an intervention to dreadful agro-climate in low rainfall areas and seasons. Climate change is a major barrier to economic growth in Sub-Saharan Africa as a result of the large fraction of economies that agriculture represents and its vulnerability to climate anomalies (Brown and Hansen, 2008). Modern technology prompts ways for tackling the effect of these natural and other manmade disasters by using irrigation development structures (Van Averbeké and Mohamed, 2006). Access to reliable irrigation can enable farmers to adopt new technologies, leading to increased productivity. It can also enhance overall higher productivity and greater returns from farming. This, in turn, opens up new opportunities both on-farm and off-farm and can improve income, livelihoods and the quality of life in rural areas (Hussein *et al.*, 2004).

Hussein *et al.* (2004) mention five key interrelated dimensions of the relationship between access to agricultural water, socioeconomic uplifting in rural communities and poverty reduction. The dimensions are production, income/consumptions, employment, vulnerability/food security and overall welfare. In general, access to good irrigation allows poor people to increase their production and income and enhances opportunities to diversify their income base, reducing vulnerability caused by the seasonality of agricultural production as well as external shocks. Thus, access to good irrigation has the potential to contribute to poverty reduction and the movement of people from ill-being to well-being (Hussein *et al.*, 2004). Increased output from irrigated agriculture may arise from improved yields, reduced crop loss, improved cropping intensity and increased cultivated area (Namara *et al.*, 2010). Accordingly, reliable access to water enhances the complementary inputs such as high yields cultivars and agrochemicals which also increase output levels, improve farm income and reduce poverty (Smith, 2004; Fanadzo, 2012).

Irrigation facilitates agricultural production intensification and improves agricultural productivity. It also helps to diversify crop grown and hence increase food variety and availability. Lastly, it can assist to present alternative cropping pattern decisions between cash and food items (FAO, 2000d). Intercropping due to irrigation gives more stable cash flow and is a way of diversifying income on scarce land resources while through mixed cropping practices employed on schemes, the labour demand can be spread over a longer time period (PDARD, 2011).

Irrigation also enables producers to select high calorie crops for their production using continuous flow of water; the availability of such facilities affects cropping pattern and related cropping decision (Bagson and Wuleka Kuuder, 2013). Expansion and intensification are systems by which irrigation enhances agricultural production because such interventions can increase the number of harvesting times within a year (Fanadzo, *et al.*, 2010). The benefits extend beyond increased agricultural productivity; it gives women time to start market gardens, helps families reduce debt, increase school attendance, limits seasonal migration for work and improves cash earnings ability to pay for health care and other services (Suleiman, 2010).

According to Reinders (2011), irrigated agriculture plays a central and dynamic role in the improvement of livelihoods in the rural areas where poverty is predominant. However, it is often subject to criticisms of inefficiency in water use, high capital and recurrent costs, lack of sustainability and association with inequity in the distribution of both land and water. This failure is mainly due to the lack of adequate attention to the business plan, collective management of the schemes and conflict resolution mechanisms. In many developing countries, small-scale irrigation schemes were counted on to increase production, reduce unpredictable rainfall and provide food security and employment to poor farmers (Chazovachii, 2012).

Irrigated agriculture plays major a role in rural livelihoods through four important inter-related mechanisms that can alleviate poverty (DFID, 2001; Smith, 2004): (a) improvements in the levels and security of productivity, employment and income for irrigating farm households and farm labour; (b) linkages in the rural economy; (c) increased opportunities for rural livelihood diversification; and (d) multiple uses of water supplied by irrigation infrastructure.

In irrigated agriculture where conditions are favourable, income for farmers can be increased through irrigation by ensuring that adequate water is supplied throughout the growing season. This may lead to higher yield and quality by eliminating water deficits and providing at least a measure of drought protection. Moreover, new crops or varieties for which market opportunities exist can be cultivated because water is available even during dry season. Farmers benefit through reduced risk and higher returns in the use of complementary inputs such as improved seeds and fertilizer. Farm labourers benefit through increased, more continuous and evenly spread farm employment. Furthermore, landowners benefit from the appreciation of the value of land that has access to irrigation. This appreciation often enhances access to credit and social standing (DFID, 2001; Smith, 2004).

Studies of SISs across Africa (FAO, 2000c; Kilpatrick, 2011) have shown that irrigation improved income even though there are still various avenues for improvement. The potential for irrigation development in sub-Saharan Africa is tremendous. A study by FAO in three small-scale schemes in Burkina Faso, Mali and United Republic of Tanzania found that irrigation improved income, diets and health (FAO, 2000c). This, in turn, enables to get access to food by improving purchasing power of individuals; it is found that existence of irrigation can increase income by creating more employment since it is labour intensive (Kilpatrick, 2011).

Irrigated agriculture, if successful, can lower food prices for consumers through more quantity being produced which reduces the price per unit produced. However, lower prices may offset producers' gain from higher productivity unless gains in productivity are sufficient to sustain profitability through reduced cost per unit of output. Benefits from irrigated agriculture have multiple effects, as irrigation contributes to agricultural growth by raising productivity of land and labour while these production linkages stimulate the farm input supply and output processing and distribution industries. Moreover, this effect leads to consumption linkages as rural households purchase more goods and services. Furthermore, if demand for goods and services increases, more jobs are created; this raises income in a virtuous circle that multiplies benefits from the original gains in farm productivity (Reinders, 2011). Smith (2004) noted that these linkages lead to improvement in human capital through better nutrition and increased ability to pay for health and education. Moreover, financial capital can be increased as the ability to save, borrow and invest in capital can reduce vulnerability and contribute to productivity. Poor rural households benefit from multiple uses of irrigation water supply as they may use water for drinking, washing and also for homestead food gardens. This saves their time and energy for lifting water from the river which could be far away from their homestead (Smith, 2004).

Irrigation has long played a key role in feeding expanding populations and is undoubtedly destined to play still a greater role in the future. It not only raises the yields of specific crops but also prolongs the effective crop-growing period in areas with dry seasons. With the security provided by irrigation, return on on-farm investment is more guaranteed and less risky. Consequently, additional inputs needed to intensify production further (pest control, fertilizers, improved varieties and better tillage) become economically feasible. Irrigation reduces the risk of these expensive inputs being wasted by crop failure resulting from lack of water (Oni *et al.*, 2011). Irrigation schemes are meant for improving the standard of living of the rural poor.

Therefore, expectations can be related to social, equity, economic and any other policy directed goal.

However, irrigation also has some negative effects on rural livelihoods. Irrigation has additional costs related to increased use of pesticides, fungicides and fertilizer application (Oosterbaan, 1988). The increased competition among farmers has the potential to reduce the prices and hence income to farmers (Oosterbaan, 1988). In addition to increased cost to farmers, irrigation systems have indirect environmental negative effects. These include competition for water use with downstream uses including fishing, among others, the dislocation of people, reduction of grazing land and wetlands due to the creation of large water reservoirs such as dams, depletion in the groundwater levels resulting in increased cost of lifting water; possible subsistence of land due to lower groundwater levels, soil degradation through waterlogging and salinity resulting in reduced yields, loss of land and a higher incidence of water-borne diseases, and reduction in water quality due to contamination by fertilizers, chemicals and manures (Oosterbaan, 1988; Tadić and Tadić, 2009). The high demand on family labour in smallholder irrigation systems might, however, result in a negative trade-off with off-farm income opportunities. For most families the additional income earned from agriculture might not offset income loss in off-farm employment.

Thus, the literature has shown that it is important to critically consider all livelihood aspects of smallholder farmers in small-scale irrigation to fully assess the potential of irrigation in improving livelihoods, income and employment opportunities. The extensive discussion has shown several benefits of smallholder irrigation on the livelihoods of smallholder farmers. However, there is still a need to balance these benefits with the direct and indirect negative impacts for sustainable irrigation agriculture. Conceptualization of these issues points to the need to invest in human capital in terms of farming and marketing knowledge, increasing water use efficiency (WUE) and improvement in marketing opportunities for farm produce. This study will show the current situation as regard farmer sources of livelihoods, cropping enterprises, water use and marketing opportunities.

2.5 Water availability, access and security

2.5.1 Water availability

South Africa is regarded as the 30th driest country in the world since it receives about half of the average annual rainfall in terms of available water per capita (Schreiner *et al.*, 2010). Over 60 percent of the country receives less than 500 mm rainfall per annum and about 21 percent

receives less than 200 mm (Perret, 2002; Sinyolo *et al.*, 2014). Water use in agriculture has steadily declined from around 80% in 1980 to 61.3% in 2011 (Zhang *et al.*, 2013). Most of the basin in Africa and South America are not the driest but they have poor access to water due to lack of appropriate storage and diversion infrastructures which expose them to drought (Cai *et al.*, 2011b). Water availability is limited due to physical and economic scarcity and thus reducing agricultural production and productivity.

One of the most noted problems leading to the limited or reduced availability of irrigation water is the fact that in a typical irrigation scheme, it is costly to exclude others from drawing water and even excluding others from drawing more water than the allotted amount, the case of head and tail problem. The other problem is the issue of water theft, where some illegally draw water and distort resource allocation to those who are legally entitled to use water (Kähkönen, 1999). Furthermore, water is often underpriced as farmers are charged an annual flat rate which is unable to cover the cost of operation and maintenance. A lower value is placed on water for agriculture as compared to the value placed on industries, cities and the environment. Some argue that while water is scarce in many areas, the price of agricultural water is low and this underestimates water scarcity to farmers. There is also little evidence that charging for water use can increase water use productivity because the “responsiveness to higher water prices is limited by existing systems of water rights, inadequate measurement and monitoring of water deliveries and strong opposition to higher water prices in agrarian societies” (Finney, 2013:478). Increasing water charges can be seen as a further penalty for producers who are already struggling to make a living (Molden and Sakthivadive, 1999). However, relatively cheap pricing of agricultural water creates inefficiencies; farmers over-irrigate which directly reduces water values. As farmers continue to add more and more litres of water, the marginal productivity of water diminishes as per the law of diminishing returns.

Moreover, the types of irrigation system used have an effect on production as other systems are more efficient than others. A study conducted by Al-Said *et al.* (2012), in Oman, revealed that a drip irrigation system had higher returns to water use than a sprinkler irrigation system mainly because it delivers the proper amount of water directly into the soil, reducing water waste and protecting the plants’ leaves and stems. However, this does not necessarily mean that farmers should install drip irrigation, but assuming that economic resources are abundant, a drip irrigation system would be a prime option to increase water productivity. The disadvantage of a drip irrigation system is that it is more expensive than other systems and needs regular maintenance (Reinders, 2011).

Investment in improvement for water productivity is essential through a range of technical and management practices. Drip and sprinkler irrigation and canal lining influences productivity and increases yield. Many strategies exist for improving water use productivity but the adoption rates remain low due to several reasons such as costs, profitability, risk and access to markets, water availability, education, incentives and institutional structures (Molden *et al.*, 2010). Incentives for increasing water productivity are rarely in place; farmers are more interested in making their entire enterprise profitable and enhancing household food security than increasing water use productivity. Water quality is also a major concern due to the limited quantity of water left in river channels and aquifers. Degradation of water quality is caused by emission from cities, rural households, and in agriculture, especially in areas of intensive irrigation by over-application of fertilizer. Degraded water quality will gradually lead to low water use productivity (Cai *et al.*, 2011a).

2.5.2 Access to water

According to WHO/UNICEF (2006), water access is classified as a universal need and a basic human right. It acts as an important element in human development, poverty alleviation and also a crucial component of preventive healthcare. It is estimated that almost one in four people in the developing countries lack access to improved water sources. Water is a universal solvent which is used for consumptive and productive purposes; it contributes positively to rural and urban livelihood in complex ways. In many instances poor people do not have access to enough water for both productive and consumptive uses due to scarce or limited resources (Molden *et al.*, 2007).

Lack of access to water is directly and indirectly related to poverty (Roy and Crow, 2004). Direct links are those that have to do with control over or with ownership of water resources while indirect links have to do with access to safe water. According to Madulu (2000), low level of access to improved water supply is mainly a result of poverty and has major adverse health effects on the population. Households which have poor access to water stand a risk of being attacked by water-borne diseases. Households whose members are affected by these diseases have to spend their resources taking care of the ill. This reduces labour available for productive purposes thereby accentuating poverty (UNESCO-WWAP, 2003).

According to UNESCO-WWAP (2003), a number of international ideas such as the 1981-1990 International Decade for Water Supply and Sanitation whose goal was to enhance the coverage of improved water supply have been initiated due to global anxiety about improving the water

supply. In 2000, the second world water forum held at Hague elaborated more on the importance of providing safe water and also the UN general assembly emphasized the importance of improving water supply and hence set targets to reduce the proportion of population without access to safe water in the SDGs. It has been noted that improved access to safe water is increasingly understood as satisfaction beyond basic needs. In rural areas water is not only important for satisfying basic needs but also for supporting critical household productive activities upon which their livelihoods depends. Some productive activities include watering vegetable gardens, livestock watering and other activities (Madulu, 2002; Makoni *et al.*, 2004).

The budgets of most departments, NGOs and international donors and financing communities are spent on water lifting, storage and conveyance to bring water to homes and fields in rural and peri-urban areas in developing countries. The United Nations declaration of water as a human right ratified by various governments commits governments and donors to deliver water for domestic uses to all citizens for health. Organisations such as World Bank, WHO, International Fund for Agricultural Development of United Nations and other financing organisations reengage in agriculture and irrigation, with the stated aims of unlocking farmers' productive potential for food and income (NEPAD, 2003; World Bank, 2007). Less rainfall and more extreme draught and floods under climate change reinforce the call for accelerating improvement in water lifting, storage and conveyance to protect the poor.

According to Faures and Santini (2008), rural livelihoods in the sub-Saharan African countries are highly depending on natural resources and water may be one largest constraint to expand and diversify the livelihood activities. Water is a basic need and a productive asset. Provision of water in these areas mainly focuses on meeting domestic needs such as drinking, cooking, washing and bathing. Since the mid-1990s, there has been a growing interest in how domestic water has been utilized for their productive activities and how it is tied to rural livelihoods. Multiple-use services were used as an approach in improving the awareness of how water provided for domestic use should be used. This approach seeks to plan and manage water services with the aim of meeting people's water needs for multiple purposes (Smith *et al.*, 2010). Providing more water and creatively designing water services around productive activities can enhance people's livelihoods and contribute a wider range of benefits than traditional designed systems (Smith *et al.*, 2010). Such additional productive systems include improved health, food security, income generation and women empowerment (Van Koppen *et al.*, 2009).

Productive use of water for livelihood diversification strategies remains relatively unexplored. Households with access to water for productive uses are able to diversify homestead production with small-scale cultivation, animal raising or other small-scale commercial services (Van Koppen *et al.*, 2009). According to Noel *et al.* (2010), domestic water supply was used for many types of household-based enterprises such as vegetable cultivation, pig raising, small eateries. Almost 60-70% of rural poor are estimated to have access to small cultivable plots, often around their homesteads and engage in water-dependent small enterprises (Renwick *et al.*, 2007).

2.5.3 The concept of water scarcity

The Comprehensive Assessment of Water Management in Agriculture (CAWMA) defines water scarcity as the lack of sufficient available water resources to meet the demands of water usage (CAWMA., 2007). Lautze *et al.* (2014:58) define water scarcity as the “point at which the aggregate impact of all users impinges on the supply or quantity of water under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment cannot be fully satisfied”.

Water scarcity can be categorized into two: physical and economic scarcity (Cai *et al.*, 2011a; Lautze *et al.*, 2014). Physical scarcity occurs when the demand for water exceeds the available water resource while economic scarcity occurs when resources required to extract water are limited due to financial, human and institutional capacity (CAWMA., 2007; Lautze and Hanjra, 2014). Economic scarcity is recognised by Lautze *et al.* (2014) as a more appropriate concept because it looks beyond physical availability by integrating the concept of water access. According to Zhang *et al.* (2014), water has an economic value in all its competing uses and therefore it should be treated as an economic good. Sometimes water can be available but does not produce potential grains due to lower water productivity or lack of infrastructural investments resulting in poverty (Carter *et al.*, 2012). To humans, when water is available in abundant quantities it is considered as non-rival and non-excludable but it stops being a pure public good when the consumption or its use by one individual has negative effects on the production and consumption possibilities of others (Zhang *et al.*, 2014).

Molden *et al.* (2007) states that a third of the world's people face water scarcity as a result of rising demand of population, continuous expansion of irrigation, growth in industries and lack of investment in machinery. Climatic changes and land degradation strain the environmental flow and there is a need to preserve the ecosystem (Janmaat, 2004). According to Boelens *et*

al. (2005), the problem of water scarcity will intensify due to increasing population, the rising demand for water for agriculture and greater climatic variability. Increasing scarcity is likely to deepen current inequalities in access to water and disadvantage to the rural communities.

Water is no longer becoming scarce only in arid and drought prone areas but also in regions where rainfall used to be abundant. This distresses the quantity of resources available and the quality of the water because of degraded water resources. The sustainable use of water resource conservation, environmental friendliness and economic viability are the priorities for agriculture in water scarce regions. New strategies are required mainly for irrigation management and practice since the agricultural sector is far ahead in demand for water. Water scarcity occurs due to various natural and man-made causes (Pereira, 1990).

Table 2.2 presents the causes of water scarcity. Drought is nature-induced risk factor with temporary imbalance in water availability consisting in lower average rainfall (Pereira *et al.*, 2002). It results in the failure of the precipitation causing a serious disruption of the water supply to the natural and agricultural ecosystem. Aridity is also a nature induced permanent imbalance in the water availability consisting in low average annual rainfall resulting in overall low moisture and low carrying capacity of the ecosystem.

Table 2.2. Causes of water scarcity

Duration	Nature-produced	Man-induced
Permanent	Aridity	Desertification
Temporary	Drought	Water shortage

Source: Pereira *et al.* (2002)

Desertification is caused by man and leads to permanent imbalance in the availability of water which is combined with damaged soils, inappropriate land use and deterioration of the carrying capacity of the ecosystem. This is associated with soil erosion and salinity. When dealing with scarce water it seems appropriate to define desertification in relation to the water and nature imbalances produced by the misuse of water and land resources, compounded by land degradation and causing water scarcity (Pereira *et al.*, 2002). Water shortage is also man-induced but temporary water imbalance including ground water over-exploitation, reduced reservoir capacities and consequent altered carrying capacity in the ecosystem. Degraded water quality is often related to water shortage and like drought it induces water scarcity.

2.5.4 Water security

Closely related to water scarcity is the concept of water security. Although water security has been defined depending on the context and differing water use perspectives (Sinyolo *et al.*, 2014), a few studies have attempted to provide definitions that can be contextualized to irrigation farming. Sinyolo *et al.* (2014) defined water security as access by irrigating households to sufficient and reliable water to meet their agricultural needs and their ability to assert their water rights against other parties. Accordingly, the institutional arrangements and governance structures are part of the definition of water security. In his paper, Bakker (2012) focuses on two aspects: water-related risk and availability of water of sufficient quantity and quality to support livelihoods and other needs. Shah and Koppen (2006) discuss access to and reliability of water to meet both productive and consumptive uses. Two common concepts are derived from these definitions, that is, water adequacy or sufficiency and water reliability. These concepts are important in smallholder irrigation where the reliability and sufficiency of quantities of water available affect the productivity of the irrigated plots, *ceteris paribus*.

2.6 Water use productivity

2.6.1 The concept of water use productivity and the water-energy-food nexus

Water use productivity is a controversial statement in water resources management. According to Gleick *et al.* (2011), several authors, water scientists and water managers have debated and explored how to define, measure and evaluate water use productivity in agriculture. There are several problems being outlined which complicate definitions of water use productivity, which, among others, include confusion about its assumptions and the inappropriate application of narrow disciplinary tools to a complex inter-disciplinary topic. Water productivity is affected by many factors including natural and management conditions such as seeds, labour and fertilizer and hence the application of the concept in isolation fails to capture the relative contribution of diverse factors (Cai *et al.*, 2011a). The water productivity concept is better understood in conjunction with specific system settings, i.e. whether it is a water-abundant or water-scarce area; whether productivity is constrained by yield or water use; whether it is an irrigated or a rainfed system. According to Cai *et al.* (2011b), water productivity results in isolation typically fail to enable tailored-recommendations and fail to provide any specific guidance on how to improve conditions. Thus, such shortfalls raise a question as to whether the use of the concept adds additional value to the joint use of water efficiency and agricultural productivity (Zoeb, 2006).

According to Zoebl (2006), the water productivity concept violates the opportunity cost of saved or lost water. Therefore, high water productivity values may not be a suitable target because the values do not say much about the economic wise use of this resource. Moreover, irrigation efficiency remains a valuable and significant parameter provided it is well defined and used at the level of individual farmers or irrigation projects (Zoebl, 2006). In contrast, others argue that water productivity does add value to joint use because the concept enables comparison of the production benefits associated with the use of water in one location to another. Accordingly, it also serves as a decision-making guide to water allocation compared to WUE (Molden *et al.*, 2007; Molden *et al.*, 2010, Hussain *et al.*, 2007). Though the water productivity concept may have its short-fall, it still holds value if applied in combination with other indicators. But if it is used in isolation, it holds the potential to mislead.

According to Dam and Malik (2003), there are several definitions of the water use productivity concept, as it is not uniform and it changes with the background of the researcher and stakeholder involved. Economists are often interested in maximizing the economic value of water used while plant breeders are more interested in maximizing kilograms of dry matter production per unit of transpiration. Furthermore, productivity based on actual yield as harvested product in kg is less useful if the concern is to compare different crops or different regions. A definition based on economic value is, therefore, more appropriate for this study since the aim is to compare the productivity of various farmers. Thus, this study employs the economic value of water as a proxy for water use productivity.

The water productivity concept originated from the term irrigation efficiency in the late 1990s. Lautze *et al.* (2014) define it as the quantity of output per unit of water which is used to assess performance towards the end of maximizing production derived from water use. However, Molden *et al.* (2010:528) go further and define water productivity as the “ratio of net benefits from crop, forestry, fishery, livestock and other mixed agricultural systems to the amount of water used in the production process”. The benefits can be measured in various terms such as physical mass, economic value and nutritional value. Physical water productivity refers to the ratio of agricultural outputs to the amount of water consumed and economic water productivity refers to the value derived per unit of water used while the nutritional value is based on the energy and vitamins per unit of water consumed and used by the crop (Molden *et al.*, 2010).

Various reasons can be outlined why it is necessary to increase water productivity. Firstly, water should be used in a most productive way so to meet the rising demands for food from a

growing, wealthier and increasing urbanized population in the light of rising water scarcity. Secondly, to respond to pressures from agriculture to re-allocate water to other sectors and ensures that water is available for environmental users. Furthermore, improving water productivity can reduce poverty levels and contribute to economic growth in South Africa (Molden *et al.*, 2010). If water productivity is improved, investment cost can be reduced by using less cost to extract water to the field. It is, therefore, crucial to increase water use productivity because the more producers are able to produce with an equal amount of water, competition for water may be reduced and the greater will be the local food security and increased water for agriculture, household and industrial uses. An increase in agricultural water productivity is the key approach to mitigate water shortages and to reduce environmental problems (Ali and Talukder, 2008; Cai *et al.*, 2011a).

However, in coming up with strategies for increasing water use productivity, there is a need to understand the water-energy-food nexus. Water and energy are coupled in intimate ways as many technical processes of extracting and producing energy utilise water. This interdependency, shown in Figure 2.1, is referred to as the water-energy nexus. It is a crucial issue for future planning and strategic policy considerations in an effort to increase water use productivity (Siddiqi and Anadon, 2011; Rasul, 2014).

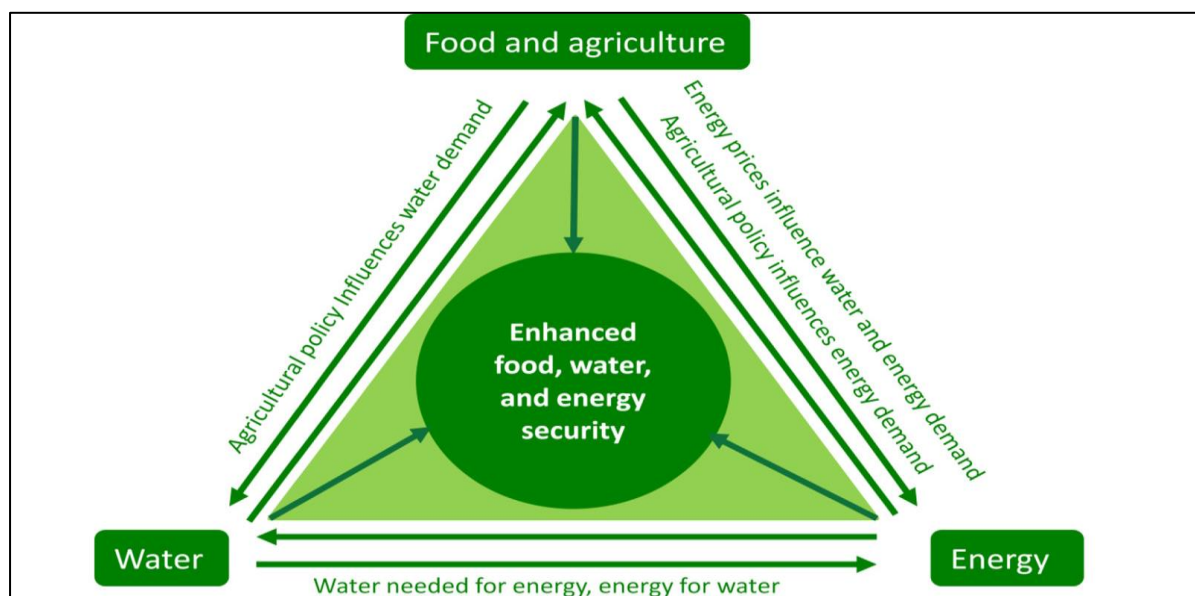


Figure 2.1. The water-energy-food nexus

Source: Rusul (2014)

Furthermore, strategies should take cognisance of the fact that the demand for water, energy and food is going to increase in the foreseeable future. Global projections have indicated that the demand for freshwater, energy and food will increase significantly due to the pressure of population growth and mobility, international trade, economic development, diversifying diets, technological change and climate change. It is estimated that, globally, total water withdrawals for irrigation will increase by 10% by 2050 while global energy consumption will increase by up to 50% by 2035 (FAO, 2011). According to Ringler *et al.* (2013), in 2007 food prices increased by nearly 40% and further increased in 2008, while in 2011 prices flared up and it seems that they are unlikely to decline in the foreseeable future. Given the interdependence between natural resources and agriculture, higher food prices are an important signal of growing natural resource scarcity. It is indicated that, among other factors which lead to price increases (such as changes in demand, available technology, etc.), the key factors are associated with water supply, energy and land use.

However, the water-energy-food nexus cannot present a complete picture of rural livelihoods on its own and it needs to be studied along with the sustainable livelihoods framework (SLF) in order to know where best intervention can be made, to productively use water while not degrading the environment. By assimilating SLF and water-energy-food nexus, the inter-linkages among prices, energy, water, capital assets and the environment is identified. Figure 2.2 below brings together the water-energy-food nexus and the SLF.

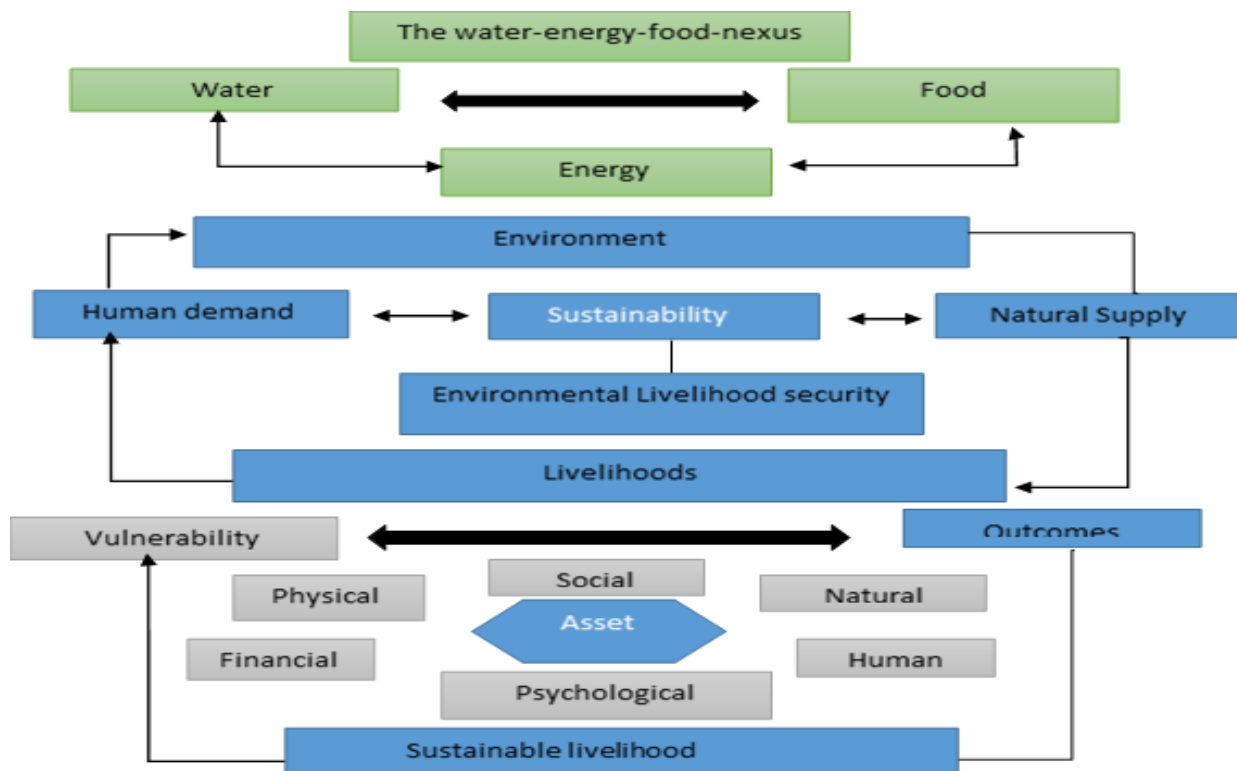


Figure 2.2. Inter-linkages between the water-energy-food nexus and the sustainable livelihoods framework

Source: Adapted from Biggs *et al.* (2015)

The primary inter-linkage can be recognised as a mutually re-enforcing relationship between water and livelihoods as water is essential to support livelihoods in irrigated agriculture while livelihood activities and capital assets determine the preservation of water access and supplies (Biggs *et al.*, 2015). For example, “physical capital (infrastructure) may enable more efficient water extraction and transportation while financial capital (public or private funds) may assist in implementing more sustainable practices in water use or purchase access to alternative supplies” (Biggs *et al.*, 2015:393). Hence, these inter-linkages need to remain balanced and resilient under prevailing vulnerabilities which threaten sustainable rural development.

2.6.2 Factors influencing water use productivity

2.6.2.1 Access to productive resources/assets

Farming inputs are basic and essential to any farm enterprise. The strategies attempting to link African farmers to markets and increase farm productivity must first consider how inequality in productive assets constrains the majority of smallholders’ ability to participate in markets (Delgado,1999). In South Africa, smallholder farmers are characterised by lack or poor access

to capital assets including physical, financial, social, human and natural assets, which are crucial in increasing productivity and alleviate poverty. Lack of these capital assets increases risk and creates disincentives to increase production (Sikwela, 2013). According to Pote (2008), production assets are the key requirements for increasing farm profitability and increase market access and that is why the majority of farmers are unable to participate in lucrative markets because of lack of specific household production assets.

Machete (2004) noted that lack of infrastructure (lack of storage facilities) severely limits productivity. This includes post-harvest storage facilities and cold rooms which help in maintaining the quality of the products due to the perishable nature of agricultural products. Magingxa *et al.* (2009:50) argue that “assembly and the storage point for farmers’ produce are unsuitable for agricultural products”. Moreover, smallholder farmers sell their produce immediately after harvest when prices are low due to lack of storage facilities which directly reduce their output value and productivity (Tollens, 2006; Magingxa *et al.*, 2009). This is also triggered by cash flow problems as these farmers often do not have cash reserves to wait until prices recover. According to Katundu *et al.* (2010), smallholder farmers at Embo still use traditional storage methods, where traditional huts with earthen floors are primarily used as the farmers’ storage. These huts are not suitable to be used as potato storage and as a result due to poor storage capacity resulted in higher post-harvest losses due to greening and spoilage from exposure to indirect sunlight. Furthermore, due to lack of storage facilities, farmers cannot sell their surpluses and supply consistently during the off-season. Their inconsistency makes them less competitive in the value chain and this prevents them from participating successfully in the chain. Due to their inconsistency and low competitiveness, other role players in the chain (e.g. supermarkets) avoid working with them. According to Reardon (2005:29), cited by Baloyi (2010), supermarkets prefer to not work with smallholder farmers because they do not deliver the required quality products regularly (start/stop) and they do not invest consistently. Henceforth, according to Delgado (1999), in order to increase small-scale market access and productivity in Sub-Saharan Africa, strategies should focus on the four keys, namely, access to assets, access to information, access to services and access to remunerative markets.

In agriculture, especially in small-scale farming, most of the resources are considered as common pool resources, where non-excludability is difficult, which usually leads to resources being used more than the social optimum and ultimately being exhausted. This is commonly identified as the tragedy of the commons. One of the main characteristics of small-scale farming is heterogeneity in terms of farm size, income inequality, head-tail users, etc. The latter

is regarded as the key problem as far as smallholder irrigation scheme management is concerned. Head and tail users differ in terms of their access to irrigation water, where water use for end-tail is highly determined by head-user, often leading to conflicts in water allocation. Thus, social capital is considered to be an important instrument for common pool resources management through collective action management (Aida, 2011; FAO, 2001; Muchara *et al.*, 2014). Furthermore, the formation of collective action such as co-operatives or informal groups enables farmers to attain goals that are difficult to be achieved on their own as individuals. Farmers are able to benefit from economies of scale through sharing of transport to access inputs, purchasing of inputs, sharing of information and knowledge and selling output as a group which increases market access and reduces transaction costs. However, the success is primarily based on the trust and cooperation between members as a result of which productivity can be increased (FAO, 2001; Aida, 2011).

To reduce farmers' vulnerability to short-term income, access to credit is a vital instrument for improving the welfare of the poor directly by reducing liquidity constraints. Farmers who are less risk-averse are more willing to take credit for productive investment to overcome liquidity constraints directly boosting production and income (Sebopetji, 2008). However, the majority of smallholder farmers do not have access to credit due to land tenure insecurity and collateral issues as was noted in section 2.5.1 above.

Training and education assist farmers in applying new methods required for improving irrigation water management and farming operations as a whole and training benefits farmers to understand guidelines on the use of agrochemicals and adopt innovative agricultural technologies. Human capital affects the adoption and utilisation of technology which directly influences the decision making in resource allocation while directly influencing farm productivity (FAO, 2001). Montshwe (2006), further states that education levels also affect the level of market participation among smallholder farmers as they will be able to understand and utilise both technical and management operations. Delgado (1999) also agrees that in new commercial items and non-traditional exports, only those individuals with high levels of education, better access to management and technical advice and better knowledge of market opportunities are most likely to grow their operations compared to those without. Lastly, PsyCap is an important asset unique to individual farmers as to how they perceive and show commitment toward farming. There will be more details on the SLF in the following chapter.

2.6.2.2 Crop-related factors

Genetic improvement has played a vital role in improving yield potential for crops. In the past, more emphasis has been on WUE as an important determinant of yield under stress conditions and even as a component of crop drought resistance. It has been used to imply that rainfed plant production can be increased per unit of water used, resulting in ‘more crops per drop’. However, if biochemistry of photosynthesis is not improved genetically, greater genotypic transpiration efficiency and WUE will be low as it is mainly controlled by plant traits or genetics (Bouman, 2007). Another improvement in transpiration efficiency may be the conversion of C3 plants into C4 plants through genetic engineering, as C4 plants are more efficient in their photosynthetic pathway and also have higher WUE than C3 plants (Bouman, 2007; Molden *et al.*, 2010). If the right combinations of crops are chosen, high economic return from production can be obtained with limited water resources.

According to Ali and Talukder (2009), in mathematical modelling, water productivity is largely a function of the carbon dioxide and vapour concentration gradient between the inside and outside of the leaf. This process is regulated by stomata, so the stomata behaviour determines the water productivity of a cultivar. In irrigated agriculture, an extensive volume of water is lost as evaporation or leakage during storage and transporting of water to the fields where the crops are grown (Qadir *et al.*, 2003; Wallace, 2000). If there are no improvements in water productivity, the average annual agricultural evapotranspiration (ET) could double in the next 50 years. Furthermore, with improvement in water productivity, the increase in global ET could be reduced to 20-30% (Molden *et al.*, 2010). ET process is defined as the combination of two separate processes whereby water is lost from the soil surface by evaporation and from the crop by transpiration (FAO, 2000b). Transpiration rate is influenced by crop characteristics, environmental aspects and cultivation practices, crop development and management practices. Factors such as soil salinity, poor land fertility and limited application of fertilizers, the presence of hard or impenetrable soil horizons, the absence of control of diseases and pests and poor soil management may limit the crop development and lead to poor mechanization of the crop (FAO, 2000b; Karam *et al.*, 2009; Molden *et al.*, 2010). Therefore, it is important to develop farm management strategies to effectively increase crop productivity.

Better cultivars are required to increase crop yield per unit of scarce water. However, the challenge is to: improve genetic make-up in order to capture more of the water supply for use in transpiration, exchange transpired water for CO₂ more effectively in producing biomass and convert more of the biomass into the harvestable product. Developing genotypes that are able

to maintain adequate fertility despite severe water scarcity is a prime option for plant breeders (Bluum, 2009; Passioura, 2006).

2.6.2.3 Inputs and agrochemicals

Shortage of sufficient nutrient supply and poor soil structure are the principal constraints to crop production under low input agriculture. Soil organic matter management is very important for the development of sustainable low-input agriculture system and for the improvement of soil quality (Ouedraogo *et al.*, 2001). Fertilizer plays a crucial role in increasing overall productivity which directly increases soil cation exchange capacity and improves Soil pH, enabling farmers to harvest large quantities of produce (Ouedraogo *et al.*, 2001). The use of agrochemicals increases food production and increases profits for farmers as the high loss in food production caused by pest is combated, thus enabling farmers to sell more quality products. Moreover, using agrochemicals (such as herbicides) reduces the cost of labour for production as the amount of time required to manually remove weeds and pests from fields is reduced (Aktar *et al.*, 2009). However, in sub-Saharan Africa, the use of chemical fertilizer in small-scale farming remains very low despite the fact that it is an important factor in increasing crop production (Freeman and Omiti, 2003). Adoption of fertilizer has remained low due to high risk of low variable rainfall patterns, inefficient input distribution and unavailability of agricultural inputs and services in rural retail. Furthermore, farmers are uncertain about the returns from fertilizer use because of various risk factors associated with volatility in prices, pest infections and also restricted or lack of liquid capital to purchase them (Freeman and Omiti, 2003; Morris *et al.*, 2007; Diiro *et al.*, 2015).

Agrochemicals are essential agricultural inputs required to protect crops from diseases, control pests and weeds thus increasing overall productivity. It has been estimated that pre-harvest crop losses due to weed infestation, plant diseases and arthropods is around 30-35% but with the application of agrochemicals, losses can be significantly reduced (Kughur, 2012). Moreover, agricultural chemicals significantly increase crop yields by reducing damage by the pest, competition for water and nutrients from weeds and by providing large amounts of nutrients in a form that is easily available to plants. Agrochemicals contribute not only to crop growth but also reduce food waste, allowing consumers to consume a high-quality product that is free of insect blemishes and insect contamination. Moreover, due to reduced losses during production, the cost of food is reduced because high-quality yields are being produced thus increasing returns from water use (Kughur, 2012).

Despite the positive effect caused by agrochemicals, they significantly have negative effects on the environment and on human life. According to Hussain *et al.* (2007), water values are affected by time dimension as most of the project impacts are realised in a longer period where extensive use of agrochemicals may start to cause harm to the environment. Agrochemical use disrupts the balance of an ecosystem as they do not stay in a location where they were applied but can move through water, soil and air and cause harm if they come in contact with other organisms (Biswas *et al.*, 2014).

Extensive use of agro-chemicals and fertilizers in a long-term period has a negative effect on soil fertility, water quality and air quality which directly reduces water values. Nitrate leaching (from ammonium-based fertilizer) causes soil acidification which reduces soil fertility and during runoff causes harm to aquatic ecosystems and impairs water use for humans and livestock (Morakinyo *et al.*, 2013; Biswas *et al.*, 2014). During run-off contaminated nutrients enter into water bodies and reduce oxygen levels of aquatic ecosystems. Livestock and humans directly consume contaminated water which immobilizes some of the haemoglobin in blood, reducing the ability to transport oxygen and eventually leads to chronic illness or even death. In irrigation schemes, inadequate drainage and over-irrigation cause waterlogging and salinization which degrades downstream ecosystems due to polluted run-off (Killebrew and Wolff, 2010). Furthermore, according to Killebrew and Wolff (2010:2), “during the microbial processes of nitrification and denitrification that take place in fertilized soils, nitric (NO) gas is released. Nitric emissions impact local and regional air quality by contributing to the formation of smog, ozone and acid rain”. Polluted air directly causes harm to human health by causing Asthma and other related diseases (Aktar *et al.*, 2009; Killebrew and Wolff, 2010, Morakinyo *et al.*, 2013; Biswas *et al.*, 2014).

2.6.2.4 Farm management-related factors

Crop rotation is one of the oldest farm management criteria for improving productivity and it is the most effective cultural control strategy for keeping soil quality and structure. Crop rotation has several advantages such as preventing soil depletion, maintaining soil fertility and reducing soil erosion. It is also a cultural means for controlling pest and reducing pest build-up thus preventing crop diseases and helping to control weeds. Reduced tillage also plays a significant role in improving water use productivity (FAO, 2000a). Reduced tillage helps in reducing the effect of raindrop impact on the soil surface; it also increases water infiltration into the soil while reducing runoff from the soil surface. Moreover, it helps in reducing rapid breakdown of the soil structure and reducing the formation of hard pan layers in the soil. This

leads to a better soil environment for the crop growth thus increasing water use productivity (FAO, 2000a; Woyessa *et al.*, 2004). The other important management factor is related to water use or management in irrigation schemes. There is a significant loss of water in many irrigation schemes due to over-irrigation and lack of proper irrigation management tools that are required to assist a farm manager on how much and when to irrigate. This is known as irrigation scheduling. Furthermore, with accurate irrigation scheduling, there is a possibility of achieving high performance of irrigation schemes in terms of water productivity (Woyessa *et al.*, 2004). Water management in the agricultural sector cannot be applied without a precise and reliable method of crop water requirement determination, comprehensive information on the irrigation system, farming practice, appropriate measuring devices and information on return flows. Thus, a farmer is required to know the daily crop water use of each crop, to measure rainfall and the amount of water applied so as to make precise demand and application of irrigation water (Woyessa *et al.*, 2004). Crop water requirement is defined as the amount of water required to compensate the ET loss from the cropped field. It basically represents the difference between the crop water requirement and effective precipitation; it also includes additional water for leaching of salts and to compensate for non-uniformity of water application (FAO, 2000a; Woyessa *et al.*, 2004).

Procedures for irrigation scheduling are based on soil, crop and weather monitoring. These determine the level of irrigation efficiency in the scheme as it depends on how crop water requirement is determined. Various methods have been proposed for the determination of crop water requirement. These methods are SAPWAT 4.0 (WRC, 2016) and CROPWAT (Smith, 1992). These methods have become the international standard used on the global scale for irrigation management. SAPWAT method was primarily developed for South African conditions with a link to further development on an FAO planning model. CROPWAT was developed as a planning and management aid that is supported by extensive South African climate and crop databases (Woyessa *et al.*, 2004).

Deficit irrigation can also help in increasing water use productivity and save scarce water by applying less water than cumulative ET. Root zones utilise stored soil water in the winter or pre-season irrigation. Deficit irrigation limits water application to drought-sensitive growth stages with an aim of maximizing water productivity and stabilizing yield. Water is saved because irrigation requirements in the early irrigation in the spring season can be less than that indicated by ET. Deficit irrigation saves water without reducing the yield; however, critical periods should be avoided (Shatanawi, 2005).

Supplemental irrigation is one of the highly efficient practices for improving water use productivity and improving livelihoods, especially in dry rainfed areas. “Supplemental irrigation is defined as the addition of small amount of water to essentially rainfed crops during times when the rainfall fails to provide sufficient moisture for normal plant growth, in order to improve and stabilize yields” (Oweis and Huchum, 2006:62). Supplemental irrigation is scheduled not to provide moisture-stress-free conditions throughout the growing season but to ensure a minimum amount of water available during the critical stages of crop growth that would permit optimal instead of maximum yield. Supplemental irrigation increases not only yield but also water productivity.

2.6.2.5 Policy-related factors

In addressing rural poverty and inequalities inherited from the past apartheid regime, the South African government has put forward various reform measures. Water legislation is among other programs which are developed to promote “equity, sustainability and efficiency through decentralised water management, new local and regional institutions, water user registration and licensing and the emergence of water right markets” (Perret, 2002:284). Rising water scarcity due to population growth and economic development has necessitated formulating appropriate water institutions which include well-defined water rights. Water institutions are defined as “the humanly devised constraints that regulate water development, allocation and utilisation” (Zhang *et al.*, 2014:71).

The main objective of the new water resource management regulation is to promote equal access to water, where farmers and rural communities should form “Water User Associations (WUAs)” with an aim of enabling communities to pool financial and human resources for carrying out more effectively water-related activities. Moreover, only members of WUAs apply for a license and then they are given the right to use water under specified conditions. However, those who fail to become members of WUAs are limited in right to use water, particularly irrigation on a commercial or subsistence scale while individuals at the household level and rural people are granted free and unregistered right to use water for irrigation (Perret *et al.*, 2002).

These institutions are able to achieve an efficient allocation of water among the users to maximise total net benefits. The adoption of a system of volumetric surface-water pricing is an incentive for using water more efficiently and productively. Finney (2013) defines water management charges as a form of economic instruments where government licenses water users the right to abstract water and charges are based on either licensed volume of abstraction,

regardless of the volume actually used, or on the volume abstracted and measured in cubic metres. Water abstraction management charges usually include components such as the environmental value of water, the opportunity cost which is the economic value or scarcity value of water and the administration cost of water resource management (Finney, 2013).

Water fees were introduced to meet the cost of water supply and improve water efficiency. However, many authors (such as Young, 2005; Wang *et al.*, 2010) further argue that the current prices charged for irrigation water are well below the market levels and are, therefore, not sustainable. These fees do not even cover the costs of operating and maintaining the irrigation system. As a result, this hinders the efficient allocation of water under the prevailing water institutions. Moreover, water abstraction charges are widely adopted by high-income and some middle-income countries including South Africa, while they are employed only by few low-income earners because low-income countries have limited managerial and technical capacity (Rogers *et al.*, 2002; Nieuwoudt and Backeberg, 2011; Finney, 2013).

Land tenure security is one of the most critical elements affecting water use productivity and hence sustainable agriculture and poverty reduction. Secured tenure creates incentives to invest and use resources more efficiently. Wannasai and Shrestha (2008) define secure land tenure as the possession of private land with land titles issued and the landowners who hold this certificate possess unrestricted rights of sale, transfer and inheritance. According to Roth and Haase (1998:2), from an economic angle tenure insecurity is a “function of inadequate number of rights or lack of key rights, inadequate duration or lack of assurance”. Figure 2.3 below indicates the conceptual framework for tenure security.

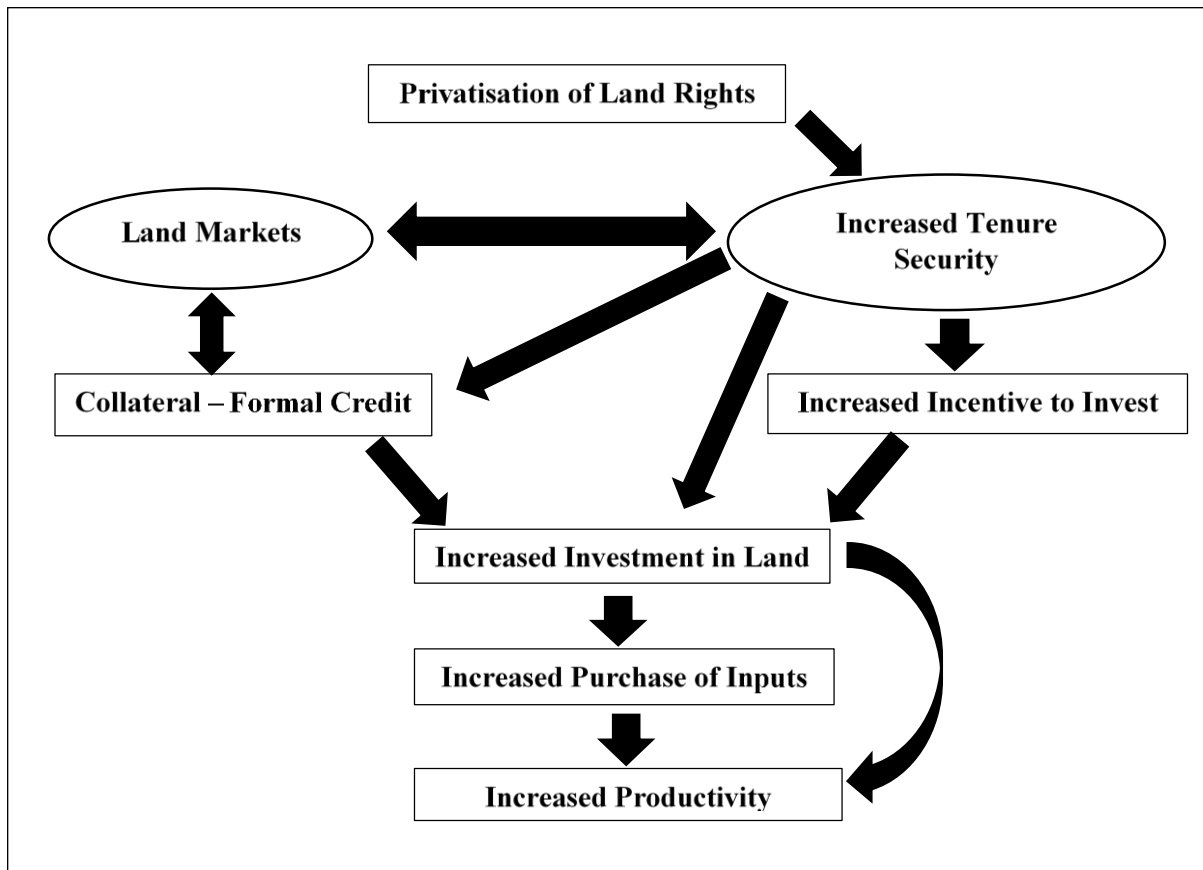


Figure 2.3. Conceptual model for tenure security

Source: Adapted from Place (2009)

Secure land tenure directly increases productivity by improving access to inputs through creditworthiness and collateral value of land (Roth and Haase 1998; Darroch and Mushayanyama, 2006). It also limits land disputes because there is a clear definition and protection of rights which increases productivity through increased agricultural investments (Roth and Haase, 1998). Duration of the secured right to use land is critical in decision making in land use. To improve productivity, farmers require high tenure security before making fixed land improvements and investing in capital intensive technology. However, due to insecure tenure, it is impossible to access credit from formal lenders because they require clear and transferable title before lending while credit supply from informal lenders is insufficient. As a result, land ends up not being fully utilised, productivity decreases and the economy is negatively affected (Machingura, 2007). Hussain *et al.* (2007) state that water value is higher in production of high valued crops (such as tree crops, coffee, etc.) but due to poor land

security, investment in high-value crops is limited and farmers have no option but to cultivate crops with lower value which even do not present opportunities for market access.

Despite insecure land tenure that hinders farmers' performance, small plot allocation is another major problem that hinders high productivity. In a South African nationwide survey, it was found that at least 25% of smallholder farmers are approaching landlessness as they control less than 0.11 ha per capita. According to Jayne *et al.* (2010:1386), "under the existing conditions, the ability of this bottom land quartile to escape from poverty directly through agricultural productivity growth is limited by their constrained access to land". Small plot (s) are insufficient for a producer to benefit from economies of scale and to access markets through being able to supply large quantities. From a survey of smallholder farmers of two Districts in Limpopo Province (Vhembe and Capricorn), it was found that vegetable profit margin per beneficiary was low because the total net profit was shared amongst all the 26 beneficiaries of the Ratanang project (Baloyi, 2010). Despite efforts of the South African government through the land reform programme aimed at promoting efficient land use for agricultural production by smallholder farmers (Land Bank, 2011), the majority of these farmers still do not have access to land (Machete, 2004).

According to Machete *et al.* (2004) and Fanadzo *et al.* (2010), smallholder agriculture intensification by improving the management and productivity of land and water in a viable way is a solution for agricultural growth in developing nations. Increasing agricultural productivity is necessary when land and water are scarce and there is a necessity to gain all the benefits of production inputs (Sharma *et al.*, 2010). Among the common factors contributing to the failure of smallholder irrigation projects in the rural areas is unproductive water management, rundown irrigation water infrastructure and limited understanding of irrigation system (Machete *et al.*, 2004; Holden and Ghebru, 2016). According to Migot-Adholla *et al.* (1991), "As new technologies become available, credit, input and product markets improve and rural infrastructure is developed, then more significant relationships between tenure security and productivity begins to emerge".

Empirical studies by Fenske (2011) and Bellemare (2013) have suggested that formal land rights have no influence on productivity and that informal land rights (i.e. landowners' subjective perceptions of their rights) have mixed effects on productivity. Sitko *et al.* (2014) found that assigning land titles to smallholders in Zambia did not lead to any sort of advantageous fluctuations in smallholders' production levels and investment approaches desirable to grow farming-based poverty alleviation. Therefore, understanding the existing land

use rights is necessary as it can guide how best land use rights can be formalized in a way that will improve productivity of smallholder farmers.

According to Namara *et al.* (2010), “understanding and enabling changes on how improvements in water management can reduce rural poverty are the most important policy and research challenges for the coming decades”. Sharma *et al.* (2010) argue that instead of attempting to prescribe solutions to water scarcity, policy choices and associated approaches should be grounded on a set of general main beliefs that are effective throughout various socio-economic situations and should be founded on the good empirical evidence. Meinzen-Dick (2014) and Hodgson (2016) argue that rights that are on paper only are not secure and customary law provides better tenure security in those situations. The development of irrigation projects calls for essentially amending prevailing property rights by passing on rights and by making new rules (Meinzen-Dick, 2014).

According to Hodgson (2004), the impact of land and water use rights on livelihoods has received little research. To close this knowledge gap, Hodgson (2004) suggests the use of livelihoods approach to identify the extent to which land and water use rights, or their absence, constrain productivity.

2.7 The heterogeneity among smallholders and its implications

One of the key challenges in development research, policies and programmes is the misconception that smallholder farmers are homogeneous. Goswami *et al.* (2014) state that though it is important to characterise farming systems, there is a tendency to ignore the heterogeneity of smallholder farmers. However, this heterogeneity impacts on an individual farmer’s ability to transition towards more commercial production (FAO, 2014).

Many studies in the development economics literature have shown the existence of heterogeneity among smallholders (e.g. Chapoto *et al.*, 2013; Goswami *et al.*, 2014; Torero, 2014; Pienaar and Traub, 2015). Studies on farm typology have shown that smallholders are not a homogenous group but have varied opportunities, endowments and constraints in terms of the resources available to them and their lifestyle (Soule, 2001; Cousins, 2013). The heterogeneity includes farm-level heterogeneity (farm size, soil quality, slope, irrigation and rainfall), heterogeneity among farmers (gender, age, education, risk preferences, PsyCap endowment) and social dynamics such as access to extension, learning from others and related network learning effects (Juma and Spielman, 2014; Torero, 2014). Given this reality,

considering them as a homogenous unit is inaccurate and it hinders the process of action, research and development for policy and management interventions.

Evidence from SA has also shown the existence of different farm types in smallholder irrigation. Van Averbeké (2008) used household income to classify farmers and found nine different typologies of farming households in Dzindi scheme in Limpopo province. These were one-generation pensioner households; two-generation pensioner households; three-generation pensioner households; wage-earner households reliant on skilled formal employment; wage-earner households reliant on unskilled formal employment; market-oriented farming households; subsistence farming households; and households active in the informal sector; and diversified-income households. Using farming diversity, Van Averbeké (2008) also identified four farming styles such as profit makers, employers, food farmers (type 1) and food farmers (type 2). Further analysis showed several differences in the different categories of households that helped shape recommendations for improving farming in irrigation schemes. Denison and Manona (2007a) found four types of farming styles from smallholder irrigation schemes and classified them as the Business Farmer, Smallholder Farmer, The Equity Labourer and the Food Producer.

2.8 Aspirations for expanding irrigation activities and smallholder agriculture

Understanding smallholders' aspirations and/ motives for adopting certain farming methods continues to be of considerable significance to policy makers as they have to design and put into practice policies that yield positive effects on farmer' behaviours and attitudes. Wilson *et al.* (2013) argue that improved insight on the drivers and behaviour of smallholders' leads to policy delivery that is directed to specific farmer groups to accomplish improved results. Therefore, it is essential to capture the drivers of smallholder' aspirations through their willingness and ability to expand their farming operations. The levels of smallholders' aspirations reveal their aptitude to react to improvements in agricultural policy and regulation (Morgan *et al.*, 2010). With government initiatives aiming to commercialize smallholder farmers, no empirical research has been conducted to evaluate the willingness and ability of smallholder farmers to expand their farming operations.

The future of smallholder agriculture in South Africa is tied to the expansion of smallholder irrigation through the extension of existing schemes or establishment of new ones (DAFF, 2015). The desire to expand land under irrigated crop production also represents aspirations of

most smallholders given the frequent droughts and inconsistent and unreliable rainfall. National policies, e.g. the NDP Vision 2030 and the Irrigation Strategy 2015, place irrigation expansion at the forefront of sustainable smallholder agriculture development in SA (National Planning Commission, 2011; DAFF, 2015). However, the potential for expansion is limited given the country's scarce natural resources (DAFF, 2015). This means, it is critical, using the available resources, for policy to ensure that irrigation expansion achieves the targeted objectives of food security, employment creation and increasing income of smallholders.

One way of doing this is to focus on the farmer, the beneficiary of the programme. The achievement of the objectives of irrigation expansion will depend greatly on the ability of the smallholder farmer to recognise and utilise the opportunities presented through the expansion programme. This ability is influenced by their aspirations as they relate to irrigation expansion. Although the literature on aspirations in general (from the field of psychology) is extensive (focusing on aspiration formation and life outcomes), the concept is foreign to empirical research in smallholder agriculture. There is limited literature and understanding on what affects smallholder aspirations in farming. A quick scan through the literature reveals a few studies on farmer aspirations but none focusing on irrigation expansion (Schwarz *et al.*, 2009; Leavy and Smith, 2010; Kosec *et al.*, 2012; Kibirige, 2013; Bernard and Taffesse, 2014; Mekonnen and Gerber, 2016). Moreover, the existing literature fails to distinguish factors affecting one's willingness/interest and that of capability/ability to achieve one's aspirations, which could be different for irrigation expansion. This gap in knowledge means research is unable to assist policy makers to make appropriate decisions as regards this key policy strategy. Thus, this study addresses this gap by giving special attention to aspirations to expand irrigation activities in and around the irrigations schemes.

Aspirations influence future decisions and behaviour of people especially those related to savings, investment and credit-seeking (Bernard *et al.*, 2014; Genicot and Ray, 2014; Mekonnen and Gerber, 2016). Likewise, it is envisaged that farmer aspirations to expand irrigation activities² will influence their decisions regarding agricultural development. Bernard *et al.* (2014) indicate that despite the possibility of higher returns, poor people do not invest due, among others, to low aspirations. In their research, they concluded that changing aspirations affects several future-oriented behaviours of people. Strong and positive aspirations

² Irrigation expansion can either be through intensification of production on the same land or increasing land under production. This study considers only one of these two and discusses expansion of irrigation activities in terms of increasing land under smallholder irrigation production.

result in a strong vision and commitment to growth while the lack of them leads to being less focused and/or maintaining the *status quo* and losing the incentive to disrupt the system. The other challenge is the poverty of smallholders' capacity to absorb potential risk. Recent research has shown that low aspirations have a negative effect on the willingness to take risks (Dalton *et al.*, 2017; Posel and Rogan, 2017) with negative implications on on-farm entrepreneurship. Thus, understanding what influences farmers' aspirations to expand irrigation farming activities will play a critical role in agricultural and rural development policy. It shows the challenges of conceptualizing and realizing entrepreneurship among smallholders. It also sheds more light on how to unlock on-farm entrepreneurship among smallholders, taking advantage of government investment in irrigation infrastructure and other services. This will be further investigated empirically in Chapter 8.

2.8.1 Defining aspirations

Aspiration is defined as 'hope and ambition to achieve something' (Oxford English Dictionary, 1989). 'Something' could refer to anything that is of value to the aspirant such as income, education, wealth and social status, among others. The definition is linked to words like 'mental capacity', 'will' and 'inclination'. It shows the level of willingness and desire to improve one's future situation. Aspirations are more future focused and hence are more concerned with satisfaction in the future (Ray, 2006; Bernard *et al.*, 2014). Explaining smallholders' aspirations can serve as an input to find the way out of the vicious circle of rural poverty if realizing the aspirations contributes to poverty reduction. If decision makers thoroughly understand development linked aspirations of rural communities and why they are not achieved, it will make it easy to formulate strategies that enable such communities achieve them. It will also enable them identify the enablers, areas of disconnect and mechanisms of scaling-up the impacts. The study by Dalton *et al.* (2016) demonstrates that enhancing aspirations is a sufficient condition for escaping the poverty trap. The literature also shows that aspirations should be large enough to motivate a change in behaviour but not too high to frustrate an individual (Ray, 2006; Genicot and Ray, 2017). In other words, to be of practical relevance, they should be within the means of the aspirant, i.e. accounting for resource endowments, capabilities and institutional constraints.

The study of aspirations is embedded within the literature in sociology, psychology and economics. It is formulated around several theoretical models such as the aspirations-based learning (Karandikar *et al.*, 1998; Bendor *et al.*, 2001), reinforcement-based learning (Börger and Sarin, 2000), occupational choice models (Mookherjee *et al.*, 2010) and aspirations-based

theory of poverty traps or individual behaviour (Ray, 2006; Genicot and Ray, 2017). The SLF is also key to understanding the capability dimensions of aspirations. This study resonates with aspiration-based theories on individual behaviour. It postulates that, like any other individual, smallholders have an ‘aspiration window’ and ‘aspiration gap’. The aspiration window is defined as a cognitive space where aspirants derive their aspirations from the achievement and lives of their peers. By observing the performance and lives of other farmers in scheme irrigation or with more irrigable land, smallholders in rainfed agriculture, homestead food gardening or even some scheme irrigators formulate aspirations in their minds regarding their willingness to expand or transform into irrigation farming activities. The aspiration window is affected by opportunities and constraints facing each farmer which are bound to be different due to heterogeneity in socioeconomic, psychological and institutional factors. The farmers’ ‘aspiration gap’ (Ray, 2006), in relation to the expansion of irrigation activities, is defined as the difference between the irrigable land they currently possess and the total which they aspire to put under irrigation farming. Genicot and Ray (2017) posit that it is this gap and not aspirations as such that will ultimately influence their future behaviour and the outcome.

2.8.2 Factors affecting smallholder aspirations

Arguments in the literature are that the rational choice theory is not sufficient to explain farmers’ behaviour or choices (Prendergrast *et al.*, 2008; Hallam *et al.*, 2012). Smallholders’ rationality in decision making is bounded by uncertainty. Smallholders find themselves in a world of imperfect information characterised by both ambiguity and uncertainty (Wale, 2012). They lack perfect information on the choices and the alternatives that are available to them (Wani *et al.*, 2009). Their risk preferences are affected by several factors such as resource constraints, market imperfections and differences in access to support institutions (Mendola, 2007). Even when information is available, Wale (2012) posits that it is difficult for farmers to understand and process all the important information due to the limited human cognitive capacity. Thus, in this state of limitation, farmers make decisions influenced by one’s goals, experiences and social networks (Wale, 2012; Bernard *et al.*, 2014). The decisions will differ depending on how one views the world, interprets his/her surroundings and understands him/herself (Gentner and Stevens, 2014).

In the light of the above, factors that influence farmers’ aspirations to expand irrigation farming are classified into two categories, i.e. internal and external factors (Ray, 2006; Mekonnen and Gerber, 2016) (Figure 2.4). Internal factors are those that are not quantifiable and relate to the personal attributes of a farmer such as self-efficacy, perceptions and entrepreneurial spirit.

They define an integral part of the PsyCap of a human being (Luthans *et al.*, 2015). The concept of PsyCap is explained in detail in Chapter 3. External factors are largely observable and relatively easy to measure. They include farmer characteristics (e.g. age, gender, experience, education), household factors (e.g. assets, social networks, income and membership to cooperatives) and institutional factors (e.g. access to markets, credit and extension services).

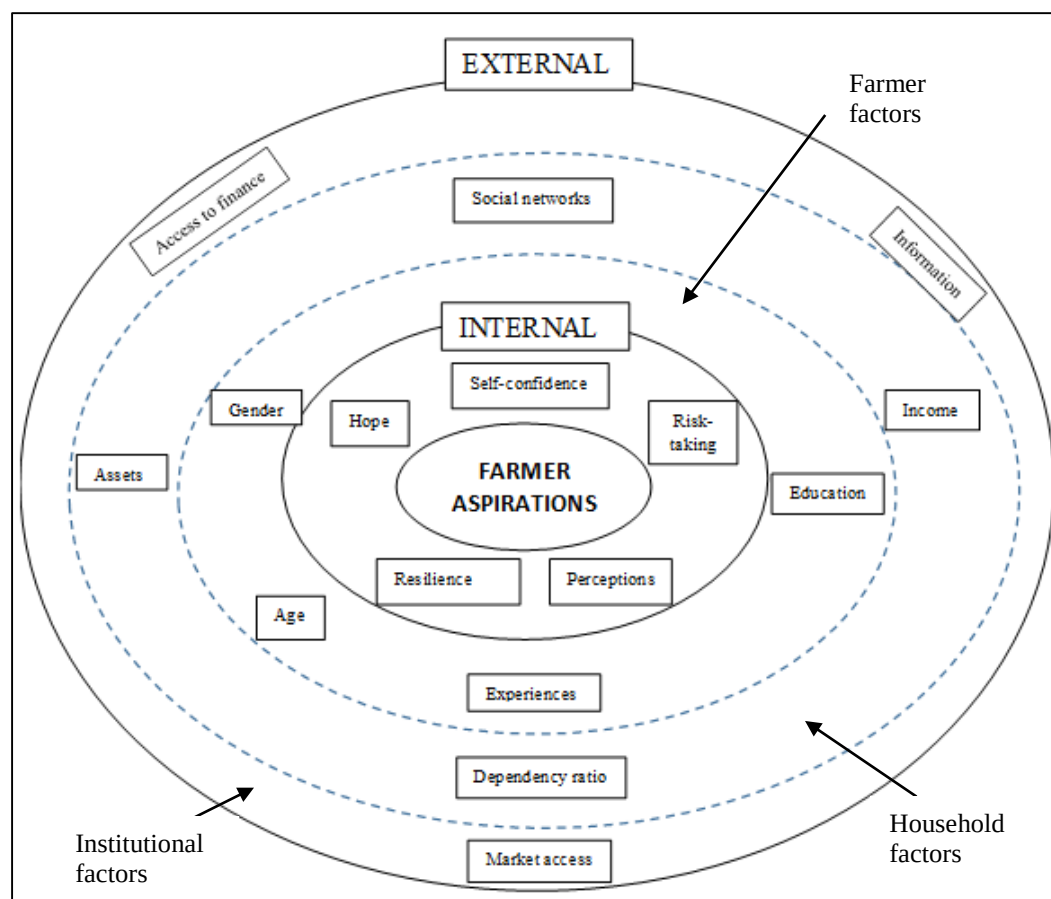


Figure 2.4. Factors influencing farmer aspirations

Source: Authors' compilation drawing from the literature

The effect of gender on farmer aspirations is context-specific, depending on the structure of gender norms and relations in a community (Leavy and Smith, 2010). While the study by Kibirige (2013) did not show any influence of gender on farmer goals, Kosec *et al.* (2012) found that men have significantly higher aspirations than women. Similarly, the effect of age is also context-specific. While age was not associated with aspirations of farming households in rural Pakistan (Kosec *et al.*, 2012), it had a significant impact on socially oriented goals (collective action, common purpose, trust and cultural norms and values) of farmers in Eastern Cape, South Africa (Kibirige, 2013). Aspirations are also influenced by education levels of

farmers (Kosec *et al.*, 2012; Kibirige, 2013; Mekonnen and Gerber, 2016) and their experiences. Individual experiences determine personal desires and standards of behaviour (Ray, 2006). How people perceive their past successes and failures also influence their aspirations (Gutman and Akerman, 2008).

Access to resources is one of the key factors that influence farmer aspirations (Gutman and Akerman, 2008; Kibirige, 2013; Bernard *et al.*, 2014; Mekonnen and Gerber, 2016). More access boosts the ability to achieve one's aspirations. Low aspirations or aspiration failure is associated with poverty (Kibirige, 2013; Dalton *et al.*, 2016; Mekonnen and Gerber, 2016). Poor people lack the capacity to aspire, i.e. they lack resources and capabilities to invest and achieve their aspirations (Appadurai, 2004). This is particularly true for smallholder households where ownership of important farming assets might enhance a farmer's ability to expand irrigation farming activities.

As discussed earlier in this section, access to psychological and social capital assets also influence farmers' aspirations to expand irrigation farming activities. Farmer heterogeneity in perceptions and attitudes on several issues, e.g. social support and land tenure security, often result in different livelihood strategies and outcomes (Liu and Liu, 2016). These views are largely influenced by their socio-cultural context and positive PsyCap endowment (Zafirovski, 2013). Evidence from the literature suggests that positive PsyCap, especially self-confidence, increases farmer aspirations (Leavy and Smith, 2010; Kosec *et al.*, 2012; Kibirige, 2013).

Social networks do influence aspirations through the 'peer or demonstration effect', i.e. through observation of the experiences and achievements of others (Ray, 2006; Leavy and Smith, 2010; Bernard and Taffesse, 2012). The implication is that through kinship networks, farmers can either be motivated or demotivated with the experiences of other people in their community. Posel and Rogan (2017, p18) concluded that aspirations in South Africa are 'stimulated by the relative success of others'. Schaefer and Meece (2009) show that social influences affect self-confidence while Ray (2006) indicates that through collective action they enhance sharing of information, with major implications on one's aspirations.

The study could not find any literature on the relationship between aspirations and access to markets or credit. However, smallholders with access to markets are expected to have higher aspirations to expand their farming activities. If farmers can see the unmet market demands for agricultural products that they can produce, they will aspire to expand their enterprises. Similarly, access to production credit will leverage farmers' ability to operate an increased land area.

2.9 Entrepreneurial development for rural livelihoods

Development of economy of any nation depends primarily on the important role played by entrepreneurs. The role played by such entrepreneurs is of vital importance in a developing country like South Africa, where there are abundant opportunities for using innovations to exploit the available resources, particularly in the field of agriculture (Pandeti, 2005). Nkechi *et al.* (2012) pointed out that entrepreneurial development can stimulate and lead to employment generation, growth of the economy and sustainable development. Moreover, the drive to commercialize smallholder irrigation begins with the development of entrepreneurial skills of farmers. However, entrepreneurship within the context of agriculture is not widely studied (McElwee, 2005); therefore, it is important to start by reviewing the concept of entrepreneurship before proceeding to farm entrepreneurship.

2.9.1 Defining entrepreneurship

There is no single definition of the term entrepreneur as it is a phenomenon studied across multiple disciplines. This is a testimony to the multidimensionality of the concept. Each scholar/discipline is focusing on certain elements or dimensions and no one is capturing all that everyone agrees on. The term has extensively evolved since its origin in the 1700s. A lot of scholarship has been dedicated to defining the concept of entrepreneurship. The lack of consensus can be attributed to the fact that entrepreneurship is not neatly contained within any single academic domain. However, numerous disciplines have contributed their perspectives on the concept of entrepreneurship, including psychology. Most definitions of entrepreneurship, however, encapsulate the standard behaviours associated with the entrepreneur in the literature. These include Schumpeter's (1950, 1961) well-known view of the entrepreneur as an innovator or agent of change (creative destructor); Kirzner's (1973) view of the entrepreneur as someone who spots opportunities for profitable arbitrage and Kanbur's (1979) view of the entrepreneur as one who "manages the production function" by paying workers' wages and shouldering the risks and uncertainties of production. Dollinger (2003) defines entrepreneurship as the creation of an innovative economic organisation for the purpose of growth or gain under conditions of risk and uncertainty. Gray (2002) defines an entrepreneur as an individual who manages a business with the intention of expanding the business and with the leadership and managerial skills necessary for achieving those goals. An entrepreneur is determined and innovative; he/she likes to take calculated risk and assumes responsibility for both profits and losses always looking for better and more profitable ways to run the business

and opportunities to improve and expand his/her business. An entrepreneur bares the qualities of a positive PsyCap (Kahan, 2004 and McElwee, 2005).

This growing body of literature has derived its inspiration from the work of Joseph Schumpeter. According to Schumpeter (1951), the entrepreneur is an agent of change who disturbs the equilibrium of the steady state. In many societies, most of the markets are inefficient, thus providing entrepreneurs with opportunities of creating wealth by exploiting those inefficiencies. Even when markets are in equilibrium, human nature combined with the search for profit, technological progress and advances in knowledge eventually destroy the equilibrium (Cuervo, 2005; Olawale and Garwe, 2010). It is innovation that is needed to disrupt equilibrium, also labelled ‘creative destruction’ (Schumpeter, 1950). This is a pervasive concept in complexity economics which is economics articulated in a more general way. It demonstrates an economy perpetually inventing itself, perpetually open to response, and creating novel structures and possibilities for exploitation (Arthur, 2013). Innovation, which can be learned and practiced, is the tool or instrument used by entrepreneurs to exploit change as an opportunity (Drucker, 1985).

Schumpeter (1951) recognised that entrepreneurs seek to profit through innovation and transforming the static equilibrium into a dynamic process of economic development. Accordingly, they change the patterns of production by utilising an innovation or new pattern of production and they are portrayed as ‘leaders motivated by the urge of act who perform the entrepreneurial function of carrying out new combinations’. From the resource base view, the entrepreneur will successfully compete as he or she develops and will maintain unique capacities that allow him or her to take advantage of opportunities and neutralise risks (Barney, 1991). Successful entrepreneurial activity drives economic growth and job creation through the multiplier effects as it is directly linked to economic growth and employment creation. Generally, entrepreneurship might be the missing link in the transition from subsistence farming to market-oriented production systems.

Hebert and Link (1989) define an entrepreneur as “someone who specialises in taking responsibility for and making judgmental decisions that affect the location, form and use of goods, resources or institutions.” Entrepreneurship is the pursuit of opportunity irrespective of limited resource conditions. These conditions are responsible for the formation of entrepreneurial motivation, the advance of the entrepreneurial process and the achievement of entrepreneurial goals (Ming and Zuguang, 2013).

Entrepreneurs need more than just their personal characteristics. They also need a range of competencies and abilities that can be learned or developed through training and experience. Entrepreneurship combines personal qualities with knowledge and technical and management competencies (Kahan, 2012 and Krantz, 2001). Most importantly, a farmer-entrepreneur is forward thinking and plans to be in business for a long time (Kahan, 2012). Entrepreneurship is about the mindset as to how opportunities and capabilities can be improved. If farmers see opportunities and think that they have the capabilities to take advantage of those opportunities, their entrepreneurial spirit would be high.

Kumar (2012) argues that there are two elements of entrepreneurship. The first is the managerial skills needed to start and run a profitable farm business. The second is an entrepreneurial spirit. At the same time, Knudson *et al.* (2004) define three entities of entrepreneurship, namely those who start their own businesses, those who work for businesses that are owned by others and those who become entrepreneurial in larger organisations. Faris (1999) hold the view that entrepreneurs are born with specific entrepreneurial qualities and that is not only something that one can learn. Timmons (1999) holds a balancing argument with the view that entrepreneurship is a combination of both talent and skills; it is the opportunity coupled with the needed resources and applied with the entrepreneurial mindset.

From Drucker's perspective, entrepreneurship requires systematic innovation that consisted of the purposeful and organised search for changes and systematic analysis of the opportunities such changes might offer for economic or social innovation. In the economic theories of entrepreneurship, there are three main noticeable dimensions of entrepreneurship, namely, risk-taking, growth orientation and innovativeness. Entrepreneurs create something new, something different and so they change values. Pandeti (2005) defined entrepreneurship as a creative and innovative response to the environment. In essence, doing new things or doing things that are already being done in a different way is part of an entrepreneurial behaviour.

According to Frederick and Kuratko (2010), entrepreneurship is associated with people endowed with certain unique personality characteristics and attributes that differentiate them from the rest. While some of these attributes are innate, others are learnt, formally and/or informally. Such qualities include having the instinctive ability to identify an opportunity and act on it, a strong drive for independence and success, self-confidence /reliance (internal locus of control), risk-taking propensity, vision and the ability to inspire or motivate others, among others (McElwee, 2006; Vesala *et al.*, 2007; Phelan and Sharpley, 2012). Most of these qualities emanate from the cognitive ability of individuals which is observed through the state

of their positive PsyCap, their mindset. That is why, it is argued in this study that the concept of positive PsyCap endowment (Luthans, 2004; Luthans *et al.*, 2007; Luthans *et al.*, 2010; Simons and Buitendach, 2013; Luthans *et al.*, 2015) and behavioural economics (Dawnay and Shah, 2005; Ariely, 2008; Etzioni, 2011; Wilkinson and Klaes, 2012; Baddeley, 2017) will remain the key resources to explain one's endowment with entrepreneurial spirit.

Though there is no universally agreed-upon definition of entrepreneurship (Frederick and Kuratko, 2010; Maluleke, 2016) or an entrepreneur, some salient features of the concept can be derived from the preceding definitions. The traits of an entrepreneur, accordingly, can be summarised as follows

- Risk-taking, tolerance for failure, being determined and persistent,
- Seizing an opportunity,
- Proactive, curious, hardworking, strong drive to achieve, independent, self-confident, positive attitude (Singh, 2013),
- Problem solving,
- Innovation or creativity – working on new, not already existing goods or services,
- Value addition, efficiency and profitability – to be at a competitive edge,
- Embracing change/growth – entrepreneurs are not necessarily sources of change but managers of change in terms of exploiting the opportunities that change creates (Singh, 2013),
- Internal locus of control, self-reliance and motivation, and
- Visionary and goal oriented – an entrepreneur must visualize where the business is destined.

An entrepreneur, therefore, can be defined as the one who is prepared to bear the risk of a new business frontier if there is a significant chance for increased productivity of resources and profit (Knudson *et al.*, 2004).

2.9.2 Entrepreneurial traits and values

The risk-taking propensity is a critical trait distinguishing entrepreneurs from general managers and is used to judge the existence of entrepreneurial behaviour in the literature (McElwee, 2008; Díaz-Pichardo *et al.*, 2012; Phelan and Sharpley, 2012). Successful entrepreneurs inevitably take risks that result in benefits (Maluleke, 2016). He/she is growth-oriented and innovative, developing new goods/services or processes that the market demands and are not currently being supplied. They engage in actions like noticing buyer requirements, casting an

eye over the surroundings, articulating tactics, building and utilizing business networks and starting new things (Lans *et al.*, 2014). In other words, they have a ‘mindset’ ready to engage and withstand the challenges that come with the entrepreneurial process. However, given the limited willingness and ability to meet the above features, it is clear that not all people can be entrepreneurs. Likewise, not every business owner is an entrepreneur, but all entrepreneurs are business owners (Maluleke, 2016). Starting a business is neither a necessary nor sufficient condition for entrepreneurship (Singh, 2013).

The traditional entrepreneurship concept stipulates that entrepreneurs should have an internal locus of control. Individuals with an internal locus of control are more likely to be entrepreneurial than those without (Bradstock, 2006; Vesala *et al.*, 2007). These are people who perceive that the outcome of an event is within their control. Such individuals are more likely to be self-reliant, depending on themselves and their resources to meet their own needs. However, the mindset of smallholders in South Africa might be considered by and large external locus of control due to ‘dependency syndrome’ and ‘expectations’ (Preisendörfer *et al.*, 2012). An external locus of control is associated with individuals who have the belief and attitude that someone else, particularly the government, is responsible for their success or failure.

Mainstream entrepreneurship thinking suggests that entrepreneurs have a motivation that drives them to engage in the entrepreneurial process. Motivation is the driving force between intention and action taken by entrepreneurs (Renko *et al.*, 2012; Zimmermen and Chu, 2013). This driving force for entrepreneurial spirit is, however, missing among most smallholders.

2.9.3 Mainstream innovation theory vs indigenous knowledge

The idea that entrepreneurship is associated with innovation was first advanced by Schumpeter (1934) in his book “Theory of Economic Development”. He posits that economic development emanates from innovation, i.e. the creation or introduction of new products or combinations in the economy. He stated that individuals who bring about innovation through creative destruction are known as entrepreneurs. However, his discussions on innovation refer more to commercial or industrial applications of the concept which are more mainstream and do not fit the African smallholder (Juma and Spielman, 2014).

However, smallholders can be innovators in their own right (Sanginga, 2009; Lorentzen, 2010; Juma and Spielman, 2014). Nonetheless, unlike the Schumpeterian entrepreneur, their innovation is neither motivated by value creation nor profit but by the need to mitigate or cope

with several challenges in farming, in what Lorentzen (2010) calls ‘scarcity induced innovation’. They innovate in their efforts to address various survival and livelihood challenges on-farm. Such farmers are also known as necessity or survival entrepreneurs (Denison *et al.*, 2016; Maluleke, 2016). Their kind of innovation is the result of ‘indigenous knowledge’. Indigenous knowledge is ‘local knowledge that is unique to a given culture or society’ (Agrawal, 1995, p 416). The knowledge is relevant to its owners, policy makers and local and international development agents (FAO, 2009). It has the potential to result in economic and social transformation (Briggs, 2005).

Indigenous knowledge is the basis of how most smallholders, in their bounded rationality, make important farming decisions that affect on-farm entrepreneurship soil fertility management, water conservation, environmental management, among others (Briggs, 2005; Sen, 2005; Oliver *et al.*, 2012). Unlike in mainstream entrepreneurship discussions, such innovation is not necessarily intentional but is produced through trial-and-error processes learnt from generation to generation (Briggs, 2005). However, the challenge is that it tends to be local and hence its transferability and replicability beyond the local context is often limited (Sen, 2005). It is also largely undocumented (Lorentzen, 2010) and under-appreciated (QUNO, 2015). Nevertheless, it has positive benefits associated with increases in yield, reduced costs on herbicides and possible multiplier effects on other farm enterprises that aids on-farm entrepreneurship (Kamau and Almekinders, 2009). For example, in Makhathini, farmers use indigenous knowledge in pest management, controlling pests affecting their cabbage crop, where commercial herbicides have failed. They mix a detergent (sunlight liquid), garlic, chillies and water and use it to spray their crop. Others grow some herbal plants around the crop whose strong scent drives away pests. This has improved the quality of their produce and hence the price fetched in the market. Therefore, the definition of entrepreneurship for smallholders has to encompass indigenous knowledge.

2.9.4 Endowment with the business mindset

When the entrepreneur is also running and managing the business, then it is important that they possess capabilities that enable them to manage it properly. Smallholders in sub-Saharan Africa need to be more business minded (Conway *et al.*, 2014). The business mindset of an entrepreneur is reflected in their management style. In their argument for European farmers, Carter and Rosa (1998) argue that farmers are primarily business owners and their farms can be characterised as businesses. However, such a thesis does not hold for most smallholders in Africa. In mainstream neoclassical economics, a business involves an organisation or entity

that creates or produces goods and services exchanged for money (Osterwalder *et al.*, 2005). It is a separate entity from the family. However, smallholder farms are family farms not distinct from family operations. Farming is a way of life, not a business. Most smallholders do not often distinguish farm operations from family activities. In the Indian smallholder sector, where agriculture is considered as a family tradition, not enterprise or business, the majority of the farmers are practicing what their forefathers or their neighbours practiced (Bhardwaj and Singh, 2015). WRC report (iSineke Development (Pty) Ltd, 2004) has also shown that scheme irrigators consider irrigation farming as an add-on activity. If motivation is subsistence-related, then it is hard to separate the family operations from the farming operations. This would require a mindset change which takes time.

Studies in Eastern Cape and Limpopo provinces (Muchara *et al.*, 2014a; Denison *et al.*, 2015) show lack of business mindset among smallholders. This behaviour is explained by applying heuristics (rules of thumb) (Simon, 1959) and the theory of human motivation, the so-called Maslow's Hierarchy of Needs (Maslow, 1943). The theory of satisficing behaviour states that the motive to act stems from one's drive and the action is terminated when that drive is satisfied, not maximised. Beyond these satisficing levels (or needs), the farmers are reluctant to exert more effort to reach higher levels, choosing to stick to their traditional ways instead (Kahan, 2012). In his study, Ligthelm (2013) described satisficing behaviour as 'unproductive entrepreneurship' which is mainly concerned about survival and not growth. Bromley (1982) also found the same behaviour among small American farmers. The theory of human behaviour says the most basic level of needs must be met before the individual will strongly desire the secondary or higher-level needs (Maslow, 1943). Given that most of the smallholders in SA are poor, their behaviour is thus in line with this theory. The satisficing mindset is against and not in line with the ideals of mainstream business thinking, i.e. seizing opportunities, creatively destroying the *status quo* and taking calculated risks. Moreover, the culture of record keeping inherent in mainstream businesses is almost non-existent or rudimentary at best. It will, therefore, remain difficult to trace their operations, estimate costs and revenues to figure out whether or not they are making a profit.

2.9.5 Institutional constraints limiting farmers' entrepreneurial spirit

The acceptance of entrepreneurship as a central development force by itself will not lead to rural development and the advancement of rural enterprises. What is needed in addition is creating an environment enabling entrepreneurship in rural areas. The existence of such an environment largely depends on policies promoting rural entrepreneurship. The effectiveness

of such policies, in turn, depends on the extent to which these policies create incentives to derive entrepreneurship and conditions to increase entrepreneurial success.

In the introduction of Schumpeter's book, John Elliot indicated the importance of financing in the success of entrepreneurs (Schumpeter, 1934). Furthermore, entrepreneurship is induced by well-developed information services, transport infrastructure and markets. However, the entrepreneurial environment is different for the smallholder in sub-Saharan Africa. It is characterised by several challenges facing smallholders outlined earlier in the first chapter and stringent requirements of commercial agri-food chains (consistency in supply, homogeneity and quality of produce) that affect the performance of smallholders (Salami *et al.*, 2010; Fanadzo, 2012; Jordaan *et al.*, 2014). The lack of a supportive institutional environment is often blamed for low productivity in smallholder agriculture in Africa (Djurfeldt, 2013). Thapa and Gaiha (2014) state that removing market failures, institutional gaps and policy distortions will make the smallholder farmer more competitive.

Smallholder farmers' access to credit in South Africa is limited. This is mainly because most smallholders in South Africa do not meet the commercial banks' 10 ha cut-off to receive production financing (Denison *et al.*, 2015) and their land cannot be used as collateral due to lack of tenure security. Informal institutions such as savings clubs (*stokvels*), friends and relatives and money lenders (*mashonisa*) are the major sources of funding albeit at high-interest rates (Denison *et al.*, 2015). This shows the failure by commercial banks to penetrate the rural markets and their reluctance to learn how to do business with the poor (Rukuni, 2011) while government programmes through different agencies have failed to effectively benefit smallholders due to poor management, corruption and inefficiencies (Herrington, 2011). Similar challenges also exist in access to markets and these are well-documented in the literature (Van Auerbeke, 2008; Salami *et al.*, 2010; Fanadzo *et al.*, 2010). The challenges make it difficult to promote entrepreneurship among smallholders and put farmers at the lower end of the bargain. For irrigation to play a more important role in poverty reduction, creating enabling institutional and economic environments is a major prerequisite (Bacha *et al.*, 2011).

2.10 Entrepreneurship on a small farm in South Africa

In the South African society, there is a sense of entitlement, dependency and culture of expectation that big businesses, government and others should create jobs, rather than creating and managing one's own sources of livelihoods (Herrington, 2011). There is a low entrepreneurial spirit and activity when compared to other developing countries (Modiba,

2009). One reason could be the dependency syndrome entrenched by the many years of different forms of social grants. Only 35% of South African adults believe that they have the knowledge and experience required to start a business which is in stark contrast to Peru (74%), Serbia (72%), Ecuador (73%) and Dominican Republic (78%) (Herrington, 2011). As one of the means to boost the country's economic growth, R&D activities should seek to increase the farmers' level of entrepreneurship. This requires identifying, encouraging and releasing the peoples' entrepreneurial strengths as necessary keys to achieve greater economic prosperity within the country (Harper, 2003). Unlocking farmers' entrepreneurial capacity as a means of generating livelihoods can enhance their capacity to productively use SISs, land and other resources and boost their livelihoods.

In response to all events and changes affecting farmers' day to day decisions, they will make choices among alternatives available, as influenced by their hopes and aspirations, as well as the shifting opportunities or threats that the individual is presented with.

In South Africa, research on the impact of entrepreneurial development amongst smallholder farmers is limited, while huge investments are continuously made to improve the livelihoods of these farmers. The results of this study can inform policy on the possible unintended consequences of the social security program, ways and means of enabling farmers and rural people help themselves and the required institutional investments on SISs. Even though there are many studies globally that have been done on rural farm entrepreneurship (McElwee and Bosworth, 2010; Vesala *et al.*, 2007; McElwee, 2006; McElwee, 2008), there is very little research on entrepreneurship within the context of agriculture (McElwee, 2005) and the literature in South Africa is even thinner.

The available evidence for South Africa indicates that the size of the landholding on irrigation schemes tends not to change. What are the prevailing constraints to expand from gardening to smallholder farming and then to commercial farming? In order to show the way forward, research should be carried out based on real situations on existing irrigation schemes where real livelihood impacts can be achieved and scaled up. This can be done by involving farmers and potential beneficiaries on irrigation schemes in the research process and moving away from *ad hoc* solutions. This will support policy and management decisions to be informed by empirical research outputs.

2.10.1 The state of entrepreneurship in South Africa

There is increasing recognition of the importance of entrepreneurship to the economic and social development of South Africa as entrepreneurs are believed to be able to create new, competitive markets and businesses leading to job creation and have a substantial multiplier effect on the economy. The South African government has also recognised this contribution and, therefore, has the goal of establishing South Africa as an entrepreneurial nation that rewards and recognises entrepreneurship (National Planning Commission, 2011). The 2009 conference on “State of Entrepreneurship in South Africa” organised as part of a series of activities and dialogues to foster national debates on entrepreneurship has concluded that South Africa’s entrepreneurial activity is improving but still lags behind as respect and recognition for the contribution of entrepreneurs is not sufficient. In some circumstances, aspirant and existing entrepreneurs face huge challenges and frustrations. Entrepreneurial skills are severely lacking and most female entrepreneurs in South Africa seem to be lifestyle and not high-impact entrepreneurs (FNB, 2009). The dialogue also recommended that the main success factor in entrepreneurship is the ‘psyche’ (the passion and drive) of the entrepreneur and the government needs to employ smart ways to support emerging entrepreneurs.

South Africa has the lowest Total Entrepreneurship Activity (TEA) rate of any developing country, confirming that entrepreneurial activity on a range of measures is extremely low (Foxcroft *et al.*, 2002). South Africa’s early-stage entrepreneurial rate is 7.8% which is significant below the average of 13% of other middle to low income countries (Herrington *et al.*, 2008). Studies by the Global Entrepreneurship Monitor (GEM) over the years have conclusively shown that the low level of early stage entrepreneurial activity in South Africa is shaped by low levels of education, social and entrepreneurial factors that do not encourage entrepreneurship as a career path of choice, a lack of access to finance, particularly in the micro-financing arena and a difficult regulatory environment (Herrington *et al.*, 2009.)

The major reason to start businesses in South Africa is necessity or survival when the individual has no other source of income and cannot get ‘formal’ employment (Herrington and Kew, 2014). According to the same report, about 61% of young people in South Africa believe that most young adults who have started their own businesses did so because they could not find a job (*ibid*). Statistics show that young men are 1.3 times more likely than young women to be potential entrepreneurs and 1.7 times more likely than young women to indicate an intention to start a business. GEM surveys over the years have shown that men are more likely to pursue entrepreneurship than women (Herrington and Kew, 2014).

South Africa's market dynamics is cited as one of the most constraining factors for entrepreneurship by 29% of GEM's national experts. The aggregated mean score for market dynamics of 2.81 suggests that the country's market shifts in demand and supply do not change dramatically enough. The more dramatic and frequent the market's shifts, the more opportunities there are likely to be because of thriving competition and innovation. South Africa's market dynamics score may help to explain in part why the country's rate for perceived opportunities of thirty-six percent is below the average for efficiency-driven countries of forty-one percent (Fal *et al.*, 2009).

Development of the economy of any nation depends primarily on the important role played by entrepreneurs. The role played by such entrepreneurs is crucial to the developing economy of a country like South Africa. South Africa has displayed a nation-wide effort to support entrepreneurship, which is apparent through the Black Economic Empowerment policies and other similar types of initiatives (Fal *et al.*, 2009). The South African agricultural sector strategy aims to integrate the majority of smallholder farmers into the commercial agricultural economy. However, despite such efforts, the entrepreneurial spirit is not as set in motion as it should be (Foxcroft *et al.*, 2002).

Given the failure of the formal and public sector to absorb the growing number of job seekers in South Africa, increasing attention has focused on entrepreneurship and new firm creation and its potential for contributing to economic growth and job creation (Herrington *et al.*, 2009). Despite the importance placed on promoting entrepreneurship and the abundance of resources committed to encouraging entrepreneurial activity, policymakers have primarily been operating without the benefit of substantive research findings (Dennis, 2000).

Several government institutions support entrepreneurial development, including the Small Enterprise Development Agency (SEDA), the Small Enterprise Finance Agency (SEFA), the National Empowerment Fund (NEF), the Industrial Development Corporation (IDC), the National Youth Development Agency (NYDA), the Land Bank and the Micro Agricultural Financial Institutions of South Africa (MAFISA). These institutions are supported by various NGOs, a number of which are initiatives from foreign countries that support business creation in developing countries. However, many of these programmes are strongly criticised by the recipients as well as experts, for reasons such as bureaucracy, inefficiency, high-interest rates and limited access (GEM, 2011).

The Small Business Development Corporation (1996) cited in Ladzani and Van Vuuren (2002) reported that up to 50% of the small businesses started in South Africa eventually fail. The general perception amongst entrepreneurs is that access to capital is a major inhibitor to entrepreneurial growth and activity. The general misconception is that this is a result of the scarcity of funds available to funding institutions. The issue is not so much a lack of access to capital, but the stringent and lengthy process required to access funding. This is intensified by the general lack of awareness about the procedures and the courses of action involved in gaining equity funding. This leaves entrepreneurs under-prepared and under-researched. Unprepared applicants often end up frustrated and disappointed with the process. Therefore, discovering the factors that motivate the individual to embark on an entrepreneurial career becomes important in stimulating entrepreneurship (Fal *et al.*, 2009).

Entrepreneurship is the solution to many social problems South Africa faces at present. The longer it takes to fully adopt a culture of entrepreneurship, the longer it will take to see the benefits of democracy. A significant amount of resources has been dedicated to stimulating small business development in South Africa by providing financial incentives, creating infrastructure and deregulating restrictive legislation. Despite this effort, an estimated 10 million South Africans still do not have access to transportation and are thus restricted in their physical movements (Fal *et al.*, 2009; Mitchell, 2004). Mobility increases peoples' exposure to new ideas. Consecutively, exposure to new ideas drives one's sense of experimentation and innovation. The latter is critical to entrepreneurship development (Fal *et al.*, 2009; Sorensen and Sharkey, 2014). There are lots of studies in various countries including in Europe that have been done in rural farm entrepreneurship (McElwee and Bosworth, 2010; Vesala *et al.*, 2007; McElwee, 2006; 2008). However, very few have been done in South Africa and in sub-Saharan Africa.

2.10.2 Entrepreneurship and smallholder farming

The agricultural potential and smallholder farmers' adaptive behaviour in South Africa has given rise to more attention on entrepreneurship in agriculture. Ligthelm (2013) argues that in a formal-informal dichotomy, the danger of generalization of small businesses develops when a more knowledge of different and multifaceted range of businesses is required, especially in the rural areas. According to Vesala and Vesala (2010), "agriculture has had a distinct position in society by differing from other branches of business and, thus seeing farmers as equal to other entrepreneurs has not been self-evident". The switch of smallholders to start to function as the entrepreneurial model requires a change of mindset, income sources and their business

principles (Vesala and Vesala, 2010). Agriculture is now more considered and valued as a business or strategic sector by government which has the potential to enhance the country's economic development, reduce poverty and create employment as well as ensuring food security (Seuneke *et al.*, 2013).

A growing literature is now emerging on rural entrepreneurship and, in particular, on the role of business enterprise characteristics and the range of skills regarded as critical to the success of farm enterprises (Crommie, 2000). It is imperative that we distinguish between rural and corporate (urban) entrepreneurship. Urban entrepreneurs are more likely to start new businesses because of their networking opportunities. Rural entrepreneurship can be defined as new ventures that happen to be created in rural areas as a result of an intervention, such as a tax subsidy to attract businesses into an area or through the in-migration of city dwellers that then start businesses. It can also be described as a start of new enterprises that result from the unique endowments in rural regions that are not present in metropolitan areas. Such businesses are more likely to involve agriculture (Lee and Phan, 2008). Integrating agricultural training with enterprise training can help smallholders to manage and market their farm production more effectively, to take advantage of new agricultural opportunities (Hussin *et al.*, 2012).

Rural businesses face challenges that are not often experienced by those in urban settings. Apart from gaps present in telecommunications and transportation networks, social services and other standard business infrastructure, the owners themselves are often lacking the necessary skills and capabilities required for business start-up and operations (Lyons, 2002). Yet, entrepreneurship skills are imperative for the transformation of farmers from subsistence farming to commercial farming (Bacha *et al.*, 2011; Kahan, 2012), to which asset endowment is a key. This explains the common trend in rural areas where the market for products is too low to encourage expansion of entrepreneurial activities. For the market that exists, products are sold at a very low price failing to benefit the majority of the poor who live in rural areas. This limits entrepreneurs from exploiting some opportunities in rural areas (Ngorora and Mago, 2013). Juma (2014) indicates that the quality of human resources is critical to the execution of the entrepreneurial function.

While farming is certainly an important factor in rural economies, rural areas contain a wide range of economic activities. It is only in recent years that a new paradigm of rural development emerged that takes a broader view on the rural economy, incorporating economic activities other than farming, while highlighting the broad diversity of rural development processes. Generally, this is referred to the diversification of the rural economy (Geetha, 2007). These

diversifying activities may include farm, non-farm and other non-agricultural activities, often linked with other activities carried out by rural as well as non-rural households.

There exist different views of a farmer in literature. The neoclassical view considers farmers as production factors while the institutional school of thought view them as multidimensional economic agents (Junankar, 1982; Kherallah and Kirsten, 2002). Neither of these views is wrong but they have affected the debate on smallholder agriculture and its role in the transformation of livelihoods and rural economies (see further discussion in section 6.5). Hence, a disagreement exists in the literature on the topic of agriculture being a suitable sector in which to study the ways that entrepreneurial competence can be characterised and identified, how it develops and how it can be applied (Lans, 2009).

Many studies of farm business processes are resistant to considering farmers as entrepreneurs. This reluctance comes from the existing views of farmers, particularly under state subsidy systems and as having been separated from the normal market process (Gasson and Errington, 1993). Additional reluctance originates from farmer identities that are formed primarily as producers rather than as business people (Van der Ploeg, 2003; Juma and Spielman, 2014). Bauernschuster *et al.* (2010) argue that African farmers, in particular, do not fit the modern characterisation of an entrepreneur. The argument is that they are often viewed as independent producers who operate outside the formal markets by consuming what they produce.

The opposing argument is that farmers are not just users of technologies developed elsewhere but they perform entrepreneurial functions that involve the transformation of knowledge into goods and services (Juma and Spielman, 2014). Contrary to popular perceptions, farmer entrepreneurship is equivalent to all those activities which help farmers adjust to a free market economy (Richards and Bulkley, 2007). Beedell and Rehman (2000) confirm that in order to fully understand the concept of entrepreneurship one needs to pay careful attention to farmers' attitudes and motivation in an increasingly competitive business environment. Vesala *et al.* (2007) assert that a major challenge for the agricultural sector is to enable farmers to develop their entrepreneurial skills.

Entrepreneurship is an important attribute for the survival of small-scale farming in the dynamic and increasingly complex global economy. Farmer-entrepreneurs need to view and treat their farms as businesses (McElwee, 2006). However, this entails various inherent constraints including lack of distinction between family and farm operations, absence of record keeping culture and smallholder farmers' mindsets (Audretsch, 2009).

Farmers are “innovative reservoir in agricultural communities and potential sources of entrepreneurship” (Alsos *et al.*, 2003). Development agencies see rural entrepreneurship having employment potential whereas farmers favour it as a way of improving earnings. Rural women identify entrepreneurship as creating employment possibility near their homes, which promotes independence (Chandramouli *et al.*, 2007; Carr, 2008). The contribution of farmers to rural business development can go beyond the operation of their farm businesses but also in their ability and propensity to start additional non-farm businesses (Carter, 1998). Entrepreneurial development among smallholders has a positive relationship with agricultural growth.

Lack of technical skills, poor networking and risk aversion also influence rural entrepreneurship (Ozgen and Minsky, 2007). The level of a farmer’s entrepreneurial skills may also be seen to be suggestive of the farmer’s relative economic autonomy and, reflects his/her ability to respond to developments in agricultural policy and regulation and to be more responsive to markets (McElwee, 2008). Rural networking may lead to direct support in terms of raising funds, inter-trading, cooperative efforts, leadership and entrepreneurship development (Hookoomsing and Essco, 2003). Groenewald (1993) argues that the entrepreneurship lacking in much of African agriculture cannot be all attributed to the irrational behaviour of farmers but partially to the lack of economic opportunities.

Sources of risk for entrepreneurs in smallholder agriculture are related to volatile market prices, unpredictable weather conditions, financial uncertainties, changing policies and regulations, pests and diseases and unknown outcomes of new technologies or practices (Kahan, 2013; Adesina *et al.*, 2014; Harvey *et al.*, 2014). Some of the risks such as weather changes are due to factors that are uncontrollable to the smallholder. However, others exist because smallholders are bounded in their rationality due to imperfect information and their limited capacity to evaluate and process that information timeously (Boahene, 1996). This complicates decision making and when farmers fail to deal with this complexity, most become risk averse. For a risk averse farmer, the fear of failure can be a barrier contrary to an entrepreneur who sees a learning opportunity in failures. There is evidence that smallholders are generally risk averse (Dillon and Scandizzo, 1978; Binswanger, 1981; Bardsley and Harris, 1987). This is understandable given the prevalence of poverty, limited access to information, lack of capacity to absorb potential shocks and farming being the primary source of livelihoods. For smallholders, taking risks and trying out new technologies/new crops is tantamount to gambling with their livelihoods.

It is important to note that neither of the entrepreneurship drivers are effective in isolation. They need to be integrated in thought (analytically or conceptually) and in action (practically) (Tyson *et al.*, 1994), for entrepreneurship to be the major force for economic development (Ansari *et al.*, 2012). Smallholders' probability of being an entrepreneur depends on their access and use of sustainable livelihood assets (Cetindamar *et al.*, 2012). Smallholder farmers' entrepreneurial spirit is formed and mobilized by socio-economic developments and institutional support systems that exist in rural areas and by individual, location and physical features (Morgan *et al.*, 2010; Hansson *et al.*, 2013; Seuneke *et al.*, 2013). Highlighting the level of entrepreneurial spirit of different smallholder farmer typologies offers the most important opportunity in agricultural entrepreneurship field. This, therefore, makes it important to also identify factors that influence the entrepreneurial spirit and aspirations of smallholder farmers.

2.10.3 The need to redefine the concept of entrepreneurship in the context of smallholders

The remaining question is how one should define on-farm entrepreneurship in such a way that it informs policy and impacts the way farmers think and decide with the ultimate objective of reducing rural poverty on the ground. Using the concept of PsyCap (Luthans *et al.*, 2015) and drawing from behavioural economics (Dawnay and Shah, 2005; Wilkinson and Klaes, 2012; Baddeley, 2017), this study will redefine an entrepreneurial smallholder. Why is this necessary?

Entrepreneurship is an important concept in smallholder agriculture but should be conceived differently to make it relevant to this sector. The study will seek to validate the applicability of the mainstream concept of entrepreneurship to smallholder agriculture with a focus on smallholder irrigation. The literature review suggests that smallholders and their context do not conform to the common neoclassical paradigm underpinning the mainstream concept of entrepreneurship. However, this does not mean smallholder farmers cannot be entrepreneurial, but it highlights the need to redefine the concept for application in their context.

In the quest for improving the performance in smallholder irrigation, a paradigm shift is, therefore, required to which the concept of PsyCap and lessons from behavioural economics are found to be of special relevance. The farmers' mindset is one critical resource that determines farming decisions and behaviour and hence entrepreneurial spirit. Although changing smallholder farmers' mindset takes time, it is the primary step for unlocking on-farm entrepreneurship. Taking this approach, section 6.5 in Chapter 6 proposes a definition of

entrepreneurship applicable to smallholders. The definition emphasizes the need for entrepreneurial smallholders to internalize rather than externalize their challenges, resorting to own initiatives for solutions, even in the face of constraints.

The following components of entrepreneurial behaviour were used to substantiate the new definition. The components are (Pandeti, 2005):

- *Innovativeness*: The degree to which an individual adopts new ideas relatively earlier than others in his social system;
- *Decision making ability*: The degree of weighing the available alternatives in terms of their desirability and their likelihoods and choosing the most appropriate one for achieving maximum profit in the farming;
- *Achievement motivation*: The desire for excellence to attain a sense of personal accomplishment;
- *Information seeking ability*: The frequency of contact or exposure of a farmer to different sources for obtaining farm information;
- *Risk taking ability*: The degree to which the farmer is oriented towards risk and uncertainty in facing problems in farming;
- *Coordinating ability of different activities*: The degree to which an individual coordinates action in a time dimension;
- *Leadership ability*: The degree to which an individual initiates or motivates the action of others;
- *Knowledge of farm enterprise*: The degree to which the factual information is possessed by the respondent regarding the farming enterprise;
- *Assistance of management services*: The degree to which a farmer gets assistance of management services;
- *Cosmopolite-ness*: The degree to which a farmer is oriented outside his community or village that might make him more accessible with innovations.

2.11 Realizing the development of smallholder farming enterprises: challenges and opportunities

Smallholder agriculture is simply too important for generation of employment, human welfare and political stability in sub-Saharan Africa to be either ignored or treated as just another small sector of a market economy. Smallholder farmers have the potential to produce a marketable surplus. Smallholder farmers in Zimbabwe, for example, tripled maize production between

1980 and 1987 and increased their share of the national marketable maize surplus from 10 percent in 1980 to 40 percent in 1987 (Machethe, 2004). This is a practical example to indicate the significant contribution of small-scale farming in the country's economy.

Many of the services required to promote smallholder agricultural development are public goods. Therefore, little progress can be expected in achieving the objectives of agricultural development without government involvement. Some of the initiatives of the South African government aimed at promoting smallholder agricultural development include:

- **Land Reform:** Access to land for production purposes is an essential requirement for the poor to enjoy the benefits of agricultural growth. The Settlement/Land Acquisition Grand (SLAG) did not live up to expectations and a new program, Land Redistribution for Agricultural Development (LRAD) was introduced in 2000. However, land reform program was able to target the poor and was successful in combining equity and efficiency;
- **Agricultural Credit:** Improving access to production credit is often regarded as one of the key elements in raising agricultural productivity;
- **Infrastructure:** High transaction costs is one of the major factors constraining the growth of smallholder agriculture in African countries and this can largely be attributed to poor infrastructure. An analysis of the experience of any country that has successfully developed its agriculture will always identify the provision of good infrastructure as a requirement for achieving higher levels of agricultural productivity and profitability;
- **Comprehensive Farmer Support Services:** Smallholder agricultural growth cannot be achieved without access to farmer support services. International experience has shown that, with adequate access to farmer support services, smallholder farmers can significantly increase agricultural productivity and production.

Moreover, the NDP Vision 2030 identified agricultural and rural development among the key pillars for the creation of employment, economic growth and poverty reduction in South Africa (National Planning Commission, 2011). Smallholder production in South Africa has the potential to play a key role in reducing poverty as well as stimulating economic development in the country. However, the smallholder producers are currently not fulfilling the potential. The Department of Agriculture, Forestry and Fisheries (DAFF) is, therefore, in the process of coming up with a strategy that would ensure the smallholder producers' potential is harnessed to reduce poverty and foster economic growth.

There are various reasons to believe that the smallholder sector has huge potential to prosper and expand and thereby contribute significantly to mitigating South Africa's unemployment problem and food insecurity challenges (DAFF, 2012). Smallholder producers tend to use labour-intensive methods rather than capital-intensive ones and as such, if properly capacitated, smallholder agriculture tends to absorb more labour and use land more intensively. There is extensive literature and persuasive evidence to suggest that measures that improve smallholder producers' capacity to increase food production and productivity, whilst linking them to markets, will enhance their purchasing power and increase wider food availability (Oxfam, 2014). This will contribute to increased food production and domestic food security. However, the smallholder sector has effectively remained static over the past 10 years for which there is comparable data (DAFF, 2012).

Recognizing the fact that smallholder farming remains much untapped potential to create economic opportunities, especially in rural areas of South Africa, the Department of Agriculture, Forestry and Fisheries (DAFF) has recently designed a strategic plan for smallholder support (DAFF, 2012). The strategic plan starts by identifying the location of the majority of smallholder producers and the support currently provided versus the support that can be availed and it submits six main mechanisms or approaches that must be pursued in parallel in order to have maximum impact. These main mechanisms are:

- Improved planning and investment coordination,
- Massifying investment in human development and skills,
- A stronger and more coherent approach to partnerships,
- Revising and refining infrastructure and mechanization support programs,
- Scaling-up scheme-based interventions, and
- Phasing in and expanding systemic interventions.

These mechanisms are not mutually exclusive. On the contrary, they are mutually reinforcing, both in time and space, though some will merit greater emphasis than others, depending on the local circumstances.

2.12 Land and water policies to take advantage of irrigation schemes

South Africa's National Water Act of 1998 (Act.36 of 1998) is widely regarded as an innovator of an international wave of reform in the water sector, including the EU Water Framework Directive (EU, 2000) and Mexico's National Water Plan which embodies a set of guiding principles agreed at the 1992 International Conference on Water and the Environment (ICWE)

in Dublin (World Bank, 1993; 2004). International norms differ from South Africa water reform. Goals of the legislation redress the past inequalities in water use (World Bank, 2004).

The purpose of the National Water Act (NWA) is stated as to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways that meet human basic needs of present and future generation. This requires promoting equitable access to water, the efficient, sustainable and beneficial use of water in public interest and also facilitating economic and social development amongst people (World Bank, 1993, 2004). According to the National Water Act, all water in South Africa is considered to be an 'indivisible national asset', for which the government's Department of Water Affairs and Forestry now known as Department of Water Affairs and Sanitation (DWS) is the custodian in South Africa (DWAF, 1997).

In the past, water reform and land reform have hardly been linked (Woodhouse, 2012). There are immediate links between the current land reform and water (Van Koppen *et al.*, 2009): firstly, in the case of irrigated land that is restituted and redistributed and secondly, in the case of water as one aspect of land tenure reform in communal areas. Agrarian reform holistically regards land and water resources in South Africa as assets for rural redress, higher productivity and improved wellbeing. According to DAFF (2012) and Denby *et al.* (2016), the insufficient application of policies is an outcome of the misalignment of policies among various government departments, lack of knowledge on the effects of policies at macro and micro levels and lack of engagement among regulators, implementation groups and stakeholders.

This lack of coordination at a policy level between land and water reforms is made worse by the marked lack of sufficient incentives or political will within regional and local institutions to collaborate (Denby *et al.*, 2016). Based on National Water Resource Strategy (NWRS)-2, DWS works with the DRDLR and DAFF (and PDARD) to attain a comprehensible programme of land, water and agrarian reform. The NWRS-2 aims to support rural development through a programme of support to smallholder water users. However, despite the progressive reforms, water allocation remains a profoundly political issue due to the historical context of South Africa, the economic importance of water and the many complex needs of multiple stakeholders from differing departments, socioeconomic classes and political regimes (Denby *et al.*, 2016).

Property rights perform a critical role in sustainable irrigation and their reform has to be based on thorough knowledge of the existing rights to land, water and their primary institutions.

Malzbender *et al.* (2005) emphasize the importance of recognizing legal heterogeneity that exists at local level. The typology method proposes a tool for evaluating and developing more distinguished policies taking into account differences in tenure systems. Meinzen-Dick (2014) argues that there is no one optimal property right system that can be applied in all irrigation systems across the developing countries. Instead, more alternatives are required and knowledge of how they can be tailored to an ever changing physical and institutional environment.

Hodgson (2016) summarizes water tenure systems into two groups, namely, tenure arrangements defined by formal law and those not defined by formal law. Tenure arrangements defined by formal law consist of: (i) 'traditional' formal water rights (rights to use water resources derived from land tenure rights), (ii) 'modern' formal water rights (permit-based long-term rights which do not depend on land tenure rights), (iii) regulatory licenses, (iv) agency control (water agency holds legal power to abstract and use water resources) and (v) common-hold water tenure (rights to water held in common by a distinct community of users such as members of WUAs and are highly dependent on effective governance within). Tenure relationships not well-defined by formal law consist of: (i) customary water tenure (rights to abstract or use water resources based on local law), (ii) informal water tenure (use of water that is not legally recognised but is tolerated by the water administration), (iii) assumed rights (formal water rights are wrongly assumed to exist due to the 'official' nature of the use).

FAO (2016) summarizes three diverse states of commons, namely, (i) commons may be publicly or state-owned land that is collectively used and managed by local groups, (ii) commons may be owned by indigenous peoples or other communities with customary tenure systems and this may be legally recognised and (iii) commons may be newly established where groups come together to create rules and norms to use, manage and even own a specific natural resource collectively. Using these summaries by Hodgson (2016) and FAO (2016), the tenure systems that currently exist in the selected study areas are different. For example, in Makhathini Irrigation Scheme the tenure system that exists for water is the agency control and the agency is called Mjindi Farming. In Bululwane and Tugela Ferry Irrigation Schemes, the tenure system that dominates is the customary water tenure which is similar to common-hold water tenure but the difference is that water is managed by scheme committees and not WUAs. However, for smallholders outside the schemes, the informal water tenure dominates. Similar to all schemes, the commons are state-owned land resources which are collectively used and managed by local groups or traditional authorities under customary tenure.

Hodgson (2004) and Bainville (2017) argue that customary tenure is neither an impediment to investment nor an absolute safety net for smallholders. The presence of excludability right in African tenure arrangements implies that productive use of land can be attained (Sjaastad and Bromley, 1997; Bugri, 2008). Deininger *et al.* (2008), Place (2009) and Hodgson (2016) argue that in Africa, the lack of individual titles to land or water resources doesn't necessarily equate to lack of tenure security. According to Bugri (2008), individual titles to land do not necessarily equate to high agricultural production in agriculture. Furthermore, Hodgson (2004) and Holden and Ghebru (2016) argue that the assumption that customary land tenure systems are insecure is problematic. However, there is an acknowledgement that where insecurity of customary tenure occurs in an agrarian economy, it leads to low agricultural production. A study by Fort (2008) found that in customary tenure arrangements, simple land use rights administered by local authorities appeared to be adequate to encourage land users to invest and transfer of rights that did not meaningfully advance investment motivations.

Binswanger-Mkhize *et al.* (2010) argue that collective rights with formal and informal rules for access and use are usually more effective than individual private property or any state managed property rights. Unlike urban investors, rural communities believe their rights are better represented in the customary sphere (Cotula, 2006) and trust amongst community members plays a critical role. This raises a concern of whose agenda is being pushed when private individual rights are being enforced. According to Toulmin (2008), one of the key questions for generating growth and reducing poverty is how provision for land titling and registration can yield benefits for the poor. Thus, there is a need to improve the existing local systems and institutions that manage common property resources and also ensure that land registration systems can improve the land use rights of smallholders.

2.13 Summary

The chapter has highlighted key concepts critical to the transformation of homestead and smallholder irrigation in South Africa. It started by establishing the context in relation to smallholder farming before giving a historical overview of homestead food gardening in South Africa and a few selected countries. The literature reveals the importance of homestead food gardening to livelihoods in rural communities in terms of food, nutrition and income security. It also defined who the smallholder farmers involved in agriculture are and the contribution of smallholder irrigation to agriculture. The literature demonstrated the role played by smallholder irrigation in transforming rural economies, especially given the increasingly negative impact of climate change on agriculture. Given the importance of sustainable use of water in irrigation,

the chapter also reviewed literature on water availability, access, security and water use productivity.

The chapter also highlighted the literature on the importance of recognizing smallholder heterogeneity in the design of policies, programmes and interventions meant to assist smallholder farmers. The focus of the study also pointed to the need to review literature on aspirations starting by giving a definition of aspirations, followed by an assessment of factors that influence smallholder aspirations. This discussion revealed that, for effectiveness and impact, it is important to focus on both an individual's aspirations and capacity to achieve those aspirations. The greater part of the last section of the chapter dwells on the concept of entrepreneurship. It sought to establish an understanding of entrepreneurship as a concept and in the context of smallholder farmers. It also presented the state of entrepreneurship in South Africa, which is quite limited.

3 RESEARCH METHODOLOGY

3.1 Introduction

The chapter gives a description of the research design encompassing the conceptual underpinnings adopted for the study, empirical methods of data collection, data analysis techniques and dissemination of the study findings. The process for study site selection is described in Chapter 4. The Sustainable Livelihoods Framework formed the basis for conceptualizing the study. However, due to several thematic issues that needed to be addressed by the research, other concepts such as PsyCap, behavioural economics and a common pool resource-management were also employed. The combined understanding of these concepts was critical in the addressing the objectives of the research.

The research approach was participatory and sought maximum involvement of key stakeholders including farmers at every stage of the research. To this end, several data collection methods were employed that enhanced interaction between the research team, farmers as participants, other key stakeholders in government, the private sector and the research community. The study was structured in phases and data collection was conducted in continuous stages in order to reduce research fatigue and ensure the collection of credible data.

3.2 The pillars of the conceptual framework

The conceptual basis for the design, analysis and interpretations of the results in this research project was drawn from the body of work including the SLF approach (Scoones, 1998; Carney *et al.*, 1999; De Satgé and Holloway, 2002; Ellis and Freeman, 2005); opportunities and challenges in taking advantage of the premises of wealth at the bottom of the pyramid (Prahalad and Hammond, 2002; London, 2009); PsyCap (Luthans *et al.*, 2004; Luthans *et al.*, 2007 and Luthans *et al.*, 2015); behavioural economics (Simon, 1955, 1959; Tversky and Kahneman, 1974); challenges in unlocking rural entrepreneurship, innovation and farmers' entrepreneurial spirit (McElwee, 2006; 2008; Drucker, 1985; Kirzner, 1973); and principles from complexity economics (Arthur, 1999). Integration of these concepts/issues and the development of a holistic conceptual model enabled the research team to lay out the mechanisms and understand the challenges holding up rural people for managing transition from homestead food gardens to small-scale farming, then to small-scale commercial farming.

However, the main conceptual framework that underlies the design of this research project and then guide interpretation of the results is the SLF approach. The SLF embraces that capital

assets represent the capabilities available to households to follow different livelihood strategies (Chamber and Conway, 1992; Scoones, 1998; Carney *et al.*, 1999; De Satgé and Holloway, 2002). They have a critical role in defining the ability of households to utilise available opportunities to improve their livelihoods. For example, an area might have good rains and soils which represent an excellent farming opportunity. However, if a household does not possess, through ownership or otherwise, the assets that make farming possible, the result is a failure to utilise the available opportunity.

The framework can help to understand linkage between rural livelihoods, food value chains and smallholder irrigation schemes. A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (DFID, 2001). A social sustainable livelihood has to cope with and recover from stresses and shocks and improve its capabilities and assets both now and provide for future generation while not condemning the natural resource base (Chamber and Conway, 1992).

In the achievement of a sustainable livelihood the trade-offs between productivity, equity and sustainability are critical. Core concepts are that the approach is people-centred, holistic and dynamic in seeking to understand, learn from and build upon change. It starts from an analysis of people's strengths, opportunities and constraints rather than needs, seeking to build on existing poverty reducing potential and emphasizing the issue of sustainability (Hasnip *et al.*, 2011).

In water sector, livelihoods analysis is essential. Irrigation schemes and irrigated farm enterprises are a complex interaction of physical, social and economic factors that can best be understood within an integrated systems framework (Bembridge, 2000). Livelihood analysis builds on better understanding of multiple perspectives and values water as economic capital (agricultural input, domestic needs), physical capital (irrigation infrastructure), managerial and institutional capital (water organisations), social capital (collective action) as well as political capital (Ashley and Carney, 1999). It assesses gains and losses of the rural poor from water reforms (Lankford, 2005). It improves the knowledge of the context from the local level upwards and helps to analyse opportunities and constraints of the rural poor to benefit from the changes within the given context (Nicol, 2000). It helps to identify what options have better potential to reduce poverty within the given context and what enabling conditions, policies and

incentives are needed for the poor to increase the range of better livelihood options (Scoones, 1998; Ellis, 2000; Moriarty *et al.*, 2004; Lankford, 2005).

Some distinctive features of the livelihoods framework are that it takes an “all-round” view of people’s means of gaining a living, including the social and institutional circumstances in which people’s livelihoods are embedded. At the centre of the approach is a relationship between the assets or resources that people own or can obtain access to, including land, irrigation water, skill- and education levels of family members. The generic SLF consists of five main components; namely livelihood assets, vulnerability context, transforming structures and processes, livelihood strategies and livelihood outcomes. It presents the main factors that affect people’s livelihoods and typical relationships between the livelihood assets that farm households own or have access to, which are categorized as natural, human, social, financial and physical assets. Following the work by Luthans (2004) and Luthans *et al.* (2007, 2015), a sixth additional livelihood asset, the PsyCap, is also added to this list. The households utilise these assets in their productive activities in order to create income and satisfy their consumption needs, maintain their asset levels and invest in their future activities. The access to the assets is strongly influenced by the vulnerability context and policies and institutions.

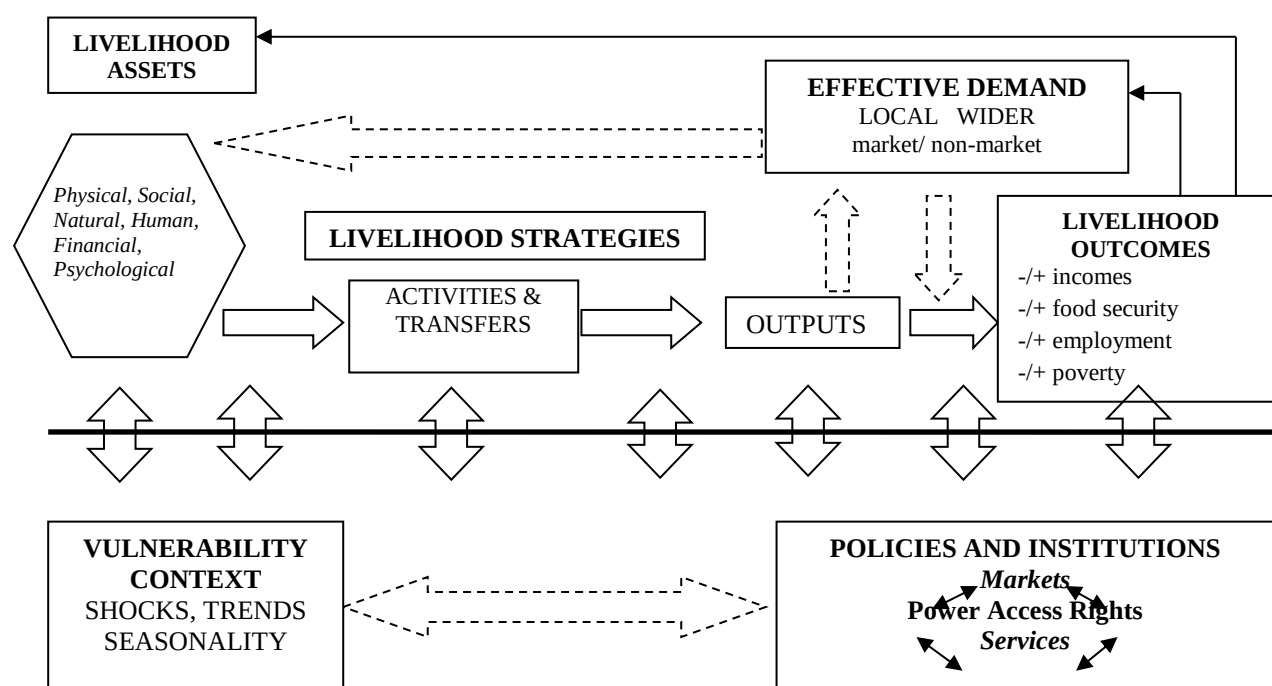


Figure 3.1. Modified sustainable livelihoods framework

Source: Adapted from Dorward, 2001

Livelihood sources are presented as economic activities that one can engage in order to earn a living and transfers such as social grants and remittances. The framework recognises the heterogeneity in smallholder households and their different aspirations for dynamic livelihoods. Livelihoods must generate income through the provision of goods and services that have effective market and non-market demand at prices and costs that provide a satisfactory return (Dorward, 2001). Focus should be on the ability of farmers to participate in the markets both as consumers (buyers of inputs) and suppliers in the food value chain (producers selling output).

The framework implicitly recognises the need to account for the concept of sustainability in livelihoods. In this regard, Dorward (2001) states that in pursuing different livelihood options there is changing demand on natural resources such as water, land, forestry, biodiversity and unsustainable utilisation of these resources will in long-term have negative effects on livelihoods of smallholder farmers. This is particularly important for smallholder irrigation where the key resources for production, water and land can be depleted if not efficiently utilised and more so in the presence of the inevitable adverse effects of climate change (Benhin, 2008; Bryan *et al.*, 2009).

Savitha (2010) defines livelihood as the means people use to support themselves, to survive and to prosper. Livelihoods are an outcome of how and why people organize to transform the environment to meet their needs through technology, labour, power, knowledge and social relations. Livelihoods are also shaped by the boarder economic and political systems within which they operate. A livelihood in a simple form is a means to gaining a living. It provides support for the enhancement and exercise of capabilities (an end); and capabilities (a means) enable a livelihood to be gained.

There are four major ways of acquiring livelihoods by the rural households. A large proportion of the small and marginal farmers gain livelihoods through production on small pieces of land while other livelihoods are labour based. Another form of livelihood is the exchange or market-based livelihood. Those rural households which produce surplus food and non-food agricultural products, or non-farm goods earn their livelihoods by selling these surpluses in the market. The fourth set of livelihoods is transfer-based entitlements (Sen, 1981). The households without any income-earning asset or able-bodied person to work for their livelihoods depend on transfers from the government or the social organisations. The rural livelihood systems in the developing countries thus encompass a broad range of factors and depend on several macro sub-systems of the economy (Savitha, 2010).

3.2.1.1 Livelihood capital assets

A livelihood is made up of the capabilities, assets (stores, resources, claims and access) and activities necessary for a means of living. Livelihood is, therefore, broader than income; it includes everything done to obtain a living (De Satgé and Holloway, 2002). Rural dwellers of developing countries have been thought to engage only in small-scale agriculture, but this is a misnomer that is continually being disproved with emerging studies of peasant livelihoods showing highly diversified livelihoods (Rahman *et al.*, 2007).

There are traditionally, five livelihood capital assets, namely: human, natural, physical, financial and social assets (David, 2000; De Satgé and Holloway, 2002). The additional asset to make them six, is the PsyCap. The implication of access to irrigation to these capital assets is briefly discussed below.

Human capital

Human capital refers to “knowledge, experience and skills possessed by people involved in the production process which is directly influenced by education and training” (FAO, 2001:28). Human capital is not only limited to education but also to the individual state of health. According to Okpachu *et al.* (2014:27) “increased agricultural productivity depends primarily on the education of the rural farmers to understand and accept the complex scientific changes which are difficult for the illiterate rural farmer to understand”. To improve the production capacity of a population, the human capital theory postulates that formal education is highly instrumental and essential as it increases the level of cognitive stock of economically productive human capability which is a product of innate abilities and investment in human beings (Okemakinde, 2008 cited by Okpachu *et al.*, 2014).

Introduction of irrigation can change to favour increased crop production, increased cropping intensity and intensification of cultivation. Harvest and processing activities can create greater opportunities for labour encouraging seasonal migration from less intensively irrigated areas. Better opportunities can be created for the landless that are usually the poorest in the community. Higher agricultural production can lead to an increasingly mobile community and higher demand for processing, transport and marketing services. The services of rural mechanics are needed to fix agricultural equipment and drivers move fuel, fertilizers, cereals and vegetables.

Increased income available to invest in education and increased awareness of the benefits of education can increase school attendance particularly of girls and those from previously poor

families. General literacy rates can be increased faster than the national trend. Even though men remain generally better educated in the traditional communities than women, the educational level of women could be better improved through access to irrigation. Although food production and household food security can improve, crop diversification can enable more households grow and consume vegetables to meet various nutritional requirements. This will contribute a well-balanced diet and so results in improved health. Reduction in overall food deficit and a greater income available for expenditure on food, healthcare and medicines can further contribute to these improvements.

Despite the anticipated improvements in production, there is still a need for reliable training on irrigation and cultivation techniques, particularly for improved and diversified cropping. Information tends to be passed from farmer to farmer, which though important has its limitations. At present, the extension system seems to largely focus on providing relevant information for irrigation farmers organised in cooperatives, less focused on smallholder farmers operating independently who actually aspire to transform themselves to entrepreneurs.

Natural capital

In South Africa, irrigation is particularly attractive because it obviously enables farmers to cultivate their land and grow crops during the dry season even though there might be frost damage in some locations. In most areas not only cropping intensity is expected to increase, but also low yielding local staple crops may be replaced by High Yield Variety (HYV) and higher value crops such as vegetables. However, the area traditionally cultivated with staple crops such as maize during the rainy season may be reduced.

The trend to mono-cropping of maize in dryland farming can be partly justified by the fact that the perception of farmers that higher value crops are associated with greater risks and higher marketing costs. Nevertheless, different water management practices are needed to cultivate various crops. Farmers within an irrigation scheme must agree and co-ordinate cropping patterns and water use. However, it is important to note that a year-round and extended cultivation of crops can bring the potential for negative environmental impact, for example: lowering of the water table, reduction in groundwater quality and soil fertility and loss of species diversity in marginal areas. Even though the exact changes remain to be quantified, the trend appears to be real and calls into question the sustainability of an intensive cultivation farming system.

Physical capital

Irrigation can also be a catalyst for infrastructure development. An increase in the development of physical infrastructure such as electricity, shops and services, can follow the development of irrigation schemes. Moreover, the construction of road infrastructure is important in encouraging the development of other physical infrastructure which does generate higher income. Irrigation can also encourage farmers to build and develop infrastructure on and around their land. These can be an increase in housing development which reflects an improvement in living standards, such as additional rooms, new roofs, latrines and drinking water supplies. Irrigation development can also encourage intensification of livestock production, with adoption of improved breeds and stall-feeding rather than free grazing. Some households can concentrate upon crop production, reducing livestock numbers to the minimum needed for own consumption, while others can produce dairy and meat products for the market. There are also obvious inter-linkages between human and physical assets. The irrigation scheme needs to be functioning well in order for farming to be sustainable and physical assets such as schools, shops, health posts and roads need to be available for improved farming to contribute to better livelihoods. It is likely that irrigation can be a ‘pull-factor’ that initiates service provision in the areas around irrigation schemes.

Financial capital

Increased crop yields from irrigated plots and the generated profits can improve the economic condition for farmers. Irrigation infrastructure enables farmers to grow high yield varieties in place of a relatively low yielding, rainfed crop. Financial gains through irrigation can help to stimulate the local economy. An increase in disposable income of farmers can allow them to acquire a range of household goods, spend more on education, housing improvements, food, health care and medicines. Consequently, the number of shops, crafts, traders and service providers can increase in response to demand. Irrigation is expected to help all stakeholders to reduce their risks and vulnerability to shocks as irrigated plots provide more reliable yields. Farmers can diversify their activities by using capital accumulated from increased crop production for enterprises. Landless labourers can also be able to take up non-farm employment yielding an income less dependent upon the farming calendar. Where land is unequally distributed, irrigation development may initially favour farmers with larger landholdings, but smallholder farmers can still benefit if access to water can be ensured. This can be achieved variously, by facilitating access to credit, access to appropriate irrigation equipment and water. Facilitating this environment for economic activity means that the benefits from increased

production due to irrigation are more widely distributed, which in turn provides employment opportunities for the landless.

Social capital

Social capital is defined as one's ability to utilise social networks and institutions. Social capital is considered as an important capital because it determines access to other capital assets such as land title, credit access and equipment, all of which have implications for resource allocation and hence productivity (FAO, 2001). Njuki *et al.* (2008:10) state that social capital can be categorized into three, namely, binding, bridging and linking. Binding social capital is defined as a "cohesion that takes place between individuals of similar ethnic background and is reinforced by working together, whereas bridging social capital links networks requiring collaboration and coordination with other external groups to achieve set goals". Engagement of local groups with institutions or agencies in higher influential positions is considered as a linking social capital. Linking social capital enables poor households to have access to resources, information and support from organisations and networks (Njuki *et al.*, 2008).

Irrigated farming has a significant influence on social capital, allowing sufficient improvement in the general standard of nutrition and income to free people from the preoccupation of survival and allows them to attend to other development issues. As irrigation develops, the demand for and profitability of, agricultural goods and services will tend to increase and leads for more shops and services in the irrigated areas and an increase in spending and market participation by rural people. People will be better able to support infrastructure projects on the proceeds of irrigation. The social value associated with roads, paths and bridges, facilities such as schools and health posts and cultural focal points such as meeting halls, religious places and ceremonies should not be underestimated. Improved infrastructure can support increased social capital, making it easier for people to travel to meetings, ceremonies and participate in events. Cultural observance and ceremony is important and the formation of committees and the increased ability within the communities to fund ceremonies is a positive aspect.

Improvements in education raise the potential for and the effectiveness of, communication. Better levels of understanding and greater access to information encourage people to pull together to achieve their development objectives. The improved individual skills resulting from formal and informal education also have a community, as well as a private, value. Education of girls can realign the allocation of responsibilities in the home, smoothing out some of the

early distortions from the introduction of irrigation that tend to disadvantage women through a greater workload.

Both informal and formal social capital can also facilitate broader distribution of the gains from irrigation and help to build other assets. Reciprocal exchange of labour, whereby households mobilize labour from other households in addition to their own family labour, can help to meet the increased labour requirements of irrigated cropping, while formal networks and groups are important for information exchange and management of shared resources.

Whilst employment can provide a livelihood, most livelihoods of the poor are based on multiple activities and sources of food, income and security. In both rural and urban contexts, the vast majority of the poor have individual, household and community survival strategies that may include employment, but go beyond this range of other economic activities that include informal sector work, exploitation of common property resources, share-rearing of livestock and reliance on social networks for mutual support as well as a number of other mechanisms for coping in times of difficulties (Hassan *et al.*, 2002).

The means of securing livelihoods are diversifiable and they can be natural resource or non-natural resource based. Examples of natural resource-based activities include livestock and arable farming, community-based tourism and mining. Examples of non-natural resource-based activities are rural trade and formal employment. Different forms of livelihoods activities require different forms of assets in order to generate a livelihood (Dirwayi, 2010).

Sustainable development and/or sustainable livelihoods approaches have also been adopted as the framework for development. The core principles of sustainable livelihood approach are (Krantz, 2001):

- **People-centred** – livelihoods reflect the choices people make given their unique circumstances;
- **Participatory** – working with people, using a battery of participatory methods, to analyse their livelihoods rather than extracting information at a distance is central to the sustainable livelihoods approach;
- **Holistic** – people do not live discretely defined lives. They are not only farmers or only family members;
- **Differentiation** – households are unique and differ one from another; likewise, the members of a single household;

- **Dynamic** – livelihoods are dynamic in nature and are subject to influences which are also dynamic;
- **Building on strengths** – start with people's strengths not needs. This implies a recognition of everyone's potential and calls for efforts to remove constraints to the realization of this potential;
- **Macro-micro links** – development activity needs to balance and bridge macro and micro foci. Higher-level policy needs to be informed by local level insights;
- **Sustainability** – sustainability for both developments in general and of livelihoods in specific rests on several dimensions, including environmental, economic, social and institutional.

3.2.1.2 *Integrating Psychological Capital into the Sustainable Livelihoods Framework*

One of the unique features of this project is its explicit integration of PsyCap to the sustainable livelihoods framework. The integration of PsyCap in the SLF is meant to explain diversity among farmers brought about by differences in individual mindsets, their PsyCap. Although the effects of psychological, social, cognitive and emotional factors on the economic decisions of individuals and institutions and their consequences on resource allocation are the subjects of behavioural economics (Baddeley, 2017), PsyCap as a livelihood asset has not yet been integrated to the SLF. Past studies on farmer typology (e.g. Bigodeza *et al.*, 2009; Goswami *et al.*, 2014; Pienaar and Traub, 2015) have also failed to account for smallholder heterogeneity in PsyCap.

In the past, heterogeneity among smallholder farmers has been attributed to differences in indigenous knowledge, farm management practices and other resource endowments (Wale and Yalew, 2007; Muthamia *et al.*, 2011). However, there is no literature to explain differences normally observed among smallholders working in the same village, having a similar resource endowment and faced with similar institutional and infrastructural constraints. It is the view of this study that variations in PsyCap endowment can explain these differences observed even among smallholder farmers in irrigation. Indeed, Liu and Liu (2016) posit that farmers' different perceptions and attitudes towards their lives, affects their livelihood strategies and outcomes. PsyCap induced differences can help to explain differences in farmers' ability to take advantage of opportunities availed through irrigation farming; the dependency tendencies observed among some smallholders; different levels of confidence in agriculture as a

sustainable livelihood strategy; and the farmers' varying abilities to cope with different challenges.

On the other hand, irrigation farming can help boost farmers' PsyCap by increasing their confidence in farming as a livelihood and business and self-belief in themselves as farmers. Irrigation farming enhances farmers' resilience and hence ability to cope with shocks such as droughts and inconsistent rainfall. This has positive implications on their PsyCap endowment. Individuals endowed with psychological can manage and utilise all the other forms of resources available to them effectively (Chipfupa and Wale, forthcoming).

PsyCap emanates from the literature on positive organisational behaviour with firm foundations from the social cognitive theory (Luthans *et al.*, 2007). This concept should be at the centre of defining and characterising entrepreneurship in smallholder agriculture. The ability to identify unmet demand in the market, take that as a business opportunity and integrate that into one's livelihood strategy is an important character of an entrepreneur (Shane and Venkataraman, 2000). This ability is a function of one's PsyCap endowment, a concept so far neglected in the sustainable livelihoods literature. PsyCap is a state of mind of an individual at a given time (Seligman, 2002). It is about the individual mindset that enhances or hinders willingness and ability to take advantage of opportunities (like irrigation schemes) despite the prevailing constraints. It goes beyond the 'human capital (what you know)' and 'social capital (whom you know)' to 'who you are and more importantly what you intend to become' (Avolio and Luthans, 2006). If individuals are endowed with positive PsyCap, their entrepreneurial drive is enhanced and they will most likely develop the tenacity necessary to go through the entrepreneurial process (Hmieleski and Carr, 2008).

PsyCap is multi-dimensional and made up of four constructs, i.e. confidence, optimism, hope and resiliency (Luthans, 2004; Luthans *et al.*, 2007; Luthans *et al.*, 2015). *Confidence* is the belief in oneself's ability to accomplish one's goals. Having confidence motivates one to invest more time and persevere even in the face of challenges (Luthans *et al.*, 2007). *Optimism* depicts a scenario where one looks forward to a positive, meaningful and desirable future. It is defined either as an explanatory style (Seligman, 1998) or an expectancy perspective (Carver *et al.*, 2010). As an explanatory style, optimistic persons 'attribute positive events to personal, permanent and pervasive causes and interpret negative events in terms of external, temporary and situation-specific factors' (Luthans *et al.*, 2007, p90-91). Using the expectancy perspective, optimistic people are those that expect a desirable result from putting more effort and hence

would continue to work hard even when faced with difficulties (Carver *et al.*, 2010). *Hope* is about the willpower to accomplish something and the ability to generate alternative routes to achieve one's goals (Luthans *et al.*, 2007). Luthans *et al.* (2010, p45) describe a hopeful person as 'one who proactively generates one or more pathways to goal accomplishment in a given situation'. *Resiliency* is the ability to adjust or adapt in the face of hardships or risk that allows one to quickly bounce back and move ahead (Masten and Reed, 2002).

For smallholders, their mindset is the single most important factor that dictates their entrepreneurial spirit. Creating a conducive environment, access to new technologies, market access and access to finance, though necessary, will not sufficiently create agripreneurs unless smallholders have a mindset which says, 'I can do it' and 'I am ready to face the challenges'. Individuals who have self-confidence persevere even when faced with difficulties and those who are optimistic take these obstacles as opportunities to think differently (Simons and Buitendach, 2013). They always bounce back and through hope, they generate different pathways to accomplish goals (Simons and Buitendach, 2013). When resources are limited and, individuals are faced with risky decisions, those with positive PsyCap are in a better position to make effective decisions and employ more resilient adaptation strategies. Access to PsyCap determines access to other forms of capital (Luthans *et al.*, 2004). It is, therefore, found imperative to assess the PsyCap of smallholders, focusing on factors hindering farmers from realizing their potentials.

3.3 The empirical methods of data collection

3.3.1 The data collection process

The research process was structured in four stages, namely, (i) contextualization and establishing facts, (ii) exploratory survey and rapid rural appraisal, (iii) focus group discussions (FGDs) and primary rural household survey data collection and finally (iv) data analysis and preparation of development pathways and validation.

3.3.1.1 Contextualization and establishing facts

The first stage included contextualization of available economic theories and suggested best practices in such a way that they are relevant to the research context. Extensive review of literature and reports from various organisations both from within South Africa and other relevant countries was conducted and the conceptual framework for the research was refined. The published materials and reports provided information regarding trends in population and its dynamics, property right regimes, institutional arrangements and governance, livelihoods

assets and activities, social capital and networking, among others. This process had a refining effect on action and the research team regarding exploring for sustainable institutional design and arrangements needed to support the livelihoods of the plottolders in the irrigation schemes.

3.3.1.2 Exploratory survey and rapid rural appraisal

The exploratory survey of the study area and communities complemented findings from the literature review. This rapid assessment provided qualitative information and helped to assess the relevance of the research tools to be used in the following stages. Research tools including institutional mapping, focus group discussions and key informant interviews were used at this stage to acquire relevant information. This involved intensive engagement of the research team with the sample communities at the irrigation schemes in an attempt to unpack the challenges with the intention of shedding light on outcomes such as improved income, employment generation and promotion on the entrepreneurial ladder. Based on the findings from this stage, tools or methods were amended. Focus group discussion and key informants were used to explore the criteria to identify successful households in terms of entrepreneurial development. For more on this, please see section 3.3.2.1 below.

3.3.1.3 FGDs and primary data collection

In all the study sites, FGDs were held with different groups in the communities in the initial stages of the project. The FGDs gave the opportunity to the research team to discuss and obtain group opinions (agreements and divergent views) on key thematic issues of the project. Seven such FGDs were conducted in Makhathini and Ndumo-B, 2 in Bululwane and 2 in Tugela Ferry. The FGDs were conducted with leaders of cooperatives, small-scale irrigators, homestead food gardeners, maize and vegetable marketing committees and farmers irrigating outside the irrigation schemes (independent irrigators). An additional ten FGDs were also held as part of the methodology for testing and validating the established entrepreneurial development pathways. These are elaborated in detail in Section 3.3.2.3 below.

After the exploratory stage, a series of structured, unstructured and semi-structured questionnaires were designed in phases and administered to sampled households in communities in the four study sites³. Questionnaire surveys were conducted on five different occasions as will be elaborated in Section 3.3.2.2 below. Since the project supported capacity building for one PhD and four MSc students, data collection was aligned to the studies of these students. At every phase, more farmers were interviewed. To the extent possible, the project

³ Details on the study sites is provided in Chapter 4 of this report.

maintained the core of the study participants throughout the project life span. However, some farmers could not be located in subsequent visits and hence they were replaced by new farmers.

Data collection, at all stages, was preceded by enumerator training. The study largely utilised the same enumerators at every stage to maintain continuity, capture the inter-temporal dynamics and also maintain rapport with farmers. This also made it easier to address data gaps step by step as the project proceeded. Enumerator training was conducted over 1-2 two days depending on the length of the questionnaire and the new information required. After the training, the questionnaire would be pretested and minor revisions made in the field before final printing and administration. Pretesting was a critical stage of the research process since it gave an opportunity to enumerators to familiarize with the questions while identifying gaps and errors in the questionnaire and relevance of the questions to the farmer context. For more details on the data collections, please see section 3.3.2.2.

3.3.1.4 Preparation of development pathways and validation

After collection, data were examined and analysed. Appropriate econometric model (see Section 3.4 below) were specified to scrutinize socio-demographic, economic and geo-physical factors associated with decision behaviour of the respondents. Respondents' knowledge, the skill gap and adoption of smallholder irrigation technologies and willingness for entrepreneurship was also examined. This was important in order to inform suggestions for future interventions.

Using the results from the analysis, the research team designed entrepreneurial development pathways for each typology of farmers engaged in homestead and smallholder irrigation in the target communities. An iterative process of consultation with resource persons, researchers, relevant government departments and non-governmental organisations was then facilitated to present the results and brainstorm on alternative entrepreneurial development options. Preliminary findings of the study were presented and discussed with the community to validate the findings and discuss the recommendations so as to scrutinize the acceptability of the proposed development options by the communities. Validation of the proposed options was conducted to check the possibility of scaling-up.

3.3.2 The data collection methods

3.3.2.1 Participatory rural appraisal (PRA)

The study used several PRA approaches that helped in conceptualization and understanding of the challenges faced by smallholder farmers in homestead food gardening and smallholder

irrigation. The methods were also quite important in validation of the study results and mapping of the solutions needed for the transformation of the smallholder irrigation sector. The PRA approaches employed include:

- Observations
- Informal discussions
- Semi-structured key informant interviews
- Focus group discussions
- Community mapping of solutions

In all the field visits, the research team took the opportunity to observe farmers in their gardens, plots or fields or during field days. For example, the researchers were able to attend and meet several key stakeholders on a field day organised in the same week as one of the field visits in Jozini. The field observations were complemented by informal discussions with members of the communities in leadership or with knowledge of the general livelihoods of the farmers. These discussions were important because they provided the foundation for the formal discussions with community members, including leadership and other stakeholders. Key informant interviews were conducted utilizing semi-structured questionnaires that allowed for further probing. Stakeholders who formed part of the key informants include representatives of relevant government departments (District DARD and Department of Water and Sanitation), Non-governmental organisations, leadership of the irrigation schemes including representatives of the board of trustees and traditional leadership, Mjindi Farming and chairpersons of cooperatives, among others.

3.3.2.2 Rural household surveys

The questionnaires for the in-depth household surveys focused mainly on sources of livelihoods, water availability and irrigation, cropping patterns, agricultural production and marketing. The local DARD offices in the study sites assisted in mobilizing farmers in the schemes and communities. In Makhithini, Mjindi Farming also supported this process. Table 3.1 below shows dates when the in-depth questionnaire surveys were conducted in the study sites.

Table 3.1. Data collection phases and sampled farmers

Date	Bululwane	Ndumo-B	Makhathini	Tugela Ferry	Total
Sep 2014	60	61	75	70	266
Jun 2015	60	42	147	70	319
Mar-Apr 2017	86	-	64	94	244
Apr and June 2016	60	102	214	70	446

Note: Subsequent data collection phases targeted farmers also sampled in the previous phase to ensure that the project was largely working with the same farmers throughout its lifespan.

The total number of farmers that participated in the study were 674. Figure 3.1 and 3.2 show the distribution of these farmers by study area.

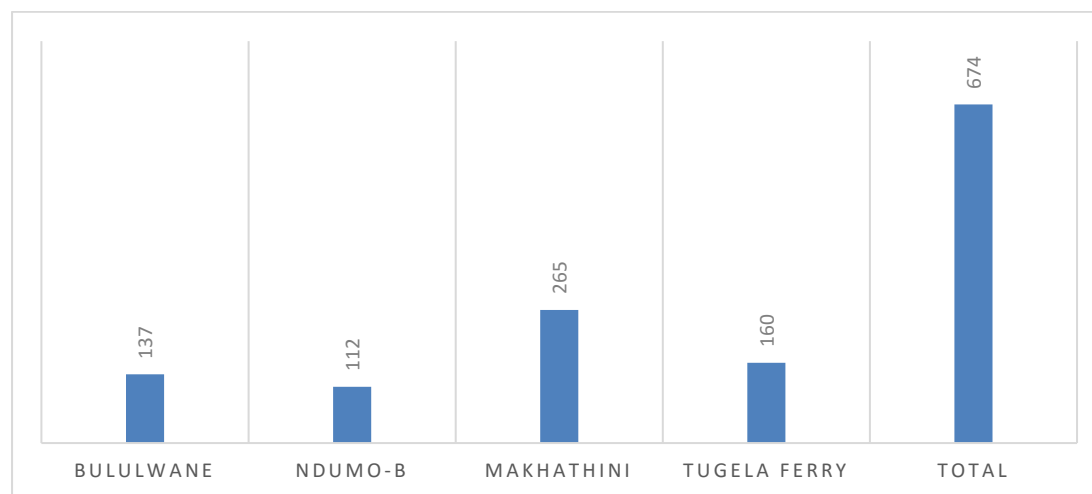


Figure 3.2. Total farmers reached by the end of the project by type of farmer

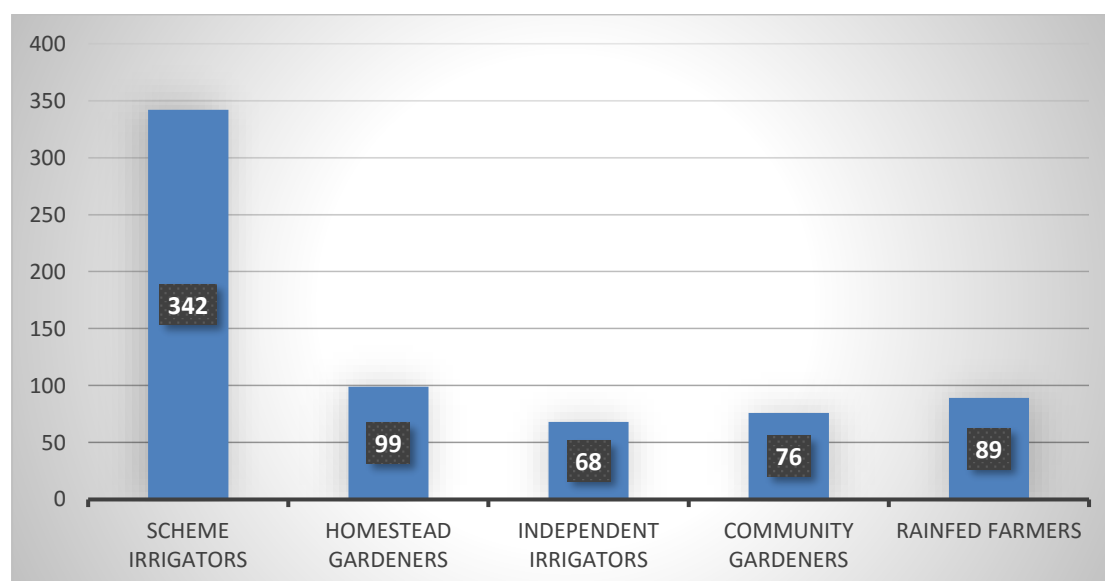


Figure 3.3. Total households reached by type of farmer by the end of the project

Source: Survey data, 2015-2017

Specifically, data collected through the questionnaire surveys included:

- a) Household demographic characteristics, capital endowment (including natural, physical, financial, social, human and PsyCap), income profile and wealth ranking, primary occupation.
- b) Vulnerability context: indicators for measuring individual vulnerability, mainly related to water resources at the household level shall be developed for this study. It comprises indicators representing shocks (i.e. natural hazards, likes floods and drought and conflict over water use), trends (i.e. variation in several sources of income) and seasonality (i.e. fluctuation of output price and lack of seasonal hired labour for agricultural activities),
- c) Cropping activities: which type of crops are produced using irrigation and/or rainfed farming, cropping calendar for various crops under various farming practices, which crops are grown for the purpose of home consumption and which ones for market as cash crops, inputs availability such as seeds, fertilizer and tractor for land preparation at the right time and place, etc.
- d) Market access for outputs and inputs and challenges faced regarding each crop cultivated by the household.
- e) Pricing of inputs and outputs which are necessary for farm budgeting and analyse profitability of each cropping activity.
- f) Income of household disaggregated by source such as from irrigated crops and non-irrigated crops, livestock, non-farm income including employment, remittance, social welfare grant, etc.
- g) Consumption expenditure of household disaggregated into food and non-food items.
- h) Farm business development pathways: Farmers' willingness to explore opportunities and challenges to transform from
 - food gardening to smallholder irrigation farming,
 - smallholder irrigation farming to small commercial farming, and
 - small commercial farming to large commercial farming.
- i) Entrepreneurial characteristics of farmers.

a) Sampling

Sampling of farmers was random and convenient. Three considerations motivated the sampling approach for the study. These are the existence of different types of smallholder farmers

irrigating both inside and outside the irrigation schemes (Van Auerbeke, 2008). The other consideration was the need to align the study with the government's objective of expanding the operation of existing schemes and establishing new ones. Thus, the sample was stratified to include scheme irrigators, farmers irrigating out of the schemes (independent irrigators, homestead food gardeners and community food gardeners) and rainfed farmers around the four schemes.

The project obtained a sampling frame of small-scale irrigators in the schemes from the local office of the PDARD. Simple random sampling was used to identify the final sample of scheme farmers for the study. For the other categories (those in homestead food gardening and irrigating outside the schemes), the study targeted farmers in the radius of 10 km from the schemes. No prior information on the actual populations of these other sub-groups was available and hence they were identified through the survey. However, this was done proportionally considering the critical mass in each area. A deliberate effort was also made to ensure representation in the sample in terms of gender, age and capital endowment of the farmers. In the schemes the study reached out to farmers who are also leasing or renting land for production.

Throughout the course of implementing the research project, the research team observed clear signs of interview fatigue resulting in some farmers refusing to consent to participate in the study. Such farmers were excluded from the survey. Most farmers who participated in the study are mostly engaging in horticultural production, mostly maize and vegetable production, which were key activities in the irrigation schemes at the time of conducting the survey.

b) Types and characteristics of sampled farmers

Scheme irrigators are smallholders engaging in farming activities inside the four irrigation schemes. Their main objectives in farming are both income generation and subsistence, although some do farm only for the market. The sizes of their plot areas depend on the scheme. They range from 10 hectares to 0.2 hectares which is found for some farmers operating as part of cooperatives in Makhathini irrigation scheme. The official land allocation per individual in Bululwane and Tugela Ferry is one hectare. However, some individuals are currently operating more due to the possibility of renting and borrowing (refer to Chapter 5 for more details).

Independent irrigators constitute smallholders outside of the irrigation schemes who irrigate as individuals. Their location is usually around an irrigation scheme or near a water source. Two key aspects distinguish independent irrigators from homestead or community food

gardeners. They are highly mechanized and use pumping systems such as electric or diesel water pumps to extract water from rivers or dams. Their major motivation in irrigation is mainly income generation and they are more resourced compared to homestead and community food gardeners.

Homestead food gardeners are smallholders who irrigate small homestead food gardens. The gardens are located at or near the homestead and vary in size, but most are less than 0.2 ha. Their source of water is usually municipal tap water and they use the bucket system for irrigation. Activities in homestead food gardens are usually dominated by vegetable crops, mostly for subsistence purposes.

Community food gardeners are not significantly different from homestead food gardeners except in terms of their management, location and water source. A community food garden is communally owned by a group of individuals who share the same vision and objective. They are located away from the homesteads along a river or near a water source. The plot sizes per farmer are small, less than 0.2 ha to as little as 100 square metres. However, the garden itself could be more than half a hectare. The system of irrigation is the bucket and the main purpose for farming is subsistence although some do sell their produce. Despite group ownership, each farmer is responsible for his/her plot and output.

Rainfed farmers are smallholders who are exclusively practicing rainfed farming. They rely on the normal rainfall for crop production and hence are most affected by drought and inconsistent rainfall patterns. Most stay further away from the schemes. They have bigger land areas than homestead and community food gardeners.

3.3.2.3 Testing the entrepreneurial development paths

The section presents the research methodology that was adopted in testing the entrepreneurial development paths (see Chapter 10). As indicated earlier, this was done through conducting FGDs with farmers in all the study communities. A total of 99 farmers participated in 10 focus group discussions. The farmers were grouped according to the six clusters identified through a farmer typology classification based on the modified sustainable livelihoods framework conducted in Chapter 9. The clusters are as follows:

- Cluster 1 (Farmers with access to information but limited access to credit)
- Cluster 2 (Risk taking and opportunistic but limited access to credit)
- Cluster 3 (Risk taking and opportunistic)
- Cluster 4 (Ambitious, optimistic but social grant reliant)

- Cluster 5 (Mixed farming and physical capital endowed)
- Cluster 6 (Young and educated)

The FGDs were designed per these clusters. However, Cluster 2 and 3 were combined because they are very similar. Using the clusters to group the farmers for the FGDs meant that there were high possibilities that each group would constitute different types of small-scale irrigators and also farmers from different villages. Thus, to make the logistics easier, farmers in each cluster from villages closer to each other were targeted for the FGDs. Five, three and two FGDs were held in Makhathini and Ndumo-B, Tugela Ferry and Bululwane, respectively. The five FGDs in Makhathini and Ndumo-B were conducted with farmers from five villages, namely, Ibiva, Sibongile, Makhonyeni, Thobothini and Makhana. Table 3.2 below show the number of farmers per each cluster per area who participated in the FGDs.

Table 3.2. Number of participating farmers per cluster in each irrigation scheme

FGD	Date	Cluster No.	Number of farmers
Makhathini and Ndumo-B			
1	11/01/2017	1	6
2	11/01/2017	2 and 3	11
3	12/01/2017	4	8
4	12/01/2017	5	10
5	13/01/2017	6	9
Tugela Ferry			
1	20/06/2017	2 and 3	11
2	21/06/2017	4	15
3	21/06/2017	6	13
Bululwane, Nongoma			
1	21/07/2017	4	11
2	21/07/2017	2 and 5	5
Total			99

Source: Survey data, 2017

The purpose of the focus group discussions was to understand farmers' perspectives on issues of access to irrigation water, land, finance, markets, transport, inputs, cooperative governance and agricultural extension. Farmers were given a chance to suggest possible solutions for the above-mentioned challenges and the team was able to compare its recommendations with those from farmers per typology. In addition, individual interviews were held with Agriculture Advisors and extension officers for the study communities to ascertain their views on the proposed solutions.



Figure 3.4. Research team verifying names and cluster of farmers as they arrive at the FGD venue in Makhathini

3.4 The empirical methods of data analysis

The data collected through all the above discussed methods were processed through both qualitative and quantitative tools for data analysis. Quantitative data were analysed using the relevant statistical software, interpreted and discussed in line with theoretical and practical implications.

3.4.1 Qualitative data analysis

Qualitative data was analysed through the thematic content analysis technique. This is a descriptive representation of qualitative data. This technique was used to analyse qualitative data collected through the FGDs and key information interviews. Common themes were identified from the interview transcripts and their details interpreted in as far as they related to the key issues of the research project. However, using expert knowledge and results from the literature review, the research team also identified unique but significant responses that were mentioned by one or a few of the participants. These were also considered as relevant and important in shaping the results of the study.

3.4.2 Quantitative data analysis

Several quantitative data analysis techniques were employed in the study. These included descriptive statistics, multivariate analysis and regression analysis. Descriptive statistics involved mostly the use of frequency tables and graphs, t-statistics, cross tabulations and analysis of variance. These helped in basic description of the data and analysis of relationships between variables of interest.

3.4.2.1 *Principal component and cluster analyses*

The most common techniques in farm typology research are Principal Component Analysis (PCA) and Cluster Analysis (CA). The ability of PCA to reduce several variables of data into smaller and manageable dimensions (Hair *et al.*, 2010) has resulted in its wide application to complement CA in farm typology formulation (e.g. Bigodeza *et al.*, 2009; Goswami *et al.*, 2014). Thus, this study employed these two techniques to come up with farmer typologies of smallholder farmers in homestead food gardening and irrigation in rural areas of KwaZulu-Natal. The PCA reduced the dimensionality of variables of interest and then CA grouped the different types of farmers into relatively homogenous clusters. The process followed three steps, i.e. first PCA was conducted on PsyCap measures to determine the PsyCap dimensions and in the second step, PCA was conducted on all variables that measure household livelihood assets including the PsyCap dimensions. The factors derived in the second step were then used as inputs in the cluster analysis.

Clustering was conducted in two stages, i.e. hierarchical followed by K-Means clustering. Agglomerative hierarchical clustering was used to determine the number of clusters. The Ward method was preferred because of its ability to produce clusters proportionally equal to each other (Hair *et al.*, 2010). A decision on the number of clusters was reached using the dendrogram generated as part of the output file. After determining the number of clusters, the extracted factors from PCA were subjected to a K-Means clustering process.

3.4.2.2 *Regression analyses*

Several regression models were employed in the study. The Heckman Selection Model and the Ordered Probit Model, were used to obtain some of the results that are discussed in Chapter 8. The two were employed separately by two postgraduate students to find the determinants of farmers' aspirations to expand irrigation crop production in Makhathini and Ndumo-B and Bululwane and Tugela Ferry, respectively. Other regression techniques used by postgraduate students to analyse their data include least squares regression, generalised linear model, double hurdle, mixed logit and Tobit regression. However, this report only details the two models whose results are used in Chapter 8.

a) Heckman Selection Model

The Heckman's two-step selection approach was employed to model farmer aspirations to expand irrigation crop production in Makhathini and Ndumo-B. The model was developed by Heckman (1979). The premises behind this approach emanates from the hypothesis that farmers' aspirations to expand their irrigation activities are a two-stage decision process

allowing those not interested to self-select out of the process. The model was preferred by the first student because of its ability to address the potential sample selection bias which negatively affects the credibility of the results. Heckman's approach first estimates a probit model for selection and then introduces a correction factor, the Inverse Mills Ratio (IMR), calculated from the probit model into the second stage. The second stage estimates an ordinary least square regression only on the non-censored observations. The study also recognises that aspirations only make sense when they are achievable, recognizing willingness in the first step and ability in the second step decision.

Farmer aspirations to expand irrigation crop production, in the study, was measured using a single dimension aspiration indicator informed by Bernard and Taffesse (2014). In relation to aspirations to expand irrigation farming activities, what matters most is to assess both farmers' willingness and ability to expand. Thus, the study adopted a two-step approach to assessing aspirations to expand irrigation farming activities. The first step assesses farmers' interest (willingness) to expand irrigation farming activities with a simple "yes" or "no" question while the second step assesses their ability to expand or achieve their aspirations. Ability to expand land under irrigation was measured by obtaining the additional irrigable land that farmers want for expansion, after considering their capacity.

b) Ordered probit

Similar to the Heckman model, the ordered probit regression was applied to assess the determinants of smallholders' willingness and ability to expand farming operations in Bululwane and Tugela Ferry. Smallholders were either willing or not willing to expand farming operations and those that were willing to expand could either be able or not able to expand. Since the outcome or the dependent variable was an ordered ordinal outcome, the ordered probit was found to be the right model to use to analyse the data. In this regression, willingness and ability to expand was measured as one variable with three categories or levels as follows:

- Category 0 = Not willing to expand
- Category 1 = Willing but not able to expand
- Category 2 = Willing and able to expand

The dependent variable was then regressed against observable and unobservable factors such as age, household size, income, land size, assets, inputs and access to irrigation equipment.

3.5 Major challenges

The major challenge encountered in the survey is that of interview fatigue. Farmers showed signs of frustration with years of the research with no feedback on the outcome of the research or any effort to address their challenges. To address this challenge, the research team carefully explained to farmers that the project was four years and at the end of the project feedback will be given. They also explained that as researchers their job was to engage grassroots communities and gather information for use by policy makers to make decisions. As much as they could promise to avail the research findings to policy makers through policy briefs and other consultative engagements, they also could not guarantee to farmers on whether policy makers will take any action to address their challenges. Farmers indicated that they will be happy receiving feedback on the outcome of the research and other processes to disseminate the findings widely since this will equip them with information to also lobby with policy makers representing their area in government.

3.6 Methods employed to disseminate the research findings

Several methods of disseminating the study results and obtaining feedback from the stakeholders were used in the project.

3.6.1 Information days/stakeholder workshops

Two stakeholder feedback workshops held with participating farmers and other stakeholders in Jozini and Tugela Ferry at the end of the research project. The workshops (in Jozini and Tugela Ferry) were held on the 11th and 18th of August 2017, respectively. The purpose of the events was to give feedback to farmers and other stakeholders on the field research results obtained under the project since 2014 and to engage with stakeholders on the feasibility of the recommendations proposed under the research. A total of 170 farmers and stakeholders attended the two feedback sessions (Makhathini and Ndumo-B – 106; Tugela Ferry – 64). This represented approximately 25% of the total farmers who participated in the project. Stakeholders in attendance in Makhathini and Ndumo-B included representatives from DARD and Mjindi Farming, local Ward Councillor and traditional leaders. In Tugela Ferry, among the stakeholders that attended the workshop were DARD, LIMA and traditional leaders. The other invited stakeholders such as other relevant government departments, Mhlosinga Development Agency, local municipalities and Technoserve, among others, could not make it for the meetings.

3.6.2 Conference papers and scientific journal articles

3.6.2.1 Conference papers

A total of six conference papers from the research outputs of the project were presented by the research team. These were presented at the following conferences:

- 54th and 55th annual conferences of the Agricultural Economics Association of South Africa (AEASA) in 2016 and 2017,
- Economic Society of South Africa 2017 Biennial Conference,
- Conference of the Water Footprint Research Alliance, 2016, and
- World Water day, Inkosi Albert Luthuli International Conference Centre, 2017.

The details of these papers are provided in Appendix 6

3.6.2.2 Journal article

A total of four journal articles from the project results have either been accepted or under review (see Appendix 6). These are under consideration for publication with the following journals:

- Development in Practice
- Agrekon
- Water SA
- African Journal of Agricultural and Resource Economics

3.6.3 Popular articles

Two popular articles have so far been published in print and electronic newsletters, i.e. *The Water Wheel* and *Agri Kultuur/Culture* in January 2017 and July 2017, respectively.

3.6.4 Policy briefs

The research team also intends on developing policy briefs from the research results. These will be short and concise speaking to the key policy issues emanating from the research. Policy briefs will be targeted at provincial and national governments and other important non-state role players who are relevant to the subject matter.

3.7 Summary

The chapter was set out to present the research methodology that was adopted for the study. It began by outlining the conceptual underpinnings which were used to understand the research problem and show the connections among the different research questions. The SLF was the main concept upon which issues affecting homestead food gardening and smallholder irrigation

could be understood. To address the other important components of the research, the study also utilised the PsyCap concept, behavioural economics and the on-farm entrepreneurship concepts, especially as they relate to sustainable livelihoods.

The research project was conducted in phases which meant data was collected at different times but in an incremental way, depending on the objective at that phase. Efforts were made to ensure that the core group of farmers was reached throughout the project lifespan. Methods of data collection were both qualitative and quantitative and they were designed to achieve maximum participation of all key stakeholders. This allowed for triangulation of the findings and a comprehensive assessment and deeper understanding of the issues affecting homestead food gardening and smallholder irrigation. Data analysis was mainly through thematic content analysis, descriptive statistics and econometric analysis. The chapter also showed that the project had made considerable efforts to disseminate the research findings through various channels such as newsletter articles, presentations at national conferences and journal publications.

4 DESCRIPTION AND JUSTIFICATION OF THE FOUR SMALLHOLDER IRRIGATION SCHEMES SELECTED IN KWAZULU-NATAL

4.1 Introduction

South Africa is among the water scarce countries and the irrigation sector utilises more than 50% of the available water resources (Fanadzo, *et al.*, 2010). Rainfall is unreliable, droughts are common and crop production in most of the country is inherently risky. Thus, irrigation becomes an important means of addressing water scarcity for a range of field and tree crops (Cousins, 2013). Irrigation offers the potential to move to year-round cropping, generating higher annual yields from a single plot and allows farmers to diversify and plant alternative cash or food crops.

In Africa, only 7% of arable land is irrigated compared to 14% in Latin America and the Caribbean, 38% in East and Southeast Asia and 42% in South Asia (Rukuni, 2011). Only less than 3 percent of cultivated land is irrigated in sub-Saharan Africa (IFAD, 2012). According to Backeberg (2006), South Africa has approximately 1.3 million ha under irrigation (under 10 per cent of all arable land in South Africa), in which only 0.1 million ha is used by smallholder farmers. Irrigated agriculture accounts for almost 30% of total crop production and is the single largest user of surface and ground water in the country (Fanadzo, 2012). Around 7.7 per cent of irrigated land, or 100,000 hectares, is used by smallholder farmers (Van Averbeké and Khosa, 2011). Around half of this consists of small homestead food gardeners and the other half is located on smallholder irrigation schemes. Denison and Manona (2007) estimate that there are about 33,000 plottolders on these schemes, each cultivating an average of around 1.5 hectares. Most schemes in South Africa are gravity-fed, using diverted water from a weir on a river to supply plots via canals and furrows and plots range from 1.2 to 1.7 hectares (Cousins, 2013).

There are different types of land property rights in South Africa which include private, common and permission to occupy (PTO), among others. The PTO is a use right given to smallholders for irrigated or rainfed agricultural land and is managed by traditional authorities. The majority of irrigation schemes in South Africa are located on such land. Most smallholders view their land use rights as secure although some (mainly rural women) do not and hence, lack incentives for productive and sustainable use of resources (land and water) (more discussions in Chapter 5). In the smallholder irrigation sector, water is misused where most farmers tend to over-

irrigate. The absence of well-articulated rules on collective water management has often led to a lose-lose outcome similar to the tragedy of the commons.

South African smallholder irrigation schemes have received huge investments from the government because they are seen as mechanisms to tackle the issues of food security, enhance rural livelihoods and also to eliminate the economic gap of the previously disadvantaged farmers. According to Denison and Manona (2007), the financial resources put into these schemes ranges from R30 000-R60 000 per hectare and it includes infrastructure restoration and human resource development. However, the wide gap between actual and desirable performance necessitates detailed contextual examination to identify the micro and macro interventions.

Given the natural uncertainties and potential impact of climate change, increasing emphasis must be placed on higher efficiency of water use under irrigation and improving the productivity of water use in agriculture. This, in turn, requires that an assessment is made of the goals and aspirations of current and potential farmers to improve the economic performance of farming enterprises through interventions like investment on small-scale irrigation schemes.

Agriculture plays a vital role in the South African economy, but it is predominantly dependent on natural rainfall. There seems to be a general consensus that improving agriculture and enhancing agricultural productivity through irrigation is the key strategy to address rural poverty in most of the low-income countries, where the livelihoods of the majority depend on agriculture (Bennie *et al.*, 1998; Fanadzo, 2012). Drawing lessons from the inherent problems, challenges and failures of irrigation schemes in South Africa and KwaZulu-Natal, this study focuses on identifying avenues of improved livelihoods and development paths for expansion from homestead food gardening to smallholder irrigation farming.

In this chapter, the focus is on the choice of four irrigation schemes in KwaZulu-Natal for further empirical investigation. The rest of this chapter is structured as follows. Section 4.2 discusses the implications of exclusive focus on physical irrigation infrastructure in South Africa. The state of irrigation schemes in KwaZulu-Natal and the justification for the choice of four irrigation schemes for further investigation is contained in Section 4.3. Finally, Sections 4.4 provides the biophysical description of the selected irrigation schemes.

4.2 Physical irrigation infrastructure without institutional and social capital: typical of South Africa?

South Africa is an arid country with limited water resources. To address the water constraint in the agriculture sector, the emphasis by government has been on the creation of large and medium scale irrigation schemes, with inadequate devolution of the ownership and management of the schemes to local community members. In terms of small-scale farms, the most successful ones are those which developed from farmers' own initiatives. Small-scale irrigation schemes are supposed to be collectively managed, controlled and maintained by farmers who are the users. Small-scale irrigation is easiest where a farmer has independent access to a water source (FAO, 1997). However, that is not the case for almost all irrigation schemes in South Africa, where more use by one farmer would mean less availability to the other(s) and water use by one would mean water use insecurity by the other.

Irrigation schemes represent assets or resources that need to be managed collectively by the users. They can be used to increase and diversify the livelihood activities of plant production, resulting in improved livelihood outcomes, either directly in the form of food or income for plotters, or indirectly by providing full or partial livelihoods to people who provide goods and services in support of irrigated agriculture on these schemes (Oni *et al.*, 2011).

According to Van Averbek (2011), there were 302 Irrigation schemes in South Africa in 2010 with the command area of 47,667 ha. However, out of these, not all of them were functioning in 2010 and not all the functioning schemes were fully effective. Some authors (e.g. Van Averbek *et al.*, 1998; Bembridge, 2000 and Fanadzo *et al.*, 2010) argue that because of their failure to meet the anticipated productivity and economic gain, the development objectives of Irrigation schemes remain largely unfulfilled.

Most of the schemes have collapsed or are utilised well below their potential which is also the case in KwaZulu-Natal. Irrigation infrastructure was generally in a poor state of repair and either partially or completely non-functional (Bembridge, 2000). Considerable infrastructural investments have been made by the government to improve the state of Irrigation schemes. However, the situation still has not improved much.

The primary goal of establishing these schemes was to improve rural livelihoods through sustainable crop production for food security and poverty alleviation (FAO, 2001). However, because of poor performance, the development objectives of Irrigation schemes remain largely

unfulfilled (Yokwe, 2009; Fanadzo *et al.*, 2010a, b). As such, the benefits of irrigation have not been realised in the smallholder sector of South Africa.

There is exclusive focus on financial investment to improve irrigation infrastructure, with little attention to the human capital (to effectively utilise, collectively manage and maintain the infrastructure). No clear plan of action on the transfer of ownership (Fanadzo, 2012). Absence of well-articulated business plan is a common constraint. According to Perret (2001), for instance, many schemes in Limpopo had been inactive for long time, as a result of poor planning and design, inappropriate management structures, lack of technical knowledge, insecure land tenure, political interference, the absence of opportunities for farmers to participate in decision-making and ‘dependency syndrome’.

The management of smallholder irrigation schemes in South Africa has generally been highly authoritarian and top down (Cousins, 2013). Fanadzo (2012) identifies weak institutional and organisational arrangements, poor technical skills of farmers and poor crop management practices as the major factors leading to underperformance of most irrigation schemes. Accordingly, human (capacity) and social (institutional) resource problems were at the heart of the poor performance of Irrigation schemes in South Africa, exacerbated by top-down approach which created a high level of dependency among farmers and failure to manage the schemes on their own. Financial constraints and abrupt withdrawal of management and finance has also led to the collapse of most schemes (Bembridge, 2000).

The success of smallholder irrigation schemes will depend on integration between technology, management, participants and the socio-economic factors (Bembridge, 2000). All studies agree on the role of institutional support for the success of irrigation schemes in South Africa. Security of land tenure and market access are critical issues for the success of any rural development interventions including Irrigation schemes. There is also a need to address issues of conflict resolution, farmer training, greater farmer participation and better training of extension workers. Stevens *et al.* (2012) indicate that the level of training presented by tertiary organisations to extension workers in South Africa does not equip them (in terms of knowledge and skills) to perform their tasks in irrigation schemes. Beneficiaries are often dissatisfied about scheme management, lack of farmer participation in scheme management and maintenance, institutional support services (including extension, training, research, markets, credit, farm inputs, mechanization services and land tenure) (Bembridge, 2000).

The evidence from Tugela Ferry and other irrigation schemes suggests that where they have access to fertile plots, irrigation water and markets, smallholder farmers can be highly productive and earn reasonable returns (Cousins, 2013).

The more recent thinking about South African smallholder irrigation development, which deals with the transfer of the responsibility of managing, operating and maintaining irrigation schemes from the government to the farmers, has been referred to as the irrigation management transfer (Van Averbeke, 2008). The process also includes formation of WUAs and development of local management institutions (Perret, 2002). South Africa initiated the program in government irrigation schemes located in former homeland areas and most transfer operators are still unsure about how to design and implement the process (Perret, 2002).

4.3 The choice of the four irrigation schemes in KwaZulu-Natal province

4.3.1 The state of smallholder irrigation schemes in KwaZulu-Natal

The agricultural potential of KwaZulu-Natal, its diverse topography, climate and soil virtually make this province a ‘world-in-one’, yet its potential is under-utilised (Joubert, 2012). The provincial government has taken irrigation schemes as key strategic areas of interventions to address poverty, food insecurity and joblessness in rural areas. Irrigation schemes are taken as strategic investment portfolios to address ever increasing water scarcity in the KwaZulu-Natal province. Thus, the province massively invested on capital expenditures to Irrigation schemes (Joubert, 2012). Similar to the national situation, most irrigation schemes are found where the incidence of poverty is the highest and hence the schemes present big opportunity for enhancing rural livelihoods.

According to Van Averbeke *et al.* (2011), in 2010, there were 35 operational schemes in the province, covering an area of 6621 ha with the total number of 6174 participants. Most schemes in the province need maintenance of equipment and infrastructure. For instance, in Tugela Ferry, siltation, cracks, leaks and dysfunctional holding dams, the outcomes of inadequate maintenance and repair work since the 1960s, are the major problems (Cousins, 2013). Bembridge (2000) found that 40% of schemes in the province were based on sugar cane production which tended to be more successful due mainly to better support services and a readily available market.

Devolution of management and ownership of the schemes to the local community is a key to the success of irrigation schemes. For instance, the majority of the Bululwane scheme beneficiaries felt management of the scheme should, over time, be taken over by themselves

(Bembridge, 2000). The business plan (which was never developed) of all irrigation schemes should have provisions for step-by-step withdrawal of government management and cost recovery so that the users can own and manage the schemes on their own. However, abrupt withdrawal of management and finance can also lead to the collapse of irrigation schemes (Bembridge, 2000).

Despite a lot of effort to get information about the status of all schemes in KwaZulu-Natal, the team was not able to solicit this from the KwaZulu-Natal Provincial Department of Agriculture and Environmental Affairs (PDAEA). Given this stumbling block, the only imprecise information available is was a database compiled by the KwaZulu-Natal PDAEA in October 2013. Accordingly, there are 49 irrigation schemes in the province, with a total capacity of irrigating 10,657 hectares. About 41 of these schemes require some kind of service including sealing dams, construction of main and infield furrows, irrigation equipment maintenance, installation of electricity, fencing, canal and pipeline cleaning and repairs, sluice gate and intake repairs, installation of pumps/pipes & sprinklers, rehabilitation of pumps/pipes/sprinklers, installation of scheme electricity supply, in-field pump improvement, intake structure and irrigation canals, rehabilitation of irrigation infrastructure, weir construction and sprinkler irrigation equipment maintenance.

In some instances, there is a need to do bush clearing, upgrading the roads and land preparation for the schemes to be used. This shows lack of proper business plans before the schemes are established. The poverty of planning in the development and construction of the schemes without proper business plans is the reasons for most schemes not functioning. It is not uncommon to find an irrigation scheme with no farmers or no markets or no suitable agro-ecology where farming can be done profitably.

Lack of ability to use the schemes at their full capacity is a common phenomenon in KwaZulu-Natal. For instance, for the Bululwane irrigation scheme, approximately 80% of the 345 ha was not being utilised in 2000 due to lack of motivation, lack of resources and support services (Bembridge, 2000). This was also the case for Thukela estate in 2000 which was irrigating only about 30% of the productive area. Currently, none of the schemes in the province are operating at their full capacity. About half of the schemes are not currently operational for a variety of reasons including, among others,

- delays in undertaking the required procurement, maintenance and rehabilitation,
- pipe/pump/canals broken/stolen,

- non- or malfunctioning drip irrigation and tunnels,
- absence of agreed rules on how to collectively manage, use and pay the running costs; social conflict, and
- problem of electricity connection.

In sum, the paradox that needs to be addressed is that KwaZulu-Natal province continues to invest on Irrigation schemes and at the same time most of the schemes continue to fail. This is the harsh reality on the ground. There is enough research on why most of schemes have failed. However, there is very little research done on “how to make the schemes work?” and so is little known on the potential of collective action institutions and rotational management. That is why this project is focusing on the challenges and opportunities of Irrigation schemes to unlock and show the pathways to move from homestead food gardening to smallholder irrigation farming and enhance rural entrepreneurship and livelihoods.

4.3.2 The choice and justification of the four irrigation schemes

The schemes chosen are meant to study entrepreneurial development paths where there is substantial farming activity. Given the project aims, the choice of irrigation schemes for further investigation is done following a three-step approach. First of all, certain criteria were identified which are discussed below. The schemes are then qualitatively ranked considering those criteria and then the four schemes are chosen for further investigation. The rest of this section aims to outline and justify this process.

First of all, to get the list of the 32 schemes in KwaZulu-Natal (ranked in order of suitability to this study), various sources of information were used:

- a recent report on irrigation database by DAFF (DAFF, 2014),
- list of irrigation schemes prepared by The Provincial Department of Agriculture and Environmental Affairs (PDAEA, 2013),
- list of schemes sent from five Districts⁴,
- past literature (Denison and Manona, 2007; Bembridge, 2000), and
- a visit in the Districts where most of the irrigation schemes are concentrated.

⁴ A request letter was sent to all the Districts in KwaZulu-Natal, the checklist of the information required and only 5 districts responded. This has made visiting all the districts in KwaZulu-Natal critical to verify and validate the information from different sources. There is still a plan to visit six more districts (Sisonke, Ugu, Uthukela, Umzinyathi, Zululand, and Amajuba) and the remaining schemes in Ilembe District.

The first approach used in the selection process of the schemes in KwaZulu-Natal was to acquire the necessary information from the extension officers of the twelve districts. Data acquired include total irrigated area in hectares, number of beneficiaries, current status of the scheme, importance of food gardening in the district and the extent of water reliability. After acquiring the necessary information from the extension officers in the respective districts, the schemes were visited to observe and verify.

The important factor that has influenced the choice of the four schemes selected below is their suitability to show ways and means of enabling small-scale farmers to become commercial farmers in the future and to transform those who plant for homestead food gardening to smallholder farmers and then to commercial farmers. Other criteria such as the importance of non-farm livelihood opportunities, access to infrastructure and public services and agro-ecological conditions in the district were also considered.

According to the information provided by DAFF and PDAEA, it is apparent that the majority of the Irrigation schemes in KwaZulu-Natal are located in Uthungulu, Umkhanyakude and iLembe districts. That is why these three districts were visited first. A total of eight schemes were visited from 19-23 May 2014, 2 in uMkhanyakude (Ndumo-B and Makhathini), 3 in iLembe (Mbolembe, Vukuzakhe and Thuthukani) and 2 in uThungulu (Masibumbane and Zamimpilo).

The three districts were visited based on the following criteria:

- The prevalence of homestead food gardening,
- Access to small-scale irrigation water,
- Growth potential, to transform from homestead food gardens to small-scale farming and then to small-scale commercial farming and then to large commercial farming,
- Project to encompass women, and
- Large number of irrigation schemes.

Homestead food gardening appeared to be crucial to food security in the communities of all the eight schemes visited. What was also evident across all the communities visited was the 'dependency culture' amongst the members of the schemes, i.e. community members expect the local municipality and government in general to do everything for them (e.g. supplying inputs such as machinery, fertilizer and other chemicals, scheme maintenance, etc.).

A working list of the biggest schemes in the province was then drawn using the above sources and processes. Whenever, the different sources contradict, the latest figure is considered and

more importantly the information from the visits is taken as more reliable as the post-graduate students have verified its accuracy. In arriving at this list of schemes, the exclusion rules followed include:

- Schemes currently not functional or operational for whatever reason;
- Schemes serving less than 100 households;
- Schemes with an irrigation capacity of less than 30 hectares;
- Schemes currently irrigating less than 20 hectares;
- Schemes currently under construction;
- Schemes where there are no much agricultural activities;
- Schemes operating at their maximum capacity with no potential for further growth and scaling up of their operations and impacts; this is rare both in South Africa and KwaZulu-Natal;
- Schemes where there is no homestead food gardening;
- Schemes which are under maintenance and temporarily not functioning.

One of the desirable criteria considered is the extent to which the scheme is operating at its full capacity. Thus, schemes which are operating more than half of their full capacity with a potential for further scaling up get a better rank. Drawing from the above sources of information, the level of success (in terms of achieving the pre-defined objective(s)) is another factor considered. Like the case of operation at full capacity, schemes which are on their way to success get a better rank.

The schemes should have plot-holders running smallholder farming and/or food gardening in surrounding villages. The schemes should be big enough (in terms of maximum capacity, land size irrigated and number of irrigators benefiting from the scheme) in terms of having some critical mass of smallholder growers to be able to study the constraints holding the project from further expansion and the respective potentials. Completeness and accuracy of the information acquired so far is another factor that has informed our decision.

Additional districts were also considered for the project and these were uMzinyathi (Tugela Ferry) and Zululand (Bululwane) irrigation schemes. Before going to the field in these two areas, data on active irrigation schemes with more than 100 beneficiaries was received from the districts and from previous research. In conducting the field visit, information was gathered from farmers who were leaders in the irrigation schemes, extension officers from the PDARD

and the national Department of Rural Development and Land Reform (DRDLR). PDARD extension officers were responsible for organizing chairpersons of the blocks that were currently active.

Table 4.1 below presents the list of the selected and short-listed schemes in order of their suitability to this project.

Table 4.1. Selected and short-listed schemes in KwaZulu-Natal

No.	District	Project Name	Decision
1	uMkhanyakude	Makhathini	Selected
2	uMkhanyakude	Ndumo-B	Selected
3	uMzinyathi	Tugela Ferry	Selected
4	Zululand	Bululwane	Selected
5	uThukela	Thukela Estates	Short-listed
6	uMzinyathi	Mooi River	Short-listed

Following the above steps and processes, the four schemes selected for further investigation in KwaZulu-Natal are Ndumo-B, Makhathini, Tugela Ferry and Bululwane. All schemes have been functioning for over two decades but have yet to function at their full capacity. The visit made it apparent that there are large and small irrigators as well as successful and unsuccessful irrigators in both schemes which gives the study an opportunity to examine the drivers of success (enabling factors), inhibitors and opportunities for further expansion. All schemes are serving small-scale farmers and food gardening is important in all schemes. Figure 4.1 and 4.2 show the location of the study districts and schemes in KwaZulu-Natal province.

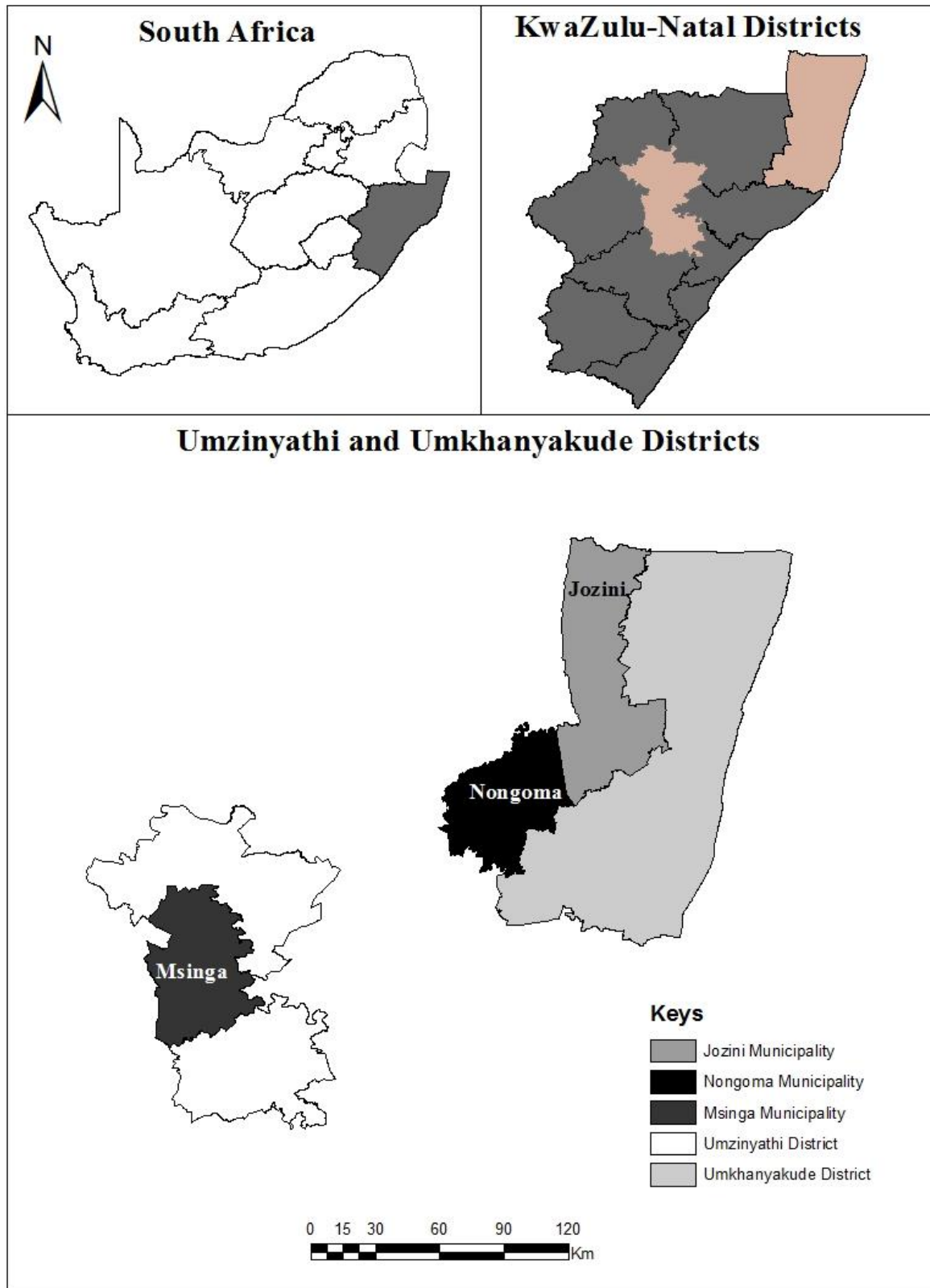


Figure 4.1. Map showing location of the study districts

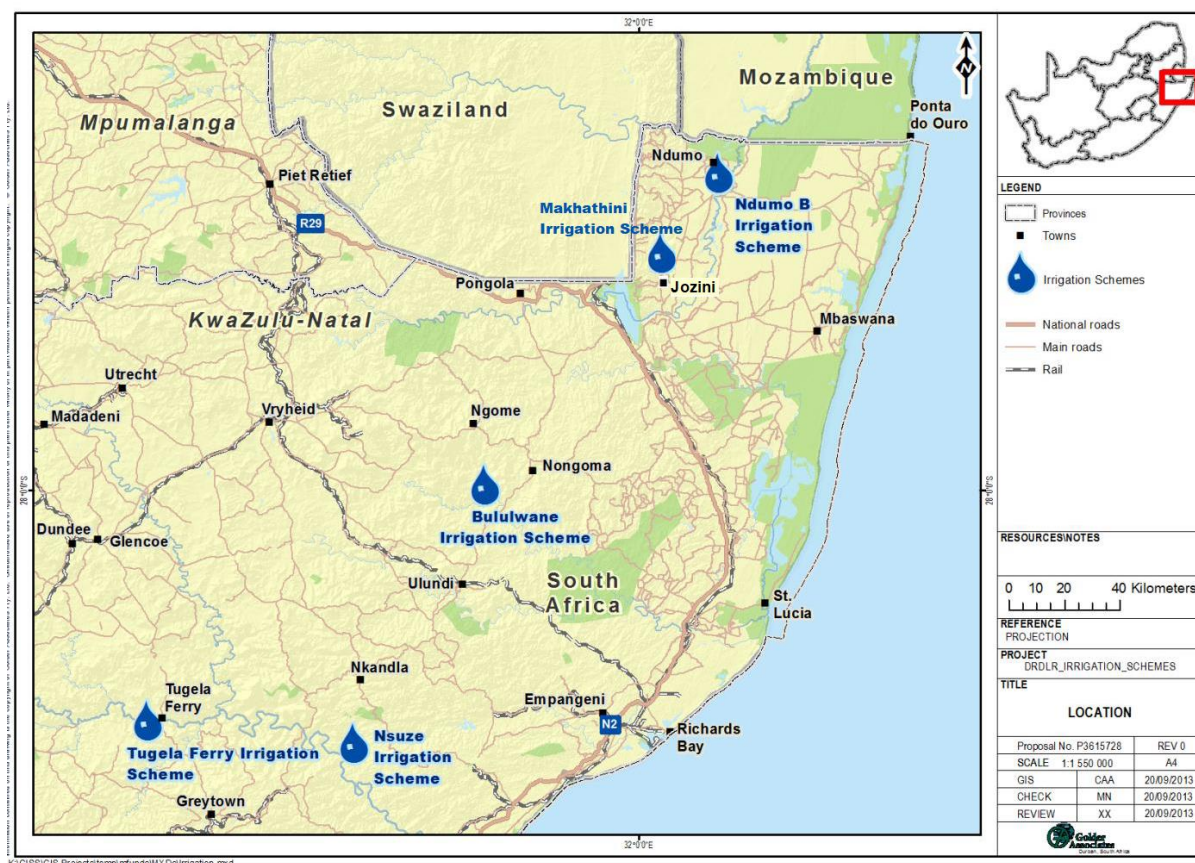


Figure 4.2. Location of Makhathini, Ndumo-B, Tugela Ferry and Bululwane Irrigation Schemes

Source: Golder Associates, 2014

4.4 The biophysical description of the selected irrigation schemes

The selected schemes have the potential to illustrate the role of capital endowment to agricultural entrepreneurship and water use productivity. The most popular crops in the schemes in terms of area cultivated are cotton, sugarcane and maize (Lankford *et al.*, 2011).

4.4.1 The Pongola River Catchment – Jozini Municipality

The Jozini municipality has many smaller, non-perennial rivers and their streams have their source within the higher-lying mountainous areas and drain in an easterly direction toward Pongola River. Some larger rivers, such as the Ngwavuma River and the Pongola River itself, cut through gorges, having originated further to the east and, together with the Great Usutu River, are considered the only perennial systems within the central to northern area. The Pongolapoort Dam is established along the Pongola River as it flows through the Pongolapoort Gorge within Jozini town. These rivers drain into the Pongola River (the eastern boundary of

the municipal area), which drains northwards toward the Great Usutu River into Mozambique (uMkhanyakude local municipality, 2003).

In the upper catchment, it passes through a region of extensive alien plantation forestry – a stream flow reduction activity (Taylor, 1997). It flows eastwards along the coastal plain and passes the Lebombo mountain range into the Pongolapoort Dam. The first 25 km of the Pongolo floodplain in the south is narrow and almost restricted to the main river channel and its associated lower terraces. The pans (oxbow shaped lakes) Mayazela, Mfongozi and Nhlanjane, of significant proportion, found in the southern portion of the floodplain are sustained mainly by feeder streams, but only receive water from the Pongolo River during exceptionally high floods (Jaganyi *et al.*, 2009). While some of the pans in this northern sector have local catchments, they are all under the direct influence of the Pongolo River and dependent on its floodwaters for the bulk of their water supply (Heeg and Breen, 1982).

Trends suggest that the Pongola River is an important resource in many households in all the municipalities and rain water harvesting using rain water tanks is hardly practiced (Jaganyi *et al.*, 2009). The area adjacent to the floodplain, beyond the reach of flood waters, is known as the Makhathini flats, where peoples' homes are situated. It is also where almost all the irrigable soils are available to the Makhathini irrigation canal system, downstream from the Pongolopoort Dam (see figure below).

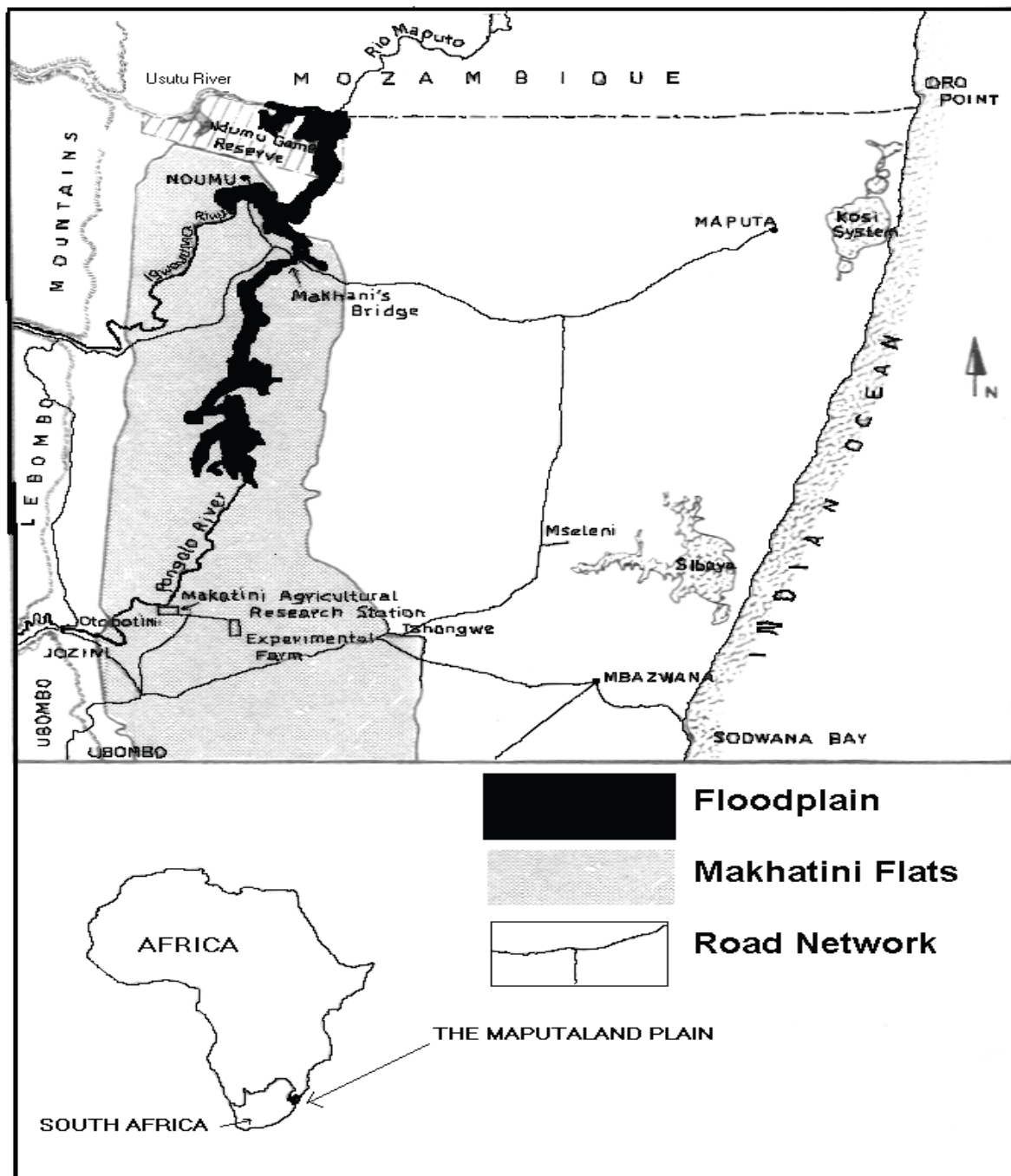


Figure 4.3. Location of the floodplain relative to the Makhathini flats

Source: Jaganyi *et al.*, 2009

There are complex problems affecting agricultural production in the area downstream of the Pongolapoort Dam and the Makhathini flats. The interaction between various factors (economic, financial, technical, socio-political, infrastructural and institutional) has shaped the problems experienced on the Makhathini irrigation scheme, adjacent dry land areas and the floodplain (Jaganyi *et al.*, 2009).

Generally, the climate of the region has been described as warm to hot humid sub-tropical, frost free with high summer temperatures (Schulze, 1997). Winter crops can be grown on the Makhathini flats because winters are short, mild and frost free (National Department of Agriculture, 1994). However, it has been reported that during winter a riverine mist frequently occurs in the lower lying areas bringing along high humidity and cooler conditions in the morning. In late winter, very often very hot days can suddenly be followed by cool, overcast weather bringing higher humidity and the incidence of various fungal diseases that can be detrimental to crop production if precautionary measures are not taken (National Department of Agriculture, 1994). Jaganyi *et al.* (2009) calculated a mean annual rainfall of 690 mm (maximum 1341 mm and minimum 376 mm). Annual precipitation throughout the region averages only 580 mm, which is concentrated in the summer months between September and May (Schnurr, 2012).

Water for irrigation development is stored in Pongolapoort Dam. Evaporation values from the dam have been shown to be higher than precipitation values (Jaganyi *et al.*, 2009). The area is subject to very high winds, particularly during the period September to December when the average daily wind run is 230-240 km/day. Annual wind patterns are similar to rainfall and temperature trends (Jaganyi *et al.*, 2009).

Soil textures on the Makhathini flats area, i.e. areas covering the floodplain, the Makhathini irrigation scheme, Ndumo-B irrigation scheme in the north and the wider areas on the east and west side of the Pongolo River, are illustrated in the figure below.

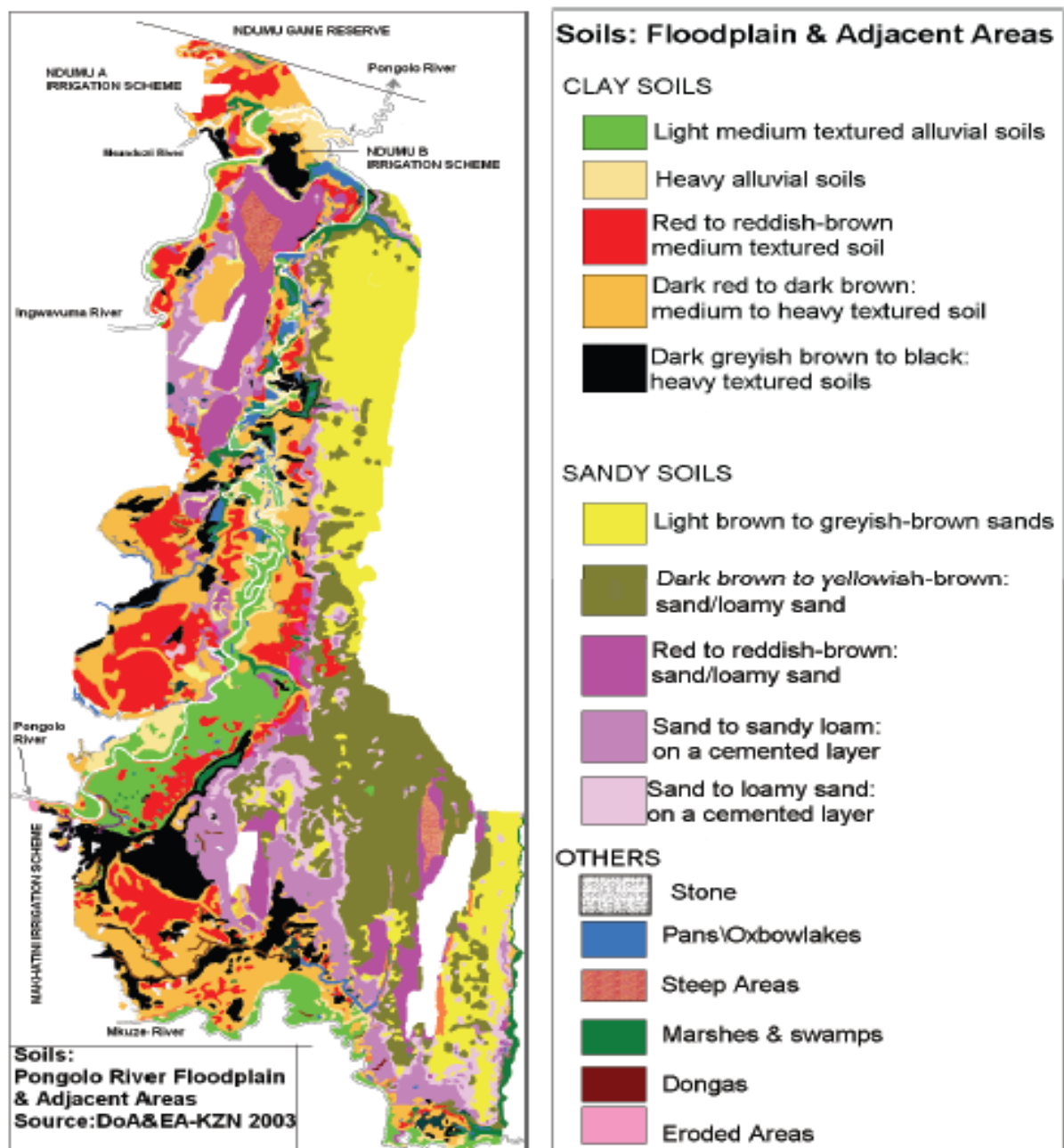


Figure 4.4. Soil distribution patterns

Source: Jaganyi *et al.*, 2009

Most areas on the west side of the river have fertile soils and are targeted for commercial agricultural development expansion. All areas on the east side of the river have sandy soils except for the areas which form the floodplain, Makhathini and Ophansi irrigation schemes. Soils found off the floodplain on the east side of the river where floodplain communities live are mainly sandy soil textures, not suitable for growing many crops. The implication is that should floodplain communities be denied access to the use of floodplain resources, without

providing feasible alternatives, they can easily become highly vulnerable to the effects of drought, hunger, poverty and disease.

On a soil fertility score of 0-10, the Pongolo River floodplain soils have a very high fertility score (8-9) and may mean that crops can be grown on the floodplain without additional artificial fertilizers (Schulze, 1997). The area adjacent to the floodplain in the east where the majority of floodplain communities live has a very low fertility score (1-2) and therefore requires artificial supplies of nutrients from fertilizers or may require lime treatment to enhance the base status. Comparatively, the mid-catchment areas have an average fertility score of 4-5, while the upper catchment has a low fertility score of 2-3, which may result from soil acidification accelerated by human activity, e.g. extensive alien plantation forestry.

In winter, the whole catchment experiences soil water stress, but the upper catchment experiences more stress. In summer, the lower catchment experiences more days of soil and water stress (70-80%) when compared to the rest of the catchment (Mid and Upper), 60-70% and 50-60%, respectively. The soil water availability days is lowest in the lower catchment (150-175 days) and highest (200-225 days) in the upper catchment. When the gross annual irrigation requirements of the upper, mid and lower catchments were compared, the lower catchment downstream of Pongolapoort Dam has the highest irrigation requirements and the lowest mean annual precipitation (Schulze, 1997). Therefore, in the absence of irrigation, rainfall alone cannot ensure high crop yields on the Makhathini flats.

The main supply of water for irrigation purposes is extracted from Pongolapoort Dam. The Pongolapoort or Jozini dam is managed by the Department of Water Affairs and Forestry. It was built in early 1960s and was opened in 1974 (DWAF, 2001). The Pongolapoort dam has a catchment area of 7831 km² with the mean annual runoff 1059 million m³ and mean annual precipitation of 871 mm. The full supply capacity is 2,446 million m³ with the full supply area of 133 km. Only 315 million m³ per annum is utilizable after ecological/social releases. This is a very large dam but with very little allocable water; the allocable amount might even match some smaller Dams (DWAF, 2001). The floodplain and lake areas are used in the local fishing industry, using special local fish traps or kraals within these water bodies. However, only individuals that have permit are allowed to fish. They are restricted by KwaZulu-Natal Wildlife with the aim of avoiding over-exploitation.

The Pongola river, with a catchment of 7081 km² at the eastern extent of South Africa, descends steeply from its source at 2200 metres above mean sea level and passes through a narrow gorge

between the Lebombo and Ubombo mountains where the Pongolapoort Dam is now situated (Lankford *et al.*, 2011), see Figure below. The total annual supply available to the Pongolapoort Dam is approximately 1000 million m³/year, on average (Lankford *et al.*, 2011).

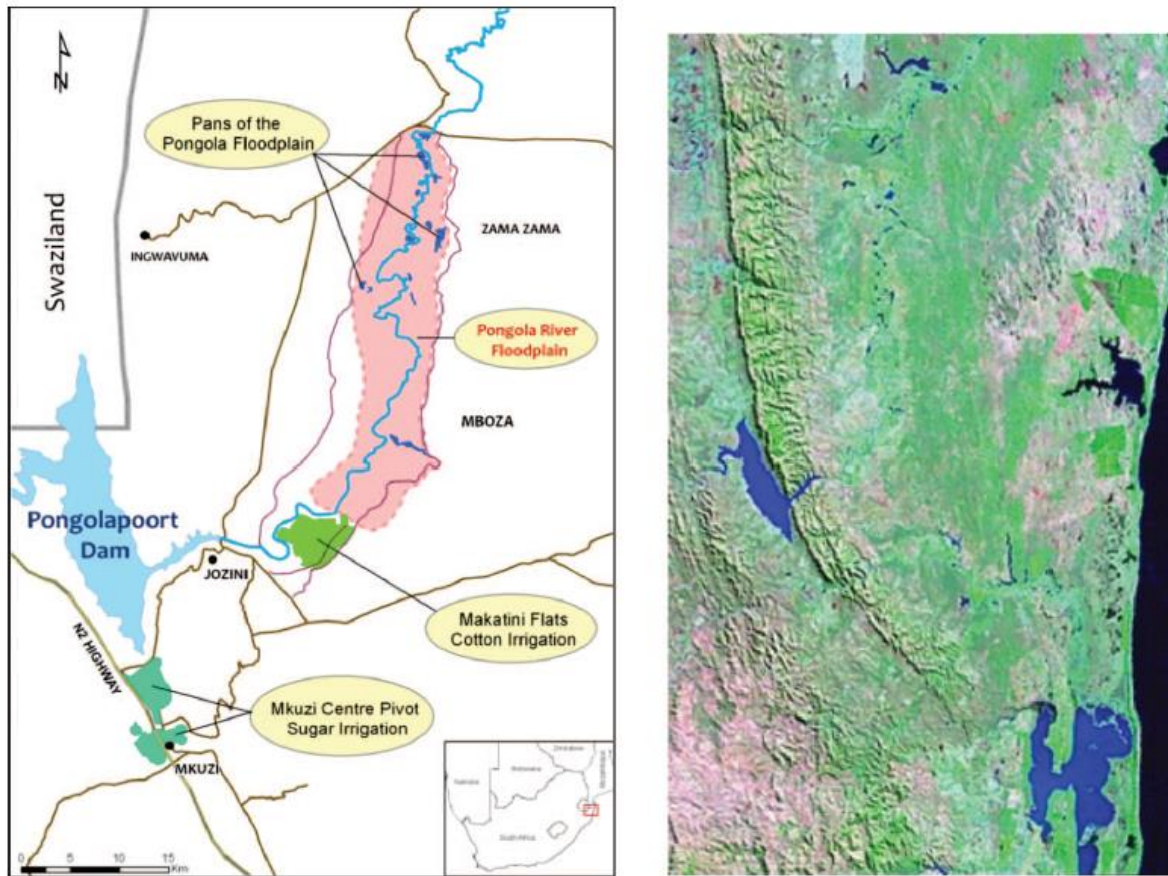


Figure 4.5. Map of the Pongola River

Source: Lankford *et al.*, 2011

4.4.2 Makhathini irrigation scheme

The Makhathini Irrigation Scheme, established in 1985, is reported to be irrigating 4,500 hectares, though it was designed to irrigate 12,000 hectares. The scheme is part of the government's rural development initiatives. The main irrigation systems used are center pivot for maize and sugarcane and sprinklers for vegetables such as cabbage, spinach and butternuts. The number of beneficiaries at Makhathini is about 300 farmers. Farmers in the scheme lease out land if they fail to cultivate for whatever reason. Mjindi Farming (Pty) Ltd is employed by the Provincial DARD to manage water supply (canals, pump stations and water delivery from the dam), extension and advisory services, provide infrastructure services and assist farmers and link them to markets.

The Makhathini flats forms part of the Makhathini irrigation scheme, which was established for small-scale and emerging farmers on the floodplains of the Pongola River (Lankford *et al.*, 2011). Crops such as maize, which can only be grown during the rainy season in the summer rainfall areas of South Africa, can be grown throughout the year in the Makhathini Flats under irrigation. Furthermore, some crops grown in this area can reach the market 3 to 4 weeks before those grown in other areas of South Africa due to favourable temperatures of the area. The scheme has the potential to produce food in quantities to make a significant impact on South African markets, given its extensive and diverse agricultural practice, soil types, water availability and stable weather and climate throughout the year.

The Makhathini irrigation scheme is located on the North-Eastern part of KwaZulu-Natal, below the Jozini dam in the Pongola drainage region, Jozini local municipality, where the unique climatic and biophysical resources of this area hold immense potential for agricultural production. The Jozini area has a sub-tropical climate and water is made available for irrigation from Pongola dam. The Pongolapoort Dam was built between 1966 and 1972, with the intention of putting some 33,000 ha of sugarcane under irrigation on the Makhathini flats.

In 1974, the original proposals for developing the dam and irrigation scheme was aimed at establishing a poverty upliftment scheme for white farmer settlement where each farmer would be allocated a 20 ha plot. After reappraisal of initial development plans, the Apartheid government decided in the early 1980s to allocate resources for settlement of smallholder farmers with commercial enterprises (National Department of Agriculture, 1994). In 1984, the South African Development Trust Corporation was appointed to manage and implement the project (3,000 ha) and begin the process of settling black farmers on the Makhathini Irrigation Scheme. In 1985, nine black farmers were settled on 5 ha plots during the cotton-growing season of 1985/86 (September-March). In 1986, 37 black farmers were settled on 5 ha plots and another 47 farmers on 10 ha plots. In the two years from 1985 a total of 93 black farmers had been settled on 700 ha. In 1987, 4 farmers were settled on 10 ha plots. New block 6A settled some 57 farmers on 598 ha. In 1988, the Development Bank of South Africa (DBSA) financed the development and settlement of another new block, 6B. Settlement of 664 ha of the estate-run portion of the scheme (1,255 ha) was made whereby the original settler holdings of 5 ha was expanded to 10 ha.

As indicated earlier, the scheme currently covers a range of 4,500 ha of irrigated hectares and it has the potential of expansion to cover an area in excess of 15,000 hectares. The main irrigation systems used are center pivot for maize and sugar cane and sprinklers for vegetables.

Water is extracted from Jozini dam to the built-in canal using underground pumps then to the pump station up to the field. The scheme works by means of open concrete canals, balancing dams and 5 pump stations each powered by fourteen 132 KW electric motors. The scheme has the potential to enable farmers produce food not only for themselves but also for the market. This is due to extensive and diverse agricultural practices, climate, soil conditions, water availability and stable weather throughout the year.

The number of beneficiaries currently in the scheme is about 1,495 farmers (314 operating as individuals and 1,181 in cooperatives), growing mainly vegetables, maize and sugarcane. Individuals hold an average of 10 ha depending on their capacity of cultivating the land while most of those in cooperatives farm on 0.2-0.5 ha of land. Farmers can lease out land if they cannot cultivate it for whatever reason. Some part of the land is communal and most land belongs to the state.

The major crops grown are sugar cane and maize, followed by vegetables such as cabbage, spinach, butternuts. Maize is planted throughout the year and it is relatively easy to get market throughout the year. Market access for the other crops (especially vegetables) is, however, a challenge as farmers can't access urban market and they often end up selling to local consumers and receive poor prices. The perishability of these products is another dimension of the challenge. Most of them try to market their products individually, using their plots as selling points. Van traders come to the field with their own vehicles to choose and buy which reduces farmers' bargaining power and results in poor gross margins. The majority of the farmers in Makhathini have little formal education and this also affects operation of their farms as small businesses.

The Mjindi co-operative farming manages and continuously maintains the scheme. It offers training service on how to produce and assist local people in finding markets to their produce. It also provides technical support involving extension, training and farming methods. It also used to supply farmers with inputs. At the time when the project started in 2014, farmers were paying R2500/ha/year for water to the Department of Water Affairs and Sanitation. This amount has gradually increased over the years to nearly R3000/ha/year by the end of 2017.

The crops that can normally be cultivated only in the rainy season in the summer rainfall areas of South Africa can be grown throughout the year in the Makhathini Flats under irrigation. Furthermore, some crops grown on this area can reach the market 3 to 4 weeks before those grown in other areas of South Africa because of the favourable temperatures of the area.

In 2011/2012, the Department initiated a programme for the revitalisation of five irrigation schemes under the “Recapitalization and Development Programme” (KZN PDAEA, 2012). A total of R62.8 million was spent at Makhathini in 2011/12 financial year. In 2014, the Makhathini Flats received an investment of R1.1 billion from the KwaZulu-Natal cabinet to revamp agriculture and improve agricultural infrastructure in the Jozini and Umhlabuyalingana municipalities (KZN PDAEA, 2014). In 2002, the PDAEA in KwaZulu-Natal rolled out its agricultural development plan for the Makhathini flats, known as ‘the green revolution’ (KZN PDAEA, 2002). Land with potential for irrigation development on the Makhathini Flats area is 106 000 ha. Out of this total area, the Makhathini irrigation scheme comprised 11,200 ha and only 3,900 ha was under irrigation in 2002.

4.4.3 Ndumo-B Irrigation Scheme

Ndumo-B irrigation scheme is situated along the Pongola River, approximately 80 km away from Makhathini irrigation scheme. It is also located in uMkhanyakude district, Jozini, close to Mozambique border (see Figure below). The land is strictly owned by Mathenjwa Tribal Authority. Ndumo-B was also initiated under the Makhathini project master plan in 1987. The scheme was established in 1993. It is relatively small compared to Makhathini and covers 500 ha of land. At its full operational capacity, this scheme will benefit about 115 farmers. Currently, about 200 ha is irrigated by over 350 KW of electric pumps. Furrow irrigation has been replaced by overhead sprinklers and draglines. The operating farmers extract water along the Pongola River/ Jozini dam. The soil is relatively fertile and the major crops grown are maize, vegetables (especially cabbage), potatoes and sugarcane.

The scheme was established in two phases (Golder Associates, 2014). Phase 1, approximately 2000 ha, was established some years ago and comprises of 19 members, excluding farmers that are renting in land, operating on plots averaging 10 hectares. This was further followed by Phase 2 which is established on 308 ha of irrigation land. However, at the time of the study Phase 2 was not operational. A contractor had been appointed to do rehabilitation of that portion of the scheme and provide specifications for expansion.

Food gardening is also important in this project area where most of the farmers produce for their own consumption. Like Makhathini, many of the farmers in this scheme over-irrigate hoping to maximise yield but often the result is spoilage of the quality of the produce. Farmers are allocated land according to the number of assets they have. Market access seems to be the major problem that restricts success of farmers because they end up selling their produce at lower prices and they can't make enough profits to accumulate wealth. The other problem is lack of drainage system and relatively high water salinity.

There is some interesting contrasts between Makhathini and Ndumo-B that inform the study: in terms of challenges / opportunities, the extent to which they are studied before, key factors for success or failure, water reliability, agro-ecological setting, history and size. They also differ in farmers'/gardeners' enterprise diversification, community composition and crop-livestock enterprise choice (food vs. cash crops). The institutional setting (e.g. importance of different land tenure regimes – private, communal, any other arrangements) is another dimension of contrast. While Makhathini is studied more extensively, there is no much study known to the authors about Ndumo-B. The two schemes also contrast in the level of engagement of the local community members and the role of government and other stakeholders in scheme governance and finance.

4.4.4 Bululwane Irrigation Scheme

Bululwane irrigation scheme is located in Zululand District, KwaNongoma local Municipality, KwaZulu-Natal. The scheme is about 30 km away from Nongoma town where the district DARD offices are located. The scheme was established around 1962 with the aim of increasing food production and creating employment opportunities in the community.

The total extent of Bululwane irrigation scheme is 550 hectares which are owned by the Isilo, King Zulu Goodwill Zwelithini. About only 191 hectares of land is irrigable and the 359 hectares is dry land. The king operates 63 hectares of land in the irrigation scheme while only 128 ha is available to the community. There are four blocks in the irrigation scheme and a total of 128 farmers are the beneficiary of the land in the scheme.

There are four blocks in the irrigation scheme and are categorised as follows:

- Block 9A with 31 beneficiaries,
- Block 9B with 35 beneficiaries,
- Block 10 with 21 beneficiaries, and
- Blocks 3 and 4 with 41 beneficiaries.

The other blocks are in dry land comprising those who are also in the scheme and few non-scheme irrigators. Approximately, 60% of the 359 ha of dry land is not being utilised at present due to a combination of factors including shortage of water, lack of resources and support services and lack of motivation. Shortage of water restricts the capacity of the scheme to operate at its full capacity. Farmers cultivate only dry land during rainy seasons. Thus, only 128 ha of land in irrigation is being fully utilised throughout the season.

The land is distributed almost equally among farmers where each farmer is allocated one hectare of land on average. The King has given the scheme committee members power to distribute land in the scheme. The committee is made up of six members and one of the members is the chairperson of the whole scheme. There is a joining fee that is paid every year by scheme members to remain as members depending on the constitution of the Block. For example, Blocks 9A and 9B pay R200 per annum and Blocks 3 and 4 pay R300 per annum.

Farmers are not allowed to lease out their land in case they fail to utilise it but are allowed only to borrow scheme member's only for one year and if you fail to cultivate it again in the following year, the land is given back to the scheme committee in order for them to reallocate it to those who are outside the scheme and willing to join the scheme. This is one of the rules that was stated in their constitution. Women dominate in the scheme. Youth constitute about 20% and the majority joined in 2014 just after the canal system was changed because it was demanding more of their time for irrigating.

The scheme was using a gravity fed by a canal from the Bululwane River from 1960 to 2011. Due to leakage and water conflicts in using the canal system attributed to head/tail issues, the system was changed and farmers started using sprinkler system as from 2014 through funding from DRDLR. The scheme has two dams which supply water to the four blocks, where the smaller dam supplies blocks 3 and 4 and the bigger dam supplies blocks 9A and 9B.

a. Bigger dam supplying blocks 9A and 9B



b. Smaller dam supplying blocks 3 and 4



Figure 4.6 Bululwane irrigation scheme storage dams

However, farmers experience water shortages as these two dams have to supply King Zwelithini's 63 ha of land. These two dams are also used by the community as sources of drinking water, livestock and other domestic use. The main crops that are irrigated are cabbage, chillies, maize, beans and spinach. They are pumping water from these two dams using a gravity-fed irrigation system and the water pressure is good which enables them to irrigate simultaneously.

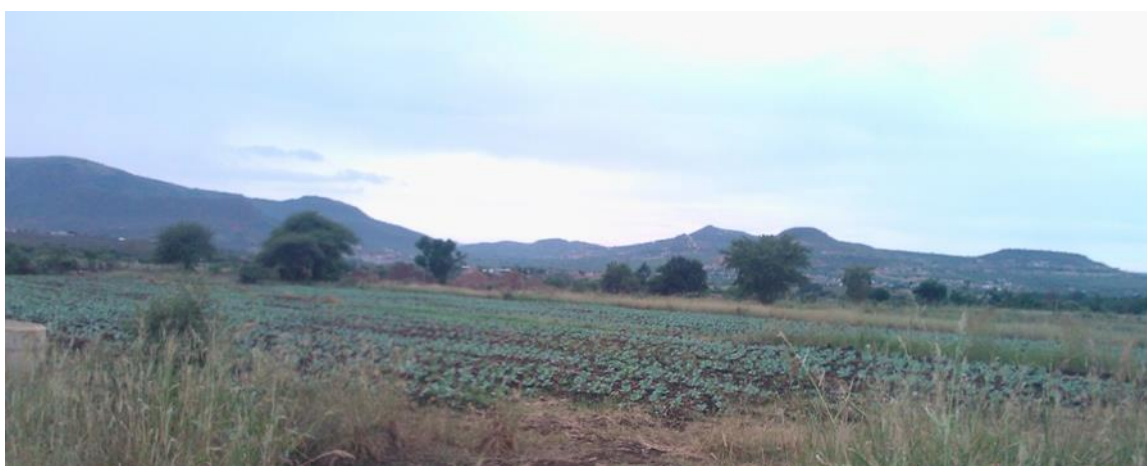


Figure 4.7 Cabbage production under sprinkler irrigation system, Bululwane Irrigation Scheme

Farmers do not have water licence; they use water for free. Farmers from each block irrigate on the same day, i.e. all farmers in Block 9A irrigate on the same day and all farmers in Block 9B irrigate on the same day. Selected individuals are responsible for opening the main engine from 7 am to 4 pm every day. The scheme members contribute equally to the maintenance of

the scheme equipment as stated by the scheme committee. Farmers hire labour and they currently pay R50 per day depending on the farming operation. Each hectare of land has about four sprinklers. Each block has volumetric metres for measuring water used by each block but there are no metres per plot. Farmers indicated that they don't use any scientific instruments to measure the amount of water used to irrigate the plants. Even though they have the instruments to do so, they have not been trained on how to use them.

Farmers own two trailers and two tractors which were purchased by DRDLR and PDARD. Furthermore, DRDLR bought 4,800 litres of diesel for tractor use.

4.4.5 Tugela Ferry Irrigation Scheme

The Tugela Ferry irrigation scheme is located in uMzinyathi district, Msinga Local Municipality, KwaZulu-Natal. The closest town is Greytown, which is located about 48 km from the scheme. Tugela Ferry Irrigation Scheme is currently active with 882 farmers who work in 364 ha (Blocks 2, 4, 5 and 7). The land in the scheme is owned by three different traditional authorities namely Mthembu (Block 2, 4 and 5); Mabaso (7A) and Bomvu (7B). Block 6 is currently not operating due to water scarcity.

Most farmers in the irrigation scheme own one plot of land which is 0.1 ha. Overtime, some farmers have managed to acquire more plots through borrowing from neighbours or negotiating with the traditional authorities. Land can be borrowed for more than 5 years depending on the agreement between the two parties involved. Land is accessed mainly through the traditional authorities who allocate land to households in consultation with block committee. Selling land is not permissible under the current traditional land tenure system. The land is to be returned to the traditional authority for re-allocation if the plotholder⁵ no longer wishes to use it. The traditional authority can take the land from the farmer if they don't cooperate with the block committee or if they see that the land is not being used for what it was meant for.

Land is mainly registered to men and most women get access to land through marriage. Widows and single women with kids are also allowed by their traditional authorities to own land or plots so that they can maintain their families. Most young people gain access to plots through inheritance. If a farmer wants to borrow land or a plot, he/she has to compensate the plotholder with R200 per plot when they have harvested their produce. In addition, they also have to pay for electricity (i.e. R100 per plot per month in Block 5) or diesel (i.e. R25 per plot per month in Block 4) to pump water to irrigate that plot. The policy is 'no pay, no water'.

⁵ A plotholder is a farmer who holds the use rights to a given piece of land

The source of water to the different blocks of the irrigation scheme is Tugela River. The farmers in Tugela Ferry Irrigation Scheme use canal irrigation system, diesel irrigation system and electricity irrigation system. Electric pump is used in Block 4B (see figures 8 to 14 below). Irrigators take turns to divert irrigation water to their plots, getting water at least once per week. Farmers do not have water licenses and they use water for free.



Figure 4.8. The electric generator pump station in Block 4B



Figure 4.9. Pipes pumping water from the river to the dam



Figure 4.10. Pumped water passing through the community to the dam



Figure 4.11. The dam for Block 4B



Figure 4.12. Water pressure controlling station



Figure 4.13. Water pipes per plot



Figure 4.14. Idle plot within the irrigation scheme with no pipes to irrigate

PDARD is planning to build storage and packaging facilities for the irrigation scheme. It is also currently in the process of handing over tractors to the irrigation scheme beneficiaries and they are currently supplying them with inputs like seeds and fertiliser. DRDLR was responsible for installing the irrigation systems that are currently running in all the blocks.

Many farmers in the irrigation scheme and out of it don't have homestead food gardens because there is a shortage of water where they stay. Some farmers and community members use water from the irrigation scheme for domestic use (such as cooking and washing) as shown in figure 9. People from the community are filling up their tanks using water meant for the irrigation scheme. Those that stay very far have to pay for services of the government water delivery trucks that supply them with water. They normally pay R200 to fill a 2500 litre tank with water. Many people who are not part of the scheme and have no water to start their homestead food gardens end up looking for jobs in the irrigation scheme and they prefer getting paid with output during harvest. Many farmers have livestock which they keep mainly for consumption purposes and selling only in emergencies.

Many farmers in the irrigation scheme participate in stokvels and have their own funeral covers. Stokvels are one form of informal credit and savings associations. They can be a minimum of 12 or more and they are initiated by the members. They comprise a group of women who contribute a certain amount of money per month and at the end of the year they purchase food in bulks (at a good deal, say, during a festive season) which they divide amongst themselves. They use some of the money to buy school uniform for the kids, pay school fees and/or funeral insurance. During the year members are able to borrow money from the stokvels, the maximum amount decided based on the amount he/she deposited. Stokvels play a very important role in the livelihoods of women farmers.

4.5 Summary

Based on the observation it was clear that farmers in the smallholder irrigation schemes visited face a lot of similar challenges. Water issues were identified across different schemes and the control over its use was difficult for farmers. All the irrigation schemes visited were not paying for water and had no water licenses but the extension officers indicated that they are in the process to help them get registered. Other farmers were already paying for operating and maintaining the irrigation systems.

Another common problem across the visited irrigation schemes was that of poor market access, post-harvest wastage and poor storage infrastructure. Farmers in many parts of the irrigation schemes visited had no homestead food gardens because there was no water closer to where they were staying. Young people were still limited in the irrigation schemes. Farmers indicated that they need training on how to properly operate and maintain the irrigation system, how to market their produce and how to manage pests and diseases.

Across all the visited irrigation schemes there was land that was not being utilised and it was also noted that farmers used different land tenure systems. Women own plots in the irrigation schemes visited and farmers could borrow each other plots given certain conditions. It is, therefore, envisaged that if farmers get supported in the areas they have indicated they can increase their income and improve their livelihoods. Farmers were sceptical about their dams and river levels in the future. It is essential to understand the challenges and factors that impact the water use so that all the smallholder irrigation schemes can operate to their full capacity.

5 EVALUATION OF NATURAL, PHYSICAL AND FINANCIAL ASSETS IN THE FOUR IRRIGATION SCHEMES IN KWAZULU-NATAL

5.1 Introduction

The chapter addresses the first study objective. It is focused on evaluating the physical, natural and financial capital endowment of smallholders in and around the four irrigation sites. The analysis is conducted with a specific attention on irrigation potential. Following the discussions in Chapter 3, this chapter will deal with natural capital (natural resource stocks available to people), physical capital (basic infrastructure such as roads and water supplies) and financial capital (financial resources such as savings and access to credit). The rest of the chapter is structured as follows. The following section briefly describes the common pool resource endowments in the study areas. This is followed by a larger portion of the chapter which presents the situation regarding the three capital endowments. Lastly, the chapter concludes with a summary of the findings.

5.2 Common-pool resource endowments in and around the schemes

Conditions of the road networks are necessary in determining access to transportation. According to uMkhanyakude district (2012), there are about 37 provincial road networks that serve as the main connectors to the five local municipalities. The district has about 63 district roads which serve as a major connection to major towns, major centres and rural settlement areas. Furthermore, the road conditions are poor because most of them are characterised by potholes due to poor maintenance level and most of them are gravel which makes it relatively difficult to use during rainy seasons. Most of the road networks are relatively in good condition but there are some which are unsatisfactory. For instance, the roads that connect Jozini town and Mbazwana and Bhambanana and Ngwavuma are characterised by potholes. The poor condition of some of the roads has negative implications on the transportation linkages and hence mobility in the district.

Biodiversity and grazing areas in rural South Africa are common property resources. According to uMkhanyakude district (2012), biodiversity within the municipalities is under pressure owing to climate change, unsustainable harvesting of natural resources and wide spread of alien species. Therefore, in Jozini local municipality, if farmers want to harvest trees for business or for household use, they have to consult with tribal authority since some land is owned by tribal authority and also have to consult with the Environmental Affairs.

For communal grazing areas, farmers have access through the tribal authorities. This means that access to communal grazing area is based on which tribal authority the farmer belongs to. However, uMkhanyakude district (2012) stated that it is difficult to manage and control communal grazing in terms of agricultural efficiency. This is because overstocking is common and pasturage is not maintained. Furthermore, livestock tend to negatively affect croplands owing to insufficient control of their movements.

5.3 Evaluation of natural, physical and financial assets

Capital endowment is critical to sustainable livelihoods, irrigation water use productivity and farm entrepreneurship. The different forms of capital are complements to each other. They need to be integrated analytically and practically. The different forms of capital are often reinforcing each other, i.e. one form of capital facilitates access to another form of capital. Moreover, one form of capital enhances the productive use of the other, hence the use of the SLF as the analytical framework.

5.3.1 Makhathini Irrigation Scheme

5.3.1.1 Natural capital

Natural capital in this study mainly refers to land and water. Land and water in Makhathini is allocated in blocks of 10 and 20 hectares each. Sustaining land and water is a key element of the long-term success of the farm business. The land use plan of the Makhathini irrigation scheme show that Makhathini flats has a high potential for irrigation development but low potential for dryland production (National Department of Agriculture, 1994). The overall land use plan of the Makhathini irrigation scheme is shown in Figure 5.1. In 2002, 3,900 ha was under irrigation (276 plots). The potential for expansion existed (7,200 ha) and is being undertaken by Makhathini Cotton Company who has built a cotton gin on site (G). There were also plans to build a sugar mill on site if the area under sugarcane increases to levels that justify construction of a mill.

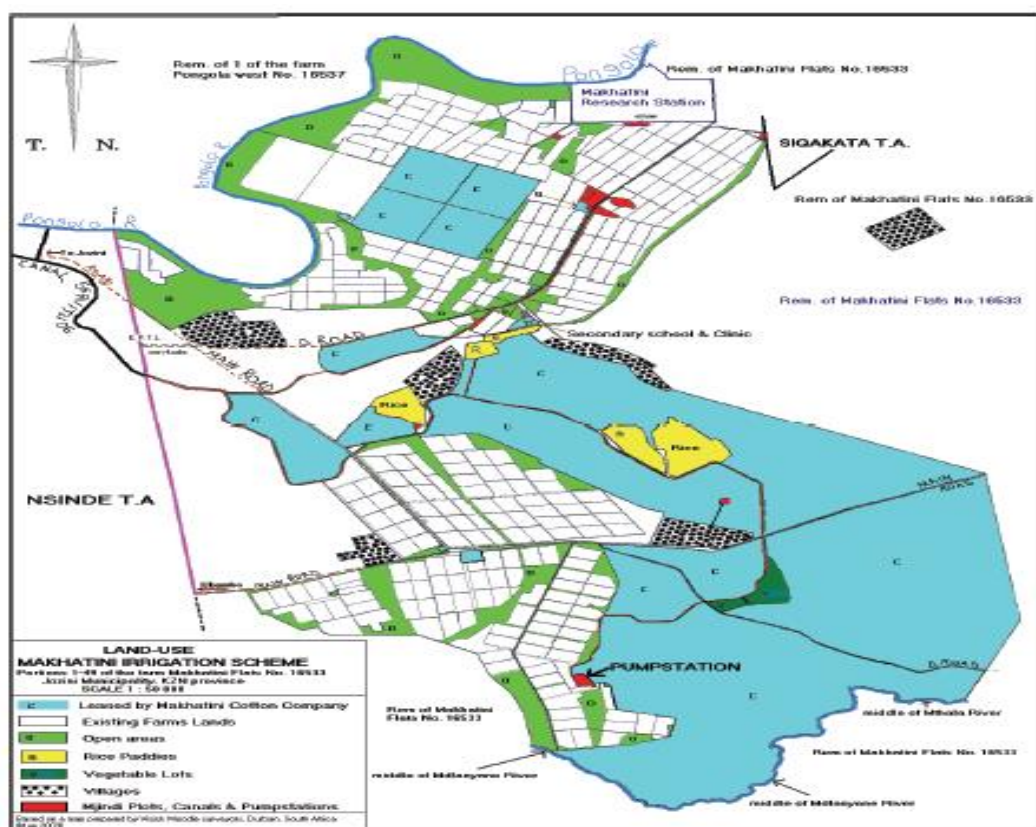


Figure 5.1. Land use plan of Makhathini Irrigation Scheme (11,200 ha)

Source: KZN PDAAE, 2002

Most of the sampled smallholders (75.4%) in Makhathini were allocated land in the scheme, 23% were leasing while the rest were using borrowed land. The average amount paid for land fees in the scheme was R935.74 per hectare per year. The results in Table 5.1 show that among the sampled farmers, the average farmer in the scheme operated 0.54 hectares of irrigated land. Independent irrigators had the highest operated irrigated land (1.27 hectares) followed by community food gardeners and then homestead food gardeners. Overall, land utilisation is high at 90% with no significant difference among the different types of farmers.

Renting of land is common among scheme farmers but not homestead or independent irrigators. About 26.2% scheme farmers in Makhathini wholly or partially rent irrigated land they are operating. Discussions with farmers revealed that irrigated land rental fees in Makhathini range from R3,000-R3,500 per ha per season which is usually four months. Farmers who rent out their land are those that fail to operate their land due to limited resources or limited human capacity.

Table 5.1. Land use rights and utilization (ha) – Makhathini

	Scheme irrigators	Independent irrigators	Homestead food gardeners	Community food gardeners	Non-irrigators	Total
Total land allocated (All)	0.69 (1.78)	1.44 (2.63)	0.74 (2.07)	0.89 (1.55)	3.24 (4.64)	1.28 (2.84)
Total irrigable land allocated	0.69 (1.78)	1.44 (2.63)	0.70 (2.03)	0.85 (1.56)	-	0.68 (1.77)
Total land operated	0.54 (1.43)	1.27 (2.65)	0.61 (1.79)	0.84 (1.57)	3.01 (4.43)	1.13 (2.64)
Irrigable land operated	0.54 (1.43)	1.27 (2.65)	0.56 (1.74)	0.80 (1.58)		0.58 (1.56)
Percent utilisation all land	0.90	0.89	0.89	0.89	0.92	0.90
Percent utilisation irrigable land	0.90	0.89	0.89	0.87	-	0.90

Note: () in parenthesis are standard deviations

Source: Survey data, 2016

Tenure security still remains a huge institutional problem (see Table 5.2 below) with approximately half of the farmers in Makhathini dissatisfied with their present land tenure security. Dissatisfaction among scheme irrigators is found among those renting or borrowing land and hence cannot make long-term decisions regarding that land. They also know that the plotholder can repossess the land at any time.

Table 5.2. Makhathini farmers' satisfaction with the present land tenure security of their irrigated land (N=61)

Perception	Percent	Cumulative Percent
Strongly dissatisfied	41.0	41.0
Dissatisfied	8.2	49.2
Neutral	23.0	72.1
Satisfied	16.4	88.5
Strongly satisfied	11.5	100.0
Total	100.0	

Source: Survey data, 2014

Furthermore, some of the farmers in Makhathini were not satisfied with fencing around the scheme or the broken gates which allowed livestock and thieves into plots. Scheme farmers also raised concerns regarding proposed land consolidation plans by government and which means farmers surrender their use rights to a company that will farm on behalf of the farmers. The supposed arrangement is expected to increase production and productivity in smallholder irrigation schemes. Farmers will become shareholders and can also provide paid labour to the

schemes. However, farmers are afraid that government is trying to repossess their land under the disguise of land consolidation.

Dissatisfaction among independent irrigators and community food gardeners mostly comes from the fact that land in the community is owned by the tribal authorities through the chiefs and hence some uncertainty exists in term of continued operation of the land in the future. Most homestead food gardeners are satisfied with the present security of land. This is because gardens are situated near the homestead and the land is usually part of the homestead and belongs to the household.

About 72% of the farmers pay water fees. The water fees per hectare is R2,700/ha per year. Water accessibility was rated very good and good only by 34.4% and 21.3% of sampled farmers, respectively (Table 5.3).

Table 5.3. Makhathini scheme farmers' perception on water accessibility to their plot(s) (N=61)

Perception	Percent	Cumulative Percent
Very good	34.4	34.4
Good	21.3	55.7
Neutral	9.8	65.6
Bad	29.5	95.1
Very Bad	4.9	100.0
Total	100.0	

Source: Survey data, 2014

Farmers were also asked about their view on their access to irrigation water per week. The results show that 51%, 20% and 15% have access to irrigation water always, often and sometimes, respectively. The rest get water rarely. Table 5.4 below reports farmers' satisfaction about the water distribution schedule in general. Only 55.7% are satisfied with the water distribution schedule. The rest are either not sure or dissatisfied. This shows that there exist issues in irrigation water management in the scheme that should be resolved.

Table 5.4. Makhathini scheme farmers’ satisfaction about the water distribution schedule in general

Satisfaction	Frequency	Percent	Cumulative Percent
Strongly satisfied	22	36.1	36.1
Satisfied	12	19.7	55.7
Neutral	9	14.8	70.5
Dissatisfied	17	27.9	98.4
Not satisfied	1	1.6	100.0
Total	61	100.0	

Source: Survey data, 2014

About 49%, 41% and 10% of the Makhathini smallholder farmer plots are positioned along the middle, tail and head of the primary canal, respectively. The following table reports farmers’ perception on the effect of their position on their operations. Only 42.6% believe their position along the primary canal has positive implications on their farming operations.

Table 5.5. Makhathini scheme farmers’ perception on the effect of their position on their farming operations (N=61)

Perception	Frequency	Percent	Cumulative Percent
Very positive	16	26.2	26.2
Positive	10	16.4	42.6
Neutral	19	31.1	73.8
Negative	11	18.0	91.8
Very Negative	5	8.2	100.0
Total	61	100.0	

Source: Survey data, 2014

5.3.1.2 Physical capital and irrigation infrastructure

As noted in Chapter 4, water for Makhathini irrigation scheme is extracted from the Jozini dam to the built-in canal using underground pipes and then sent to the pump station up to the field. The scheme works with open concrete canal, balancing dams and five pump stations, each powered by 14 electric motors, 132 KW each. These canals supply 65 plots, with an average of 10.37 ha for each farmer.

In 1994, the scheme comprised 5 pressurized irrigation blocks, each served by a separate pump station. There were 259 registered irrigation plots with an average plot size of 10 ha. A total of 3,426 ha was under irrigation, out of which 2,788 ha was farmed by plottolders and 591 ha

was the commercial section farmed by Mjindi Farming (Pty) Ltd who also act as managing agents for the whole scheme. The main irrigation systems used are center pivot for maize and sugarcane and sprinklers for vegetables such as cabbage, spinach and butternuts. Mjindi Farming is a state-owned enterprise whose mandate is to rehabilitate and maintain Makhathini Irrigation Scheme, develop the irrigation potential and optimize opportunities for agri-businesses as well as provide farmer development support. One of the challenges at Makhathini irrigation scheme is that drainage system is not functioning. Salinity of the water is high which leads to low productivity.

The pictures below (Figure 5.2) show the process of irrigation system before water is distributed to the field for irrigating crops.

(a) Canal dam



(b) The main irrigation pipe or canal



(c) Pump station

(d) Irrigation system

Figure 5.2. Canal, pipe and pump station at Makhathini Irrigation Scheme

A pump station supplies water to a group of farmers within a block. Farmers within a block do not always order the same quantities of water to be supplied at the same time. This theoretically means that the pump station may have to be started (switched on) for only one farmer, which is costly and inefficient. Irrigation water is distributed by a system of concrete canals, pump

stations and pressure pipelines. The pressure provided is adequate for the direct connection of an overhead irrigation system. Farmers buy water from the managing agent. Water payment is a constant cause of quarrels between the managing agent and farmers because farmers end up paying for water they did not order, because each farmer's water use is not monitored. It is a common practice that farmers who did not order water can still tap illegally into the supply if they by-pass the locking device (Jaganyi *et al.*, 2009).

In most South African rural areas, lack or poverty of basic infrastructure is blocking starting and growing profitable farm businesses. Poor roads leading to markets, inadequate storage and market facilities and even irregular supplies of electricity create huge practical barriers to developing farm businesses (Kahan, 2012).

Investments made into the scheme have a direct relationship to the local infrastructural endowment. The South African government has made the initial physical/structural investments for most irrigation schemes. The problem is mostly with the maintenance and sustainable collective management. The ability of the beneficiaries to maintain physical capital is strongly related to endowments in other forms of capital. Communities with a greater access to financial capital and those with greater social structure, often have better success in maintaining irrigation infrastructure.

At the time of the survey, most roads leading to the Makhathini irrigation scheme were under construction. A large portion of the sampled farmers were strongly dissatisfied with roads in the area, especially roads leading to the scheme (see Table 5.6 below). The dissatisfactory road infrastructure within the scheme negatively affected the farmers whose plots are deep within the scheme. Van traders and consumers prefer to visit and do business with plots closer to the gates of the scheme.

Table 5.6. Makhathini famers' assessment of their access to infrastructure (%) (N = 61)

Variable	Strongly dissatisfied	Dissatisfied	Neutral	Satisfied	Strongly satisfied
Road Accessibility	72.1	11.5	4.9	8.2	3.3
Markets	70.3	16.4	1.6	6.6	4.9
Electricity	36.1	4.9	6.6	21.3	31.1
Agri. water supply	33.7	12.7	9.9	14.1	29.5
Drinking water supply	28.4	13.8	8.1	15.3	34.4
Agri. Information	8.2	11.5	9.8	26.2	44.3
Access to medical facilities	20	4.9	8.2	30.8	36.1

Source: Survey data, 2014

A substantial number of farmers were also dissatisfied the high market transaction cost due to lack of transport. The closest market being in Pongolo, 73.8 km away from Jozini. Sugarcane farmers also noted the high transaction costs incurred in transporting sugarcane. Water and electricity were not accessible to all members of Makhathini farming community. Farmers often take water from the scheme for home consumption. Table 5.7 shows the asset ownership among smallholder farmers in Makhathini.

Table 5.7. Asset ownership and current value of assets – Makhathini (N=61)

Asset	Asset ownership (%)		Mean Current value (ZAR)
	Own as Individual	Own as a group	
Cell Phone	96.70	-	452.77
Radio	62.30	-	720.49
Television	72.10	-	1295.90
Personal Computer	0.00	-	-
Block, tile house	23.00	-	11311.48
Block, zinc house	72.10	-	20790.16
Block, thatch house	3.30	-	278.69
Round pole and mud or shack	41.00	-	2154.10
Fridge/Freezer	73.80	-	2959.02
Bicycle	21.30	-	148.36
Motorbike	1.60	-	524.59
Trailer/cart	1.60	1.60	352.46
Water tank	8.20	-	98.36
Motor vehicle in running order	13.10	-	10852.46
Generator	8.20	-	475.41
Plough	6.50	1.60	431.20
Planter, harrow, or cultivator	3.30	1.60	488.03
Wheelbarrow	62.30	1.60	145.95
Tractor	3.30	1.60	2916.72
Total			7011.57

Source: Survey data, 2014

A substantial number of sampled farmers in Makhathini had cell phones (some even smartphones), radios, television set, fridges and wheelbarrows. None of the farmers had access to personal computers which would suggest that internet is not a common source of information in the farming area. A small number of farmers own vehicles while most walk to the scheme. Most of sampled farmer households live in block, zinc house. As they cannot afford to buy and manage machinery, most farmers resorted to hiring assets such as tractors, planters and other farming equipment.

Farmers generally had no access to formal storage facilities. Buyers picked produce straight from the plots and no produce is stored. Farmers that owned fridges used them to preserve vegetables in the household. The rest of the farmers resorted to traditional methods, such as storing in cool round mud houses, grains in sacks and cribs/granary. A substantial number of farmers owned livestock, mainly for household consumption purposes. Cattle ownership is higher compared to Ndumo-B.

Table 5.8. Livestock Ownership in Makhathini (N=61)

Type of livestock	Number owned		Current value (ZAR)	
	<i>Mean</i>	<i>Std. Dev</i>	<i>Mean</i>	<i>Std. Dev</i>
Cows	5.59	9.00	2909.80	3375.80
Calves	1.98	3.50	1650.80	5207.80
Oxen	0.54	1.30	2429.50	4411.50
Sheep	0.23	1.27	34.50	184.06
Goats	5.11	8.31	462.30	1044.10
Domestic Chickens	4.49	7.28	19.30	24.40

Source: Survey data, 2014

5.3.1.3 Financial capital

The Makhathini region is characterised by chronic poverty, with 90% of households within the municipality earning less than R1600 per month (Jozini Local Municipality, 2009). Most of the households survive on social grants (see section 7.3.1.2 for more details). The lack of financial capital is a major constraint for many farmers to expand production or diversify into new high value enterprises. Smallholders starting new enterprises often face difficulty in raising investment capital. The lack of title deeds inhibits farmers from accessing finance and thus cannot invest in other forms of capital (Kahan, 2012; Krantz, 2001).

Access to finance is a collective concern of smaller-scale farmers to expand their operations, engage in value-adding activities, purchase inputs and/or invest in new farm enterprises. Thus, lacking such access further limits their ability to take up new opportunities that arise. Eventually, this inhibits development of entrepreneurial behaviour (Kahan, 2012). The results revealed that 69% of the farmers in Makhathini Irrigation Scheme had access to some form of savings, 46.6% formal and 22.7% informal. Similar to Ndumo-B, only 13.8% of Makhathini farmers had ever taken credit from the bank. Most farmers feared that they would not be able to generate enough capital to pay back the loan. The sampled farmers also felt that the loans were not easily accessible and couldn't secure enough collateral in the absence of property rights. As a result, they often rely on informal sources. For instance, pensioner farmers in Makhathini Irrigation Scheme borrowed money from the pension fund which would be deducted from their monthly social grant income.

The lack of financial capital also affects the effectiveness of entrepreneurial training offered to farmers. Findings show that after completing training, some Makhathini farmers discover they

do not have funds to implement the new ideas, techniques and practices learnt. It is, therefore, imperative that this is taken into account when developing training programmes in the future.

The other sources of finance by smallholder farmers include social grants, crop and livestock, arts and crafts and remittances, among others. However, the unearned income might do more harm than good to the smallholder farmer since it acts as a disincentive to entrepreneurial activity (Sinyolo *et al.*, 2017) (more on this in section 7.2.1.2).

5.3.2 Ndumo-B Irrigation Scheme

5.3.2.1 Natural capital

At present, technically, there appears to be no limitation to the assurance of irrigation water supply to the scheme which has a total water demand (for both Phase1 and 2) of about 6.0 million m³ per annum. The soils of the Ndumo-B area are considered to be suitable for irrigation with the following limitations (Golder Associates, 2014):

- The heavy textured soils have a high water holding capacity which may be a disadvantage in terms of accessibility for land preparation or any cultivation practices; and
- The soils are deep but show some signs of wetness and mild waterlogging at a depth of around one metre. This is an indication of restricted drainage even under natural rainfall conditions and therefore indicates the need for careful irrigation scheduling to prevent a water table build up and any risk of soil salinization in the future.

Much of the irrigated lands at Ndumo-B are classified as Class 3 which can be described as having moderate limitations, requiring special conservation and tillage practice methods (Camp *et al.*, 1995).

Households in the former KwaZulu-Natal do not possess title deeds to their land (Fenwick & Lyne, 1999). Even the land that is available for agricultural production is too small for increased production and hence take advantage of market opportunities. Due to the limited scale of production, it is difficult to adopt new technologies whose utilisation is below capacity, rendering the fixed cost unbearable. Large scale farmers have the advantage of the economies of scale which results in marginally small average fixed cost per unit of production. They produce in bulk and supply large quantities to the markets at acceptable quality.



Figure 5.3. Current production on the Ndumo-B Irrigation Scheme

Source: Golder Associates, 2014

Most of the smallholders practice irrigated farming while only few farmers also practice dryland/rainfed production. The results show that the average operated irrigated land area operated is 1.66 hectares with a range of 0-18 hectares (Table 5.9). The operated irrigated area is significantly higher for scheme irrigators followed by independent irrigators. Community and homestead food gardeners have the least operated irrigated land. Land utilisation is high for most farmers except community food gardeners. Homestead food gardeners are fully utilizing all their land, hence there is no room for expansion on existing land.

Table 5.9. Land use rights and utilisation (ha) – Ndumo-B

	Scheme irrigators	Independent irrigators	Homestead food gardeners	Community food gardeners	Non-irrigators	Total
Total land allocated (All)	5.72 (6.01)	1.97 (1.50)	0.44 (0.43)	0.51 (0.47)	1.10 (1.27)	2.44 (3.60)
Total irrigable land allocated	5.29 (5.71)	1.78 (1.48)	0.37 (0.33)	0.51 (0.47)	-	2.23 (3.41)
Total land operated	4.03 (4.63)	1.54 (1.35)	0.44 (0.43)	0.24 (0.33)	1.10 (1.27)	1.79 (2.75)
Irrigable land operated	3.79 (4.71)	1.43 (1.33)	0.37 (0.33)	0.24 (0.33)	-	1.66 (2.74)
Percent utilisation all land	0.81	0.83	1.00	0.66	1.00	0.81
Percent utilisation irrigable land	0.80	0.85	1.00	0.66	-	0.82

Note: () in parenthesis are standard deviations

Source: Survey data, 2016

However, like in all the study areas, land is held on a PTO basis whose use rights are not universal, exclusive, transferable and enforceable. According to the results, 42% of the farmers

are dissatisfied with the present security of the land they operate while 48% of them are satisfied.

Farmers were asked to evaluate the quality of the land they operate. Accordingly, 67.3% and 25% of them regarded their land as fertile and very fertile, respectively. Only 7% of the farmers regarded their land as poor quality. Among smallholder leasing land, the rental fee varies depending on the size of the land. The minimum fees range from R3,500 to R5,000 per hectare per production season. Smallholders operating in the scheme agreed to charge each other electricity bills for two hectares of land regardless of whether the farmer cultivated the two hectares or not. Thus, farmers resort to renting out land to cover such costs.

The farmers renting land in Ndumo-B often complain about the lack of transparency in the cooperative decision-making process and they felt marginalised. Dissatisfaction with the current land tenure system is higher among smallholder renting in the land. Such farmers were concerned about the lack of legal contract signed with the plotholder. As a result, there is always a risk that they can change the conditions of the agreement to their advantage without prior notice. For example, at any time, some plotholders (lessor) allocate a different plot to the lessee which is usually of poor soil quality than the one they have been using. Thus, those renting are not inclined in investing in improving the soil quality of the allocated plot (e.g. using recommended fertilizers and practices and soil sampling) because the lack of tenure security. Such insecure tenure systems including the communal land tenure system constrain the farmers from producing to their highest potential (Machingura, 2007). There are no incentives to invest in land improvements and sustaining existing improvements to increase productivity.

Access to irrigation water is a recurrent institutional issue. About 33% of farmers perceived water accessibility to their plots as favourable while about 40% stated that otherwise. Smallholder irrigating in Ndumo-B pay for water use charges such as electricity. The charge depends on the monthly bill which is divided per hectare. The fees range from R700-R900 per hectare per month which translates to R8,400-R10,800 per hectare per year. Most of the farmers were concerned that the water fee charges are too high for them and sometimes they do not even get enough water to their plots. The pictures (Figure 5.4) below demonstrate why farmers pay high bills for water fee charges. There is high water loss due to broken and burst pipes and it takes time for the cooperative or user groups to maintain the pipes. The transaction cost of regularly maintaining the pipes is too high and there is no incentive to contribute to maintenance. This is a typical problem of tragedy of the commons that happens when there is

a common pool resource with no enforceable rules on how to use and maintain the resource. The pictures also show how they bend the pipe and use plastic to reduce leakage.



Figure 5.4. The status of pipes in Ndumo-B Irrigation Scheme

Plot position along the primary canal is one of the factors determining access to irrigation water and quantity of water available reaching each plot. The results indicate that 25% of the farmers' plots are at the head, 19.2% are at the middle and the majority (55.8%) are at the tail. About 46% of the farmers stated that their position along the primary canal affects them negatively while only 34.6% stated that it affects them positively. In general, farmers stated water supply to their plots is affected by payment of water use charges. Most indicated that if water charges are paid by all, their position on the primary canal does not matter because they are able to get enough water to their plots, with marginal impact on water pressure. Defaulting on payment by one farmer affects all the other farmers.

5.3.2.2 Physical capital and irrigation infrastructure

Physical capital refers to infrastructure. In most South African rural areas what is blocking starting and growing profitable farm businesses is basic infrastructure. Fundamental things, such as poor roads leading to markets, inadequate storage and market facilities and even irregular supplies of electricity create very real and practical barriers to developing farm businesses (Kahan, 2012). Investments made into the scheme have a direct relationship to infrastructure. The ability to maintain physical capital is strongly related to the other forms of capital available in a given community. Communities with a greater cohesion on their social structures, might have greater success in maintaining irrigation infrastructure (Kahan, 2012).

Ndumo-B irrigation scheme has been established in two phases. Phase 1 of the Ndumo-B irrigation scheme comprises a pumped sprinkler irrigation system with moveable quick coupled pipes. The pump station is located on the left bank of the Pongola River, outside of a natural bend with the river being fairly deep and slow moving at the abstraction point. There

are four pumps installed which operate in parallel. Phase 2, which is still under development, has been divided into 26 plots with an average plot size of 10 hectares, with each of the 26 farmers farming their own plots. It comprises approximately 308 hectares of undeveloped land adjacent to Phase 1. The Phase 2 pump station, which is yet to be installed, will be located adjacent to the existing Phase 1 pump station. This pump station will be similar in design to the existing pump station making suitable allowance for the annual flood release from Jozini Dam. The gross flow rate to be provided by the pumps is 1110 m³/ha. Other pertinent points relating to Phase 2 are as follows (Golder Associates, 2014):

- Access roads will be provided to suit the plot layout so that each plot has road access. Meadow drains will be constructed along the length of the roads to divert runoff water. These will be lined with indigenous grass runners and hand packed stone bolsters will be constructed across the drains at regular intervals where required;
- The Phase 2 area is drained by three shallow valleys. The plot layout will take cognisance of these natural drainage ways, which will be preserved and grassed to prevent erosion. All runoff water from the plots will be directed into these drainage ways through the formation of contour banks, to be constructed during the final land preparation phase. The area is well fenced and although it was reportedly cleared some years ago, thick bush has regrown in places. The whole area will need to be cleared before the plots and irrigation system can be laid out;
- Final land preparation will be done after the irrigation system has been installed and will be carried out by the KZN PDAEA.

Shed buildings and infrastructure maintenance – Ndumo-B (Phase 1 and 2) has only one shed which has no floor screed or walls. This is clearly inadequate for a scheme producing high value vegetables and fruit for commercial markets. All the scheme mechanical equipment, including tractors planters and tillage equipment have no proper shelter. At present there is no formal arrangement for the maintenance and repair of infrastructure on the scheme. The KZN PDAEA has assisted in emergency situations whenever possible and the farmers have employed contractors when necessary.

Access Roads – Access roads will be provided to suit the plot layout so that each plot has road access. The roads will be constructed to have a riding width of 4 m and should be provided with a 125 mm thick gravel wearing course, subject to availability of suitable burrow material. Meadow drains will be constructed along the length of the roads to divert runoff water. These

will be lined with indigenous grass runners and hand packed stone bolsters will be constructed across the drains at regular intervals where required.

Drainage – The Phase 2 area is drained by three shallow valleys. The plot layout will take cognisance of these natural drainage ways, which will be preserved and grassed to prevent erosion. All runoff water from the plots will be directed into these drainage ways through the formation of contour banks, to be constructed during the final land preparation phase.

Fencing – The area is well fenced.

Land preparation – Since the land has been unused for agriculture for an extended period it is also desirable that the whole area be ripped to at least a depth of 500 mm. Final land preparation will be done after the irrigation system has been installed and will be carried out by the KZN PDARD.

Table 5.10 below indicates the level of satisfaction of sampled farmers regarding the state of physical infrastructure in their area. The results suggest that the majority of the smallholders are strongly dissatisfied with the state of markets for their produce. This mainly due to lack of transport since most do not own vehicles that they can use to take their produce to the markets. Thus, they end up selling their produce at lower prices to hawkers/van traders. Market access seems to be the major problem that restricts the success of smallholders because with the lower farmgate prices, they can't make enough profits to cover their production cost.

Table 5.10. Smallholder perception about their satisfaction regarding access to infrastructure – Ndumo-B

Factor	Strongly dissatisfied	Dissatisfied	Neutral	Satisfied	Strongly satisfied
Road accessibility	44.2	34.6	11.5	7.7	1.9
Markets	57.7	26.9	7.7	7.7	0.0
Electricity	46.2	17.3	3.8	25.0	7.7
Agricultural water supply	19.2	32.7	17.3	19.2	11.5
Drinking water supply	51.9	11.5	7.7	11.5	17.3

Source: Survey data, 2014

Magingxa *et al.* (2009) states that physical access to the market is one of the important factors influencing market access for smallholder irrigators in South Africa. Rural non-farm employment is correlated with proximity to markets (Gollin, 2014). The impact of geographic isolation, high transport costs, time lost to road blocks, as well as failure to deliver on time to producers, or for producers to deliver products into the market when prices are more

favourable, can completely undermine the returns on investment in irrigation, inputs, credit, insurance, post-harvest storage, training, etc. (Livingston *et al.*, 2014).

Table 5.11 below presents the average number of livestock ownership of farmers. The results indicate that livestock ownership is relatively low. This is because this area is dry and is very hot throughout the season. Poultry is the common livestock owned by Ndumo-B farmers.

Table 5.11. Livestock ownership in Ndumo-B (N=51)

Type of livestock	Number owned		Current value (ZAR)	
	<i>Mean</i>	<i>Std dev</i>	<i>Mean</i>	<i>Std dev</i>
Cows	2.58	4.98	2558.8	3559.00
Calves	0.98	2.12	700.00	1399.70
Oxen	0.46	1.28	1215.69	2921.10
Goats	4.37	6.83	364.71	371.40
Domestic chicken	9.62	12.11	25.39	24.92

Source: Survey data, 2014

Table 5.12 below shows asset ownership for the sampled farmers. Most farmers own a thatch house followed by block zinc house. Quite a high percentage of farmers do not own most of the assets listed below which simply indicates that poverty is still prevalent. The table indicates that most of the farmers do not possess the necessary equipment(s) (such as planter, tractor and wheelbarrow) that are useful for their farming activities. Thus, they hire these important assets or revert to the use of labour intensive assets such as hoes, rotary slashes and spades, where necessary.

The results indicate that 82.7% of the Ndumo-B farmers do not have access to long-term storage facilities for produce like maize and 90.4% of farmers do not have access to farm storage facilities for fresh produce (like vegetable and fruits). Only 17.3% of farmers indicated to have access to long-term storage facilities while only 9.6% have storage facilities for fresh produce. Most of the smallholders use traditional methods for storing their produce. They also stated that they use thatch house for storage. Thatch house provides a cooler environment and hence is used for fresh produce while the crib/granary is for long-term storage of produce like maize. The majority of smallholders do not practice any methods as a way of preserving their produce; they only harvest output when either there are buyers or for consumption during a specified time.

Table 5.12. Asset ownership and current value of assets – Ndumo-B

Assets	Assets owned (%)		Current value (ZAR)	
	<i>Individual</i>	<i>Own in groups</i>	<i>Mean</i>	<i>Std dev</i>
Cell phone	98.10	0.00	401.40	331.80
Radio	82.70	0.00	741.40	1165.90
Television	57.70	0.00	1436.54	2010.60
Personal computer	0.00	0.00	0.00	0.00
Block, tile house	13.50	0.00	5326.90	16762.14
Block, zinc house	76.90	0.00	13484.60	12620.30
Block, thatch house	82.70	0.00	1019.20	2767.04
Round pole and mud or shack	36.50	0.00	2336.60	3558.63
Fridge/freezer	61.50	0.00	2536.50	2279.30
Bicycle	17.30	0.00	92.40	216.50
Trailer/cart	1.90	7.70	2768.90	12339.92
Water tank	9.60	0.00	205.80	814.70
Motor vehicle in running order	21.20	1.90	20250.00	76538.30
Generator	7.70	5.80	828.10	2281.70
Plough	7.70	11.50	1080.80	2742.20
Planter, harrow or cultivator	11.50	13.50	1277.90	3534.70
Wheelbarrow	48.10	9.60	272.50	383.80
Total			18914.57	45012.29

Source: Survey data, 2014

The lack of proper storage for agricultural products is one of the critical factors that excludes farmers from marketing their produce to profitable markets. Assembly and storage point for farmers' produce are unsuitable for agricultural produce (Magingxa *et al.*, 2009). Even if smallholder farmers are capable of producing quality products, absence of storage facilities makes it susceptible to spoilage by pests and other factors. The results obtained are the same as the one obtained by Katundu *et al.* (2010) which confirmed that smallholder farmers in Embo (KZN) do not use proper storage practices for their products and they still used traditional storage methods (e.g. huts with earthen floors).

5.3.2.3 Financial Capital

According to focus group meetings and a pre-planning survey conducted by Golder and Associates (2014), 44.4% of Ndumo-B farmers indicated that they get funds for inputs and labour from their personal savings. About 27.8% of the survey respondents sourced funds from

other sources which include TechnoServe, a company that aims to generate business solutions to the poor. About 11% of survey respondents indicated that funds are sourced through borrowings from neighbours and 6% source funds from microcredit institutions, government funds and international funders. None of the survey participants reported receiving funds from commercial banks, cooperatives and/or pensions. The sustainability of this can be questioned as most farmers do not earn enough to purchase seeds and fertilizer. A system that can address farmers' problem of liquidity and assist them acquire inputs and labour requirements needs to be investigated.

The study results confirm the above findings and show that 65.4% of the smallholders in Ndumo-B obtain credit from informal sources while only 34.6% have loans from informal savings. Informal savings are based on trust where a group of farmers (*stokvel*) save money on monthly basis. The money is usually used during the festive season or for school related expenses in the beginning of the year. The figure below reports farmers' reasons for not taking credit from a bank. The highest percentage of farmers stated that credit from formal financial institutions is not easily accessible while a significant proportion had their own sufficient money. Risk aversion, collateral and high interest rate were the other reasons.

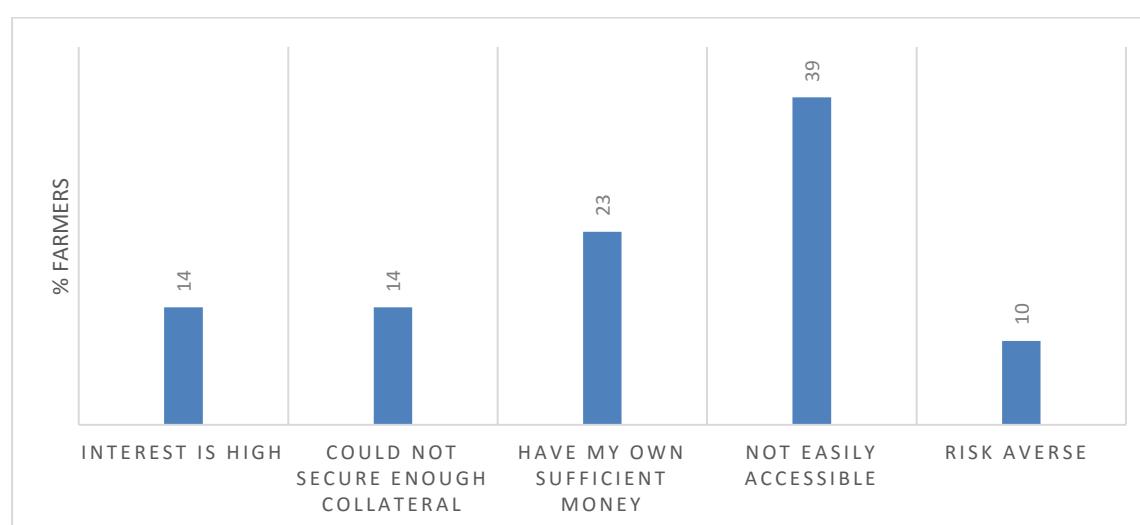


Figure 5.5. Farmers' reasons for not taking credit from formal institutions – Ndumo-B

Source: Survey data, 2014

Smallholders find it difficult to access production credit to increase their farm income (Fenwick and Lyne, 1999). Collateral is important when applying for credit because the information about the applicant is costly and often unavailable to lenders, especially for the smallholder farmers. They cannot even use land as collateral because they do not have secured title deed

(see Section 5.3.2.1). Even those who do own the land in former homelands don't have documents to prove that the land belongs to them. According to Fenwick and Lyne (1999), agricultural land had no value as collateral in the former KwaZulu-Natal homelands because title deeds cannot be used as collateral value unless they assist market transfer. The relevant variable to assess smallholders' credit worthiness is their ability to repay the principal with interest, which is perceived to be low due to poor profit margins. This assessment cannot be made to smallholder farmers because they do not keep records and they do not distinguish farm and family operations.

The other major sources of financial capital for smallholders in Ndumo-B include social support grants and income from sale of crops and livestock. The details for this and other livelihood sources are discussed in Chapter 7.

5.3.3 Bululwane Irrigation Scheme

5.3.3.1 Natural capital

As noted in Chapter 4, only 35% of the 550 hectares of land in Bululwane irrigation scheme is irrigable. The rest is dryland, 40% which is currently being utilised for rainfed crop production. Some of the scheme irrigators are also engaged in rainfed farming in the scheme. Land in and around the scheme is under the authority of traditional leadership. However, the authorities have given scheme committee members power to distribute land in the scheme. Members of the irrigation scheme pay a nominal annual subscription fee ranging from R200-R300 for them to remain as members.

Farmers are not allowed to lease out their land in case they fail to utilise it but they can lend it to scheme members for a maximum of one year. If they are unable to cultivate it again in the following year, the land repossessed by the scheme committee for reallocation to new members. The fee for leasing land in this scheme ranges from R100-R300.

Table 5.13 shows that the average land use rights of irrigable land among smallholder in and around Bululwane irrigation scheme is 1.46 hectares and is significantly higher among scheme irrigators compared to the other farmers. Community food gardeners have the least land use rights. Results in the table also shows that land utilisation is very high leaving no or little room for expansion under the current land holdings.

Table 5.13. Land use rights and utilization (ha) in Bululwane

	Scheme irrigators	Homestead food gardeners	Community food gardeners	Non-irrigators	Total
Total land allocated (All)	2.76 (1.97)	1.04 (1.48)	0.41 (0.44)	2.36 (1.96)	2.03 (1.92)
Total irrigable land allocated	2.23 (1.60)	0.89 (1.29)	0.41 (0.44)	-	1.46 (1.55)
Total land operated	2.76 (1.97)	0.95 (1.49)	0.41 (0.44)	2.04 (2.11)	1.97 (1.95)
Irrigable land operated	2.23 (1.60)	0.80 (1.30)	0.41 (0.44)	-	1.44 (1.56)
Percent utilisation all land	1.00	0.81	1.00	0.81	0.92
Percent utilisation irrigable land	1.00	0.81	1.00		0.94

Note: () in parenthesis are standard deviations

Source: Survey data, 2016

In Bululwane, most of the smallholder (88.3%) indicated that they were satisfied with the land tenure security (Table 5.14). As noted by Bugri (2008) and Van Averbek *et al.* (2011), many scheme plotters tend to feel secure about crucial tenure rights such as who the plot was allocated to.

Table 5.14. Satisfaction with the present tenure security – Bululwane (% farmers)

Type of farmer	Very unsatisfied	Unsatisfied	Neutral	Satisfied	Very satisfied
Scheme irrigators	0	10	6.7	53.3	30
Independent irrigators	0	0	0	50	50
Homestead food gardeners	0	0	6.3	62.5	31.3
Community food gardeners	0	25	0	50	25
Non-irrigators	0	0	0	75	25
Total	0	6.7	5	58.3	30

Source: Survey data, 2016

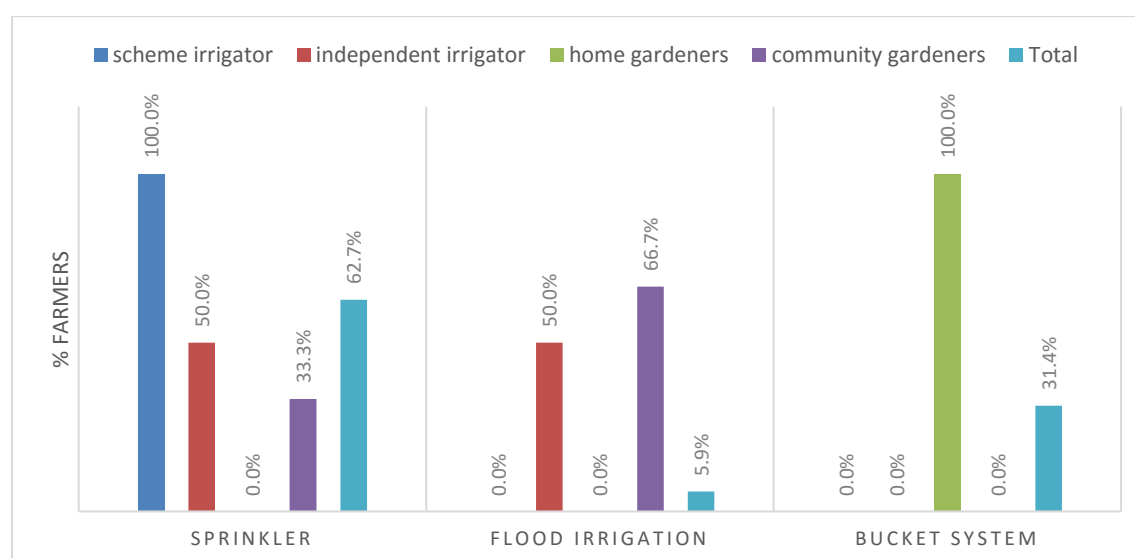
Regarding access to water in the scheme, the results show that only 59% of scheme irrigators in Bululwane were at least satisfied with the water distribution schedule (Table 5.15). Those that are not happy with the water sharing arrangement reported that sometimes water fails to reach their plots on their irrigation day. The problem was experienced by mostly those at the tail end of the primary distribution channel who constituted approximately 31.3% of scheme irrigators.

Table 5.15. Farmers’ feelings about water distribution in Bululwane

	Frequency	Percent
Strongly Dissatisfied	4	10.3
Dissatisfied	10	25.6
Neutral	2	5.1
Satisfied	18	46.2
Strongly Satisfied	5	12.8
Total	39	100

Source: Survey data, 2016

Most smallholders in Bululwane reported that water reaches the farmers’ plot through gravity (59.6%), electric pump (3.8%), hose pipe (3.8%) and watering cans (32.7%). Figure 5.6 shows that the all scheme irrigators indicated that they used the sprinkler system for irrigation. Independent irrigators and community food gardeners used the sprinkler system and flood irrigation, while most homestead food gardeners also use sprinklers and the bucket system for irrigation.

**Figure 5.6.** Type of irrigation system – Bululwane⁶

Source: Survey data, 2016

Table 5.16 shows that most of the farmers in and around Bululwane irrigation scheme indicated that unavailability of water or lack of access to water is a challenge to their farming operations.

⁶ Please note: whenever home gardeners is indicated in the figures throughout the report it refers to homestead food gardeners

Enhancing water security in the area would greatly improve smallholder agricultural production.

Table 5.16. Unavailability or lack of access to adequate water as a constraint in Bululwane (% farmers)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Scheme irrigators	0.0	3.3	3.3	30.0	63.3
Independent irrigators	0.0	0.0	0.0	50.0	50.0
Homestead food gardeners	0.0	6.3	12.5	18.8	62.5
Community food gardeners	0.0	0.0	25.0	0.0	75.0
Non-irrigators	0.0	0.0	0.0	37.5	62.5
Total	0.0	3.3	6.7	26.7	63.3

Source: Survey data, 2016

5.3.3.2 Physical capital and irrigation infrastructure

The farmers' responses towards satisfaction with the state of infrastructure in Bululwane were mixed. The results in Table 5.17 indicate that most of the farmers were satisfied with road accessibility (66.7%) and status of electricity (93.3%). However, a significant proportion of the smallholders were dissatisfied or not sure regarding the status of the markets and agricultural water supply. It seems the dissatisfaction with road infrastructure by a third of the farmers could be linked to challenges in accessing markets (more on this in section 7.3.3).

Table 5.17. Satisfaction with the state of infrastructure – Bululwane (% farmers)

Infrastructure type	Strongly dissatisfied	Dissatisfied	Neutral	Satisfied	Strongly satisfied
Status of road accessibility	10.0	20.0	3.3	36.7	30.0
Status of markets	21.7	28.3	21.7	21.7	6.7
Status of electricity	1.7	5.0	0.0	45.0	48.3
Status of agricultural water supply	18.3	35.0	11.7	21.7	13.3

Source: Survey data, 2016

The assets which the individuals mostly owned include radio, cell phones, television sets and refrigerators (Table 5.18). The information communication technology related assets provide several options for ensuring that important farming related information reach the smallholders in the community. However, ownership of the other key assets that are important to farming

such as ploughs, planters, tractors, wheelbarrow, trailer, generator and water pumps is very limited. This is evidence that limited access to physical resources could constrain efforts to improve on-farm entrepreneurial development in the area. Most of farmers also do not own vehicles that can be used for transporting or distributing produce to the markets. Similar to smallholders in the other three areas, this leaves the farmers at the mercy of van traders whose buying prices might be well below the market prices.

Table 5.18. Asset ownership and current value of assets – Bululwane

Asset	Asset ownership (%)	Current value (ZAR)	
	Owned individually	Mean	Std.dev
Radio	63.3	351.88	523.23
Cell Phone	95.0	373.84	510.24
TV	71.7	1768.10	984.43
Personal Computer	5.0	4233.33	1167.62
Fridge	81.7	3056.84	1360.88
Bicycle	6.7	975.00	607.59
Motorcycle	6.7	8125.00	4802.34
Water Tank	50.0	2246.97	799.99
Car	8.3	43375.00	7909.08
Generator	3.3	1250.00	353.55
Water Pump	3.3	1137.50	1104.46
Plough	43.3	80.59	44.90
Planter	3.3	58.60	5.68
Wheelbarrow	53.3	320.52	79.08
Total		12985.63	16710.18

Source: Survey data, 2016

Regarding livestock ownership, the most common livestock are domestic chicken and goats (Table 5.19). Cattle is owned by only 38.3% of the sampled farming households in Bululwane. This means most of the smallholders do not own cattle, an important livestock in smallholder farming. This further highlights the levels of poverty and vulnerability among these farmers.

Table 5.19. Livestock ownership – Bululwane (N=60)

Livestock	Percent households	Average number of livestock owned	Average current value of livestock owned (ZAR)
Cattle	38.3	9.43	6 939.75
Goats	60.0	17.06	605.41
Domestic chicken	65.0	16.34	50.00

Source: Survey data, 2016

5.3.3.3 Financial capital

Savings are an important component of a household's financial capital endowment. Only 51.7% smallholders in Bululwane indicated to have savings. There was no significant difference between the different types of farmers in as far as savings are concerned. Among those with savings, most had informal savings (55%) while 29% had formal savings. The remaining farmers (16%) had both forms of savings.

Access to credit was also limited. Only 52% of the farmers reported that they had access to credit or a loan facility. The main sources of credit were relatives or friends (31.3%) and savings club (31.3%) (Figure 5.7). Only 12.5% and 6.3% received a loan facility from commercial banks and government, respectively. The role of microfinance institution in financing smallholder farming in Bululwane is also evidently very low. Farmers' reason for not accessing credit also highlight their challenges. They cited high interest rates (42.9%) and unwillingness to be indebted (38.1%) as the major reasons not taking credit or loan facilities.

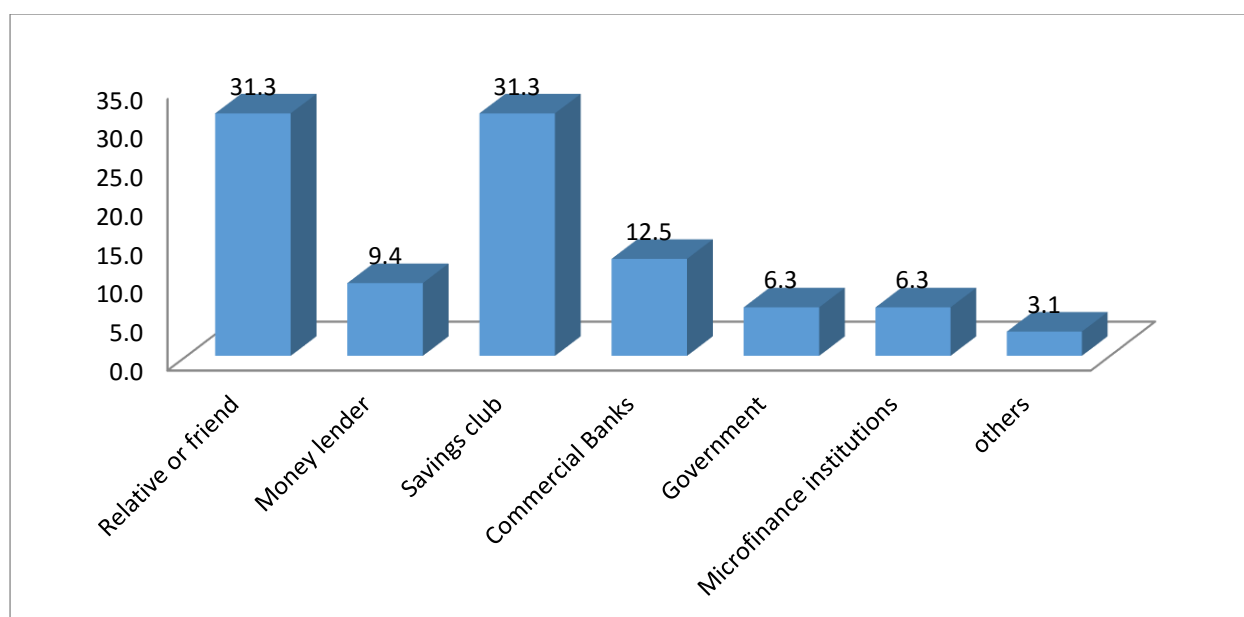


Figure 5.7. The main sources of credit or loan among farmers in Bululwane (N=32)

Source: Survey data, 2016

Like the other study areas, smallholders in Bululwane have other sources of income that contributes their financial capital endowment. These major ones are social grants, crop sales, remittances and income from selling arts and craft. The results show that 47% of the farmers indicated that they use their social grant money for agricultural purposes. These are discussed in detail in section 7.4.1.2.

5.3.4 Tugela Ferry Irrigation Scheme

5.3.4.1 Natural capital

Land ownership in Tugela Ferry is either through the land use rights obtained from the traditional authorities (PTO), renting or borrowing. Like, Ndumo-B and Makhathini, there were no renting or borrowing activities among homestead food gardeners and community food gardeners. Such activities were found among smallholders farming in the scheme. The minimum rental fee for a plot of land per season ranges from R200-R800. About 5.2% smallholders in scheme irrigation in Tugela Ferry were also involved in homestead food gardening while 16% farmers classified as community food gardeners also has scheme plots.

Table 5.20 shows the average land holdings and land utilisation in Tugela Ferry. The average land holding is 0.28 hectares, most of which is irrigated land in the scheme or in homestead and community food gardens. The landholdings range from 0.2-1 hectares of land. Most homestead food gardeners own 0.2 hectares while those in the scheme operate one hectare plots of land. Comparison between the different types of smallholders in irrigation show that scheme irrigators have higher land use rights compared the other farmers while homestead food gardeners have the least use rights. Land utilisation is very high. Most are utilizing all their existing land.

Table 5.20. Land use rights and utilization (ha) in Tugela Ferry

	Scheme irrigators	Homestead food gardeners	Community food gardeners	Total
Total land allocated (All)	0.30 (0.18)	0.11 (0.06)	0.22 (0.28)	0.28 (0.19)
Total irrigable land allocated	0.30 (0.18)	0.11 (0.06)	0.22 (0.28)	0.28 (0.19)
Total land operated	0.30 (0.18)	0.11(0.06)	0.19 (0.21)	0.27 (0.18)
Irrigable land operated	0.30 (0.18)	0.11(0.06)	0.19 (0.21)	0.27 (0.18)
Percent utilisation all land	1.00	1.00	0.96	1.00
Percent utilisation irrigable land	1.00	1.00	0.96	1.00

Note: () in parenthesis are standard deviations

Source: Survey data, 2016

Regarding land tenure security, the results show that 78.6% of the farmers in Tugela Ferry were satisfied with the present land tenure security (Table 5.21). However, more scheme irrigators are either not sure or dissatisfied with their land tenure security compared to the other types of

farmers. Dissatisfied farmers were renting land in the scheme and complained about not so clear contractual arrangements which meant the plotholder could claim their land back anytime.

Table 5.21. Satisfaction with the present land tenure security of ownership – Tugela Ferry (% farmers)

Type of farmer	Very unsatisfied	Unsatisfied	Neutral	Satisfied	Very satisfied
Scheme irrigators	1.7	10.3	12.1	25.9	50.0
Homestead food gardeners	0.0	16.7	0.0	16.7	66.7
Community food gardeners	0.0	0.0	0.0	83.3	16.7
Total	1.4	10.0	10.0	30.0	48.6

Source: Survey data, 2016

The smallholders in Tugela Ferry irrigation scheme were generally satisfied with the water distribution schedule. The results show that 72.9% of the farmers were satisfied or strongly satisfied (Table 5.22). Those dissatisfied, complained about the water sharing arrangements which result in inadequate water reaching their plots or low pressure in the water.

Table 5.22. Farmers' feelings about water distribution in Tugela Ferry Irrigation Scheme

	Frequency	Percent
Strongly Dissatisfied	3	5.1
Dissatisfied	11	18.6
Neutral	2	3.4
Satisfied	24	40.7
Strongly Satisfied	19	32.2
Total	59	100

Source: Survey data, 2016

Several approaches were used to carry water to the irrigation plots. The results show that the most common methods were gravity (41.4%) and electric pump (34.3%). However, other smallholder use hose pipes (8.7%) and watering cans (15.7%). Flood irrigation followed by bucket system and hosepipes are the common irrigation system in Tugela Ferry (Figure 5.8).

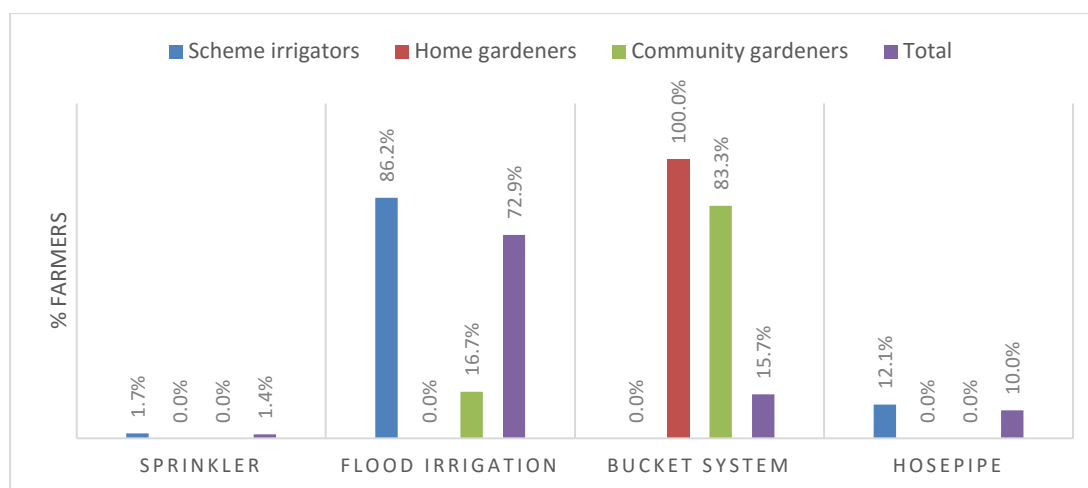


Figure 5.8. Types of irrigation systems – Tugela Ferry

Source: Survey data, 2016

In the scheme, the flood irrigation system, used by 98.3% scheme irrigators, was the most common method for irrigation. Others use hosepipes while only 1.7% use sprinklers. The homestead food gardeners use the bucket system while community food gardeners use both the bucket system and flood irrigation. As regards the location of the plots in the scheme, results indicate that most of these farmers' plots (50%) were located in the middle of the canal, while those at the head were 29.3% and those with plots at the tail were 20.7%. Table 5.23 shows that a high proportion of community and homestead food gardeners indicated that lack of access to water is a constraint. This is expected since homestead food gardeners rely on local municipality tap water which is not reliable while community food gardeners draw water from rivers and dams. Its availability and access are not guaranteed due to drought and lack of appropriate equipment for drawing water to the plots.

Table 5.23. Unavailability or lack of access to adequate water as a constraint in Tugela Ferry (% farmers)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Scheme irrigators	20.7	31.0	5.2	13.8	29.3
Homestead food gardeners	0.0	16.7	0.0	33.3	50.0
Community food gardeners	16.7	0.0	0.0	33.3	50.0
Total	18.6	27.1	4.3	17.1	32.9

Source: Survey data, 2016

5.3.4.2 Physical capital and irrigation infrastructure

In Tugela Ferry, at least 50% and 70% of the farmers were not satisfied with the status of the roads and markets, respectively (Table 5.24). A large percentage of the farmers (70%) was satisfied with the status of electricity. Approximately, 56% of the farmers were satisfied or strongly satisfied with the status of agricultural water infrastructure. Nearly 60% of the farmers were not satisfied with the status of drinking water.

Table 5.24. Satisfaction with the state of infrastructure – Tugela Ferry (% farmers)

Infrastructure type	Strongly dissatisfied	Dissatisfied	Neutral	Satisfied	Strongly satisfied
Status of road accessibility	22.9	30	2.9	28.6	15.7
Status of markets	47.1	25.7	20	7.1	
Status of electricity	7.1	14.3	8.6	44.3	25.7
Status of agricultural water supply	11.4	18.6	8.6	34.3	27.1
Status of drinking water supply	24.3	32.9	8.6	21.4	12.9

Source: Survey data, 2016

The assets that the farmers in Tugela Ferry mostly owned included a cellphone, television and refrigerator (Table 5.25). The results also indicate the low percentages of ownership of assets such as bicycles (8.6%), cars (5.4%) and motorcycles (2.9%). Regarding farming equipment such as ploughs, planters and tractors, the results show that the asset ownership was low at 4.3%, 2.9% and 2.9%, respectively. This highlights the difficulties of conducting farming operations by these smallholder farmers.

Table 5.25. Asset ownership and current value of assets – Tugela Ferry

Asset	Asset ownership (%)	Current value (ZAR)	
	Own as individual	Mean	Std.dev
Radio	44.3	161.54	102.18
Cell Phone	91.4	399.03	359.48
TV	64.3	1088.50	1236.65
Personal Computer	1.4	0.00	0.00
Fridge	72.9	1819.80	791.83
Bicycle	8.6	508.33	226.75
Motorcycle	2.9	12666.67	8736.89
Trailer/ Cart	0.0	0.00	0.00
Water Tank	20.0	1190.00	975.81
Car	5.7	37000.00	16431.68
Generator	0.0	0.00	0.00
Water Pump	1.4	2700.00	974.68
Plough	4.3	533.33	305.51
Planter	2.9	1783.33	1338.22
Wheelbarrow	37.1	280	202.09
Tractor	2.9	150 000.00	50 000.00
Total		12676.87	36558.26

Source: Survey data, 2016

The livestock ownership of the farmers in Tugela Ferry is shown in Table 5.26. Only 22.9% of the smallholders owned cattle. The average number of cattle ownership is 6 cattle per household. The farmers that owned goats constituted 48.6% of the sample, with an average of 12 goats per household. The most common livestock owned was domestic chicken. About, 61.4% smallholders owned the livestock asset, with an average of 13.5 chickens per household.

Table 5.26. Livestock ownership – Tugela Ferry (N=70)

Livestock	Percent households	Average number of livestock owned	Average current value of livestock owned
Cattle	22.9	6.38	6 266.01
Goats	48.6	12.65	600.00
Domestic Chicken	61.4	13.48	50.00

Source: Survey data, 2016

5.3.4.3 Financial capital

Smallholder's propensity to save is minimal. Only 47.1% of the sampled farmers in Tugela Ferry indicated to have some form of savings. Homestead food gardeners (83.3%) followed by

community food gardeners (66.7%) indicated to have some form of savings. Informal savings accounted for 67% of the saving whereas 18% of the farmers had formal savings in commercial banks.

Most of the farmers (66%) reported no access to loans or credit facilities. Among the 33% that had access, their major sources of credit were the money lenders (*mashonisa*) and friends or relatives who accounted for 41.7% and 25%, respectively (Figure 5.9). The credit offered through money lenders is mostly consumption credit provided at high interest rates of 20-30% per month. This credit might be relieving in the short-term but in the long-term it most likely makes farmers more vulnerable. Other sources of credit include savings clubs (*stokvel*) and microfinance institutions. The results also show that a very small population of the sampled farmers in Tugela Ferry are accessing credit through government channels or through input suppliers.

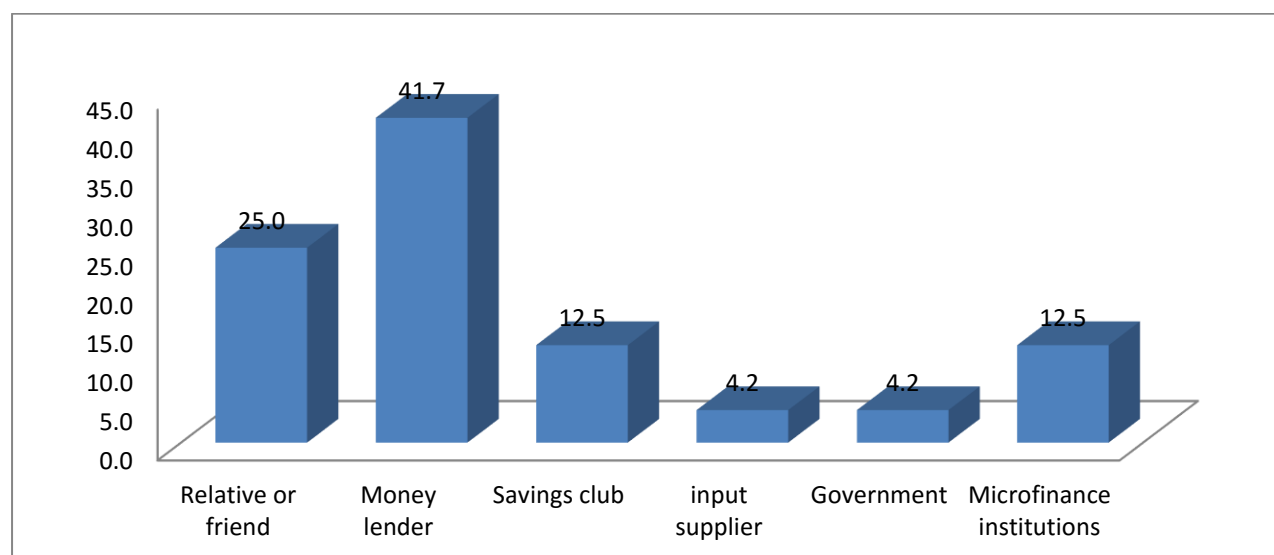


Figure 5.9. The main sources of credit or loan among farmers in Tugela Ferry (N=24) (% farmers)

Source: Survey data, 2016

The main reasons for farmers not accessing credit was that they did not want to be indebted. Previous bad experience with similar debts coupled with the risk nature of smallholder agriculture, it all makes smallholders in Tugela Ferry risk averse.

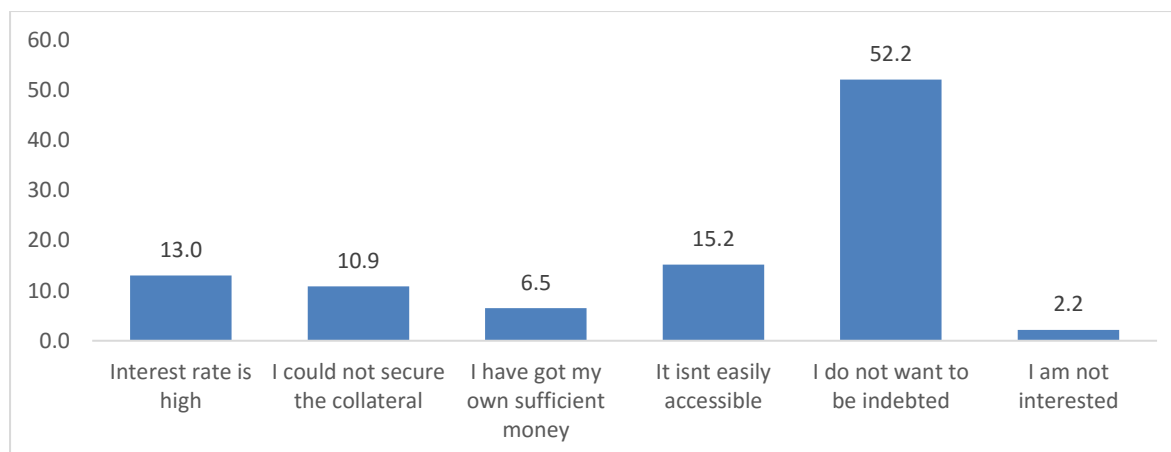


Figure 5.10. Farmers' reasons for not taking credit in Tugela Ferry (% farmers)

Source: Survey data, 2016

There are several other sources of household income that contributed to the household's financial capital. These included social grants, income from sale of crops and livestock, formal and informal employment and remittances, among others. These are discussed in detail in Chapter 7. However, it is important to note that 52% of the smallholders in this area indicated that they always use their social grant for agricultural purposes while 26% sometimes use it for the same purpose. In this case, it seems social grants contribute to smallholder agriculture. The net effect of social grants on entrepreneurial development in smallholder agriculture will depend on the magnitude of its effect as a form of investment, the significance of that investment vis-à-vis its negative incentives on entrepreneurial spirit.

5.4 Summary

The focus of this chapter was to evaluate capital endowment (natural, physical and financial) of farmers in and around the four irrigation schemes. The findings highlight that more intervention is required in order to better utilise the available capital assets and increase the competitiveness of smallholder farmers. Access to land is generally limited and worse for homestead and community food gardeners. Comparison across the scheme irrigators in the four areas shows the Ndumo-B smallholders are better endowed with more land compared to smallholders in the other schemes.

Land tenure security concerns in and outside the scheme should be addressed. The leasing arrangements in the scheme should be administered in such a way that those renting land have secure use rights during the lease period. The existing *ad hoc* partial land market and land rental related transactions provide opportunities for increased utilisation of irrigable land and deter farmers from speculative holding of unused land in the four schemes. The partial land market

increases the opportunity cost to holding on to unused land. However, renting land in the schemes brings its own challenges in terms of collective management of the schemes. Firstly, it increases pressure for irrigation infrastructure and equipment and secondly, it is difficult to get commitment from farmers renting land on collective management issues since they are temporary.

Lack of access to water is a challenge both in and outside the scheme. This is due to limited availability of water affecting mostly those irrigating out of the schemes and poor maintenance of irrigation infrastructure and a lack of enforceability of water sharing arrangements in the schemes. These findings highlight the challenges of managing common pool resources.

Regarding physical capital endowment, findings highlight the vulnerability of the smallholders in all the four areas to poverty. They lack physical assets that are important in farming. This affects the smallholder's capacity to operate more land and their market access. The findings also highlight the inherent challenges that smallholders continue to face in accessing credit. High interest rates, lack of collateral and the inability to absorb the risks related to borrowing are the major limitations to access of credit. Their current land holding rights do not allow for use of land as a collateral. Although, some farmers in all the areas indicated that they use income from social grants for agricultural purposes, this needs to be evaluated in view of the amounts actually invested and the empirical evidence suggesting their negative effect on the entrepreneurial spirit.

The study concludes that the institutional arrangements regarding access to land, water and credit need to be transformed for these resources to contribute meaningful to rural livelihoods. Intervention strategies must be holistic in nature, considering the important connections and complementarities of the various forms of capital. Above all, a rational, integrated approach to management in all these areas is needed to run smallholder farming as a business and make it profitable.

6 EVALUATION OF HUMAN, SOCIAL AND POSITIVE PSYCHOLOGICAL ASSETS AND ENTREPRENEURIAL SPIRIT IN THE FOUR IRRIGATION SCHEMES IN KWAZULU-NATAL

6.1 Introduction

The chapter addresses the second objective of the study. It deals with human capital (skills, knowledge, health and ability of labour), social capital (social resources including membership of groups, family and social networks) and PsyCap (individual mindset). It focuses on entrepreneurial spirit and management capabilities within incentives of secure land tenure, water use rights and leadership in organisational structures on the four schemes. The purpose is to evaluate the extent to which smallholder farmers in South Africa can run farming as a business and examine the extent to which endowment in human, social and psychological entrepreneurship drivers enhances farm entrepreneurship and water use productivity. This is meant to generate information on the role of the three capital endowments in unlocking agricultural entrepreneurship, with particular emphasis on smallholder irrigation schemes.

The rest of the chapter is structured as follows. Section 6.2 discusses the socio-demographic features of the respondents for each of the four study sites. Section 6.3 and 6.4 presents and discusses the empirical results on the human, social and psychological entrepreneurship drivers in Ndumo-B and Makhathini and Bululwane and Tugela Ferry, respectively. Section 6.5 discusses key issues for making entrepreneurship relevant to smallholder farmers while Section 6.6 draws lessons for future on-farm entrepreneurial development paths. The summary of the chapter is given in Section 6.7.

6.2 Socio-demographic features of respondents in and around the irrigation schemes

6.2.1 Makhathini and Ndumo-B

The mean size of households of farmers is 5.5. This figure is slightly above the average household size of uMkhanyakude district which is 4.9 according to the 2011 KwaZulu-Natal Provincial Census Report (Statistics South Africa, 2014). Scheme irrigators seem to have bigger families compared to other types of farmers although there is no significant difference across the types of farmers. Comparison by scheme shows that scheme irrigators in Ndumo-B have significantly higher household size compared to scheme irrigators in Makhathini and those outside of the scheme.

The average age of sampled farmers is 49.1 years. Although there is no significant difference across the types of farmers or between the schemes, the results show that very few young

people are involved in farming. Focus group discussions in Makhathini and Ndumo-B revealed that young people are not interested in farming preferring to do menial jobs or migrate to urban areas for jobs with quick financial rewards and better living conditions. This confirms evidence from Van Niekerk *et al.* (2011) that show one of the problem in smallholder agriculture as the lack of involvement of young people in farming. The other long-term problem is lack of succession plan in smallholder agriculture.

Most small-scale irrigators are women. Backeberg and Sanewe (2010) show that 56.5% of households in South Africa are headed by women and these constitute 61% of those involved in farming (Cousins, 2013). Unlike Makhathini irrigation scheme, Ndumo-B has a higher proportion of male farmers (76.2%) compared to females compared to 23.8% female. According to Golder Associates (2014), the gender distribution in Ndumo-B irrigation scheme is skewed towards men, partly due to the fact that when the scheme was initiated, only male farmers participated. Findings also show that more women are involved in homestead and community food gardening compared to scheme or independent irrigation. This could be related to access to resources that are required for scheme and independent irrigation. Women still face challenges relating to resources which limits their capacity to ensure agricultural productivity, security of livelihoods and food security, among other issues (Department of Economic and Social Affairs, 2009).

The mean dependency ratio is 0.58 which shows that generally smallholder households in and around Ndumo-B and Makhathini have more economically productive members compared to dependents. Comparison between the schemes show that farmers in Makhathini irrigation scheme are more economically burdened compared to those in Ndumo-B.

Table 6.1. Household demographics – Makhathini and Ndumo-B

Characteristics		Scheme irrigators (n=82)	Independent irrigators (n=38)	Homestead food gardeners (n=24)	Community food gardeners (n=15)	Makhathini (n=61)	Ndumo-B (n=21)	Out of scheme (n=77)	Total (n=159)
Size of household		5.9	5.3	5.4	4.4	5.6	6.7	5.2	5.5
Age of household head		48.1	50.7	49.1	50.5	47.7	49.4	50.2	49.1
Gender of household	Female (%)	54.9	57.9	66.7	60.0	65.6	23.8	61.0	57.9
	Male (%)	45.1	42.1	33.3	40.0	34.4	76.2	39.0	42.1
Percent economically active household members		0.70	0.69	0.80	0.79	0.77	0.75	0.75	0.72
Dependency ratio		0.65	0.48	0.41	0.71	0.77	0.33	0.51	0.58

Source: Survey data, 2015

Figure 6.1 confirms that farming is the main occupation of farmers (84%). No farmers in the scheme are self-employed and have a regular salaried job in the study. This concurs with findings from focus group discussions both in Makhathini and Ndumo-B, as farmers mentioned that farming is their major source of income. “We are the ones who are also responsible for creating job opportunities in the area as there are no other means of living except farming in this area because there are no factories nearby” said one of the farmers in Ndumo-B irrigation scheme. Some homestead and community food gardeners are not fulltime farmers but engage in farming as a secondary occupation. Their primary occupation includes salaried jobs, temporary jobs and self-employment.

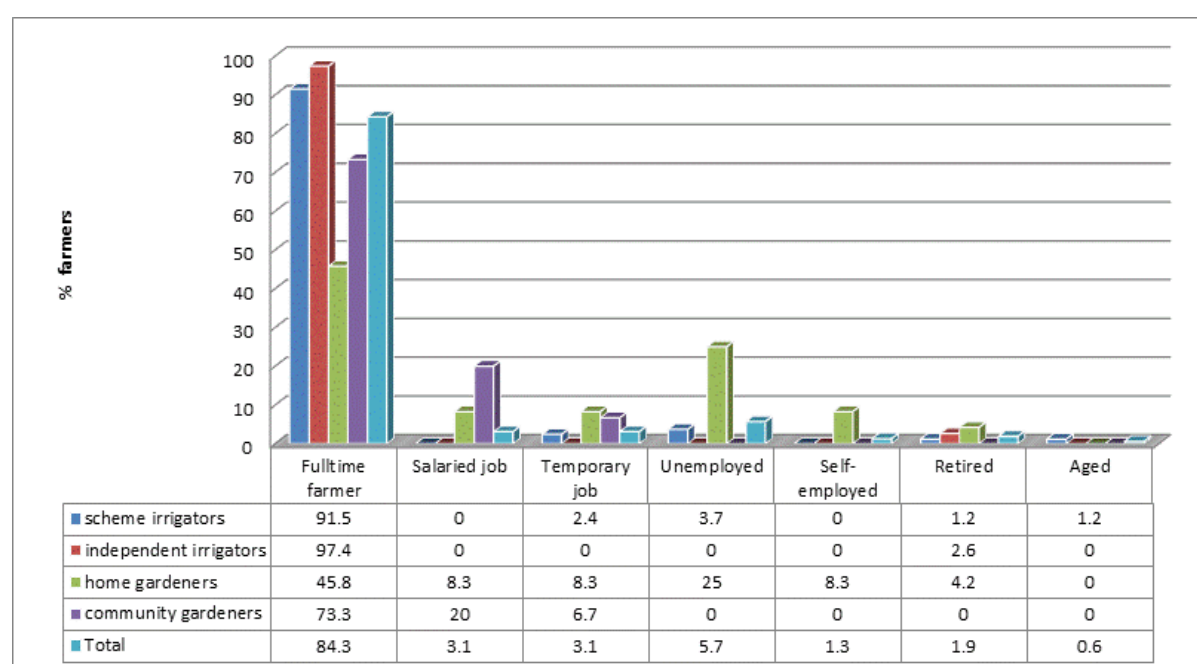


Figure 6.1. The main occupation of the farmer – Makhathini and Ndumo-B

Source: Survey data, 2015

6.2.2 Bululwane and Tugela Ferry

This section provides some socio-demographic description of smallholder farmers in and around Bululwane and Tugela Ferry irrigation schemes. The average age across all types of smallholder farmers was 51.6 years which is higher than that of Ndumo-B and Makhathini. Bululwane has slightly older farmers compared to Tugela ferry. There were no significant differences across the different types of smallholder farmers. The results confirm the above findings that very young people are involved or participate in farming.

According to the focus group discussions held in Nongoma and Tugela Ferry, it was mentioned that it is difficult for young people to gain access to irrigable land because of its scarcity. Those

that do have access receive it through their parents or inherit it from their parents. The majority of the farmers further mentioned that their children are not interested in farming because they don't see opportunities in it and they don't see smallholder farming contributing meaningfully to their family livelihoods. This is consistent with the findings by Mkhabela (2005) and Fischer and Qaim (2012) who found that the younger generation is not much interested in farming but rather hopes to find employment outside agriculture in the future, preferably in urban areas.

The majority of the farmers in the two areas were female and constituted 76.2% of the sampled population. The trend is the same across different types of farmers and scheme. Comparison across the schemes show that a smaller percentage of smallholders in Bululwane irrigation scheme are female compared to Tugela Ferry irrigation scheme and those irrigating outside of the schemes. During the farmer group discussions in Tugela Ferry, it was mentioned that most men still see farming as a women's job. It was revealed that most men only assist women when the need arises (i.e. when preparing the land, weeding and harvesting). Some female scheme irrigators in Tugela Ferry reported that their husbands only visit the plot when the produce is ready to be harvested.

The results show that farmers in and around Bululwane and Tugela Ferry irrigation schemes have larger household sizes compared to those from Ndumo-B and Makhathini. The average household size is 8.2 members and is significantly high across all types of farmers. The economic burden of households in and around these two schemes is also higher than those in Ndumo-B and Makhathini. The average dependency ratio is 1 which means the number of dependents equals that of productive household members. Bululwane irrigation scheme has a higher dependency ratio compared to Tugela Ferry. No significant differences were observed across the different types of farmers, although homestead food gardeners have the lowest dependency ratio. However, the dependency ratio in this study has to be taken cautiously as most of the people in the rural areas between the ages of 15 to 64 are usually unemployed and families depend on the social grants and remittances and not earned income. This will be elaborated in detail in Chapter 7.

Table 6.2. Household demographics – Bululwane and Tugela Ferry

Characteristics		Scheme irrigators (n=88)	Homestead food gardeners (n=22)	Community food gardeners (n=10)	Bululwane (n=32)	Tugela Ferry (n=58)	Out of scheme (n=40)	Total (n=128)
Size of household		8.4	8.0	6.8	8.3	8.4	7.7	8.2
Age of household head		51.2	53.9	54.6	53.9	49.1	53.4	51.6
Gender of household head	Female (%)	75.0	81.8	90.0	59.4	81.0	82.5	76.2
	Male (%)	25.0	18.2	10.0	40.6	19.0	17.5	23.8
Percent economically active household members		0.6	0.6	0.6	0.5	0.6	0.6	0.6
Dependency ratio		1.0	0.8	1.0	1.4	0.8	0.9	1.0

Source: Survey data, 2016

Most smallholder farmers (88.5%) consider themselves as fulltime farmers (Figure 6.2). Only a few proportion of the farmers are engaged in temporary jobs or are engaged in salaried jobs. The results show that farming is important for sustaining livelihoods for all farmers in the study areas.



Figure 6.2. The main occupation of the farmer – Bululwane and Tugela Ferry

Source: Survey data, 2016

The level of education and experience in farming of the farmers in the study communities are discussed as part of the following sections – section 6.3.2 and 6.4.2.

6.3 Human and social entrepreneurship drivers in Makhathini and Ndumo-B

In the past years, irrigation infrastructure was regarded as the single most important constraint for the failure of many smallholder irrigation schemes. However, studies such as De Lange *et al.* (2000) have revealed that, human capital is the main source that leads to success or failure affecting water use productivity. To improve water use productivity and enhance the impact of irrigation on rural livelihoods, the human dimension has to be given enough attention along with improving infrastructure.

6.3.1 Why do Makhathini and Ndumo-B farmers farm?

The study seeks to describe and analyse farmers' endowments to human, social and psychological entrepreneurship drivers within Makhathini and Ndumo-B. Access to these

forms of capital is critical to sustainable livelihoods, irrigation water use productivity and farm entrepreneurship.

The challenge for South African smallholder development policy is the creation of conditions necessary to motivate and enable smallholders to progress from subsistence to commercial producers (Van Auerbeke and Mohamed, 2006). Available evidence suggests that there is hope in the development of entrepreneurial capabilities among smallholder producers in Makhathini. The responses show that the farmers are more commercially inclined as the majority of them are producing for income. This was consistent with findings by Golder Associates (2014) that farmers around the Makhathini area are commercially oriented and do market their produce through various market channels.

The starting point to understand farmers' endowment with PsyCap is the reason they do farming. Despite a wide range of social, human, physical and financial challenges, it is important to understand broadly the reasons for community involvement in agriculture. Aliber and Hart (2009) analysed the 2006-2007 labour survey data and concluded that most smallholder farmers get into agriculture to use it as an extra source of food. Farmers, thus, were asked as to why they farm. Table 6.3 summarizes the reasons for farmers to participate in agriculture.

Table 6.3. Reasons for household participation in farming – Makhathini and Ndumo-B

Reasons	Makhathini (n=61)		Ndumo-B (n=21)		Out of scheme (n=77)		Combined (n=159)	
	N	%	n	%	n	%	n	%
Income	58	95.1	16	76.2	40	51.9	114	71.7
Extra food	1	1.6	1	4.8	34	44.2	36	22.6
Leisure time	1	1.6	1	4.8	0	0.0	2	1.3
Employment	1	1.6	3	14.3	3	3.9	7	4.4
Total	61	100	21	100	77	100	159	100

Source: Survey data, 2015

Accordingly, the highest percentage of farmers (71.7%) practice farming to earn income and make a living while 22.6% use it as a source of food, employment (4.4%) and leisure (1.3%). While the number of those who farm as the main source of livelihood or extra source of income is huge, the numbers who do so consistently might actually be much smaller. This could not be explained with the cross-section data available.

In the remainder of this section, a detailed account of the farmers' human capabilities, social capabilities and psychological capabilities is given to fully contextualize the potential of smallholder farmers in and around Ndumo-B and Makhathini irrigation schemes to grow their agribusinesses.

6.3.2 Education, farming experience, entrepreneurial spirit and managerial capabilities

According to Golder Associates (2014), Ndumo-B irrigation scheme can be characterised as one of the most advanced schemes of all the four targeted schemes due to the calibre of farmers farming in the area. Table 6.4 shows the situation regarding three human capital aspects, i.e. level of education, indigenous knowledge and life experience.

Table 6.4. Other demographic attributes of the respondents in Makhathini and Ndumo-B (n=113)

Attribute	Makhathini (mean)	Ndumo-B (mean)	Combined descriptive statistics			
			Min	Max	Mean	Range
Highest level of education (years of formal school)	6.67	2.54	0	12	4.77	12
Availability in the household for family labour	6.36	6.29	1	7	6.33	6
Farming experience (Years)	11.49	9.31	1	34	10.49	33

Source: Survey data, 2014

In terms of education, the majority of farmers have no matric education, most having completed 4.7 years of formal education, 2.54 for Ndumo-B and 6.7 for Makhathini. This might be attributed to historical reasons. Level of education affects decision making and entrepreneurial capabilities of farmers. In South Africa, there is a positive correlation between opportunity-driven entrepreneurship and levels of education (Herrington and Kew, 2014), implying that education is enabling people to identify opportunities.

The average farming experience is 11.5 years. Most of them started farming when they were growing up and others used to work for white commercial farmers while cotton was irrigated in Makhathini flats. Most now have their own plots of land inherited from their forefathers which they are now operating.

From the sampled farmers, about 95% were able to identify the crops that can work best with irrigation and 85% cultivated their irrigable plots with these crops. It is also important to note

that each farmer handles knowledge in a distinct way. More traditional farmers tend to hang on to the knowledge they acquired from their fathers. Alternatively, market-oriented farm entrepreneurs actively seek new and reliable information that will help them decide how to make their farms more profitable (Kahan, 2012). The common indigenous knowledge amongst the sampled farmers is the importance of paying careful attention to the growth stages of crops. They emphasised the importance of knowing when and how to apply fertilizer. Over the years, farmers have switched from using manure to using chemical fertilizer.

How farmers handle knowledge is a good indicator of how serious they are about making profits and being an entrepreneur (Kahan, 2012). Many of the farmers interviewed felt that training in packaging was unnecessary since consumers picked the produce straight from their plots. As a result, farmers did not attend such opportunities and instead left it to the cooperative leaders. Some had no information about these training opportunities and others were still new in farming. Lack of information about the training being offered couldn't have been the main reason why the sampled farmers failed to attend some of the training opportunities because 44.3% of them found accessing agricultural information very easy.

The results indicate that 78.8% of the Ndumo-B farmers' farm as individual or as household while 19.2% as cooperative. This is in contrast to Makhathini farmers where 62.3% are operating under agricultural cooperative group and practising farming as members of cooperatives. The survey explored the extent to which farmers are willing to work together in buying inputs, harvesting and negotiations on prices of produce. The results indicated that the majority buy their own equipment as individuals which means they do not share cost or buy inputs in large quantities at the cheaper price to reduce the transaction cost of doing business and take advantage of economies of scale.

6.3.3 Access to agricultural training

A successful training programme should ideally increase entrepreneurial capacity and increase desire to act. Access to agricultural training is an important human enabler, which is vital for entrepreneurial development. This is particularly important where the target community has low levels of formal education. For Makhathini and Ndumo-B farmers, 27.4% of the respondents never received any form of agricultural training, while 34.5% accessed training from government extension services (Table 6.5).

Table 6.5. Access to agricultural training services – Makhathini and Ndumo-B (n=113)

	Makhathini		Ndumo-B		Combined	
	n	%	N	%	n	%
Department of Agriculture	16	26.2	23	44.2	39	34.5
Private Company	8	13.1	1	1.9	9	8.9
Non-Government Organisation	1	1.6	1	1.9	2	1.8
Cooperative Members	2	3.3	1	1.9	3	1.8
More than one	17	27.9	12	23.1	29	25.7
No training at all	17	27.9	14	26.9	31	27.4
Total	61	100	52	100	113	100.0

Source: Survey data, 2014

It is important to note that 25.7% of the respondents received training from more than one service provider (Table 6.5), signifying the importance of public-private partnerships (PPPs) in the development of the smallholder sector in South Africa. Of those that received training, the sessions dwelled more on agronomic aspects, i.e. vegetable production, fertilizer application, herbicide application, among others and less on handling of produce after harvesting (Table 6.6).

Table 6.6. Agricultural training among farmers – Makhathini and Ndumo-B (n=113)

Training on:	Makhathini (% trained)	Ndumo-B (% trained)	Combined (% trained)
Vegetable production	62.3	67.3	64.6
Land preparation	67.2	69.2	68.1
Fertilizer application	67.2	71.2	69.1
Herbicide application	68.9	69.2	69.0
General irrigation practice	63.9	65.4	64.6
Irrigation scheduling	62.3	65.4	63.7
Irrigation water management	63.9	65.4	64.6
Commodity marketing	60.7	59.6	60.2
Packaging of fresh produce	50.8	57.7	54.0
Processing of farm produce	44.3	55.8	49.6
Pricing of farm produce	44.3	57.7	50.4

Source: Survey data, 2014

The highest percentage of training received is on fertilizer application, land preparation and herbicide applications. During the survey, farmers mentioned that before they plant crops they have to take soil sample to the Provincial DARD for soil sampling. When the soil sample results are back, proper fertilizer will be recommended for maximum productivity, based on the type and quality of soil.

A healthy and well-trained workforce is vital to ensure competitiveness, productivity and growth of agribusinesses. The ability of households to manage their labour capital and take advantage of opportunities for economic activity is constrained by the levels of education and skills and the health status of household members. About 67% have access to medical services through mobile clinics. A sound education and training system is, therefore, one of the key imperatives for competitiveness, as it is reasonable to believe that such a system will have a positive influence on an individual's self-efficacy and self-confidence, thereby increasing the chances of such individuals starting a business and making it successful (Herrington and Kew, 2014). Access to training for all agricultural activities seems to be homogeneous across the farmers in Makhathini and Ndumo-B schemes. The fact that an average of around 60% of the farmers got trained in almost all activities shows that group training could be the dominant tool being employed by extension officers in the area. Key informant interviews revealed that a single training session could cover a number of areas like vegetable production, fertilizer application, land preparation, etc. (Table 6.6). However, farmer training in the processing of farm produce, packaging and pricing of fresh produce need to be increased to improve entrepreneurial capabilities of Makhathini and Ndumo-B farmers (Table 6.6). This is even more important and ignored for post-harvest handling.

The majority of the farmers have received some sort of agricultural training, often from the DARD and other companies such as Lima and TechnoServe or a combination. However, as noted in Chapter 5, only about 59% of the farmers are able to put into practice the advice they received from the training (Table 6.7), which shows the limited applicability of the training not because it is complex but because it requires resources beyond their reach. Most farmers noted that it is not easy to practice what they had been told during the training because of limited resources and lack of financial support to buy proper equipment/input. After completing the training, some farmers discover they do not have funds to implement their new ideas (Kahan, 2012). For example, they usually can't afford to buy the recommended fertilizer after the recommendation following the soil sample. They end up using cheap fertilizers or "kraal" manure.

Effective institutions need to be developed to provide training at the right time, in the right place and with the right balance of technical knowledge and practical skills (Kahan, 2012). Several studies agree that the scarcity of jobs in the formal sector is driving many people to rely on land and natural resources extraction activities (Andrew *et al.*, 2003). This is even more

so when education levels are low (McKeown *et al.*, 2002), which appears to be the case in Jozini area.

Those farmers who had not attended the above training sessions (Table 6.6) stated different reasons for not doing so including:

- Lack of awareness of the training being offered,
- Reliance on other farmers for advice,
- Lack of knowledge about the training being offered,
- Not yet finding it necessary,
- Never invited to any training; often times only cooperative leaders or scheme leaders attend training sessions,
- No training offered, and
- Still new as a farmer.

Table 6.7. Skills utilisation among farmers – Makhathini and Ndumo-B (n=113)

Skills utilisation	Ranking (% respondents)				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I attended all training sessions held in Makhathini and Ndumo-B	31.9	11.5	3.5	30.1	23.0
I fully understood the information provided in the training session	31.0	3.5	4.4	38.1	23.0
I am able to put into practice all the skills from the training sessions	31.0	3.5	4.4	37.2	23.9

Source: Survey data, 2014

A large number of respondents do not attend training sessions while 31% of those that attend do not fully understand the information delivered during the training sessions. There might be a need to intensify training and visit extension approaches to ensure that training takes place on farm. This might enhance farmer understanding of the training offered by the officers. The current approach makes it difficult for farmers to practice what they have been taught during the training sessions (Table 6.7). More needs to be done to explore appropriate and tailor-made training. Such approaches must take into account the low levels of prior learning and must, therefore, provide a firm foundation for the farmers.

In addition to their personal characteristics entrepreneurs also need a range of competencies and abilities that can be learned or developed through training and experience with the active support of extension officers. Agricultural extension can be used to enhance rural entrepreneurship. Extension workers have a particularly central role to play in supporting on-farm entrepreneurial learning among smallholder farmers. Offering suitable support and encouragement may require a change of extension approach and expanding extension agencies' perception of the role extension can play in fostering entrepreneurial farming (Kahan, 2012). The role of extension has to go beyond technology transfer and training. More accurately, it should include assisting with farmer group formation, dealing with marketing issues and partnering with a broad range of service providers and other agencies (Davis, 2008). After providing support to a farmer, the extension worker has to be able to identify particular skills or background knowledge the farmer lacks. At that moment training begins, i.e. training and extension are supposed to be part of the continuum of entrepreneurship development (Kahan, 2012).

After providing support to a farmer, the extension worker is able to identify particular skills or background knowledge the farmer lacks. At that moment extension stops and training begins. Training and extension are part of the continuum of entrepreneurship development to unlock rural entrepreneurial spirit and management capabilities in the context of a smallholder irrigation scheme (Kahan, 2012). However, the service that South African farmers receive from government extension workers might be inadequate and it is often characterised by less frequent farm visits by extension workers, lack of capacity to offer specific skills in marketing or agronomy and the inability to identify skills needs for individual farmers.

Despite the perception that a good education will have a positive influence on an individual's sense of self efficacy, self-confidence and entrepreneurial capabilities (Herrington and Kew, 2014), Sinyolo *et al.* (2016) shows that it is not formal education, but on the job training, farming experience and indigenous knowledge that are key to farm entrepreneurship. Herrington and Kew (2014) conducted a study to analyse the influence of education and training on the entrepreneurial capabilities of business owners in South Africa. The study, which was carried out in 2010 and 2013, was based on key informant experts' ratings on a five-point scale of (1-5) for different aspects of education and training. The results show that the current formal schooling programme in South Africa does not provide adequate grounding in the preparation for starting up and growing a new business (Table 6.8).

Entrepreneurship is better with a tertiary qualification than with secondary education only (Table 6.8). Herrington and Kew's finding points to the need to focus on the development of business management skills in preparation for starting up and growing new businesses. However, given the weakness in the formal training systems in South Africa as identified in Table 6.8, there is need to focus on specific skills training in order to enhance the chances of business success among smallholder agribusiness entrepreneurs. Informal training by extension workers to bridge the skills gap among farmers is very important to improve the entrepreneurial capabilities of smallholder farmers.

Table 6.8. Average expert ratings on education and training for entrepreneurship in South Africa, 2010 and 2013

Educational Entrepreneurial Framework Condition	Mean Score 2010	Mean Score 2013
Primary and secondary education encourages creativity, self-sufficiency and personal initiative	1.75	1.96
Primary and secondary education provides adequate instruction in market economic principles	1.67	1.63
Primary and secondary education provides adequate attention to entrepreneurship and new firm creation	1.83	1.75
Colleges and universities provide good and adequate preparation for starting up and growing new firms	2.33	2.33
Business and management education provides adequate preparation for starting up and growing new firms	2.60	2.50
Vocational, professional and continuing education provides good and adequate preparation for starting and grow new firms	2.32	2.13

Source: Herrington and Kew, 2014

6.3.4 Social capital, entrepreneurial spirit and managerial capabilities

The households' ability to manage their labour and take advantage of opportunities for economic activity is constrained by the levels of education and skills and the health status of household members. Thus, human capital is critical to the fulfilment of productive and reproductive tasks (Rakodi, 1999). Narayan (1997) defines social capital as 'the rules, norms, obligations, reciprocity and trust embedded in social relations, social structures and society's institutional arrangements, which enable its members to achieve their individual and community objectives'. Rakodi (1999) simply defines it as the social resources (networks, social claims, social relations, affiliations and associations) upon which people draw when pursuing different livelihood strategies requiring coordinated actions.

Farmer-entrepreneurs do not work in isolation. They are part of a larger collection of people including other farmers, suppliers, traders, transporters, processors and other stakeholders, each of whom has a role to play in the agricultural value chain (Coleman, 1998 and Kahan, 2012). Entrepreneurial farming is a complex system consisting of a population of interacting, heterogeneous agents in which the behaviour of each agent can be described as a function of the behaviours of other agents, as well as of other factors (Darluf, 2012).

Collier (1998) examined the effects of social interactions on social externalities and suggested four types of information flow: (1) observation, in which information flow is informal and one-way; (2) hierarchies, in which information flow is formal and one-way; (3) networks, in which information flow is informal and reciprocal; and (4) clubs, in which information flow is formal and reciprocal. The flow of information, as a knowledge-builder, has three effects: (1) increased knowledge of the behaviour of others (assessment), which reduces risk and transaction costs and increase trust; increased knowledge about the non-behavioural environment (knowledge), which improves productivity and reduces risk and transaction costs; and collective action (coordination), which increases overall social benefits. When solving social dilemmas, coordination is easy and the group members can work towards the benefit of all members individually and collectively. Such collective action benefits enable the group to identify who is good in doing what and take advantage of such skill and knowledge differences. That, in turn, reduces transaction costs, improves efficiency and enhances water use productivity.

6.3.4.1 Access to agricultural information and support

Smallholder farmers in sub-Saharan Africa face a range of production and marketing problems among which informational constraints are widely acknowledged but little researched (Magingxa *et al.*, 2009). Information that is available to rural communities may not be equally distributed and smallholder producers, especially those distanced further from the market and information centres are more disadvantaged. This is the reality that makes access to information more difficult for smallholders and the fragmented nature of their homesteads makes it more costly to connect them and improve their access to information. According to Magingxa *et al.* (2009), such smallholders often do not have timely access to salient and accurate information on prices, locations of effective demand, preferred quality characteristics of horticultural produce, nor on alternative marketing channels, which weakens their bargaining position vis-a-vis traders.

The study acknowledges the multiplicity of sources of agriculture-related information among smallholders. The Makhathini and Ndumo-B farmers consider government extension services and farmer-to-farmer sharing of information as the most important sources of information (Table 6.9). Farmer-to-farmer sharing of information signifies the importance of social networks and relations in improving production and entrepreneurial capabilities of smallholder farmers. Furthermore, farmers also gain production information through irrigation committee members, leaders of the cooperatives, NGO personnel and community meetings. Many farmers also contact the scheme leader if they need any information regarding farming. Not many farmers had used traditional leaders as source of agricultural information in the past years though many consider them as important in their livelihoods. Again, belonging to formal groups is important and improves access to information among smallholder farmers. The internet was the least used, hence the zero number of personal computers in households. Most new farmers learn from other farmers and cooperative leaders. Agricultural programmes on radio are also a good source of information. Traditional leaders apart from allocating land, play a very minimal role in agriculture in the area.

Table 6.9. Sources of agricultural information – Makhathini and Ndumo-B (n=113)

Sources of agricultural information	Respondents (%)				
	Not a source	Neutral	Not important	Important	Very important
Government extension officers	11.5	0.0	0.9	36.3	51.3
Media (Radio and Television)	31.9	4.4	10.6	34.5	18.6
Internet	88.5	0.9	2.7	3.5	4.4
Fellow farmers	2.7	0.9	1.8	37.2	56.6
Community meetings	20.4	2.7	4.4	30.1	42.5
Committee members	15.9	2.7	2.7	31.9	46.9
Cooperative leaders	18.6	0.0	8.8	31.9	40.7
Traditional leaders	70.8	1.8	11.5	10.6	5.3
Non-governmental organisations (NGOs)	24.8	6.2	8.0	23.0	38.1
Private organisations	41.6	4.4	7.1	20.4	26.5
Phones (SMS, calls, etc.)	46.9	3.5	1.8	21.2	26.5

Source: Survey data, 2014

Lack of information, awareness and preparedness amongst smallholder agribusiness entrepreneurs is a major issue affecting their success in South Africa. The issue might not be so much a lack of access to information but the stringent and lengthy process required to access relevant information to grow smallholder agribusinesses. This is exacerbated by the general lack of awareness about the procedures and the courses of action involved in gaining

information for funding, infrastructure support, marketing and agronomic practices, which leaves farmer entrepreneurs under-prepared and under-researched. Furthermore, information regarding the application processes to access support services, which is mostly from government, tends to be bureaucratic and heavily laden with protocol and red tape as funders endeavour to gain confidence and assurance when granting funding to entrepreneurs. The very fact that they are small makes it difficult for smallholders to access such services. The negative perception of the service providers about the capacity of these farmers to run their farms profitably is the other prevalent challenge.

The management of farmer expectations also presents a challenge, especially in the provision of support services. Smallholders, as upcoming entrepreneurs expect the process of getting support and funding to be quick and easy. Unprepared agribusiness entrepreneurs often end up frustrated and disappointed with the process and most quit farming. This might be an indication of low positive psychology, hence the need to encourage perseverance, preparedness, pragmatism and practicality when taking agriculture as a business.

Information is the key to change entrepreneurial spirit into practice. It is easy to access agricultural information for only 61.6% of the farmers. Those farmers who stated that it is easy to get information noted that extension officers are their primary source of information. For about 33% of the farmers, it is difficult to access agricultural information. However, not only accessing information but also capacity to process and utilise the information is another constraint.

6.3.4.2 The role of collective action and leadership structures

Collier (1998) states that for the effects of social interaction to be classified as social capital, either the structure that produces the effects is durable or the effects themselves are durable. Using this line of thinking, both informal and formal social interactions help solve problems associated with groups by reducing transaction costs and increasing knowledge sharing. There is thus an increase in net benefits available for members through learning, trust and rules. Despite the prevailing knowledge about the importance of collective action, 55.8% of the farmers in Makhathini and Ndumo-B produce as individuals, 1.8% in informal groups and 40.7% are members of registered cooperatives. A further breakdown of the various activities of production and marketing and the extent to which farmers are involved as groups is reported in Table 6.10.

The results of the table below indicate that the majority of the farmers are not involved in group activities. The results correspond to the results reported before that most farmers practice farming individually. The study found that high percentage of farmers negotiate on selling prices.

Table 6.10. Involvement of respondents in group formations – Makhathini and Ndumo-B (% farmers) (n=113)

Activities	Makhathini			Ndumo-B			Combined		
	Not at all	At times	Regularly	Not at all	At times	Regularly	Not at all	At times	Regularly
Pump maintenance	57.4	11.5	29.5	63.5	9.6	26.9	60.2	10.6	28.3
Canal maintenance	57.4	14.8	27.9	65.4	9.6	25.0	61.1	12.4	26.5
Market price negotiations	57.4	26.2	16.4	46.2	15.4	38.5	52.2	21.2	26.2
Hiring transport for marketing	65.6	24.6	9.8	53.8	17.3	28.8	60.2	21.2	18.6
Hiring tractors/ machinery	59	26.2	14.8	69.2	13.5	15.4	63.7	20.4	15
Commodity marketing	67.2	19.7	13.1	63.5	19.2	17.3	65.5	19.5	15
Weeding	77	11.5	11.5	71.2	11.5	15.4	74.3	11.5	13.3
Irrigation	78.7	8.2	13.1	78.8	7.7	13.5	78.8	8	13.3
Planting	78.7	9.8	11.5	61.5	25.0	13.5	70.8	16.8	12.4
Harvesting	77	13.1	9.8	73.1	15.4	11.5	75.2	14.2	10.6
Securing commodity markets	70.5	16.4	13.1	75.0	17.3	7.7	72.6	16.8	10.6
Input procurement	67.2	26.2	6.6	75.0	15.4	9.6	70.8	21.2	8
Land preparation	82	9.8	8.2	84.6	7.7	7.7	83.2	8.8	8

Source: Survey data, 2014

According to Ostrom (1998), the linkage between social capital and collective action is embedded in the behavioural rational choice theory that proposes the idea that a ‘core relationship’ between trust, reputation and norms of reciprocity reinforce each other and can lead to increased levels of cooperation and, hence, net benefits. This applies well to choice activities like planting, commodity marketing, market channel choice and harvesting, of which the results in Table 6.10 show that farmers prefer to perform such activities as individuals rather than collectively. As a result, they are not able to take advantage of the possible economies of scale benefits of collective action. Although the results indicated that farmers are involved in collective bargaining of market prices (26.2%), there was a lower percentage of farmers (15%)

marketing collectively. Such a trend might reveal a number of aspects including: (1) farmers might have a lower understanding of the importance of reducing transactions costs along the entire supply chain, (2) farmers do understand the role of collective action but fail to understand how it can help them improve their business in terms of access to inputs/services which they would not be able to access otherwise and (3) it might be because of the failure of collective action institutions in smallholder agriculture due to their failure to trace and suppress/correct free riding and other opportunistic behaviours / institutional failures. Farmer training and facilitating collective action in critical production and marketing activities, input procurement, securing commodity marketing and commodity transportation might improve the competitiveness of smallholder farmers in Makhathini and Ndumo-B irrigation schemes.

On the production front, farmers have shown slight increase in group participation in the maintenance of common pool resources like irrigation pumps and conveyance canals. The importance of collective action local leadership structures in the management of water resources is also evidenced by fewer occurrences of disputes around water sharing and management in both schemes. In the Makhathini scheme, 73.8% of the respondents indicated that they have never witnessed any water-related conflict among the farmers, while 40.4% reported the same in Ndumo-B irrigation scheme. Only 9.7% farmers stated that disputes occur often. However, when such disputes occur, 59.3% of the respondents from both schemes revealed that they engage block committees to resolve the problems while 30.1% approach the Mjindi agricultural cooperative for dispute resolution. The importance of effective local management structures to improve resource management is key to the success of community irrigation schemes. The results suggest that there is good working relationship among farmers in relation to water use. Those who noticed disputes are mainly the ones renting land. During the survey those farmers who are renting in portion of a divided plot mentioned that they had to share the same irrigation equipment and wait for other renter(s) to finish first with irrigating the portion of land he or she is renting. Accordingly, sprinklers are not enough for all of them to share.

The survey has revealed that farmers in both Makhathini and Ndumo-B irrigation schemes do not utilise the local WUAs as anticipated by the legislative framework governing water use in South Africa. The association is not active and therefore its responsibilities are shared between the block committees and the Mjindi cooperative. However, the use of multiple structures to resolve institutional problems related to water might cause problems where variations in the penalty systems differ and end up disadvantaging other users. Local organisation and

governance affects the success of small-scale irrigation schemes (Holbrook, 1996). When the irrigation scheme is dependent on pumping water, centralized control is needed while decentralization of authority would be the outcome when the irrigation system is gravity-fed. In sum, the discussions held with the relevant key informants shows the poverty of leadership in local organisations, such as formal WUAs or informal/formal tribal structures.

6.3.4.3 Collective management of smallholder irrigation schemes

Water management at a local level is undertaken by WUAs, defined as co-operative associations of individual water users undertaking water-related activities for their mutual benefit (Woodhouse, 2012). It is voluntary and the leaders are elected through a participatory process. All WUAs are to be managed by a management committee and may charge its members to fund its activities (Woodhouse, 2012). However, the case of Ndumo-B and Makhathini irrigation schemes resemble a different management structure for both water and land resources. Ndumo-B irrigation scheme is managed by a single cooperative of 21 members, which oversees irrigation maintenance, fee collection and dispute resolution. A committee selected by the members through a voting process is responsible for the management of the scheme. All WUAs in the scheme are inactive and hence all water management issues are addressed by the cooperative. The members of the scheme hold PTO for the land, which are flexible and permit sub-leasing arrangements to potential tenants. As such, a large number of community members are taking part in irrigation farming in the Ndumo-B irrigation scheme.

It is clear that holders of PTOs in Ndumo-B scheme are not utilizing their allocated land in full, hence the prevalence of land fragmentation and leasing of land to community members. This raises a question of whether the current land size is too big for a single farmer or the farmers lack resources to fully utilise the land. This can also inform land allocation programmes in the planned expansion of Ndumo-B scheme. However, informal interviews with tenants revealed that accessing PTOs in the scheme is a challenge and seem to benefit relatives of the current group of farmers through inheritance of the land. Farmers view the current land allocation and plot size as too big and not favouring new entrants to join the scheme. There might be a need to revisit land allocation in Ndumo-B with a view to allowing potential entrepreneurial farmers to join and participate in the scheme.

The cooperative concept is also implanted in Makhathini irrigation scheme, which is managed by Mjindi private limited company. Farmers in Makhathini scheme are organised into about 27 cooperatives that are coordinated by elected committee members. There is also an umbrella

committee known as the Board of Trustees, made up of representatives from each cooperative. The umbrella committee (scheme committee) holds regular meetings with the Mjindi personnel, where issues of irrigation maintenance, service charges and water issues are discussed. Again, like the Ndumo-B irrigation scheme, the Makhathini Scheme has no active WUAs. Mjindi assumes all responsibilities of water allocation and management in the scheme.

The business model of Makhathini irrigation scheme is such that farmers are encouraged to operate in groups, hence the formation of numerous cooperatives. The cooperatives allow farmers to access business funding and pave way for Makhathini farmers to expand their agribusinesses if managed properly. The model has benefited farmers through access to training and irrigation infrastructure. Furthermore, farmers believe that the model allows a quicker and fair dispute resolution mechanisms since the Mjindi personnel, which are believed to be neutral are involved in the processes. If such partnerships like the “Government-Mjindi-Makhathini” are reinforced by effective market development for the farmers, there is potential of growth among smallholder irrigators. Such public-private partnerships can also create the platform for farmers to raise issues, constraints and future plans so that the stakeholders involved can use that information to enhance local leadership and management of smallholder irrigation schemes.

6.3.5 Psychological capital, entrepreneurial spirit and managerial capabilities

If one has the determination and courage to succeed despite adversities, he/she will make “things happen”. It was, therefore, found imperative to assess the PsyCap of irrigators, focusing on factors hindering farmers from realizing their potentials. An entrepreneur endowed with PsyCap is determined, always looking for opportunities to improve and expand his business.

The mechanisms through which farmer-entrepreneurs can grow their farm businesses include increasing the area under production to increase marketable surplus, using better technology, using better agronomic practices to enhance productivity, diversifying enterprises to reduce risk and processing and packaging to add value. What most farmers failed to acknowledge was that while the organisation may still remain simple, growth would require more managerial skills and qualities to cope with the more complex farm management activities and decisions.

What enables rural people to possess and utilise PsyCap on the farm? There is little research done on this question. According to Schumpeter (1934), the incentives that derive entrepreneurial spirit include: the dream and the will to find a private kingdom; the will to prove oneself superior to others and succeed; and the joy of creating and getting things done.

Why is it that these incentives are absent in smallholder farming? One problem with the Schumpeterian concept of entrepreneurship is that he gave risk taking as the responsibility of the bank, which is not the situation smallholders face today. They face risk emanating from nature, policy, market and social/private reasons. They are expected to absorb and manage all these potential changes and their consequent impact on their farms and their livelihoods. Lack of interest in agricultural entrepreneurship is further exacerbated by the fact that agriculture is not sexy as a result of which especially the youth appeared to be less interested in it.

PsyCap paves the way to effectiveness in the management of smallholder farms. A broader focus and adoption of strategies to enhance PsyCap among irrigators is anticipated to improve irrigation performance and the level of entrepreneurial capabilities among farmers. It can be argued that technical skills training and the redesigning of irrigation policies without supporting the psychological component might yield minimum results in the long run. The notion that smallholder farmers in most communally-managed schemes are still being funded by the government and regard the infrastructure as belonging to government (Perret, 2002) can be changed through a mindset shift, defined in the context of PsyCap.

Farmers were asked if they would see themselves developing into commercial farmers in the future, to which 77.9% of the respondents from both Makhathini and Ndumo-B schemes answered in the affirmative. Furthermore, due to the nature of the production system and high reliance on community owned resources, the attitudes of the farmers towards participating in the management of the resources are also important. As such, respondents were also asked to indicate their interest in taking part in the management process. The results indicate that more than 83% are more than interested in serving as committee members of the scheme and more than 75% are interested to engage in collective management of irrigation facilities (Table 6.11). The question then follows as to the impediments to the development process of smallholder farmers in Makhathini and Ndumo-B irrigation schemes and the whole of South Africa. Some of these challenges have been discussed as human capabilities and social capital, among other factors (e.g. agronomic, technical, environmental, etc.).

The largest proportion of farmers (94%) believe that farming should be run as a business. This is a good positive attitude in a positive direction as those farmers who believe so will strive to run their farm as a business. However, the difficulties in smallholder farmers' context are lack of records and farmers' failure to distinguish between farming operations and family operations. The survey results show that only 50% of the Ndumo-B farmers distinguish their farming operations from family operations which is in contrast to Makhathini farmers where

90% of the farmers were able to distinguish farming business operations from family operations. Unless farmers distinguish family operations from farming operations, running a farm as a business will remain an illusion.

Table 6.11. Preparedness to participate in the management of community resources – Makhathini and Ndumo-B (n=113)

Interest on:		Percent of respondents			
		Very interested	Interested	Neutral	Very little interest
Makhathini	Interest in being scheme committee member	36.1	49.2	9.8	4.9
	Interested in collective management of irrigation	36.1	37.7	23.0	3.3
Ndumo-B	Interest in being scheme committee member	23.1	57.7	5.8	13.5
	Interested in collective management of irrigation	19.2	59.6	13.5	7.7
Combined (Makhathini and Ndumo-B)	Interest in being scheme committee member	30.1	53.1	8.0	8.8
	Interested in collective management of irrigation	28.3	47.8	18.6	5.3

Source: Survey data, 2014

Only about 60% of Ndumo-B farmers see themselves as future potential commercial farmers while this figure is 93% for Makhathini farmers. The highest percentage of farmers noted that they can achieve this goal if they can get access to more land and also if government can assist them with capital. Most Ndumo-B farmers (56%) think that agriculture is resilient to shocks such as drought and other natural disasters, while this figure is 75% for Makhathini farmers.

If enough profit is earned in the next 2 years, 91% of farmers would expand their farming operations by investing back the capital accumulated as a result. However, that has not been happening. This could be because there has been no profit or no capital accumulation. Land is the other constraint. Makhathini farmers who were interested in expanding their operations and could see themselves progressing into commercial farmer (97%) felt that land was a major constraint. If they get the opportunity to expand, they would rent more land. Only 48% of the Ndumo-B respondents have reported that all or some members of their family members are employed. For the majority of Makhathini farmers (74%), family labour is not a constraint to expand farming operations.

Sampled farmers had the majority of what the literature suggests are psychological traits of entrepreneurship though they lack access to other forms of capital. For instance, the majority (72%) of Makhathini farmers are confident that they can contribute to discussions on the management of irrigation schemes. This figure is even more (88.5%) for Ndumo-B farmers who are confident in their capacity to contribute to discussions related to collective management of irrigation schemes. About 52% of the Ndumo-B farmers are satisfied with the performance of the irrigation scheme while this figure for Makhathini is 69%.

6.3.5.1 Confidence, entrepreneurial spirit and managerial capabilities

An individual's positive psychological state of development is characterised by having confidence (self-efficacy) to take on and put in the necessary effort to succeed at challenging tasks (Luthans *et al.*, 2004). Negative PsyCap, on the other hand, pulls down individual entrepreneurs and makes them lose self-esteem and eventually move out of business. Table 6.12 below presents the outcome of the assessment of PsyCap among farmers in Makhathini and Ndumo-B irrigation scheme.

Table 6.12. State of confidence among smallholder farmers – Makhathini and Ndumo-B (n=113)

Indicators	Percent of respondents				
	Very high	High	Neutral	Low	Very Low
State of confidence in yourself as a farmer	50.4	41.6	0.9	5.3	0.0
State of confidence in farming as a means to sustainable livelihoods	48.7	48.7	0.9	1.8	0.0
Extent to which farmers consider farming as a business	66.4	28.3	1.8	2.7	0.9
Confidence that the farm will succeed	1.8	3.5	6.2	38.9	49.6
Interest in expanding the farm business	59.3	35.4	0.9	1.8	2.7
Confidence to contribute during discussions about irrigation schemes and their management	41.6	38.1	10.6	7.1	2.7

Source: Survey data, 2014 and 2015

The results indicate that about 94.7% of the sampled farmers in Makhathini and Ndumo-B irrigation schemes consider farming as a business. About 92% of the farmers have confidence in themselves as farmers. This is complemented by the fact that the majority of them are highly

interested in expanding their farm operations (94.7%) and the overwhelming majority (97.4%) also have confidence in making a living out of farming (Table 6.12). Despite all these hopes, more than 88% of the farmers rank “low and very low” their confidence to succeed in their farming in the future (Table 6.12). Arguably, this low self-esteem could be the source of high failure rate and poor investment by smallholder farmers in most rural communities. The finding also contradicts the fact that most of these farmers (79.7%) have confidence to discuss their challenges in community or irrigation related meetings, where most of their challenges are supposed to be addressed. However, most of the farmers have lost hope in the capabilities of management structures to resolve the problems in the scheme. Intervention strategies that seek to address the challenges related to production and marketing might help improve farmers’ perception about agribusiness.

6.3.5.2 Hope, entrepreneurial spirit and managerial capabilities

It is important to note that smallholder farmers in Makhathini irrigation have higher hopes to succeed in their agribusinesses. This was revealed by the fact that more than 90% of the farmers anticipate a better quality of life if they continue participating in agriculture (Table 6.13).

Table 6.13. State of hope and vision among smallholders – Makhathini and Ndumo-B (n=113)

Indicators	Ranking (% respondents)				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Hope for improvement in quality of life	0.0	0.9	1.8	46.9	50.4
Hope for a positive future in agriculture	0.0	0.9	5.3	46.9	46.9
Have a clear future plan for the farm	1.8	2.7	7.1	42.5	46.0
I would not be farming if I had an alternative source of income	20.4	25.7	4.4	15.9	33.6
Willingness to forgo profit opportunity in the short run for long-run potential profits	21.2	29.2	5.3	15.0	29.2

Source: Survey data, 2014 and 2015

The results show that smallholder farmers anticipated positive returns from their farming business, which can make a positive contribution to household welfare. Farmers stated that,

despite current challenges, they anticipate a positive future in primary agriculture as a family business and expect improvement in quality of life. As such, most of them believe that they have a clear plan of action for the future (Table 6.13). However, farmers are less prepared to forgo profit opportunities in the short-run in order to benefit from potential profits in the long run. This might be an important characteristic of smallholders that they have short decision horizon and they produce to meet immediate family needs in terms of cash and food supply. Furthermore, smallholders have very minimal or no savings, hence the immediate household cash demands are high, making it difficult to forgo any profit at any given opportunity. The use of social grants to procure agricultural inputs might also be contributing towards the need for farmers to gain immediate financial returns and minimum long-term capital investments by smallholders. This realization points to the need to avail more credit sources and financial support for smallholder agribusinesses to improve long-term investment and higher returns.

It is interesting to notice that nearly half of them would not be farming if they had an alternative source of income, i.e. they are farming because they can't find anything else to do. It will be an illusion to think about on-farm entrepreneurship if the farmers are not taking farming as business out of interest and out of the love of the job as a means of livelihood.

6.3.5.3 Resilience, entrepreneurial spirit and managerial capabilities

The concept of resilience of farmers has been addressed more from the perspective of psychology (e.g. Hegney *et al.*, 2007) and sociology (King *et al.*, 2009) than from business management. Although there are contributions from general business management literature, the perspective of farm business management has been limited. Table 6.14 below summarizes the findings of the survey that attempted to profile the resilience capabilities of farmers in Makhathini and Ndumo-B. The behaviour and practices of farmers in the two areas were benchmarked against resilience indicators, from the literature (see Coutu, 2002) to identify gaps and opportunities for improvement.

Table 6.14. Resilience indicators – Makhathini and Ndumo-B

Resilience indicator	Discussion
1. Constantly scan their environment	• Farmers must have the ability to scan their business environment for relevant changes or trends or emerging opportunities and threats. • Farmers would require training in business aspects (prices, costs, demand shifts, supply chain issues, cash flow, finance) and natural/environmental issues (weather and climate, salinity) to build enough resilience
2. Build flexibility into the farm business and prepare for potential disruptions	• A contingency plan would envisage selling or changing planting dates due to unforeseen disruption in agriculture • Farmers in Makhathini and Ndumo-B schemes operate small pieces of land and often do not have the capacity to influence changes on markets or agribusiness environment • They also lack up to date information to inform their decisions on planting dates or crop choices, which is often influenced by their traditional practices
3. Build networks of personal communication	• Farmers rely on each other for agronomic information. However, group formation and collective action should be encouraged to increase the intensity of networks • Networks should be rich, mutually-supportive and trust building relationships with fellow farmers, suppliers, service providers and their family and employees. These networks have rich information flows. Social capital is usually high under such networks.
4. Experiment, innovate, know and share goals and values	• Farmers should be encouraged to tap into the indigenous knowledge systems and be innovative on varieties, disease control and storage issues. While some farmers have their working practices, there is currently no platform to encourage sharing some of the viable indigenous practices among farmers

Source: Survey data, 2014

According to Youssef *et al.* (2007), resilience recognises the need for flexibility, adaptation and even improvisation in situations predominantly characterised by change and uncertainty. It goes beyond the successes and failures of the current situation. The resilience capacity uniquely searches for and finds meaning despite circumstances that do not lend themselves to

planning, preparation, rationalization, or logical interpretation (Coutu, 2002). As such, extension training in Makhathini and Ndumo-B should capacitate farmers to foresee challenges and prepare them to react positively to protect their agribusinesses against shocks.

Table 6.15. State of perseverance among smallholders – Makhathini and Ndumo-B (n=113)

Indicators	Ranking (% respondents)				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Enjoy new challenges and opportunities	1.8	4.4	20.4	41.6	31.9
Persistent to overcome obstacles	0.9	4.4	7.1	46.0	41.6
Willingness to take farming risks compared to other farmers	2.7	8.8	23.9	40.7	23.9

Source: Survey data, 2014 and 2015

6.4 Human and social entrepreneurship drivers in Bululwane and Tugela Ferry irrigation schemes

6.4.1 Why do Bululwane and Tugela Ferry smallholders farm?

The Table below summarizes some of the reasons the farmers in Bululwane and Tugela Ferry participate in agriculture. The results indicate that for the majority of smallholders in both areas, i.e. Bululwane (88.33%) and Tugela Ferry (74.29%), the main reason for engaging in farming is to obtain sufficient food to feed their families. This shows the farmers are mainly concerned about meeting their subsistence requirements before anything else.

Table 6.16. Reasons for household participation in farming – Bululwane and Tugela Ferry (n=130)

Indicator	First reason		Second reason	
	Bululwane (%)	Tugela Ferry (%)	Bululwane (%)	Tugela Ferry (%)
To have sufficient food to feed my family	88.33	74.29	0.00	2.56
To earn an income from sale of crops	10.00	25.71	72.34	89.74
To create employment for people in the community	1.67	0.00	2.13	5.13
To create employment for myself and family members	0.00	0.00	25.53	0.00
As a form of leisure	0.00	0.00	0.00	2.56

Source: Survey data, 2016

The second reason for farming in both areas, is income generation from sale of crops. However, 25.3% of smallholders in Bululwane cite that the second reason for farming as a means to create employment for themselves and their family members. A very small percentage of smallholders in Tugela Ferry also indicated that they practice farming as a form of leisure. This was reported mostly by older farmers who said that farming activities keep them fit and busy.

6.4.2 Education, farming experience, entrepreneurial spirit and managerial capabilities

The statistics in Table 6.17 show the demographic distribution of the respondents in Bululwane and Tugela Ferry irrigation schemes. The demographic indicators that were considered were the level of education of farmer (in years of schooling) and years of experience in farming (general).

Table 6.17. Other demographic attributes of the respondents Bululwane and Tugela Ferry (n=130)

Attribute	Bululwane	Tugela Ferry	Combine descriptive statistics				
	Mean	Mean	Mean	Std. Dev.	Range	Min	Max
Level of education of farmer (in years of schooling)	5.57	3.59	4.50	4.37	15	0	15
Years of experience in farming (general)	18.92	20.73	19.89	14.56	58	1	59

Source: Survey data, 2016

The survey indicates a low level of education among smallholder in and around Bululwane and Tugela Ferry irrigation schemes. The mean years of schooling is 4.5 showing that most farmers did not complete primary school. Comparison between the two areas show that smallholders in Bululwane have more years of schooling compared to Tugela Ferry farmers. However, the averages for both areas were lower than that of Makhathini and higher than that of Ndumo-B. Regarding farming experience, the farmers had more years of experience in general farming. However, their experience was higher than that of farmers in Makhathini and Ndumo-B.

6.4.3 Access to agricultural training

The response of farmers in Bululwane regarding the training they received about farming and general business is shown in Table 6.18. Most of the farmers had received training in the areas such as vegetable production, land preparation, fertilizer application, herbicide application and general irrigation practices. Less than half of the farmers had received training related to agricultural commodity marketing (i.e. only 38.3% received). This kind of training is important

for farmers if post-harvest losses are to be reduced. The relatively low percentage of farmers who have received such training may indicate that post-harvest related losses of crops may be linked to their limited understanding of the marketing of agricultural commodities. The processing of farm produce and pricing are also key in improving the overall farmer income. Only 25% of the farmers had received training related to the processing of farm produce and only 20% of them had received training related to pricing. The farmers' skill rating relating to business planning and budgeting/ bookkeeping was also low.

Table 6.18. Training received by farmers – Bululwane (n=60)

Training received	Percent farmers
Vegetable production	75.0
Land preparation	71.7
Fertiliser application	66.7
Herbicide application	61.7
General irrigation practice	53.3
Irrigation scheduling and water management	43.3
Agricultural commodity marketing	38.3
Processing of farm produce	20.0
Pricing of produce	25.0
Business planning	25.0
Budgeting/ bookkeeping	25.0

Source: Survey data, 2016

Table 6.19 presents the training that farmers in and around Tugela Ferry irrigation scheme received. At least 50% of the farmers reported having received training related to vegetable production and fertilizer application. The farmers reported having received little training on the other aspects of training (such as irrigation and water management, agricultural commodity marketing and processing of farm produce). Training on business planning was very low and only 2.9% of the farmers reported to have received this type of training. Comparison between the four areas show that Tugela Ferry has farmers who have received the least training in all the areas.

Table 6.19. Training received by farmers – Tugela Ferry (n=70)

Training received	Percent farmers
Vegetable production	52.9
Land preparation	42.9
Fertilizer application	54.3
Herbicide application	45.7
General irrigation practice	34.3
Irrigation scheduling and water management	35.7
Agricultural commodity marketing	28.6
Processing of farm produce	12.9
Pricing of produce	10
Business planning	2.9
Budgeting/bookkeeping	12.9

Source: Survey data, 2016

Smallholders from both areas were also asked to indicate their current training needs. The results show a high demand for training. At least 80% of the farmers in Bululwane and Tugela require training in agronomy-related aspects, irrigation scheduling and water management, agricultural commodity marketing, packaging of produce and business planning.

6.4.4 Social capital, entrepreneurial spirit and managerial capabilities

As much as 58.4% of the farmers in Bululwane reported that it was easy or very easy to access agricultural-related information (Figure 6.3). The remainder are farmers who were not sure (13.3%) or who found it difficult/very difficult (28.3%) to access agricultural-related information. A higher proportion of smallholders in Tugela Ferry (64%) compared to Bululwane indicated that it was fairly easy for them to obtain agricultural information. Those that noted that it was difficult to access such information accounted for 30% of the farmers in Tugela Ferry. The results highlight the challenges with access to information faced by a significant population of smallholder farmers in irrigation. This points to the need of strengthening existing extension programmes and exploring new strategies for enhancing access to relevant information in real time.

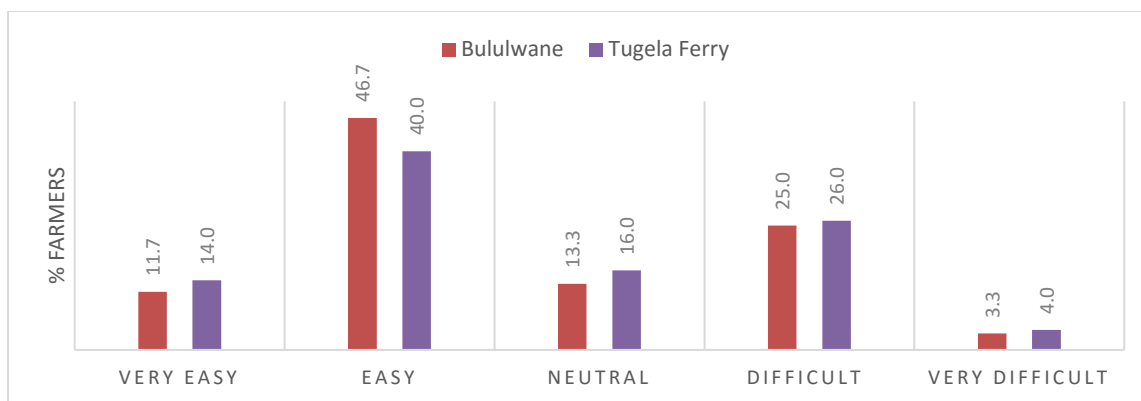


Figure 6.3. Access to agricultural information – Bululwane and Tugela Ferry

Source: Survey data, 2016

Figure 6.4 shows the importance of information sources to the farmers in and around Bululwane irrigation scheme. The results show that farmers consider information sources (such as extension officers, the media, fellow farmers' community meetings, irrigation scheme and so on) as being important. More farmers rated the internet as unimportant. This may reflect on the limited access and knowledge on the importance of internet and the general lack of infrastructure which provides internet services.

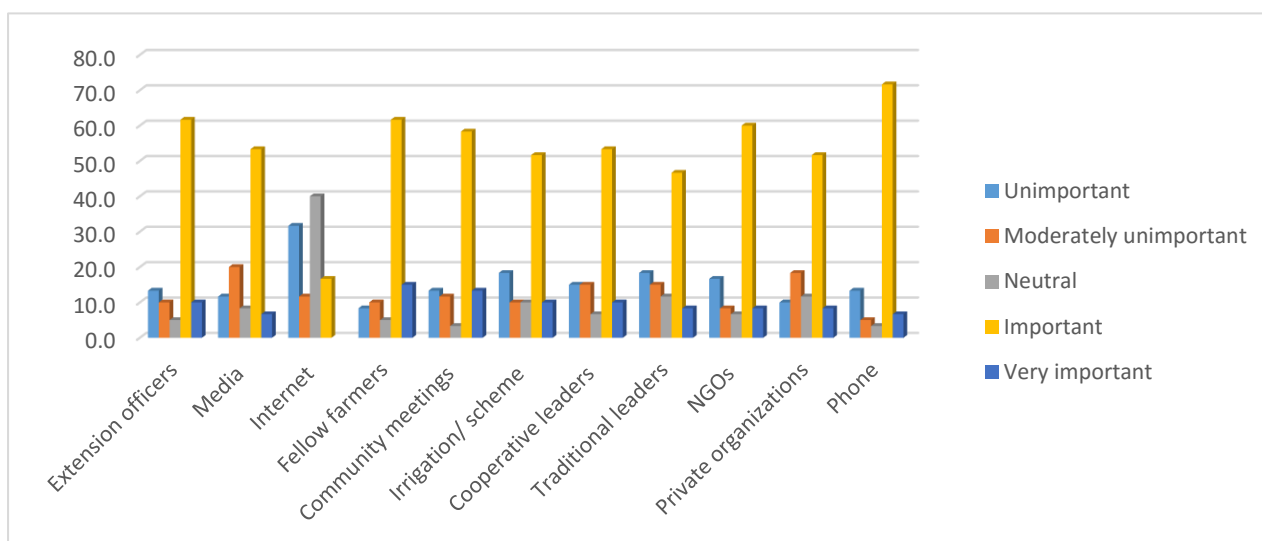


Figure 6.4. Importance of sources of information – Bululwane

Source: Survey data, 2016

Figure 6.5 shows the responses of the farmers in Tugela Ferry to the importance of the different information sources. Over 50% of the farmers ranked extension officers, community meetings, irrigation scheme and phone as very important sources of information, together with media,

cooperative leaders, traditional leaders, NGOs and private organisations. The internet was also considered as unimportant by the farmers in Tugela Ferry.

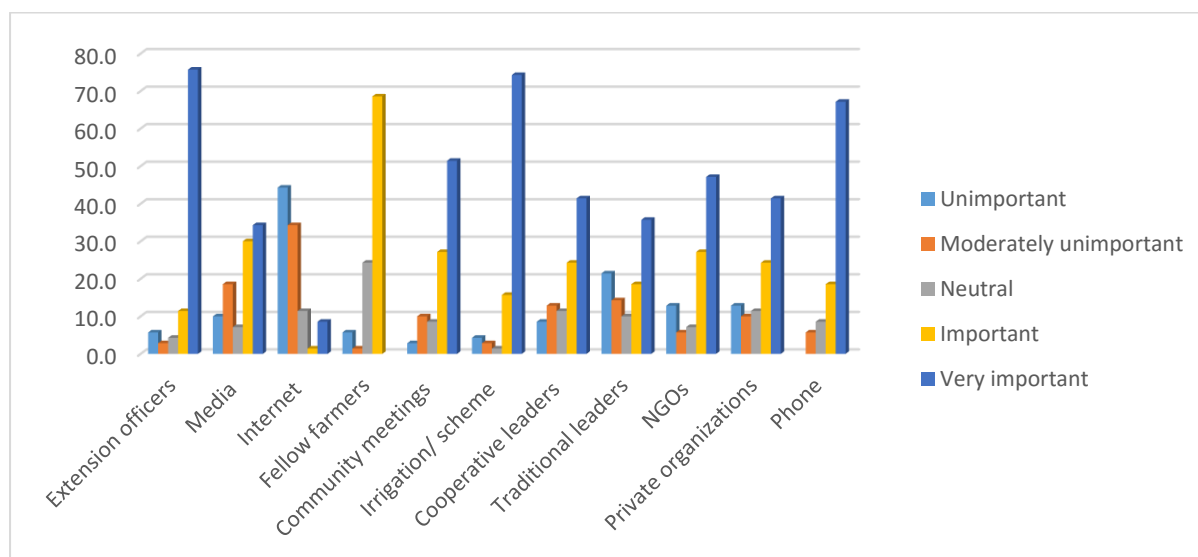


Figure 6.5. Importance of sources of information – Tugela Ferry

Source: Survey data, 2016

Regarding the farmers' ability to utilise skills learned in training, the survey results show that 73.3% and 65.7% of the farmers in Bululwane and Tugela Ferry, respectively, were able to put the skills into practice. Regarding the farmers' opinion about taking a job or starting a business which is not related to farming, the results further show that 65% and 44.3% in Bululwane and Tugela Ferry, respectively, were prepared to take up opportunities outside farming. The results in Table 6.20 show that the farmers' insight into business plan development was low. Only 11.7% and 4.3% smallholders in Bululwane and Tugela Ferry, respectively, reported having written a business plan. Most of the farmers in the two areas did not have one and the problem is worse in Tugela Ferry. There are a few who indicated that they tried to develop one but failed due to lack of knowledge while others reported having a business plan conceptualised in their mind but have not put it on paper.

Table 6.20. Business plan development by farmers – Bululwane and Tugela Ferry (n =130)

	Bululwane (%)	Tugela Ferry (%)
I do not know what is a business plan?	18.3	8.6
I have a business plan conceptualized in my mind	3.3	11.4
I have a written business plan	11.7	4.3
I do not have one (tried to develop one but failed)	3.3	8.6
I do not have (never developed one)	63.3	67.1

Source: Survey data, 2016

Table 6.21 shows the farmer responses regarding why they do not have a business plan. The main challenge in development of business plans in smallholder farm businesses in the two areas is the lack of knowledge and skills. Some farmers do not see it's the importance hence it never crosses their mind. Some in Tugela Ferry felt that their operations were too small and hence no need to write one. Whatever the reason, the challenge is that the culture of documenting and/or recording the details of farming operations is non-existent among smallholders. This is among aspects that need to transform if smallholders are to compete in the emerging local and international agricultural markets.

Table 6.21. Hindrances to farmers writing down a conceptualized business plan

	Bululwane (%)	Tugela Ferry (%)
I do not know where to do the plan	7	0
I have never thought of writing it	14	22
I do not even know what a business plan is	15	0
I do not have enough knowledge/ skills	64	45
I do not see the need to write	0	11
I am not yet ready	0	22
Total	100	100

Source: Survey data, 2016

6.4.5 Psychological capital, entrepreneurial spirit and managerial capabilities

Table 6.22 shows the attitudes and preparedness of farmers in Bululwane and Tugela Ferry to participate in the management of resources in their community. The farmers were asked of their 'interest in being part of a collective institution governing water use'. More than 75% of the farmers in Bululwane and Tugela Ferry show a positive attitude and are willing to participate in collective management of their resources. The respondents were also asked to indicate their 'interest in taking part in training in the collective management of the irrigation

scheme'. The results show a strong desire by farmers in both areas to acquire knowledge that will enhance them to effectively participate in collective management of the scheme.

Table 6.22. Preparedness to participate in the management of community resources – Bululwane and Tugela Ferry (n= 130)

	Percentage of farmers				
	<i>Not interested at all</i>	<i>Disinterested</i>	<i>Neutral</i>	<i>Interested</i>	<i>Very interested</i>
Bululwane irrigation scheme					
Interest in being part of a collective institution governing water use	6.67	5.00	10.00	25.00	53.33
Interest in taking part in training in collective management of irrigation scheme	5.00	6.67	6.67	25.00	56.67
Tugela Ferry irrigation scheme					
Interest in being part of a collective institution governing water use	4.76	6.35	12.70	25.40	50.79
Interest in taking part in training in collective management of irrigation scheme	1.59	4.76	12.70	31.75	49.21

Source: Survey data, 2016

6.4.5.1 Confidence, entrepreneurial spirit and managerial capabilities

Table 6.23 below presents the outcome of the assessment of PsyCap endowment among farmers in and around Bululwane irrigation scheme. The results indicate a high confidence among all sampled smallholders in farming as a way of life. About 98% of the same farmers are also quite confident in themselves as farmers. Most of the farmers are also interested in expanding their farm business operations (83.3%). These results demonstrate some level of self-efficacy. However, despite their interest in collective management of irrigation schemes above (Table 6.22), most of the farmers are either not sure or agree that being an irrigation scheme member deprives them of individual decision-making powers. This means that they feel less empowered in terms of their voice in the collective leadership structure. For their confidence to remain high there is a need to address such issues.

Table 6.23. State of confidence among smallholder farmers – Bululwane (n= 60)

Indicators	Percentage of farmers				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am confident in farming as a way of life	0.0	0.0	0.0	26.7	73.3
I am confident in yourself as a farmer	0.0	0.0	1.7	18.3	80.0
Interested in expanding farm business?	16.7	10.0	0.0	16.7	56.7
Being a member of an irrigation scheme deprives one of individual decision-making powers	5.0	8.3	51.7	16.7	18.3

Source: Survey data, 2016

Table 6.24 shows the state of confidence among smallholder farmers in and around Tugela Ferry irrigation scheme. Their confidence in farming as a way of life (87%) and confidence in themselves as farmers (88%) are also very high.

Table 6.24. State of confidence among smallholder farmers – Tugela Ferry (n= 70)

Indicators	Percentage of farmers				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am confident in farming as a way of life	1.4	7.1	4.3	54.3	32.9
I am confident in yourself as a farmer	1.4	4.3	5.7	47.1	41.4
Interested in expanding farming operations?	31.4	5.7	0.0	22.9	40.0
Being a member of an irrigation scheme deprives one of individual decision-making powers	15.7	47.1	15.7	14.3	7.1

Source: Survey data, 2016

The proportion of those interested in expanding their business is lower than that of Bululwane although it is still greater than 60%. Regarding their voice in decision making, smallholders in Tugela Ferry irrigation scheme seem empowered in their decision making. Unlike Bululwane farmers, most of them (above 62%) do not agree with the statement that being an irrigation scheme member deprives them of individual decision-making powers.

6.4.5.2 Hope as a form of positive psychological capital

The state of hope and vision among smallholders in and around Bululwane irrigation scheme is shown in Table 6.25. Most smallholders in Bululwane seem to be long-term focused because they are willing to incur the opportunity cost of forgoing current profits in order to benefit from potential profits in the future. Such behaviour is synonymous with entrepreneurship and

indicates the existence of some entrepreneurial traits among these farmers. However, a significant 30% of the farmers are short-sighted and hence prefer not to plan and invest into the future.

Table 6.25. State of hope and vision among smallholders – Bululwane (n= 60)

Indicator	Percentage of farmers				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am willing to forgo a profit opportunity in the short-run in order to benefit from potential profits in the long run	1.7	5.0	23.3	40.0	30.0
I would not be farming if I had an alternative source of income	25.0	31.7	8.3	18.3	16.7
I am optimistic about the future of agriculture in your area	1.7	0.0	6.7	21.7	70.0
I have hope that the quality of life will get better	1.7	0.0	0.0	38.3	60.0

Source: Survey data, 2016

Approximately 35% of the farmers indicated that they would not be farming if they had alternative source of income. Such farmers have no confidence in farming as source of livelihood and believe that there are better opportunities in the other sectors. These will not hesitate to leave farming at any given time. However, optimism on the future of agriculture and quality of life among the farmers is positive.

Table 6.26 shows the state of hope and vision among smallholders in Tugela Ferry irrigation scheme. A lower proportion of farmers in this area compared to Bululwane are future-oriented and hence willing to forgo opportunities in the short-term in-order to benefit from potential profits in the future. This evidence shows that Tugela Ferry farmers might be less entrepreneurial than those from Bululwane. The results also indicate that 31.5% of the farmers would not be farming if they was an alternative source of income. Given the above Bululwane results, a third of farmers in the two areas are not keen on farming. However, similarly to Bululwane, Tugela Ferry farmers are optimistic and hopeful about the future of agriculture and improvement in their quality of life.

Table 6.26. State of hope and vision among smallholders – Tugela Ferry (n= 70)

	Percentage of farmers				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am willing to forgo a profit opportunity in the short-run in order to benefit from potential profits in the long run	8.6	15.7	15.7	38.6	21.4
I would not be farming if I had an alternative source of income	38.6	27.1	2.9	18.6	12.9
I am optimistic about the future of agriculture in your area	2.9	2.9	8.6	50.0	35.7
I have hope that the quality of life will get better	1.4	5.7	5.7	57.1	30.0

Source: Survey data, 2016

6.4.5.3 Resilience, entrepreneurial spirit and managerial capabilities

The state of perseverance among smallholders in and around Bululwane irrigation scheme is shown in Table 6.27. Most of the farmers (77%) are willing to take more risks than other farmers in their community. A high proportion of the farmers reported that they enjoy new challenges and opportunities. They also indicated that they try alternative approaches to address a persistent challenge. Thus, according to farmer responses, smallholders in Bululwane show traits of resilience to some challenges and situations that could be encountered when managing their farms as businesses.

Table 6.27. State of perseverance among smallholders – Bululwane (n= 60)

Indicators	Percentage of farmers				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am willing to take more risks than other farmers in my community	3.3	6.7	13.3	48.3	28.3
I enjoy new challenges and opportunities	0.0	5.0	6.7	31.7	56.7
If one problem is persistent, I try alternative approaches to address it	0.0	3.3	11.7	48.3	36.7

Source: Survey data, 2016

Table 6.28 shows the state of perseverance among smallholders in and around Tugela Ferry irrigation scheme. More than half of these farmers reported that they willing to take more risks than other farmers in their community. However, the percentage is lower than that of Bululwane. Although lower than Bululwane, a high proportion of farmers in Tugela Ferry also enjoy new challenges and opportunities. Most of the farmers also indicated that when faced with a persistent problem, they don't give-up but try alternative ways of addressing it.

Table 6.28. State of perseverance among smallholders – Tugela Ferry (n= 70)

Indicators	Percentage of farmers				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am willing to take more risks than other farmers in my community	7.1	20.0	18.6	38.6	15.7
I enjoy new challenges and opportunities	0.0	12.9	17.1	44.3	25.7
If one problem is persistent, I try alternative approaches to address it	4.3	5.7	8.6	55.7	25.7

Source: Survey data, 2016

6.5 Towards making entrepreneurship relevant to smallholders

Drawing from the above assessment, this section identifies the following key imperatives/tenets that should be given attention in future efforts to promote and improve the relevance and applicability of the entrepreneurship concept to smallholders in South Africa and beyond. These include integration of positive PsyCap and behavioural economic principles to explain and adapt on-farm entrepreneurship in the context of smallholders, nurturing local indigenous knowledge, embracing heterogeneity of smallholder farming and the creation of an enabling environment that cultivates smallholder entrepreneurial spirit.

The case for the inclusion for PsyCap as one of the livelihoods assets in the SLF has been detailed in Section 3.2.1.2. Findings in this chapter have demonstrated the importance of this livelihood asset to on-farm entrepreneurship. The redefinition of entrepreneurship in smallholder agriculture is incomplete without a concerted effort to create an environment that cultivates smallholders' positive PsyCap and the entrepreneurial spirit. The idea is to make farmers more optimistic, resilient, hopeful and confident in themselves and enable them to consider farming not just as a way of life but also as a business. This is only possible if policies, institutions and services are well-prepared to support the entrepreneurial smallholders who can embrace new ideas and take advantage of opportunities.

Behavioural economics principles should also be integrated into the definition of entrepreneurship in smallholder agriculture since smallholder on-farm decisions are of behavioural nature and not maximizing profit. Neoclassical economics, on the other hand, is concerned with the immediate effect that does not last long and asserts that humans are rational and maximise their self-interest. It assumes that individuals have perfect information on the choices and the alternatives that are available to them and have the ability to make logical calculations (Goodwin *et al.*, 2009; Soukup *et al.*, 2015). Behavioural economics, the study of how real people make choices (Lambert, 2006), on the other hand, is concerned with explaining ‘irrational’ behaviour and long lasting behavioural change to make people comply with policies/rules. It is a field concerned with the psychology of economic decisions that ‘seeks to use inputs from psychology to obtain an enhanced understanding of and/or an improved ability to predict behaviour in respect of areas that have normally been viewed as the preserve of economics’ (Earl, 2005, p911).

Unlike neoclassical economics, behavioural economics teaches that economic agents care not just about outcomes but also how outcomes came to be (Bohnet and Zeckhauser, 2004). According to behavioural economics, individual tastes, preferences, choices and judgments are not a matter of dispute, nor can they be deemed rational or irrational (Wilkinson and Klaes, 2012). Nobel Prize winners in economics who challenged the neoclassical economics paradigm and brought behavioural economics as a subject of its own right include Simon (1955) and Tversky and Kahneman (1974). Behavioural economics provides more realistic psychological, social and emotional foundations of ‘irrational’ decision making behaviour; it does not replace/abandon neoclassical rational choice/equilibrium models (Wilkinson and Klaes, 2012). It enhances the functionality of neoclassical economics and offers answers in areas that would have otherwise been taken as beyond economics or mistakes in conventional economics (Earl, 2005).

There is evidence which increasingly shows that agriculture research focusing on smallholders is now integrating insights from behavioural economics to explain the behaviour of smallholder farmers. In the study of food security, Timmer (2012) integrates behavioural psychology to understand the behavioural dimensions of food security. Poole and De Frece (2010), while reviewing existing organisational forms of smallholder farmer associations in East and Southern Africa, relied on behavioural economics principles to understand collective action institutions and why they sometimes fail to function to their expectations. Shaba *et al.* (2017) also integrated insights from behavioural economics to understand farmers’ motivation to

participate in contract farming in Malawi. Duflo *et al.* (2008) used insights from behavioural economics to inform policy on fertilizer adoption and use in Kenya. These studies demonstrate the increasing importance of behavioural economics in agricultural research and development, especially in explaining smallholder decision making behaviour.

The key lessons from behavioural economics summarized by Dawney and Shah (2005) and relevant to smallholder behaviour include:

- People's behaviour is influenced by how others behave or act towards their behaviour (Jackman, 2015): This implies that encouragement and appreciation of farmers' efforts through recognition or awards can be used as a strategy to boost their entrepreneurial spirit. Where there are strong networks and high level of mutual trust (social capital), other people's behaviour may be important in influencing others. This is important to technology adoption and the promotion of indigenous knowledge systems among smallholders.
- Habits are important, long lasting and hard to change: This has both positive and negative implications for on-farm entrepreneurship development. On the positive, it means if smallholders get used to earning their livelihood through their own effort, such a culture will last longer and permeate to the younger generations. In addition, any policy that positively affects smallholder behaviour will create a new social norm that is long lasting and which needs little enforcement. However, because old habits die hard (Thornton, 2013), on the other hand, it means more effort is needed to change any negative behaviours that work against on-farm entrepreneurship, e.g. the dependency syndrome.
- People are motivated to do what they think is 'right', not necessarily maximizing profit: This entails adopting a different approach to promoting entrepreneurship among smallholders. As explained earlier, smallholders do not maximise (Etzioni, 2011) but optimise and satisfice. Emphasis should be put on the benefits of entrepreneurship in supporting livelihoods and survival strategies rather than profit maximisation.
- Self-expectations influence one's behaviour, making their decisions in line with their values and commitments: Thus, if building the positive PsyCap endowment of smallholders has potential to positively influence their entrepreneurial spirit (their desire for entrepreneurship), this will also be reflected in their entrepreneurial decisions and behaviour.

- People put undue weight on recent events and too little on far-off ones: This means assisting smallholders to work through their immediate challenges can be a strong incentive for unlocking entrepreneurship. This is especially important for smallholders as their behaviour by and large is as behavioural economics suggests. According to Lambert (2006), ‘there is a fundamental tension in humans between seizing available rewards in the present and being patient for more rewards in the future.
- People need to feel involved and effective to make change: Information and incentives are not enough (Thornton, 2013). Telling smallholders what to do undermines local knowledge and works against entrepreneurship development in smallholder agriculture. Rural development strategies should build on what smallholders know/have and make them believe that their destiny is in their own hands, rather than ridiculing local endowments and starting from a scratch (see the study by Chiangmai (2017)).
- A small number of influential people can have a big impact (Gladwell, 2006): Since all smallholders cannot be entrepreneurs, there is a need to focus on the few successful and entrepreneurial farmers so that their success can influence the rest and get scaled-up and multiplied.

Application of these lessons offers better chances of success for smallholder entrepreneurial development. The behavioural approach will require a paradigm shift and will result in a long lasting and positive culture of entrepreneurship among smallholders and hence improve the performance and value contribution of smallholder agriculture to the rural economy in South Africa. The focus group discussions held with farmers suggest that some of the behaviours of the sampled farmers and their responses are by and large in line with the predictions of behavioural economics.

It is prudent that entrepreneurship in smallholder agriculture embraces farmers as individuals endowed with indigenous knowledge relevant to deal with the day to day challenges of the sub-sector. Recognizing and embracing local knowledge in farming paves the way for deliberate research and documentation, nurturing and sharing of this knowledge to benefit both local and other smallholders facing similar challenges. Without support, this critical part of smallholder farming will remain obscured and local and its benefits will never permeate through to the broader agricultural sector.

Both government and private sector support are critical to growing and preserving indigenous knowledge. It is advisable to recognise that some local innovations have the potential to grow into business ideas. Hence, agricultural policies should embrace the use of indigenous

knowledge systems in farming and also protect farmers through the generation of patents. The national patenting system should recognise (define a category that fits innovations from farmers' indigenous knowledge) and have mechanisms for patenting such innovations. To improve the sustainability of the farmer-led local innovations, partnerships between farmers and the private sector should be encouraged (Rajalahti *et al.*, 2008). Government's role in such arrangements is to ensure that farmers' interests are well represented and protected.

Entrepreneurship in smallholder farming should recognise that smallholders are highly heterogeneous not only in terms of their livelihoods assets but also in their preferences (Wale and Yalew, 2007). Embracing this heterogeneity allows the recognition that smallholders are at different levels of their entrepreneurship spirit and not all farmers are highly entrepreneurial.

Entrepreneurship in smallholder agriculture should also accommodate the multi-purpose nature of smallholder farming. Satisfying household subsistence requirements is a primary and one of the most fundamental objectives of smallholder farming. It is thus, unrealistic to expect that smallholders just focus on market-oriented production. Since the household is the central decision-making unit, entrepreneurship training should help entrepreneurial farmers with knowledge on how to separate family and farm decisions. Nurturing a culture of business-minded thinking among such farmers and the audacity to follow through those plans should be a priority for agricultural extension services.

Transformation is required in several areas such as agricultural extension services (that includes training on the importance of: managing a small farm as a business, record keeping, distinguishing family and farm operations and collective action organisations). For example, how well prepared are agricultural extension services in the country to support a business-oriented smallholder? How can commercial banks be willing to lend to smallholders? How can high-value food markets, currently dominated by commercial farmers, make smallholder farmers part of the food value chain? How well serviced are the rural communities with road infrastructure and communication, among other services that foster entrepreneurial development.

Collective actions in the above areas will offer more opportunities to the entrepreneurial smallholders to explore and implement their ideas. Platforms that foster social networking and interactive learning among farmers, their communities and the various stakeholders should also be promoted as vital tools for developing and nurturing positive PsyCap and the entrepreneurial spirit of smallholders.

Using the concept of positive PsyCap and drawing from behavioural economics, this study redefines an entrepreneurial smallholder as an individual who is willing and able to do whatever he/she can and take advantage of available opportunities with what he/she has given the prevailing constraints. Someone who can see a constraint as a challenge rather than a problem. While a problem is pessimistic (negative) leading to stress, anxiety, fear, anger, depression and resentment, a challenge is optimistic (positive) driven by hope and enthusiasm. While a problem is of permanent nature, a challenge is transient. An entrepreneurial smallholder is someone who takes a constraint as a challenge resorting to own initiatives, seeing opportunities, not a problem which is difficult to deal with, hindering the achievement of a desirable objective. It takes someone who is willing to challenge him/herself to come up with contextually relevant solutions to the prevailing challenges. An entrepreneurial smallholder is one who internalises challenges, rather than externalising them. One who has an internal locus of control, not external.

Entrepreneurship in smallholder agriculture is, thus, defined as the willingness and ability of an individual or group of farmers to take advantage of available opportunities and resources (including indigenous knowledge), given the prevailing constraints. The concept is taken as a continuum recognizing that smallholders can be at different levels of the entrepreneurial ladder. The definition advances the idea that entrepreneurship for smallholder farmers is first a function of the positive PsyCap endowment before anything else. Emphasis should be put on the ability to solve problems on an ongoing basis as critical to operating the farm as a business. The positive PsyCap concept and behavioural economics can be used to identify smallholders with better or poor entrepreneurial spirit.

6.6 Drawing lessons for future on-farm entrepreneurial development paths

Several lessons for future on-farm entrepreneurial development paths can be drawn from the results of this chapter and the previous two chapters:

- One important lesson emerging is that transformation and successful on-farm entrepreneurial development paths depend mainly on mindsets of farmers. Public transfers in the form of social support and input subsidies, if not properly managed create unintended dependency syndrome among the rural poor which works against the spirit of entrepreneurship. However, changing mindsets is not easy since it is entrenched over a period of time and it is a process that requires collective effort from all stakeholders, particularly those in education, extension and financial sector.

- Smallholder irrigation offers an opportunity to run small farms as businesses. It allows farming of certain crops that would have otherwise been impossible under rainfed conditions. Land and water are important resources in farming and the establishment of smallholder irrigation schemes in the poor communities increase access to these important resources. Planning is an integral component of any business. However, proper farm business planning is not possible with rainfed agriculture due to erratic and inconsistent rainfall. In fact, in some regions of the country it is difficult engage in meaningful agricultural activities due to drought. Irrigation if managed properly offers a consistent supply of water that makes it possible to operate small farms as businesses.
- Crop quality and standards together with value addition will enhance the competitive advantage of farmers in the market. Branding will also be important in marketing, especially if the products are organic and produced through a process that is environmentally friendly.
- Some level of commitment and willingness to engage in more productive agriculture exists among farmers particularly those in schemes and engaged in independent irrigation. However, the potential to transform homestead food gardening depends on the attributes of farmers (resource endowments, objectives in farming, constraints, opportunities and mindsets). For some farmers homestead food gardening is therapeutic particularly as one gets older. Thus, transformation into smallholder plots away from the home and more involving will not be suitable for their needs. Yet others welcome the opportunity to expand and improve farming in the schemes. Future on-farm entrepreneurial development paths should be pursued based on farmer typology as each type of farmer would require different type of technology and other factors of production.
- Collective water infrastructure management is a key factor in smallholder irrigation due to the nature of irrigation water availability and its feature as a common pool resource. Thus, water security should be an integral part of the success of future on-farm entrepreneurial development paths.
- Collective action institutions such as cooperatives and farmer groups have a role in reducing transaction costs and access to inputs and services that are otherwise not accessible to homestead food gardeners and other small-scale irrigators. Group marketing enhances farmer bargaining power and buyers do not have an opportunity to engage in divisive negotiations between farmers. Through collective action institutions

it is possible to access inputs and other services at a lower cost through negotiated discounts, even deliveries to their localities. However, successful collective action will depend on the development of trust not only between farmers, but government and private support institutions involved in the processes.

- Succession planning in smallholder agriculture is critical for continual realization of the gains of years of investment in the smallholder agriculture sector. Yet this remains a challenge resulting in unproductive utilisation of fertile agricultural land in irrigation schemes. The impartation of knowledge in farming together with development of technical capacity should be holistic and contextualized to the set-up of the rural households. Capacity building should also target spouses and children of plotters.

6.7 Summary

The focus of this chapter was to assess farmers' endowment with human, social and psychological factors in and around the four schemes that limit or support the development of entrepreneurship in farming. The aim was to understand the barriers of entrepreneurial development among smallholder farmers. The study emanates from the thesis that access to livelihoods assets is the key factor to enable smallholder farmers to run their farms/plots/homestead food gardens as a business, transform into commercial farming and unlock their entrepreneurial capabilities/potentials.

Findings show that the government through the PDARD is the major service provider in terms of farmer training and agricultural information. While this is in line with the government mandate to provide services to the people, contract farming should be encouraged between smallholders and private players. Contractors would bring in expertise and training programmes for contracted farmers and through social networks, information will flow to other farmers. This has a potential to improve production in the long run.

Although farmers are aware that their livelihoods and welfare can improve if they participate in agriculture, a huge number of farmers have low self-esteem and view agriculture as not sustainable in the long run. This is a concern and an area for future intervention.

Increasing social capital in society can help people avoid conflict, create forum for negotiations and dispute resolution mechanisms, exploit gains from increased specialisation and increase knowledge about the physical and social factors important in the production and marketing of agricultural produce.

Collective action offers opportunities in irrigation scheme management. However, this principle is hindered by poor relations among farmers and buyers characterised by low levels of trust, lack of norms of reciprocity and poor reputation for farmers when it comes to meeting their market obligation in terms of volumes and quality. Increasing cooperation and production requires investment in and maintenance of, social capital if advantages of trading are to be exploited by the farmers.

Assessing the validity and applicability of the mainstream concept of entrepreneurship to smallholders emanates from the thesis that smallholders and their context do not conform to the common neoclassical paradigm underpinning the mainstream concept of entrepreneurship. The findings agree with this hypothesis and show the divergence of the neoclassical definitions with smallholders in areas such as risk-taking propensity, the locus of control, motivation, innovation, endowment with a business mindset and the entrepreneurial environment. Smallholders are generally risk-averse having an unwillingness to diversify into new/unfamiliar crop enterprises and to take agricultural related debt. Due to poverty, their capacity to absorb risk is limited. Most of them have an external and not internal locus of control, unable to look for and act, using whatever resources at their disposal, to utilise available opportunities. In South Africa, smallholder entrepreneurial motivation in farming is missing, with most of their livelihoods derived from non-farm unearned income, mainly social grants and remittances. The findings also show that smallholders do not conform to the mainstream entrepreneurship paradigm on innovation but rely more on indigenous knowledge, which is seldom recognised nor supported. Their practices do not reflect the ideas behind conventional businesses, hardly ever distinguishing between farm and family operations and with poor record keeping. They also seldom focus on profit maximisation with the majority exhibiting satisficing behaviour.

To make entrepreneurship more relevant to smallholders, the study suggests a paradigm shift that puts smallholder behaviour at the centre underpinned by the concept of positive PsyCap and behavioural economics principles. The farmers' mindset is identified as one critical resource that determines smallholders' farming decisions and behaviour and hence entrepreneurial spirit. Besides the integration of positive PsyCap and behavioural economic principles, the study also suggests the need to recognise, embrace and nurture indigenous knowledge as an important aspect of smallholder farming. It indicates that policies and strategies promoting entrepreneurial development should identify with smallholder farmer heterogeneity and multi-purposes of smallholder farming. There is also a need to foster an

environment that cultivates positive PsyCap endowment and the entrepreneurial spirit of smallholders. In closing, the study proposes a contextualized definition of an entrepreneur and entrepreneurship that is more relevant to smallholders.

7 SOURCES OF LIVELIHOODS AND OPPORTUNITIES IN THE FOUR IRRIGATION SCHEMES IN KWAZULU-NATAL

7.1 Introduction

Smallholder irrigation is a strategic sector in South Africa's national development policy (Cousins, 2013). The nation's development strategy for the next 15 years identify smallholder irrigation as critical to reducing rural poverty through increased income and employment creation (Mnkeni *et al.*, 2010; Economic Development Department., 2011; Cousins, 2013; National Planning Commission, 2011). The sector has potential to contribute significantly to food security, income and employment creation (Bembridge, 2000; Vink and Van Rooyen, 2009). However, farmers involved in smallholder irrigation in South Africa remain largely inefficient, with low productivity and poor market participation. Smallholder irrigation schemes have not yet made any meaningful contribution to food security and employment creation (Van Niekerk *et al.*, 2011; Jordaan *et al.*, 2014).

As noted in Chapter 2, smallholder irrigation schemes represent assets or resources that can be used to diversify livelihoods of plottolders and their communities (Oni *et al.*, 2011). Smallholder irrigation guarantees access to key assets of production, land and water, which affect productivity of smallholder agriculture. However, evidence from several reports suggest that these assets alone are not enough to improve the performance of smallholder irrigation and ultimately improve the livelihoods of smallholder farmers in South Africa (Van Averbeké *et al.*, 1998; Fanadzo *et al.*, 2010; Fanadzo, 2012). The livelihoods of smallholder farmers represent a complex system of interactions among asset endowment, capabilities and institutions that affect their decisions and behaviours. Access to different institutional processes will determine the livelihoods of smallholder farmers and their ability to engage profitably in farming.

The most significant opportunity that the irrigation scheme creates to smallholders is enabling them to produce most vegetable crops (and many other crops) during the winter months, allowing them to compete with well-established competitors in the market. This enables smallholders to increase their gross margins, provided they are able to access markets that are too distant from the scheme. These potential benefits to farmers must take into consideration that minimum quality and quantity supply standards are adhered to, i.e. farmers must be able to consistently supply quality products to the market.

The focus of this chapter is on the determination of sources of livelihoods and opportunities for improving farming within available food value chains. The purpose is to understand the livelihoods dimensions of each group of farmers and make recommendations for improving farming (irrigated or otherwise) as a source of livelihoods. The modified sustainable livelihoods framework (Chapter 3) provides a tool to systematically evaluate the livelihoods of smallholder irrigation farmers. In assessing sources and determinants of livelihoods for farmers in smallholder irrigation the study will focus on both farm and non-farm sources while special attention will be given to water and land as primary inputs into smallholder irrigation. As noted in the preceding chapters, land availability and land tenure security are critical elements in determining the sources of livelihoods in smallholder irrigation. Chapter 5 discusses in detail issues of land availability and tenure security in the study communities and hence, though acknowledged, these will not be discussed again in detail in this section of the report.

The chapter is structured as follows. The first part Section 7.2 presents the sources of livelihoods, income and constraints in Makhathini and Ndumo-B. Section 7.3 presents the same for Bululwane and Tugela Ferry. Finally, Section 7.4 summarizes the chapter.

7.2 The results and discussions: sources and constraints to rural livelihoods in Makhathini and Ndumo-B

7.2.1 Sources of livelihoods

7.2.1.1 Livelihoods assets / capabilities and opportunities

If a household does not possess, through ownership or otherwise, the physical assets that make farming possible, they fail to utilise the available opportunity. As was shown in Chapter 5, ownership of physical capital including agricultural assets such as plough, planter, tractor, truck or car, trailer/ cart and water tanks is quite low across all types of farmers in the two communities. Households might not own but still have access to assets. Chapter 5 showed that farmers have access to tractor services mostly through hiring. Ndumo-B irrigation scheme has ownership of tractors which farmers indicate are not enough hence critical operations are delayed. Land cultivation using the mould board plough drawn by donkeys or oxen is not common among small-scale scheme irrigators in the two areas. Hence tractor hiring service is a critical agricultural service. Discussions show that this service is available to farmers from individuals who own tractors at a rate ranging from R1,800-2,000 per hectare depending on who is offering the service. Other than tractor services there is very little hiring of other farming related equipment among farmers in Makhathini and Ndumo (Figure 7.1). This does not

necessarily mean that farmers don't need the services, but most cannot afford the service. Thus, despite the fact that farming is an important source of livelihood smallholder irrigation farmers do not possess the necessary capacity to engage productively into farming. Opportunities for hiring are available but limited financial capital affects their ability to hire. However, wide ownership of cell phones (Chapter 5) among farmers is an opportunity to improve access to markets, price information and extension services.

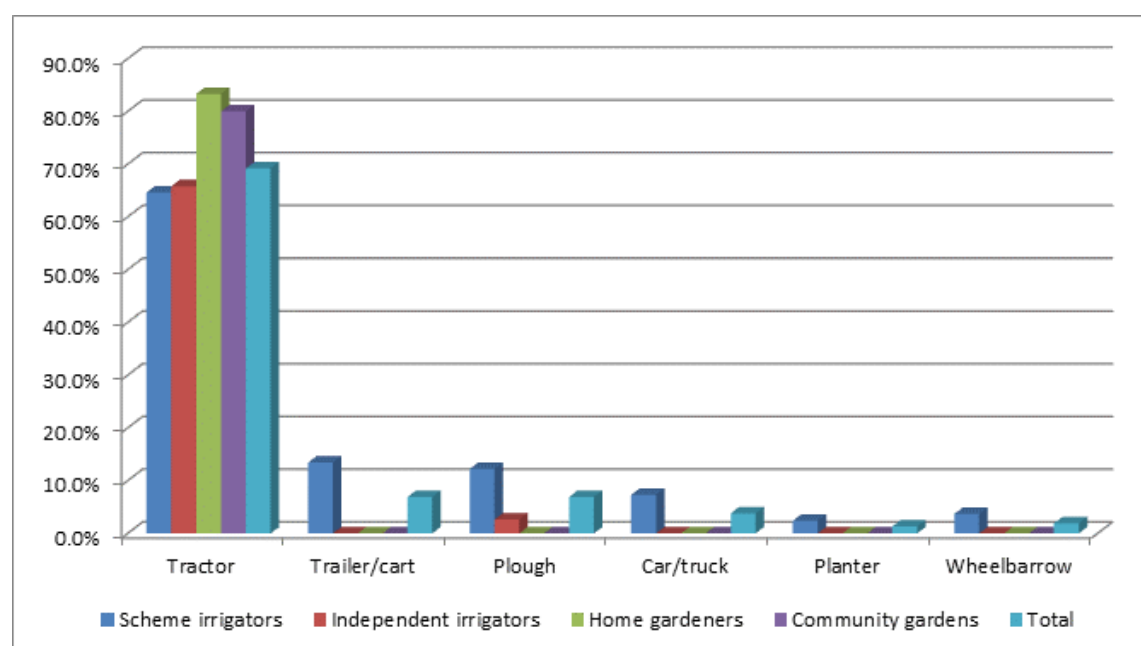


Figure 7.1. Asset hiring among different types of farmers – Makhathini and Ndumo-B

Source: Survey data, 2015

It was also found in Chapter 5 that a significant proportion of farmers in the two areas own livestock in the form of cattle (36.5%), goats (45.3%) and domestic poultry (54.1%). Livestock offer a number of opportunities to the livelihoods of small-scale irrigators. Section 6.1.3a above has shown that livestock are a source of income. Domestic poultry is highly liquid and can be easily sold at an average price of R50 per chicken. This is an important aspect in the lives of smallholder farmers since some of their cash needs are immediate and unplanned. Small ruminants such as goats are highly liquid as well with a selling price that ranges from R500-R800 in Makhathini and Ndumo.

Cattle represent a measure of a farmer's wealth and are taken as a form of investment. Other cattle uses include provision of milk and meat, ritual slaughter, sales, lobola payment, skin used for traditional clothing, draught power and tribal fines, among others (Bayer *et al.*, 2003). In other words, cattle represent the resilience or the extent to which a farmer and their household

are able to deal with external shocks or vulnerabilities. The prices of cattle in the two areas range from R5,000-R9,000, depending on the age and type of cattle. Discussions with farmers revealed that some farmers use manure from livestock as a form of fertilizer to improve soil fertility in their plots. The relationship between livestock and crop production can provide an opportunity to improve the livelihoods of small-scale irrigators and their household by exploring the potential provided from the integration of crop and livestock enterprises.

7.2.1.2 Income Sources

Table 7.1 shows sources of farmer household income. Farmers were asked a “Yes/No question to indicate if a particular source of income is relevant to their household. The results show that the common sources of household income are social support grants, sales from irrigated crops, temporary employment and livestock sales. Other households also survive from arts and crafts and rainfed agriculture. As shown above, social grants are important ingredients of the livelihoods of small-scale irrigation farmers in Makhathini and Ndumo-B. Farmers in the two areas also rely heavily on irrigated crops (75.5%) as a major source of livelihoods. Findings of the quantitative survey are confirmed by focus group discussions held with farmers and community leadership. Irrigated farming, particularly for farmers in small-scale irrigation, is a way of life, not only for the farmers but for the community in general. These farmers now consider farming as a business where they make profits and earn an income to pay permanent and temporary labour and also sustain their livelihoods. It was reported that irrigation farming provides household income and is also a source of employment to community members since there are no industries nearby, especially in Ndumo-B. Ndumo-B irrigation scheme employs 57 permanent employees and more than 150 hired labourers during periods of harvesting. Makhathini is a huge irrigation scheme and creates temporary employment for thousands in Jozini communities.

Comparisons by type of farmer show a significant difference in sources of income across different farmers. The major sources of income for scheme irrigators and community food gardeners is irrigated agriculture whilst that for independent irrigators and homestead food gardeners is social support grants. Temporary employment is a common source of income for most scheme irrigators and homestead food gardeners whilst arts / crafts and remittances are common among a significant proportion of community food gardeners. Livestock sales still play an important part in the livelihoods of all small-scale irrigators. The results also show that a smaller percentage of small-scale irrigators out of formal irrigation schemes (independent irrigators, homestead and community food gardeners) receive income from irrigated crops,

welfare and temporary employment compared to those in the schemes. However, more of those out of formal schemes receive income from rainfed agriculture, remittances and permanent employment compared to those in the schemes.

Table 7.1. Sources of income of farmers (percentages) – Makhathini and Ndumo-B

	Remittance	Arts and craft	Permanent employment	Temporary employment	Welfare grant	Crops – irrigated	Crops rain-fed	Livestock
Scheme irrigators	13.4	12.2	3.7	56.1	81.7	96.3	4.9	29.3
Independent irrigators	23.7	15.8	0.0	23.7	76.3	57.9	23.7	34.2
Homestead food gardeners	20.8	4.2	29.2	41.7	66.7	41.7	8.3	25.0
Community food gardeners	33.3	26.7	6.7	20.0	53.3	60.0	26.7	33.3
Total	18.9	13.2	6.9***	42.8***	75.5*	75.5***	11.9***	30.2
Makhathini	11.5	11.5	3.3	55.7	85.2	95.1	6.6	27.9
Ndumo-B	19.0	14.3	4.8	57.1	71.4	100.0	0.0	33.3
Out of scheme	24.7	14.3	10.4	28.6	68.8	53.2	19.5	31.2
Total	18.9	13.2	6.9	42.8***	75.5*	75.5***	11.9**	30.2

Note: *, **, *** indicate significance level at 10%, 5% and 1%, respectively. The rows do not add to 100% because a typical household head has reported multiple sources of income.

Source: Survey data, 2015

a) Income from Government Social Grants

Many studies have shown that smallholder farmers rely on social grants as their main source of livelihoods (Bradstock, 2006; Backeberg and Sanewe, 2010; Daniels *et al.*, 2013). Social grants are an important part of the livelihoods of smallholder households in South Africa. In this study, we assessed the extent of social grant support among small-scale irrigators in Makhathini and Ndumo-B. The results above show that 75.5% of interviewed farmer households receive government grant support. The range of support received includes child, old age, disability and foster grants⁷. Table 7.2 shows that most of the welfare support received by farmers is child support (67.9%), followed by old age grants (34%). There is a significant difference in the proportion of type of farmers receiving child support, old age and foster grants. Higher proportion of scheme irrigators receives child support compared to other farmers whilst a higher percentage of independent irrigators receive old age grants compared to other farmers.

⁷ A foster grant is support to take care of your foster child. A foster child is a child who has been placed in your custody by a court as a result of being orphaned, abandoned, at risk, abused and/or neglected.

Table 7.2. The importance of social grants among sampled farmers – Makhathini and Ndumo-B (percentage)

	Child support	Old age	Disability	Foster
Scheme irrigator	78	35.4	11	0
Independent irrigator	60.5	47.4	2.6	0
Homestead food gardeners	54.2	16.7	4.2	8.3
Community food gardens	53.3	20	0	0
Total	67.9**	34.0*	6.9	1.3***
Makhathini	77	37.7	9.8	0
Ndumo-B	81	28.6	14.3	0
Out of scheme	57.1	32.5	2.6	2.6
Total	67.9*	34	6.9*	1.3

Note: *, **, *** indicate significance level at 10%, 5% and 1%, respectively

Source: Survey data, 2015

Findings show that some farm households have been receiving social grant support for a long time, making them a constant, stable and reliable source of income to the household. Using South African Social Services Agency (SASSA) current payment rates for the different social grant support, the results show that small-scale irrigation farming households receiving social grant support in Makhathini and Ndumo-B, receive an average of R22,348.80 per annum. There are differences, though not significant, across the type of farmers. Scheme irrigators receive the highest value of social grant support per annum whilst community food gardeners receive the least value. In addition, farmers in Makhathini irrigation scheme receive higher value of social grant support compared to farmers in Ndumo-B irrigation scheme and those outside of the scheme. The values in Table 7.3 show that social grants are a significant income source for farmers and their households.

Table 7.3. The value of social grants received by households/year - Makhathini and Ndumo-B

	N	Mean	Std. Deviation
Scheme irrigator	73	24,480.0	38,934.7
Independent irrigator	30	23,352.0	18,217.8
Homestead food gardeners	17	15,550.6	9,141.8
Community food gardens	9	14,560.0	11,028.7
Makhathini	55	26,391.3	44,080.9
Ndumo-B	18	18,640.0	14,146.6
Out of scheme	56	19,570.7	15,293.9
Total	129	22,348.8	30,970.5

Source: Survey data, 2015

b) The dominance of unearned income and what it means for on-farm entrepreneurship

Half of the sampled farmers (50%) revealed that they are into farming not because they have chosen to be but because they have no other option (s). Such farmers have no belief that farming provides opportunities for productive employment and wealth creation. This will naturally affect the effort they put into this activity as a means of maintaining their livelihood.

Further analysis shows that 71% of the smallholder income is unearned, i.e. most of their living is coming through no effort (Table 7.4). The unearned income (social grants and remittances) is reducing recipient households' entrepreneurship drive and incentives to engage in income generating activities. In their study, Sinyolo *et al.* (2017) found that social grants which accounted for 50% of rural household income were negatively affecting on-farm entrepreneurship.

Table 7.4. Estimated farm and non-farm income sources – Makhathini and Ndumo-B

Income source	% households	Mean (Rand)	Std. dev	% of Total income
Remittances	21	1,988	6,971	7
Arts and craft	6	205	1,298	1
Permanent employment	3	1,120	9,270	2
Temporary employment	10	523	2,072	3
Social grant	88	19,645	21,322	63
Net crop income	63	9,803	34,382	23
Livestock sales	14	619	2,671	2
Earned income		12,269	36,851	29
Unearned income		21,646	22,731	71

Source: Survey data, 2016

Thus, if most of their living is coming through no effort how can smallholders be self-confident let alone entrepreneurial? How can incentives work? How can they believe that their destiny is in their hands? How can they consider themselves as farmers, mobilize resources and exert the necessary effort? How can they have an internal locus of control? People are inclined to put more effort in a given income source if it is important to their livelihood and if they can affect the outcome. Unfortunately, for most smallholders in South Africa, this source is not agriculture and hence there is no motivation to engage in entrepreneurship in farming. Most smallholders exhibit tendencies that are not in harmony or compatible with the entrepreneurial traits and values of the mainstream entrepreneur discussed in Chapter 2.

c) Income from irrigated crops

Farming is an important livelihood source of farmers in Makhathini and Ndumo-B. Table 7.5 shows revenue that farmers obtained from sale of crops in the last cycle of harvest between 2014 and 2015. The mean revenue from sale of crops is R11,022. The production season for most crops grown by farmers who irrigate is four months. Assuming three harvests per year, the average revenue from irrigated crops would be just above R30,000 per annum. Scheme irrigators have the highest mean revenue from sale of irrigated crops followed by independent irrigators. This just confirms earlier results that the two types of small-scale irrigators consider farming as a business. Homestead food gardeners get the least revenue from sale of irrigated crops.

Table 7.5. Total revenue estimates from sale of crops (2014/15 cropping season) – Makhathini and Ndumo-B

	N	Mean revenue (Rand)	Std. Deviation
Scheme irrigator	82	15269	20111
Independent irrigator	38	10166	19242
Homestead food gardeners	24	2440	9445
Community food gardens	15	3710	3218
Total	159	11022	18269

Note: F-value 4.3 significant at 1%

Source: Survey data, 2015

Figure 7.2 below shows the percentage of farmers with access to credit in the last twelve months.

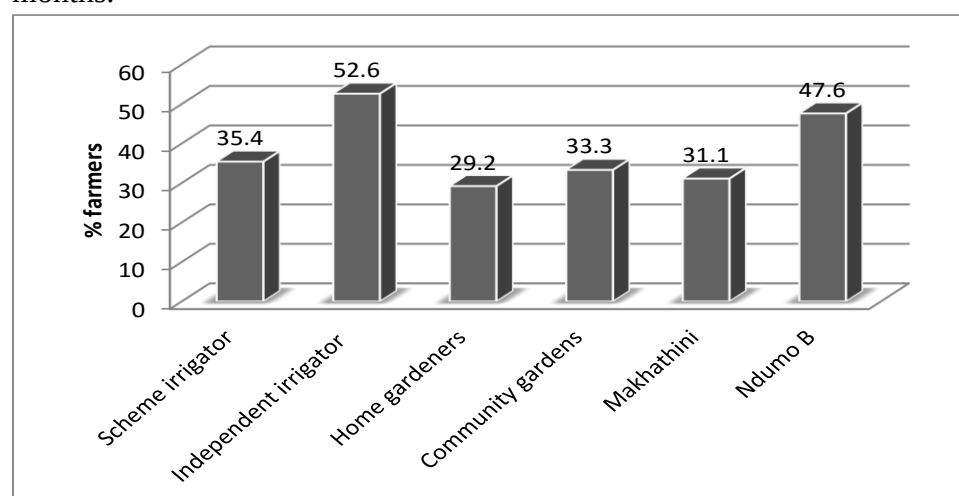


Figure 7.2. Farmers accessing credit (N=159)

Source: Survey data, 2015

The results in Figure 7.2 show that the majority of farmers do not have access to credit either for production or for family emergencies. Among the sample size of 38 independent irrigators, 52.6% had access to credit. This is probably because they have various sources of income which could have enhanced their chances to access credit either from formal or informal credit providers compared to other groups. Homestead food gardeners have the highest percentage of farmers without access to credit. Makhathini irrigation scheme farmers had more households with access to credit compared to Ndumo-B irrigation farmers. According to Sikwela (2013), financial constraints, such as limited access to credit affect farm input decision and efficiency for small-scale farmers. This is she says because timing of inputs usage is more important in affecting the yield rather than the quantities of inputs used and thus farmers facing financial constraints may not be able to optimize production.

Smallholder low-risk propensity is also evident in their borrowing behaviour. A third (33%) of the sampled farmers do not actively seek for credit because of fear of getting indebted. Such smallholders are afraid that they may not be able to produce enough for loan repayment. Kahan (2013) identified this as a financial risk since it comes because of money borrowed to finance the farm business. Boussard (1992) indicates that borrowing is a risk for smallholders because they are poor and such tendencies are deterrent to investment which is important in entrepreneurship.

7.2.1.3 Water accessibility and opportunities to improve rural livelihoods

a) Water Scarcity

As noted in Chapter 4, Makhathini and Ndumo-B irrigation schemes draw water from Pongolapoort dam and Pongola river, respectively. Pongola river, which flows from Mozambique, is the main supplier for water in Pongolapoort dam. As reported, Pongola river never dries and water is always available for irrigation and other uses. However, farmers in Makhathini report that during periods of drought water in the river is greatly reduced due to ET and thus less water is available for irrigation. In Ndumo-B farmers in the irrigation scheme report that water is readily available at all times. The availability of water in its physical form provides an opportunity for sustainable irrigation farming in the two areas.

The major challenges in water availability for farmers in Makhathini and Ndumo-B is mostly to do with economic water scarcity. Ndumo-B scheme irrigators and all identified irrigators out of the scheme do not pay for water but electricity. Water is freely available to these farmers. Only scheme irrigators in Makhathini pay an average of R260.50/ha/year as a fee to pump the

water into each plot⁸. However, all these farmers do face a cost of accessing/acquiring water for use in crop irrigation. The study separates the two costs, that is, water fee and cost of ensuring that water reaches one's plot. The later cost includes the cost for water use charges such as water infrastructure acquisition and maintenance, electricity charges and diesel/petrol costs.

Scheme irrigators in Ndumo-B are paying higher fees for water-related services compared to their counterparts in Makhathini irrigation scheme. On average, Ndumo-B scheme irrigators pay in excess of R10,000/ha/year compared to R2,700/ha/year paid by farmers in Makhathini irrigation scheme, most of which is meant for electricity charges. Ndumo-B irrigation scheme uses an electric pump to draw water from Pongola river and it is reported that on a monthly basis the electricity bill is in excess of R30,000. Unlike Makhathini scheme farmers are heavily subsidized by government through Mjindi Farming, these charges are not subsidized by government. Mjindi Farming is a cooperative that does not do farming but responsible for maintenance of water-related infrastructure and managing water-related issues. It manages the Makhathini irrigation scheme, offers training (on how to produce and market) and assists in the distribution of agricultural produce to markets.

Focus group discussions with farmers in Ndumo-B revealed a lot of disgruntlement related to why farmers in the scheme are not treated in the same way as Makhathini scheme irrigators. They want their water-related bills to be subsidized by government. On average, independent irrigators incur a cost R128 per year as a cost related to bring water to their plots. The major cost is fuel and maintenance cost for the water pump. Community and homestead food gardeners seldom incur a cost of acquiring water. They use family labour to carry water from the water source (tap or river) mostly using the bucket system. Some homestead food gardeners do have hosepipes that make it easier to irrigate their crops.

When asked their opinion on who should pay for water, most farmers regardless of them being in or outside a formal irrigation scheme agree or strongly agree that government should pay for water services (67.3%) whilst 23.9% indicate that only farmers in irrigation schemes should pay for water (Table 7.6). This shows that the willingness to pay for water is limited. Water is viewed as a gift of nature and basic commodity that the government should freely provide to its people.

⁸ Estimates obtained from Mjindi Farming and the quantitative survey.

Table 7.6. Who should pay for water? Farmers' response – Makhathini and Ndumo-B

Who?	Scheme irrigators	Independent irrigators	Homestead food gardeners	Community food gardeners	Total
No one, government only	58.5	73.7	79.2	80.0	67.3
Everyone participating in irrigation scheme	29.3	23.7	12.5	13.3	23.9
Only those irrigating a lot in terms of land size and frequency	11.0	2.6	8.3	0.0	7.5
Only those that are making more money	1.2	0.0	0.0	6.7	1.3

Source: Survey data, 2015

b) Water security

An attempt has been made to assess water security among small-scale irrigators in Makhathini and Ndumo-B. Table 7.7 above shows water security is a challenge for all farmers. Less than 50% of farmers feel their right or claim to water is secure. This is because farmers have no ownership of water resources and use rights depend on their ability to pay for the water services for those in the scheme or availability of water resources in the rivers and dams. Most farmers believe availability and security of water actually constrains their performance. Scheme irrigators also complain of the water distribution network which no longer efficiently distributes water to their plots.

Table 7.7. Farmers' perceptions regarding security of their access to water (percentages) – Makhathini and Ndumo-B

Aspects of water security	Scheme Irrigators	Independent Irrigators	Homestead food gardeners	Community food	Total	Makhathini	Ndumo-B	Outside of scheme
My right or claim to water is secure	31.7	49.5	34.7	46.6	42.4***	29.5	38.1	53.9
Water is sufficient for my cropping requirements	52.6	60.5	50.0	40.0	52.8**	57.7	42.9	53.2
Availability and security of water constrains my performance	64.2	86.4	62.5	73.3	70.1*	67.2	55.0	76.3
The water distribution network is not in a good condition	56.1				64.8**	54.1	61.9	

Note: *, **, *** indicate significance level at 10%, 5% and 1%, respectively.

Source: Survey data, 2015

c) Conflicts and water governance

Conflicts among farmers are common in smallholder irrigation except under homestead and community food gardening (Figure 7.3). They result from water use and governance issues. In Makhathini farmers report cases of conflict among those practicing flood irrigation because some farmers block and divert water away from the plot of another farmer. Whilst others take sprinklers from plots of other farmers and put them in their plots. Other conflicts also emerge with farmers that are irrigating illegally without paying for the service. Farmers reported cases of illegal withdrawal of water from the canal by farmers outside the canal, which has also been confirmed by Muchara (2015). In Ndumo-B irrigation scheme, farmers indicated that conflicts arise whenever some farmers do not pay for the electricity bill. There is one bill of electricity and since there are no water metres to measure water use by each farmer, the bill is divided equally among all farmers in the scheme. However, some farmers do irrigate more than others and thus why there are 11% farmers in the scheme who believe that only those that irrigate a lot should pay for water (Table 7.6 above).

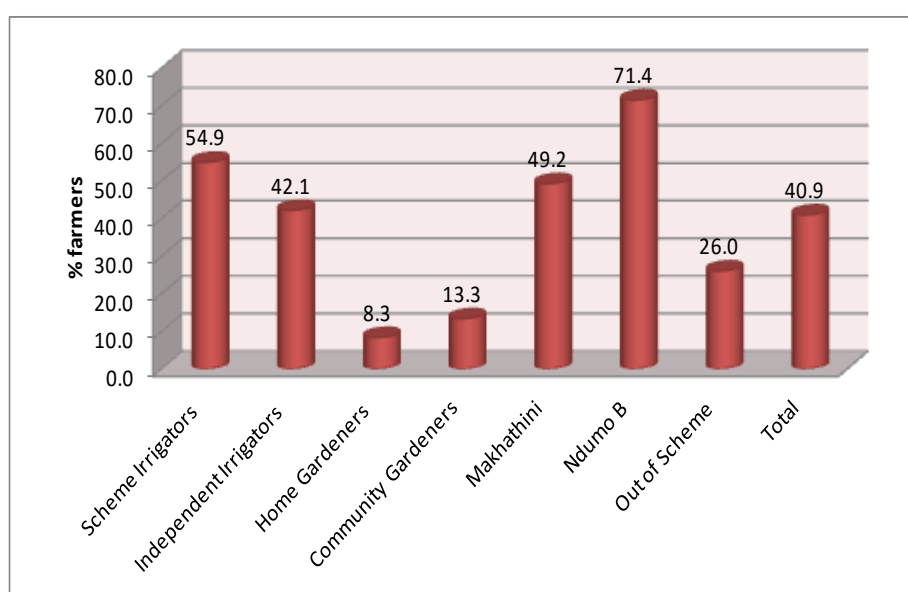


Figure 7.3. Occurrence of disputes among farmers and between blocks on water issues – Makhathini and Ndumo-B

Source: Survey data, 2015



Figure 7.4. Farmers illegally drawing water from the canal in Makhathini Irrigation Scheme

Source: Survey data, 2015

Water governance is central in smallholder irrigation schemes, particularly issues of water use management. Table 7.8 show reasons why some farmers resort to independent irrigation. The major reasons are water theft and conflicts and lack of enforceable rules in irrigation systems that are managed collectively. These reasons culminate in free riding tendencies among farmers in such systems, i.e. farmers resort to independent irrigation simply because they do not face institutional challenges when they are irrigating independently.

Table 7.8. Reasons why some irrigators are irrigating independently (percentages) – Makhathini and Ndumo-B

Farmers' reasons to irrigate independently	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Water theft is a major concern for irrigation scheme managed collectively	13.9	2.8	22.2	30.6	30.6
Lack of enforceable rules in collectively managed irrigation schemes is a challenge	16.7	5.6	22.2	25.0	30.6
There is a lot of free riding in irrigation schemes managed collectively	11.1	5.6	22.2	25	36.1

Source: Survey data, 2015

d) Lack of willingness to pay for water and farmers' external locus of control

Most farmers are concerned about what the government has done, failed to do or can do for them. Seldom are discussions about what they can do for themselves using the resources and assets they are endowed with to maintain their livelihoods. Most think that they are entitled to government support/public resources and these resources are unlimited/available always unconditionally. For example, during a group discussion, using an analogy, one farmer said that “When someone buys a car, it comes with a service plan; therefore, government must come with a service plan for the irrigation infrastructure”. According, the government should provide not only the initial investment cost but also the cost of operation and maintenance for the installed irrigation infrastructure. With such a locus of control, smallholders are not inclined to look for and act decisively to utilise available opportunities and would not act in the manner expected of an entrepreneur. The results show that about 33% of the smallholders in Makhathini and Ndumo-B are not willing to pay for irrigation water and their major reasons are that the resource should be free of charge, or it is the government's responsibility (Figure 7.5).

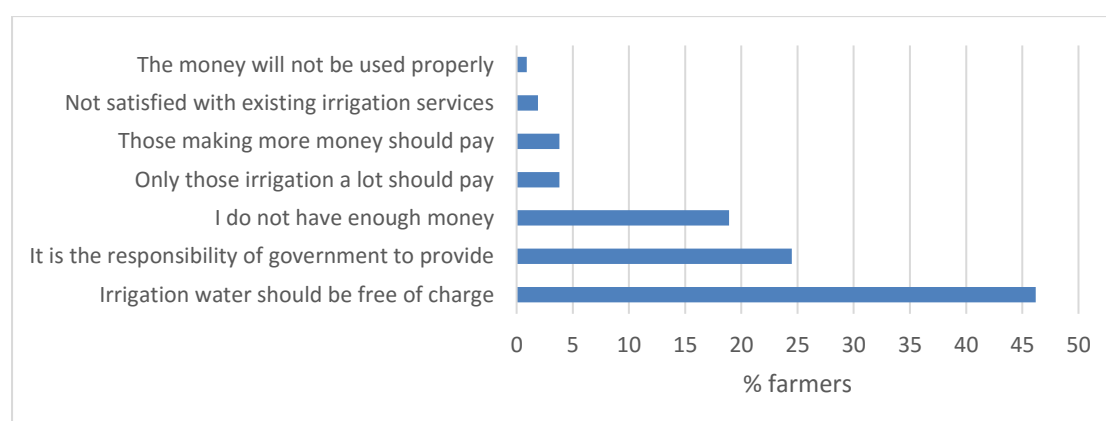


Figure 7.5. Reasons for farmers' unwillingness to pay for water – Makhathini and Ndumo-B (N=106)

Source: Survey data, 2016

Given the potential benefits from the use of irrigation water, it is only rational that users pay for the water and maintenance of the irrigation infrastructure to continue enjoying the benefits in the future. This is also necessary to make the system sustainable. However, due to the entrenched dependency, entitlement and expectation mindset, this is not happening. Moreover, the lack of cost recovery and maintenance plans and the lack of transfer of ownership and management to the smallholders at scheme level worsens the situation. These entrenched attitudes and behaviours can be explained using behavioural economics principles which say that habits are important, long lasting and hard to change, i.e. the frequency of past behaviour

influences current behaviour (Dawnay and Shah, 2005). Thus, farmers' attitudes and behaviours could be a result of the unintended negative impact of many years of the social grants programme on agricultural entrepreneurship (Sinyolo *et al.*, 2017). The demonstration knock-on effect of the social grant programme, be it positive/negative, is long lasting and difficult to change. Similarly, years of failure or dissatisfaction with production or income levels from farming can have the same negative effect on farmers' behaviour and attitudes.

7.2.1.4 Crop production by smallholder farmers

The most common crops grown by farmers irrigating in and outside of irrigation schemes are cabbage, maize, beans, tomatoes and spinach. Several other crops mostly horticultural crops are grown as shown in Table 7.9 below. The trend is similar across both schemes the only difference being that scheme irrigators in Makhathini also grow yams and calabash whilst in Ndumo-B chillies is also a major crop. Comparison by types of farmer shows some differences with homestead and community food gardeners growing similar crops whilst scheme and independent irrigators also grow similar crops. The former grows mostly cabbage, spinach, tomatoes and onions whilst the latter mostly grow cabbage, maize and beans.

Table 7.9. Percentage of farmers growing each crop – Makhathini and Ndumo-B

Crop	Scheme irrigators (n=82)	Independent irrigators (n=38)	Homestead food gardeners (n=24)	Community food gardeners (n=15)	Makhathini (n=61)	Ndumo-B (n=21)	Out of scheme (n=77)	Total (n=159)
Cabbage	42.7	15.8	66.7	40.0	37.7	57.1	36.4	39.6
Maize	32.9	34.2	8.3	6.7	27.9	47.6	20.8	27.0
Beans	23.2	36.8	4.2	0	23.0	23.8	19.5	21.4
Tomato	1.2	10.5	41.7	40.0	0	4.8	26.0	13.2
Spinach	1.2	7.9	50.0	26.7	1.6	0	24.7	12.6
Onion	0	5.3	25.0	20.0	0	0	14.3	6.9
Yams	8.5	2.6	4.2	6.7	11.5	0	3.9	6.3
Calabash	6.1	0	0	6.7	8.2	0	1.3	3.8
Green pepper	1.2	5.3	4.2	13.3	1.6	0	6.5	3.8
Sweet potato	1.2	5.3	4.2	0	1.6	0	3.9	2.5
Chillies	4.9	0	0	0	1.6	14.3	0	2.5
Carrot	0	0	8.3	0	0	0	2.6	1.3
Groundnut	0	0	4.2	6.7	0	0	2.6	1.3
Brinjal	0	0	0	6.7	0	0	1.3	0.6
Beetroot	0	0	4.2	0	0	0	1.3	0.6
Lettuce	0	0	4.2	0	0	0	1.3	0.6

Source: Survey data, 2015

Discussions with farmers revealed other crops that were not mentioned in the quantitative survey. For instance, in Ndumo-B, farmers mentioned butternut as a major crop whilst in Makhathini sugarcane was reported as one of the major crops. Butternuts are seasonal and hence by the time of conducting the study the crop was not under production. Sugarcane is grown by more established farmers on larger land areas in Makhathini irrigation scheme. The crop is a perennial crop and hence it is not popular with scheme irrigators with smaller pieces of land and limited capital base or financial resources. Sugarcane farmers in Makhathini are more successful and it is quite evident that farming has changed their lives.



Figure 7.6. Sweet potato, cabbage and spinach grown in the four irrigation schemes

Analysis of cropping patterns of the sampled farmers shows their unwillingness to take risk and the lack of ability to absorb risk. There are limited farming activities in high-value crops and markets. Although there are several reasons for this, risk aversion is one of them. Most smallholders are sticking to producing traditional horticultural crops such as green maize, cabbages, green beans, tomatoes and spinach. Few are willing to diversify into high-value crops such as chillies, paprika, turnip, lettuce and cucumbers. Farmers' past negative experiences (own experience or others) with production, post-harvest handling and marketing of high-value crops and lack of information on markets standards and prices make them more risk averse.

7.2.2 Vulnerability to external shocks and constraints to improve on-farm livelihoods

The common external shock to agricultural production common in Makhathini and Ndumo-B is drought. Figure 7.7 shows that more than 50% small-scale irrigation farmers report that drought sometimes, often or always happens in their area. Floods and hailstorm rarely or never happened in the last 10 years before the survey. Although hailstorm is rare, it was last experience as recent as March 2014 and resulted in the destruction of crops. Whenever drought

occurs, crop production particularly for small-scale irrigators out of the irrigation schemes is affected. Farmers report that in such times crops are destroyed or stressed to the extent that yields are reduced. Even though scheme irrigators are relatively less affected by drought due to risk reducing effect of irrigation, farmers revealed that drought affects the water level in the river, dam and ultimately in the canals. Thus, scheme farmers report that at such times water is sometimes not adequate or sufficient for their crop requirements.

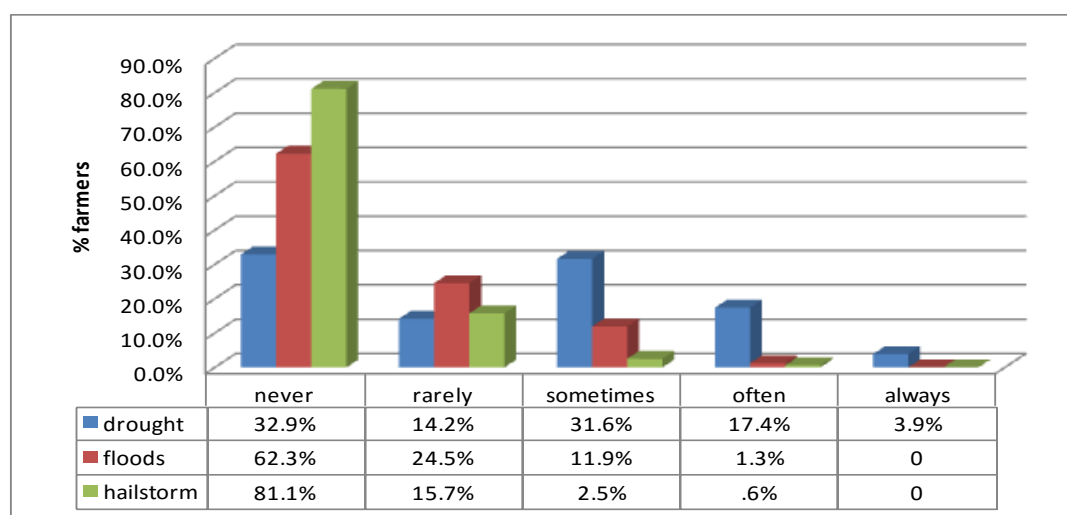


Figure 7.7. Frequency of occurrence of natural hazards in the last 10 years – Makhathini and Ndumo-B

Source: Survey data, 2015

Farmers also highlight the outbreak of pests such as whiteflies as major shocks to farming. Whiteflies are tiny, sap-sucking insects that are frequently abundant in vegetable and ornamental plantings such as cabbage and tomatoes. The major types of whiteflies in South Africa are known as B-type *Bemisia tabaci* (Gennadius) and *Trialeurodes vaporariorum* (Westwood) (Krüger). They excrete sticky honeydew and cause yellowing or death of leaves. Outbreaks often occur when the natural biological control is disrupted and their management is difficult (Flint, 2002). Farmers have reported that control of whiteflies is through a pesticide that is expensive, R5,000 per litre. However, control by pesticide is not that effective since only pests that come in contact with the pesticide die. Whiteflies are better controlled through integrated pest management practices (Flint, 2002). Similarly cabbage farmers in Makhathini have been struggling to control a pest that affects cabbage and reduces its quality. Farmers indicate that even after extension advise they are failing to control the pest which is not even known. During the survey, the team encountered an affected farmer whose cabbage was destroyed by pests and she could not sell as a result.



Figure 7.8. Cabbage crop destroyed after being affected by an unknown pest in Makhathini Irrigation Scheme

7.2.3 Input use by smallholder irrigation farmers

Smallholder farmers in South Africa are faced with several challenges. One of the challenges is missing agricultural markets which affect level of input use in smallholder agriculture (DAFF, 2012). It is reported that the lack of proper road infrastructure in the rural communities affect the transportation of inputs (DAFF, 2012). In their study, Ortmann and King (2007) highlight the issue of high transaction cost to accessing production resources as one of the key challenges of smallholder farmers in South Africa. This coupled by the fact that smallholder farmers are generally poor with limited financial base affects the level of input usage in this sector. Farmers in Makhathini and Ndumo report that prices for agricultural inputs are high and thus some farmers cannot afford to buy. The literature shows that government has been implementing programmes aimed at increasing smallholder agricultural productivity through the provision of inputs, mechanization and other support (Mudhara, 2010). However, discussions with farmers in Ndumo-B show that there is a need to assess the livelihood enhancing impacts of such programmes. Farmers indicated that although they receive support from government in terms of seeds and fertilizers, this support is inappropriate since they are never consulted on what they really need. They report that sometimes they receive inputs that they have already bought themselves whilst in some instances they indicate the inputs will be expired. Given this background the study assessed the level of input use for major crops among small-scale irrigators in and outside of the irrigation schemes.

Table 7.10 below gives a brief summary on the use of improved seed for selected crops. Use of improved seed is high among farmers. However, use of recycled or unimproved seed exists

though limited. The practice depends on the crop. Farmers report that recycling of seeds is possible with crops such as beans, calabash and yams. For other crops it is not possible.

Table 7.10. Use of improved seed among small-scale irrigation farmers – Makhathini and Ndumo-B

Crop	Use of improved seed
Maize	Out of the 44 farmers growing maize 33 use improved seed. These are mostly scheme irrigators
Beans	33 out of 34 farmers growing beans use improved seed
Tomatoes	13 of the 16 farmers growing tomatoes use improved seed. Those that use recycled seeds are two homestead food gardeners and an independent irrigator.
Calabash	Out of the 6 farmers growing calabash only 2 use improved seed.
Onion	All farmers use growing onions use improved seed.

Source: Survey data, 2015

Table 7.11 shows the percentage of small-scale irrigators in Makhathini and Ndumo-B using different agricultural inputs.

Table 7.11. Percentage of farmers using different inputs – Makhathini and Ndumo-B

Crop	N	Basal fertilizers	Top dressing fertilizers	Manure	Herbicides	Pesticides
Maize	44	81.8	77.3	20.5	23.7	63.6
Cabbage	55	81.5	76.4	52.7	17	70.4
Beans	34	76.5	55.9	52.9	8.8	64.7
Tomatoes	16	50	40	37.5	6.3	37.5
Spinach	14	50	42.9	50	0	14.3
Onion	10	40	44	80	0	40

Source: Survey data, 2015

Fertilizer use (inorganic) for crops such as maize, cabbage and beans is quite common among farmers. For other crops such tomatoes, spinach and onion use of inorganic fertilizer is limited with 50% or less of the farmers growing the crop indicating use of fertilizer. The common type of basal fertilizer used by smallholder farmers in the irrigation schemes is Mono-ammonium phosphate (MAP) whilst the common top-dressing fertilizers are Limestone Ammonium Nitrate (LAN 28) and Urea. However, both LAN 28 and urea can also be used as basal fertilizers. The difference between LAN 28 and urea is in the percentage of nitrogen content which is higher in urea (46%N) compared to LAN 28 (28%N). Comparison by farmer type shows that fertilizer use is higher among scheme irrigators compared to homestead and

community food gardeners. Table 7.12 shows fertilizer application rates for selected crops. Fertilizer application rate for maize is below the recommended rate of 200 kg per ha for top dressing whilst application rates for cabbage are normal and as expected.

Table 7.12. Fertilizer application rates – Makhathini and Ndumo-B

	Maize basal	Maize top dressing	Cabbage basal	Cabbage top dressing	Bean basal	Bean top dressing
Scheme irrigators	240	204	272	278	235	195
Independent Irrigators	199	72	125	325	158	250
Homestead food gardeners	188	63	267	267	80	0
Community food gardeners	0	0	290	238	0	0
Total	229	151	267	276	211	204

Source: Survey data, 2015

Use of herbicides is not common among small-scale irrigators in Makhathini and Ndumo-B. Table 7.11 above shows that only 23.7% of the farmers growing maize and 17% growing cabbage use herbicides to control weeds. For other crops, herbicide use is not common, instead farmers hand-weed their fields using family or hired labour. Herbicides are mostly used by farmers in the irrigation schemes and by some independent irrigators. There is no herbicide use among homestead and community food gardeners. The most common type of herbicide used is Roundup.

Farmers' use of pesticides is quite high. This is because most of the crops being grown by smallholder irrigation farmers are susceptible to attack by different pests and hence it is almost impossible to have a good harvest without using pesticides. Table 7.11 shows that pesticides are mostly used for crops such as cabbage, beans, maize, onions and tomatoes. Similar to herbicide use, pesticide use for crops such as cabbage, maize and beans is high among scheme irrigators followed by independent irrigators and then homestead and community food gardeners. Several pesticides are used such as Kickback, Duet, Cypermethrin, Mospilan, Bio-power, Punch, WETCIT and Kung Fu 250, among others.

Farmers in Makhathini and Ndumo-B also apply organic manure as a source of nutrients for their crops (Table 7.11). The commonly used manure is cattle manure. Manure is mostly used for all horticultural crops such as cabbage, tomatoes, beans, spinach and onions. Manure use in maize crop is also common with 20.5% of farmers indicating manure application in maize crop. Homestead and community food gardeners tend to use more of organic manure compared

to inorganic fertilizers. Table 7.11 shows that 80% and 50% small-scale irrigators applied manure to onion and spinach, respectively. As reported earlier, these are crops mostly cultivated by homestead and community food gardeners.

In the following figure, the first picture shows how herbicides are applied using knapsack sprayer and the other pictures show the common herbicide and chemical fertilizer used by farmers.

(a) Herbicide application

(b) Type of herbicide used

(c) Omnia fertiliser



Figure 7.9. Herbicide application in Ndumo-B Irrigation Scheme

Source: Pictures taken during the survey

7.2.4 Value chains for major inputs and products

Jordaan *et al.* (2014) state that the financial performance of smallholder farmers in South Africa remains poor despite years of effort and investment by government in linking smallholder farmers to commercial agribusiness food chains (Denison and Manona, 2007b). Ultimately, this means the objective to allow farmers to improve their livelihoods through irrigated agriculture will be difficult to achieve (Jordaan *et al.*, 2014). Several factors are identified by Jordaan *et al.* (2014) as stumbling blocks to improved financial performance of smallholder farmers including the stringent requirements of commercial agri-food chains in terms of consistent supply of good quality produce, the size of operations of smallholder farmers, insecure property rights, lack of access to credit, poor conditions of physical infrastructure, lack of trust among value chain participants, lack of market information, long distances to the market and the lack of support services. However, there are some few success stories of smallholder farmers in South Africa who are successfully participating in commercial agri-

food chains from which lessons can be drawn for the future (Bediako and Debrah, 2007; Louw *et al.*, 2008). In all the stories the contribution of collective action institutions and vertical coordination to overcome the above obstacles is very evident (Jordaan *et al.*, 2014). This section of the report briefly discusses input and output value chains for major inputs and crops identified, with the aim of teasing out the challenges affecting farmers' participation in food markets.

7.2.4.1 Input value chains

Accessibility of inputs by smallholder farmers is always a challenge. Smallholder farmers in the studied irrigation schemes mentioned distance to nearest towns, input prices and transport cost as the major constraints to accessing inputs. There are two channels for accessing inputs by farmers in Makhathini and Ndumo-B, i.e. purchases and government support programmes. Purchases are usually from local shops and agrodealers in Jozini and Pongola town, although some farmers indicated that sometimes they travel as far as Johannesburg to buy inputs. One farmer reported that although red maize is a lucrative enterprise, they can only access inputs for the crop in Johannesburg. Major agrodealers mentioned by farmers in Pongola and or Jozini are TWK, Overke, Omnia, Pioneer, Preto and Venchem, among others.

Focus group discussions show that most farmers obtain their inputs from Pongola town. The town is an estimated 74 km away from Makhathini and 147 from Ndumo-B. There is only one road that connects Pongola from Jozini which is the N2 highway. This means to get access to some inputs at a cheaper price and also extension advice regarding input use and crop management, farmers have to pay an average of R50-120 in transport fees to Pongola. This is after farmers also revealed that whenever they buy inputs the agrodealers provide advice on input use and crop management. Even those that are able to obtain some of the inputs from Jozini town still incur a transport cost of more than R50 for a return trip. Farmers indicated that travelling to Pongola is a full day trip which comes with other costs, in addition to the transport cost. For inputs such as fertilizers, farmers are charged R10 as transport fee for carrying one 50 kg bag in a bus.

Agricultural input prices vary according to their source hence the varying range of input prices for some key inputs as shown in Table 7.13 above. As always, farmers indicated that pesticides and fertilizer are expensive. The transaction cost of bringing inputs closer to farmers in Makhathini and Ndumo-B increases with distance resulting with higher prices in local shops. Farmers report the main cause of their challenge with access to input stem from their location which is far away from major towns and cities. Hence, some resort to recycling of seeds is a

cheaper alternative, although indications are that this is possible with the bean crop and not others.

Table 7.13. Prices of selected inputs – Makhathini and Ndumo-B

	Unit	Price (Rand)
Seed		
Maize	Kg	70-100
Cabbage	Seedling	0.2-0.9
Beans	Kg	15-30
Green pepper	Seedling	0.3
Fertilizers		
MAP	50 kg	285-350
LAN 28/30	50 kg	285-350
Urea	50 kg	300
Herbicides		
Round up	5l	1000
Pesticides		
Cypermethrin	1 l	120-150
Duet	0.5 l	300
WETCIT	15 ml	300
Mospilan	15 ml	300
Biopower	15 ml	300
Tamidor	15 ml	300
Punch	2 l	500
Kung fu 250	1 l	120-180

Source: Survey data, 2015

The South Africa government through DAFF is providing input support to smallholder farmers in the form of seeds and fertilizers. The current season smallholder farmers were supported with 200 kg basal and 200 kg top dressing fertilizers. This could be an important source of inputs only if support is according to farmer needs and is availed timeously. Discussions in Ndumo-B show that often government support reaches farmers late after they have already bought their own inputs. Contracting is present mostly with scheme irrigators in both schemes. However, no evidence of inputs provision as part of the contractual agreements was found in the study.

7.2.4.2 Output value chains

The results show that most farmers sell most or some of their produce except for homestead food gardeners (Table 7.14). Only 16.7% homestead food gardeners produce for the market. Homestead food gardening is mostly for subsistence purposes and some gardeners sell only when they have surplus over and above their household requirements.

Table 7.14. Proportion of farmers selling produce

Type of farmer	% selling crops
Scheme irrigators (n=82)	95.1%
Independent irrigators (n=38)	84.2%
Homestead food gardeners (n=24)	16.7%
Community food gardeners (n=15)	93.3%
Total	80.5%

Note: *P*-value 75.4 significant at 1%

Source: Survey data, 2015

Past literature has shown that smallholder farmers' participation in the output markets is limited due to high transaction costs (Jagwe and Machethe, 2011; Wiggins *et al.*, 2011). Farmers only participate in the lower value markets particularly at the farmgate and local markets due to high transaction costs associated with accessing high value food markets. The situation is no different for farmers in Makhathini and Ndumo-B as accessibility to markets remains a major constraint. The most common channel for selling crop produce is from the farmer through middlemen to the consumer or retailer. Another channel is directly from the farmer to the retailer, mostly local shops such as Spar or Indians shops though not very common. Direct selling from the farmer to the consumer sometimes happens and is common among homestead and community food gardeners. However, farmers report little proceeds from this channel and say it is not so important to them.

Most of the produce is sold at farmgate and to hawkers who come as far as Durban and Johannesburg. High value formal markets for horticultural crops that farmers are producing are in the major towns which farmers are unable to access due to distance and high transport cost. Hawkers provide their own transport (mostly bakkies) for transportation of the produce. Even though hawkers buy the crop from the fields farmers report being charged transport costs. The final price for the crop that farmers receive at farmgate is less the cost that farmers would have incurred to transport the crop to formal markets. For example, in Ndumo-B, for butternut hawkers deduct R5 as transport fee from the price of R35 per 10 kg of butternut whilst for cabbage R3 is deducted from the price of R6-7 per head which farmers would have charged.



Figure 7.10. Bakkies and trailers used to transport produce to markets – Makhathini and Ndumo-B Irrigation Scheme

Due to limited access to formal markets some farmers report selling produce on credit to hawkers. The results from the quantitative survey show that 62.5%, 21.9%, 12.5% and 3.1% scheme irrigators, independent irrigators, community food gardeners and homestead food gardeners, respectively, sometimes sell the produce on credit. However, it might result in farmers losing their produce due to none payment.

Table 7.15. Percentage of farmers selling through different channels – Makhathini and Ndumo-B

	Farm gate	Hawkers	Local shops	Roadside	Shops in town
Maize	40	73	3	8	0
Cabbage	72	63	7	2	2
Bean	67	63	4	7	0
Tomato	67	33	11	0	11
Spinach	80	0	20	0	20
Yams	88	88	0	0	0
Onion	100	50	0	0	0
Calabash	75	100	0	0	0

Source: Survey data, 2015

Group discussions with farmers revealed some form of contract farming in the two schemes. Farmers reported that sometimes they do get requests from Indians from Durban or Johannesburg to grow a certain quantity of chillies on the promise that they will come and buy at a guaranteed price. Techno-Serve also does the same with butternut but there are no formal contracts that are signed between the contractor and the farmer. Thus, the farmer as the weaker

side in the negotiations is not protected in anyway. Farmers report that there are times when the contractor does not return to buy the produce and the farmer is left stuck with the produce and no market. Another non-formalized form of contract arrangement exists between the cabbage farmers in Makhathini and Mhlosinga. Mhlosinga is an organisation that holds the school feeding tender with government. Thus, they buy cabbage for the programme at market prices currently at R50 per 10 heads of cabbage. Farmers sell as a group to Mhlosinga due to the large quantities requested which they cannot supply as individuals. Farmers indicated that as long Mhlosinga hold the tender, it offers a guaranteed market for cabbage at a better farmgate price.

Cabbage has better selling options and thus farmers are getting a better price. However, farmers complain of a low farmgate price for maize due to limited marketing options. Hawkers are buying 12 cobs of maize at between R20 and R22 yet farmers say the fair price is R25. Through their cooperatives and the marketing committee farmers agree on one selling price for their produce before the selling season starts. However, due to mistrust some farmers still sell at lower prices allowing hawkers to take advantage of their disorganisation. This highlights a key challenge with smallholder farming. During discussions in Makhathini the farmers marketing committee for cabbage and maize indicated that such challenges are worsened with the existence of farmers renting land. These do not participate in meetings and their commitment to collective management and bargaining is limited.

Figure 7.11 shows enterprise profitability for three crops grown by most farmers. Cabbage is the most profitable crop to farmers with an average gross margin of R28103 compared to R8677 and R5000 for maize and beans, respectively. Figure 7.11 show that whilst some farmers are performing well, some have negative gross margins. This is mainly due to high labour cost per hectare compared to area planted and/ or low maize yields compared to other farmers. For crops such as beans which are also produced by more homestead food gardeners, the majority of those with negative gross margins are homestead food gardeners compared to other type of farmers.

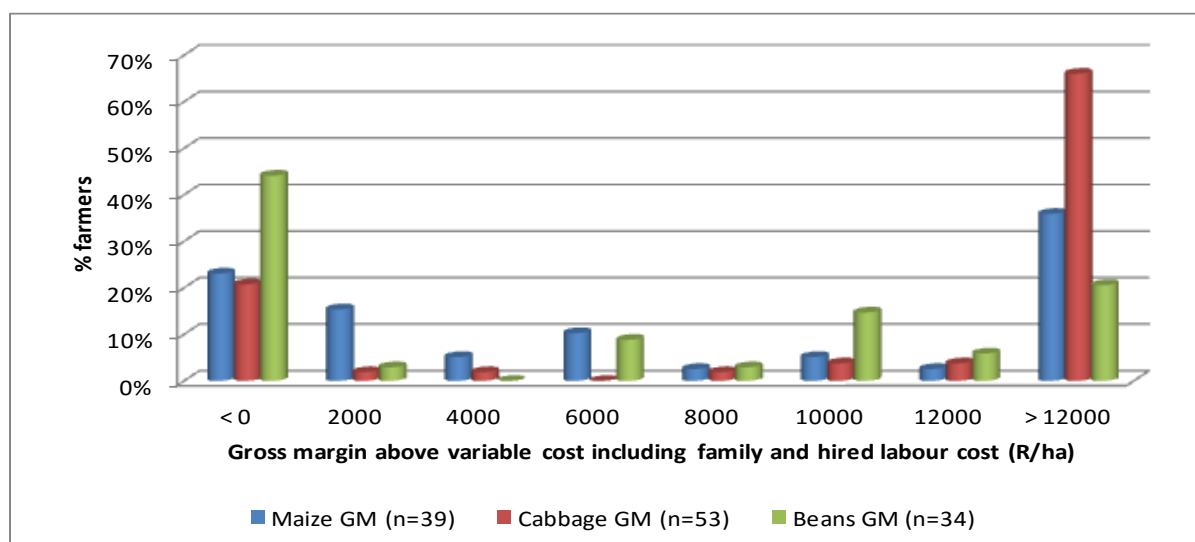


Figure 7.11. Gross margin above variable cost including family and hired labour cost – Makhathini and Ndumo-B

Source: Survey data, 2015

Very little if any value addition is done by farmers. In most cases, their produce is sold whilst it is still in the fields. In a few cases packaging is done for chillies and green pepper and grading for tomatoes, potatoes and sweet potatoes. There is no extensive value addition due to lack of knowledge and required equipment.

7.2.5 Opportunities and challenges facing homestead food gardeners and small-scale irrigators

Several challenges affecting small-scale irrigators including homestead food gardeners are identified throughout the report. The challenges affect the capacity of smallholder farmers in taking advantage of irrigation to expand or improve farming or for homestead food gardeners to transit from homestead food gardens to smallholder plots. In all these challenges homestead food gardening is worst affected because of scale of farming and its primary focus on subsistence.

The key challenges can be summarized as follows:

- The experience that farmers confirmed to have is mostly related to the technical aspects of crop production and the social dimensions of farming as a way of life, little or none related to managing farming as a business, especially financial management. There is no record keeping culture and farmers do not even have records on how much they spent on inputs, how much they sale and how much they consumed. There is a mix of farm and family operations. Given these realities, it will be hard to know whether these

farmers are making a profit or a loss. These are key practical challenges that stakeholders need to work on before considering small-scale farming as businesses. Knowledge related to farm budgeting, market search, price negotiations and value addition lacks among farmers. Coupled with lack of formal education and age differences between the farmer and the hawkers who are mostly young men and women, farmers are at risk of being at the lower end of the bargain each time they enter the market.

- There is an inherent challenge related to expectations that government must do everything for farmers. Entitlement and lack of PsyCap to make things happen using the resources and assets they are endowed with. This might have been aggravated by the unintended consequences of the social grant scheme. This issue is entrenched and it has become a culture. The problem is complicated and so is the solution.
- Participating in scheme management as a committee member is voluntary and there are no proper incentives to encourage participation. As such, it is difficult to enforce the requirements that members attend all meetings, otherwise they would opt out of the committee.
- Timing of agricultural operations is critical in farming. Access to agricultural implements improves the timely conducting of key operations such as land cultivation, weeding, pest control and harvesting. Losses in yield can occur at any stage in the crop production cycle. Tractor services are important in farming in the two areas, yet small-scale farmers get the last preference due to their size. A tractor service provider prefers to start with farmers with larger land sizes where they get more money compared to those with smaller pieces of land.
- Land preparation is constrained by poor access to tractor services. The farmers lack alternatives because there are very few private individuals who own tractors. Even when the services are available, financial constraints hinder access to key agricultural services.
- Water reliability and sufficiency is a challenge for farmers in the schemes. The high cost of water-related services (e.g. electricity bills in Ndumo-B) and poor irrigation infrastructure and equipment problems (Makhathini) hinder access to water. As a result, water pressure is low, water availability is often poor or none at all. Farmers' aspirations of taking advantage of irrigation schemes and practising double-cropping can only happen if irrigation infrastructure and water supply reliability is improved. Climate

change also threatens water availability now and in the future. Increasing temperatures and unpredictable rainfall patterns are reducing water levels. These trends have negative effects in the long run and the consequences could be detrimental to small-scale irrigation and agriculture as a whole. There are also institutional issues related to water such as use rights, collective management of common pool water resources, managerial and leadership issues in the management of the schemes.

- Lack of ownership or formal land titles, as is the case in most rural South Africa, is a recurrent challenge. Land size and lack of security of tenure are the key constraints which leave no room for expansion. Most farmers do not own land. The ones that do, leave land idle causing pest and disease problems for nearby crops. Current leasing arrangements are informal and not easily enforceable. Plottolders can always claim their land at any time, making capital investments like improving drainage or applying organic manure on the land difficult. As such, soil salinity is also a matter of concern in the scheme, which might be affecting yields and consequently the farmers' marketable surplus. The South African government needs to improve rights to land (Oxfam, 2014), engaging traditional leadership in the rural areas.
- Use of pesticides and fertilizers has become ever necessary and yet the costs are huge and unaffordable for smallholder farmers. High transaction costs negatively affect access to both input and output markets, thereby adversely affecting farming as a business. Access to roads is poor and most of the roads need maintenance. The cost of transport and market and price information search is too high for small-scale farmers. Consequently, the major consumers of produce from the local farmers/homestead food gardeners are the local community. Market access seems to be the major problem that restricts limits production planning. Farmers end up selling their produce farm gate at lower prices and they can't make enough profits to cover their production cost.
- There is limited value addition on the produce sold on the market. This would mean that farmers are not benefitting from their own produce. Other role players in the market value chain who can add value (form, shape, time and space) will be the ultimate beneficiaries. Value addition is at different levels and does not all require sophisticated technical knowledge and skills. However, farmers need to be trained on how they can add value to their produce before selling.
- Pest outbreaks are common in the schemes due to limited knowledge on integrated pest management practices.

- The apparent trade-off between livestock and crop farming is one of the biggest constraints to those smallholder producers in the Makhathini and Ndumo-B irrigation schemes. The dilemma is that both subsistence and smallholder irrigation farmers keep cattle more as a culture than as a business and they do not want to invest in them, e.g. herding, fencing, etc. The other anomaly related to livestock is the communal land tenure system, which allows cattle to roam around. Livestock are rarely herded in the area and it is the responsibility of the crop producers to protect their crops. Fencing, therefore, is an important element for practising crop farming in the area. Two options can be explored regarding fencing, namely fencing crop fields or introducing fenced grazing areas or paddocks for livestock.
- Small-scale crop producers in irrigation schemes are mostly organised as cooperatives as part of government's policy in terms of management and provision of institutional support to farmers. This is done mainly to take advantage of collective action advantages of cooperatives and to reduce transaction costs of accessing public services to smallholder farmers. Likewise, farmers also only view cooperatives as a means of accessing government support and credit lines. Others view cooperatives as a tool being used by government to control farmers and eventually take their land. Cooperatives are not viewed as institutional arrangements that offer opportunities for collective management and bargaining; opportunities for small-scale farmers to affirm themselves as producers in the market and take advantage of economies of scale. Some believe they earn more money if they operate as individuals whilst others cite issues of mistrust, accountability and the free riding syndrome as major problems in cooperatives. Some even mentioned corruption and nepotism as issues in the leadership of the cooperatives. Others cite different visions among members of cooperatives leading to lack of motivation. In such a state, smallholder farmers would not be able to take advantage of national and international opportunities in the high value food markets. They will remain vulnerable to exploitation from unscrupulous buyers and traders in the food industry.

Even though they mainly produce for their own consumption currently, Ndumo-B farmers are relatively more commercial oriented and entrepreneurial/forward-driven than Makhathini farmers and also appeared to be more business minded and independent. The farmers in Ndumo-B appeared to be relatively more eager to participate in the questionnaire survey.

Regarding the opportunities for improving farming, most farmers own mobile phones which is an innovative technology which can be used as an effective extension tool. It is possible to create platforms where farmers can get information on market channels and prices, agricultural related services and extension advice.

Livestock ownership presents another opportunity through the exploration of integrating crop and livestock production in smallholder irrigation. A study by Allen *et al.* (2007) showed that integration of the two systems can save up to 25% of the current water used in irrigation while further diversifying income. Such income diversification is more sustainable and preferred compared to the current situation where public transfers constitute a significant percentage of household income. They further demonstrate other benefits such as reduced soil erosion, lower chemical inputs including a 40% reduction in N fertilizer, improved soil microbial and enzymatic activities, enhanced C sequestration and greater rainfall infiltration than the monoculture system. Though there might be a reduction in yields, the opportunity cost is lower compared to the long-term environmental benefits and water savings (Allen *et al.*, 2007). This concept is worth considering and more research might be needed to further examine and contextualize the issues.

7.3 The results and discussions: Sources and constraints to rural livelihoods in Bululwane and Tugela Ferry

7.3.1 Sources of livelihoods

7.3.1.1 Key assets, capabilities and opportunities

This section will analyse the physical assets that farmers own and can use to improve their livelihoods. Most smallholder farmers in Bululwane and Tugela Ferry don't have access to a tractor (65%). However, among the different types of smallholders in and around the two schemes, a higher proportion of scheme irrigators (51%) have access to a tractor service compared to the other farmers. Generally, farmers in and around the two schemes lack access to machinery and equipment critical in improving their productivity.

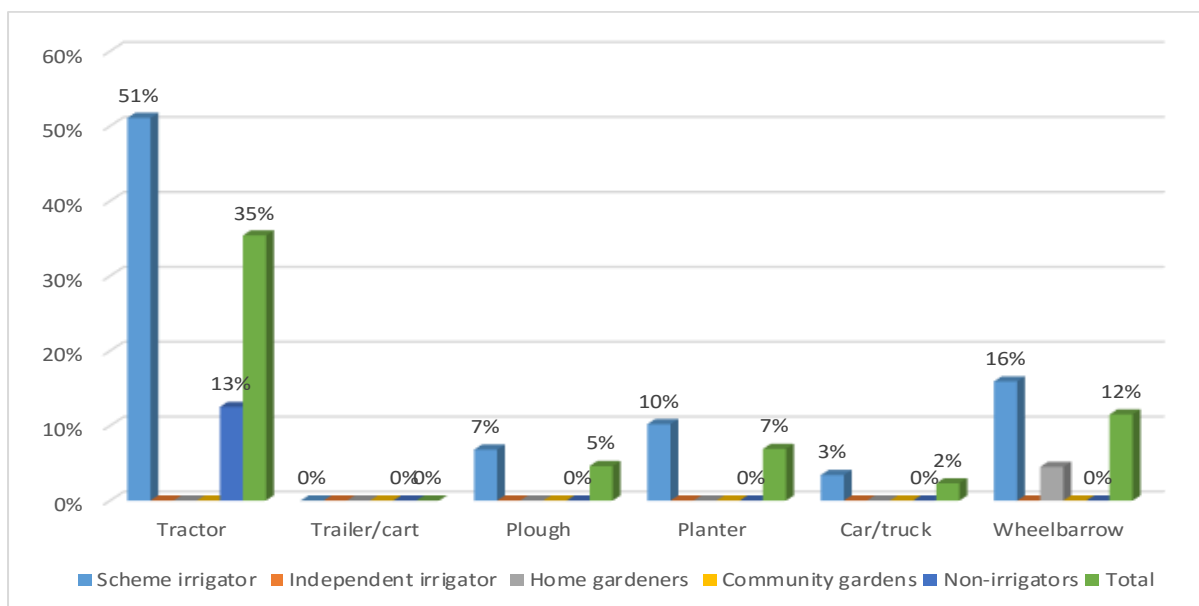


Figure 7.12. Asset hiring among different types of farmers – Bululwane and Tugela Ferry

Source: Survey data, 2016

Generally, farmers in Tugela Ferry irrigation scheme place more value to their livestock. This probably explains why they received more income on average per year. Farmers in Bululwane irrigation scheme owned twice as much domestic chicken compared to farmers in Tugela Ferry irrigation scheme and outside the irrigation scheme. Farmers in Bululwane irrigation scheme were the only farmers that owned pigs.

Table 7.16. Average current market value of total livestock owned (Rand) – Bululwane and Tugela Ferry

	Cattle	Goats	Sheep	Domestic chicken	Pigs
Scheme irrigators	64208	8725	5250	838	12000
Independent irrigators	74500	0	0	0	0
Homestead food gardeners	60000	9978	0	562	0
Community food gardeners	18000	3460	0	444	0
Non-irrigators	45467	9000	0	660	0
Total	58613	8609	5250	742	12000
Bululwane irrigation scheme	44967	8690	0	1022	12000
Tugela Ferry irrigation scheme	94100	8747	5250	686	0
Out of scheme	47886	8300	0	545	0
Total	58613	8609	5250	742	12000

Source: Survey data, 2016

The farmers in Tugela Ferry irrigation scheme have a high cattle market value compared to others. This provides a huge opportunity for farmers to earn more income from selling some of their cattle as it is expensive to maintain them due to drought. Goats have a very low market value across all the schemes and they are easy to maintain even in times of severe drought. They can easily be converted into cash, just like domestic chickens.

For majority of farmers in Bululwane irrigation scheme and those outside the scheme, livestock is mainly kept for consumption purposes. In Tugela Ferry irrigation scheme, majority of the farmers keep the livestock as a form of wealth. Very few farmers keep livestock for sales purposes. These results indicate that there is a huge threat that climate change poses on the food security and social status of the farmers, if their livestock dies due to drought for example. Many farmers are looking for alternative solutions to sustain their livestock which has a high market value. There are farmers that keep livestock to conduct cultural rituals that are necessary for them to be in connection with the ancestors.

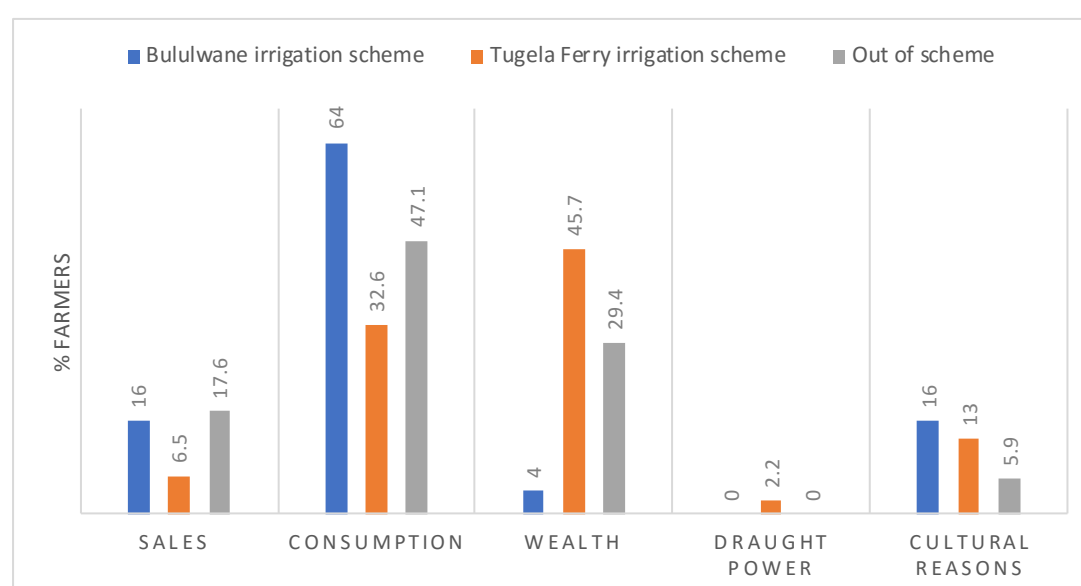


Figure 7.13. Major reasons for keeping livestock amongst farmers – Bululwane and Tugela Ferry

Source: Survey data, 2016

In the study areas, almost all the farmers own cellphones. There are a few farmers that do not own a radio or TV. Farmers use cellphones to communicate with each other and to get information from extension officers. Cellphones play a huge role amongst farmers in the irrigation schemes as they are used to call meetings or send urgent messages to farmers who stay very far. It reduces the transaction costs for farmers. Radio and TV also play a crucial role,

as government departments communicate mostly with the farmers through this media. For example, when the minister of agriculture is speaking on the radio, farmers are able to call in and speak with him directly. Most farmers are not readers and therefore newspaper use is not that common amongst farmers.

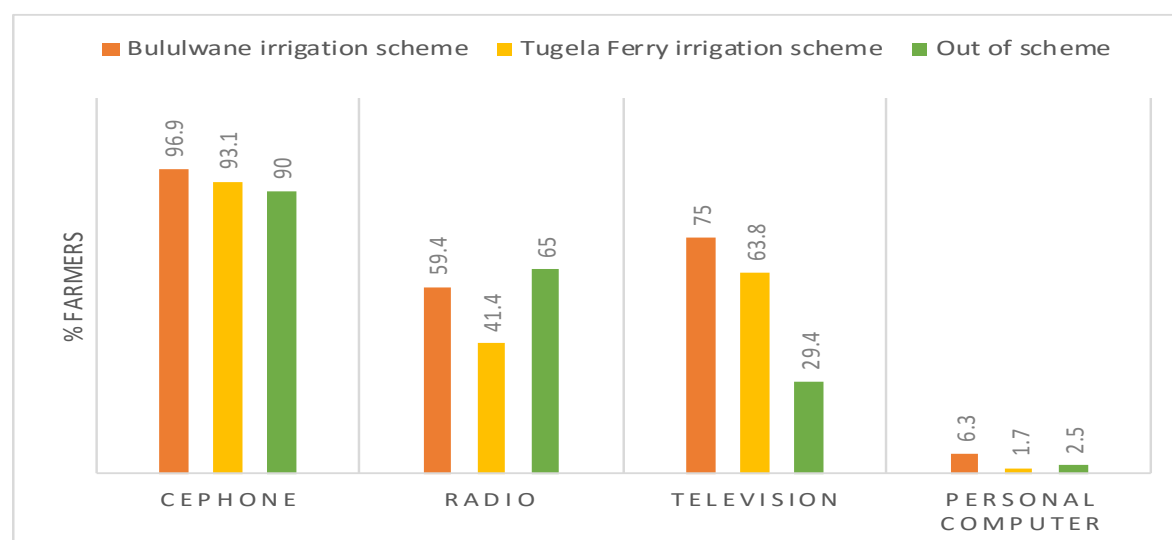


Figure 7.14. Farmers owning communication technology – Bululwane and Tugela Ferry

Source: Survey data, 2016

Proper working assets are very critical in farming and for farmers to effectively utilise the land. Most farmers in Bululwane irrigation scheme have water tanks at their homesteads and this allows them to harvest water. Very few farmers in Tugela Ferry irrigation scheme and those outside the scheme own water tanks at their homes. In most cases, among households with water tanks, they were not bought by farmers but were provided by government through some housing projects. Most farmers in Bululwane irrigation scheme own wheelbarrows as individuals. Most of the farmers use wheelbarrows mainly to transport manure and fertilizer.

Table 7.17. Working assets owned by farmers (%)

	Bululwane irrigation scheme	Tugela Ferry irrigation scheme	Out of scheme
Own water tank as individual	59.4	19	35
Own wheelbarrow as individual	62.5	39.7	37.5
Own tractor as individual	6.3	3.4	2.5
Own tractor as a group	31.3	1.7	0
Have access to tractor through hiring or borrowing	21.9	65.5	2.5

Source: Survey data, 2016

In Bululwane irrigation scheme, farmers have a tractor that they own as a group and it was given to them by the Department of Rural Development and Land Reform. Other farmers that don't own the tractor, they either borrow it from other cooperatives or the municipality. The district PDARD office used to borrow them a tractor for free, but at the time of the survey the programme had stopped which meant now farmers pay for tractor services.

The farmers in the study areas don't have proper storage facilities to place their produce once it has been harvested. Figure 7.15 displays how the farmers in Tugela Ferry irrigation scheme store their tomatoes while they wait for the customers. This can sometimes lead to incidents of theft among the farmers themselves. In Bululwane irrigation scheme the same challenge exists with chillies. During the farmer support groups, extension officers mentioned that government is planning on intervening on this matter.



Figure 7.15. Harvested tomatoes at Tugela Ferry Irrigation Scheme

Source: Survey data, 2016

7.3.1.2 Income sources

Farmers receive their household income from different sources like remittances, welfare grants and crop sales, among others. The majority of the farmers that receive remittances are outside the irrigation scheme but more farmers in Bululwane irrigation scheme receive remittances compared to those in Tugela Ferry irrigation scheme. Many farmers out of the scheme get money from selling arts and crafts to support their livelihoods and farmers in Bululwane irrigation scheme are also more involved in selling arts and crafts compared to those in Tugela Ferry irrigation scheme.

During the survey it was identified that farmers outside the scheme have very limited access to water. They do have the skills to do arts and crafts but don't have financial capital to buy inputs. Many of those farmers with no access to irrigation water depend mainly on social grants and the money they get is not even enough to cover basic food items.

Table 7.18. Sources of income for farmers (%) – Bululwane and Tugela Ferry

	Remittance income	Arts and craft income	Permanent employment income	Temporary employment	Welfare grant	Crops - irrigated income	Crops rain fed income	Livestock income
Scheme irrigators	17.0	10.2	10.2	6.8	79.5	76.1	0.0	9.1
Independent irrigators	100.0	0.0	50.0	0.0	0.0	50.0	0.0	0.0
Homestead food gardeners	31.8	31.8	4.5	22.7	86.4	22.7	0.0	4.5
Community food gardeners	40.0	20.0	0.0	0.0	80.0	50.0	0.0	10.0
Non-irrigators	37.5	37.5	0.0	37.5	75.0	37.5	50.0	0.0
Bululwane	25.0	21.9	9.4	6.3	59.4	53.1	0.0	9.4
Tugela Ferry	15.5	3.4	12.1	6.9	87.9	87.9	0.0	8.6
Out of scheme	35.0	30.0	2.5	20.0	82.5	32.5	10.0	5.0
Total	23.8	16.2	8.5	10.8	79.2	62.3	3.1	7.7

Source: Survey data, 2016

Farmers who are permanently employed were very few and Tugela Ferry irrigation scheme had more farmers employed compared to farmers in Bululwane irrigation scheme. Farmers who are temporarily employed off-farm were very common in farmers out of scheme and farmers in the irrigation schemes had very few farmers who had temporary jobs. In Tugela Ferry irrigation scheme, 87.9% of the farmers were benefiting from social grants while in Bululwane irrigation scheme, 59.4% of the farmers were benefiting. Compared to other sources of income, a significant amount of farmers are benefiting from social grants especially in Tugela Ferry irrigation scheme and in farmers that are outside the irrigation schemes. As indicated in Table 7.18, 79.2% of the farmers receive government social grants. The majority of the farmers (73%) receive child support grant and 51.2% of the farmers receive old age grant.

Table 7.19. The importance of social grants among farmers – Bululwane and Tugela Ferry

	Child support	Old age	Disability	Foster	Care dependency
Scheme irrigator	77.4	47.1	10.6	9.4	2.4
Independent irrigator	50	50	0	0	0
Homestead food gardeners	77.3	59.1	9.1	13.6	4.5
Community food gardens	40	50	10	0	0
Non-irrigators	62.5	75	25	0	0
Bululwane	81.2	43.7	15.6	6.2	0
Tugela Ferry	74.1	49.1	7.3	10.9	3.2
Out of scheme	65	60	12.5	7.5	2.5
Total	73	51.2	11	8.7	2.4

Source: Survey data, 2016

The farmers outside the irrigation schemes are the only farmers receiving income from rainfed agriculture. Approximately 89.7% and 53.1% farmers in Tugela Ferry irrigation scheme and Bululwane irrigation scheme, respectively, were selling their produce. The lower percentage for Bululwane irrigation scheme farmers was expected since many farmers had planted chillies and could not find the market on time to sell their produce. Unlike their counterparts in Bululwane, Tugela Ferry irrigation scheme farmers who had planted tomatoes were able to sell their produce to their proximity to the market in town. The number of farmers that sell their livestock is very small, as many of them keep their livestock only for consumption and as wealth.

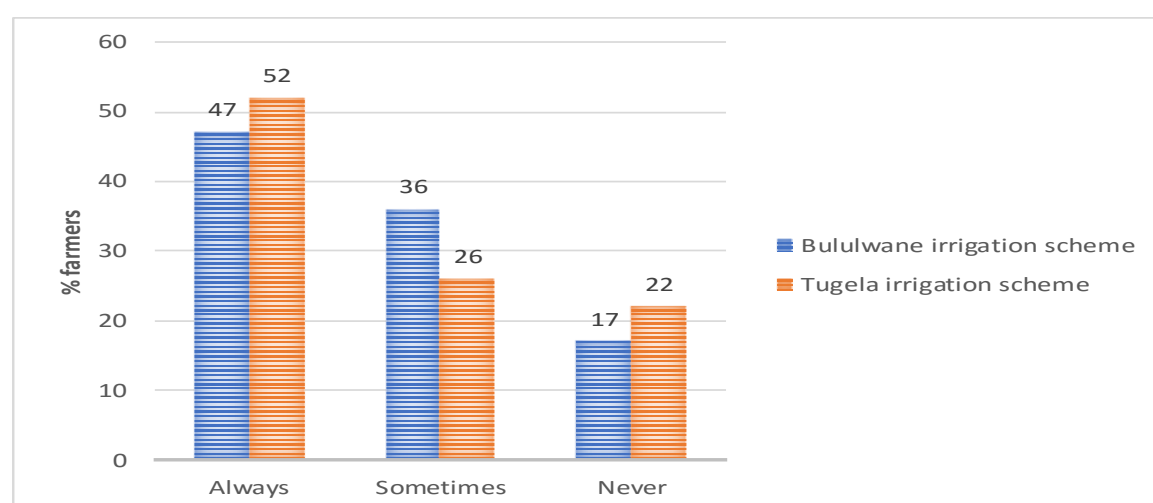


Figure 7.16. Use of social grant money for agricultural purposes

Source: Survey data, 2016

The estimated average income that farmers receive

Farmers in Bululwane irrigation scheme receive a higher remittance income (10 times per year) on average per month compared to farmers in Tugela Ferry irrigation scheme and those outside the irrigation schemes. Farmers outside the irrigation schemes get more income (6 times per year) on average per month from arts and crafts compared to other farmers. This is expected because farmers inside the irrigation schemes focus more in farming and don't have enough time to do other things. When comparing the farmers that are permanently employed, farmers in Bululwane irrigation scheme earn twice as much income on average per month compared to those in Tugela Ferry irrigation scheme.

Table 7.20. Estimated average income (Rand) of farmers – Bululwane and Tugela Ferry

	Remittance	Arts and craft	Permanent employment	Temporary employment	Welfare grant	Crops irrigated land	Crops rainfed land	Livestock	Total
Scheme irrigators	1037	344	1754	952	1537	2987	0	6849	15459
Independent irrigators	1350	0	6500	0	0	300	0	0	8150
Homestead food gardeners	690	657	3000	980	1670	760	0	1200	8957
Community food gardeners	1125	300	0	0	1638	920	0	150	4133
Non-irrigators	667	1000	0	1100	1517	3467	2060	0	9810
Bululwane irrigation scheme	1231	321	3287	1050	1456	895	0	5550	13790
Tugela Ferry irrigation scheme	933	425	1773	903	1567	3631	0	7628	16860
Out of scheme	809	683	3000	1025	1634	1446	2060	675	11333
Total	954	538	2253	994	1568	2706	2060	5614	16688

Source: Survey data, 2016

The average income per month from temporary employment (9 times per year) is not significantly different from those that are outside the schemes and those in Bululwane irrigation scheme. They are both higher than that received by farmers in Tugela Ferry irrigation scheme. The farmers outside the schemes get more social grant income on average per month of R1634.24 compared to those inside the irrigation schemes. Farmers in Tugela Ferry irrigation scheme get more social grant income on average per month compared to those in Bululwane irrigation scheme. This then suggests that the major source of income for a majority of farmers was social grants.

On average the farmers in Tugela Ferry irrigation scheme received over 3 times the amount that the farmers in Bululwane irrigation scheme received per season and 2 times the amount the farmers outside the schemes. This was expected because of the type of crop planted in Bululwane irrigation scheme and market constraints that they faced. The farmers outside the irrigation schemes received R2060 on average per season from their rainfed land. The farmers only sold their livestock only in emergencies or when their neighbours approached them. On average the farmers in Bululwane, Tugela Ferry and outside the irrigation schemes received R5550 per year, R7628 per year and R675 per year, respectively.

Savings

Majority of the farmers, especially those outside the irrigation schemes invest most of their earnings in stokvels (an informal savings group). They depend on this to buy bulk groceries in December and to pay for children school fees and uniform. More farmers in Bululwane irrigation scheme were saving their money in stokvels compared to those in Tugela Ferry irrigation scheme. The culture of saving money in the banks was not common amongst farmers and this was partly due to the fact that most banks are located in towns and are not easy to reach. Most farmers inside the irrigation schemes mentioned that they had an interest in saving but they couldn't because they had too many needs that they could not cover with the money they were already receiving. Very few farmers were diversifying their savings by saving both informally and formally.

Table 7.21. Type of farmers' savings (%) – Bululwane and Tugela Ferry

		Bululwane irrigation scheme	Tugela Ferry irrigation scheme	Out of scheme
Farmers that are saving money		46.9	41.4	62.5
Type of savings	<i>Formal</i>	26.7	20.8	24.0
	<i>Informal</i>	60.0	62.5	60.0
	<i>Both</i>	13.3	16.7	16.0

Source: Survey data, 2016

Credit

Credit or loans played a major role in farmers from Bululwane irrigation scheme compared to those that are in Tugela Ferry irrigation scheme and outside the irrigation schemes. The major creditor for farmers in Bululwane irrigation scheme was the savings club and for farmers in Tugela Ferry irrigation scheme was the money lenders or loan sharks. The majority of the borrowers (56.3%) were in Bululwane irrigation scheme. The farmers in Bululwane irrigation scheme found it more convenient for them to borrow money from the savings group as the interest was not as high as that of the loan sharks and the people were more understanding if money was not paid on time. The high percentage (42.3%) of smallholder farmers borrowing money in the rural areas indicates a potential for a tailored microfinance industry in the rural areas.

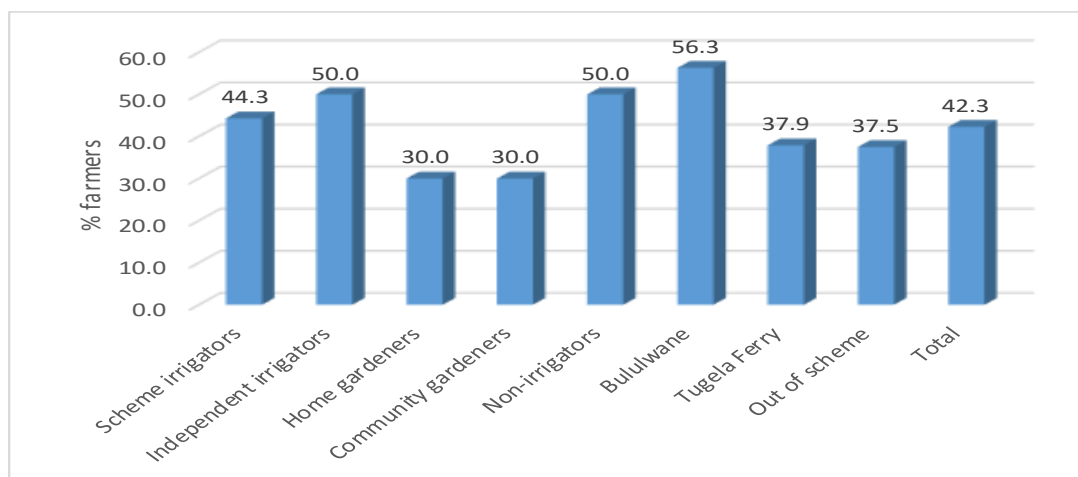


Figure 7.17. Farmers accessing credit in the past 12 months – Bululwane and Tugela Ferry

Source: Survey data, 2016

The majority of the farmers in Tugela Ferry irrigation scheme and those out of scheme were more risk averse and they were not willing to take loans. There was also an observation that there was some sort of a stigma amongst farmers. For example, Farmers didn't want to be seen taking a loan as they felt it reduced their social status in the community and if they failed paying the money, the stigma can even pass on to the children. In Bululwane irrigation scheme, more farmers would be taking loans if the interest rates were not as high and compounding.

Table 7.22. The role of credit (%) – Bululwane and Tugela Ferry

		Bululwane irrigation scheme	Tugela Ferry irrigation scheme	Out of scheme
Reason for not taking a loan	Interest rate is high	50.0	13.9	23.8
	Could not secure the collateral	0.0	13.9	0.0
	Got my own sufficient money	20.0	5.6	14.3
	I do not want to be indebted	30.0	52.8	47.6
Main source of loan	Relative or friend	27.8	27.3	31.3
	Money lender	11.1	40.9	12.5
	Savings club	44.4	9.1	18.8
	Commercial Banks	16.7	0.0	6.3
	Government	0.0	4.5	12.5
	Microfinance organisations	0.0	13.6	12.5
Purpose of loan	Family emergency	72.2	40.9	53.3
	Consumption	5.6	4.5	26.7
	Agricultural purposes	22.2	54.5	20.0
Farmers that were able to pay back the loan in time		100.0	95.5	85.7

Source: Survey data, 2016

Majority of the farmers outside the irrigation schemes (31.3%) received their credit from friends and relatives. This was because they could not guarantee that they could pay back the money on time as they had limited sources of income. Many farmers in Bululwane irrigation scheme (72.2%) and outside the irrigation schemes (53.3%) borrowed money mainly for family emergencies. These emergencies included mainly sickness for most farmers. Most farmers in Tugela Ferry irrigation scheme (54.5%) borrowed money mainly for agricultural purposes. This happened when government was not providing them with the inputs. Almost all of the farmers were able to pay back the loans they took on time.

7.3.1.3 *Water accessibility and opportunities to improve on-farm livelihoods*

Farmers in both irrigation schemes were not paying for water. Most of them were only paying for pumping water from the river to the irrigation scheme. In Bululwane irrigation scheme, almost all the farmers used gravity pump to get water to their plots. In Tugela Ferry irrigation scheme, only half of the farmers used the gravity pump and the other half mainly used the electricity pump. The farmers that were outside the irrigation schemes mainly used the bucket system to irrigate. Majority of the farmers inside the irrigation schemes were satisfied with the water access that they had. While the majority of the farmers outside the irrigation schemes were very dissatisfied with the access of water they had. This was mainly due to the drought in the area.

Table 7.23. Water use in and out of the irrigation schemes (%) – Bululwane and Tugela Ferry

	Bululwane irrigation scheme	Tugela Ferry irrigation scheme	Out of scheme
Average irrigation days per week	2.16	1.48	2.33
Average irrigation hours per day	7.47	2.60	3.32

Source: Survey data, 2016

The farmers in Bululwane irrigation scheme on average used more days and hours to irrigate their produce compared to those in Tugela Ferry irrigation scheme. Yet, farmers in Tugela Ferry irrigation scheme incurred more costs on average to pump water unlike in Bululwane irrigation scheme where farmers are not paying to pump water as they use gravity model. Farmers mentioned that the number days and hours taken to irrigate doubles in summer as a result of high temperature. In Tugela Ferry irrigation scheme, farmers are paying between R25-R200 to pump water per plot per month, on average. The variation was a result of the type of pump (diesel or electricity) being used.

There were very few farmers that were willing to pay for water across both schemes. The majority of the farmers that were willing to pay were in Tugela Ferry irrigation scheme compared to those in Bululwane irrigation scheme. The farmers were willing to pay between R10-R300 for irrigation water in both schemes. It is interesting that most of the farmers in Tugela Ferry irrigation scheme are more willing to pay for water even though they are already incurring costs for pumping water. This means that farmers in Tugela Ferry irrigation scheme place more value in water compared to farmers in Bululwane irrigation scheme.

Table 7.24. Farmers' willingness to pay for irrigation water – Bululwane and Tugela Ferry

	N	Mean	Std. Deviation	Minimum	Maximum
Bululwane irrigation scheme	32	27.5	63.09	.00	300
Tugela Ferry irrigation scheme	58	57.59	87.02	.00	300
Out of scheme	33	50.00	118.14	.00	600
Total	123	47.72	91.46	.00	600

Source: Survey data, 2016

Interestingly, in Bululwane irrigation scheme, 75% of the farmers believe that irrigation water should be free of charge. Farmers in Bululwane are used to getting water without paying and it would be difficult for them to transition from not paying for it all these years and now having to pay for it. Perhaps, they would consider if they are able to get good profit from their farms. In Tugela Ferry irrigation scheme, 83.9% of the farmers were not willing to pay because they do not have enough money to do so. This was expected for farmers in in Tugela Ferry irrigation scheme as most of them are already paying to pump water to their plots.

Table 7.25. Reason for not wanting to pay anything for irrigation water (%) – Bululwane and Tugela Ferry

	Bululwane irrigation scheme	Tugela Ferry irrigation scheme	Out of scheme
Irrigation water should be free of charge	75.0	16.1	11.8
I do not have enough money	25.0	83.9	88.2

Source: Survey data, 2016

These results show that the farmers in Bululwane irrigation scheme were using more water to irrigate, yet a significant amount of them were not receiving any income from selling their produce. This therefore suggests that farmers in Bululwane irrigation scheme need to be

supported more when it comes to their markets so that they can see the importance of water and place more value in it.

Table 7.26. Sources of water conflicts (%) – Bululwane and Tugela Ferry

		Bululwane irrigation scheme	Tugela Ferry irrigation scheme	Out of scheme
How often do water related conflicts occur?	Never	43.8	46.6	87.9
	Occasionally	40.6	25.9	9.1
	I don't know	3.1	0.0	0.0
	Often	9.4	13.8	0.0
	Very often	3.1	13.8	3.0
If water related conflicts often occur, what are the main reasons	Challenges in working together or sharing pipes or water	25.0	25.0	0.0
	Refusal to pay for water services	0.0	6.3	0.0
	Irrigating on the day not allocated to you	0.0	18.8	0.0
	Shortage of water	75.0	50.0	0.0

Source: Survey data, 2016

In both study areas the two major sources of water conflicts amongst farmers in the irrigation schemes were water shortage which meant some people were not getting water in their plots and the second challenge was that farmers had to share pipes to irrigate. The other two sources of conflict that were unique to Tugela Ferry irrigation scheme were farmers who were irrigating on the days that were not allocated to them according to their irrigation schedules and farmers who refused to pay the amount for pumping water to their plots – Bululwane and Tugela Ferry.

7.3.1.4 Smallholder crop production

The most common crops that were planted by most farmers in the study areas by scheme irrigators were maize, cabbage and tomatoes. Independent irrigators had maize, beans, cabbage, tomatoes and chillies. Most homestead food gardeners had cabbage, spinach, pepper, onions and tomatoes. Most community food gardeners had cabbage, spinach, sweet potatoes, tomatoes and onions. Community food gardeners indicated that they like to use crops that can be replanted as they help save money. Non-irrigators had maize, beans, cabbage, spinach, tomatoes and onions. Maize, cabbage and tomatoes were the three major crops that were planted by most farmers.

Table 7.27. Percentage of farmers growing each crop – Bululwane and Tugela Ferry

Crop	Scheme irrigators	Independent irrigators	Homestead food gardeners	Community food gardeners	Non-irrigators	Bululwane	Tugela Ferry	Out of scheme	Total
Maize	52.3	100	13.6	10	50	59.4	50	20	43.1
Beans	20.5	50	4.5	0	37.5	50	5.2	10	17.7
Cabbage	56.8	100	59.1	70	62.5	71.9	50	62.5	59.2
Carrot	0	0	4.5	0	0	0	0	2.5	0.8
Spinach	12.5	0	59.1	20	25	9.4	13.8	42.5	21.5
Butternut	4.5	0	0	0	0	0	6.9	0	3.1
Potatoes	9.1	0	9.1	0	12.5	15.6	5.2	7.5	8.5
Pepper	1.1	0	27.3	0	12.5	3.1	0	17.5	6.2
Sweet Potato	12.5	0	9.1	20	0	9.4	13.8	10	11.5
Tomato	54.5	50	27.3	50	25	34.4	65.5	32.5	47.7
Chillies	14.8	50	0	0	0	43.8	0	0	10.8
Onion	8	0	27.3	20	25	21.9	0	25	13.1
Lettuce	1.1	0	18.2	0	12.5	3.1	0	12.5	4.6

Source: Survey data, 2016

7.3.2 Vulnerability to external shocks and constraints to improve on-farm livelihoods

The majority of the farmers rarely experience floods, hailstorms and frost in their farms. Most of them face droughts. The drought does not only affect the farm production, but it also affects the farmers livestock which leaves the farmers vulnerable. Government has designed programs to support farmers in minimizing the effects of the drought on livestock and new farming water saving strategies are being investigated and implemented. However, the farmers that have already lost their produce and livestock got no compensation for their loss since they had no insurance to cover them.

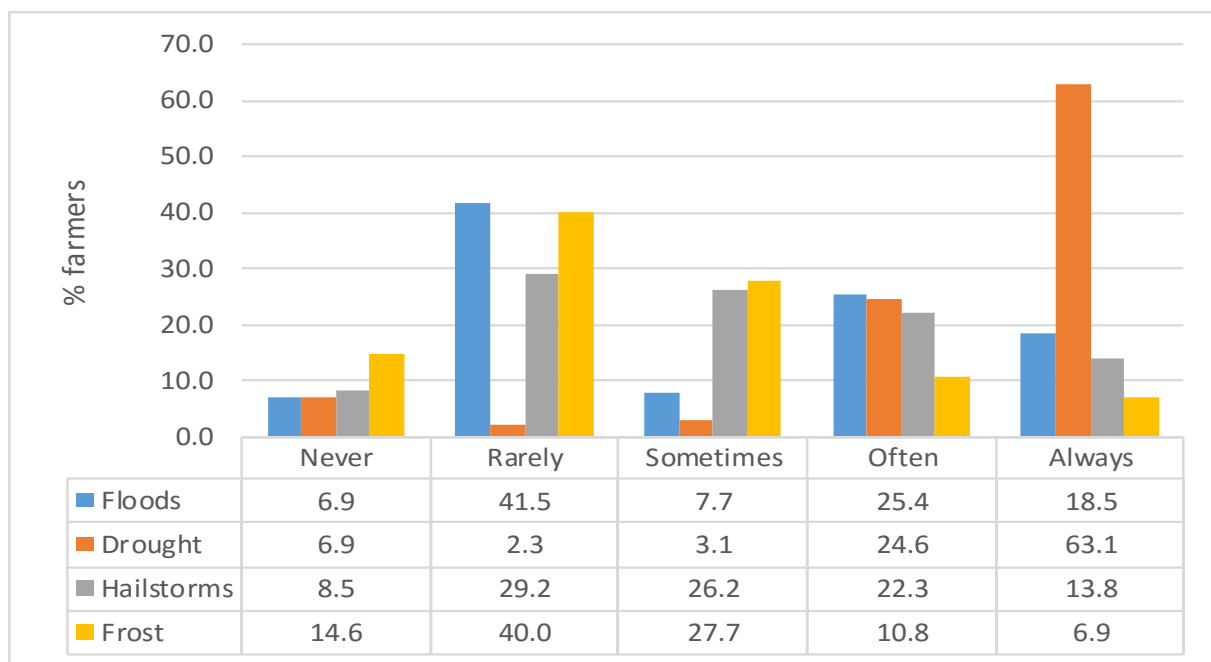


Figure 7.18. Frequency of occurrence of natural hazards in the last 10 years – Bululwane and Tugela Ferry

Source: Survey data, 2016

7.3.3 Access to input and product markets

Access to quality inputs is very critical in farming and farmers need good markets for their produce so that they can get good returns to cover their production and living costs. Almost all the farmers in and out of the irrigation schemes agreed that lack of access to the inputs was a constraint to their farming and when they could access them, they would be expensive. Majority of the farmers in Bululwane irrigation scheme lacked farming knowledge and skills compared to the farmers in Tugela Ferry irrigation scheme.

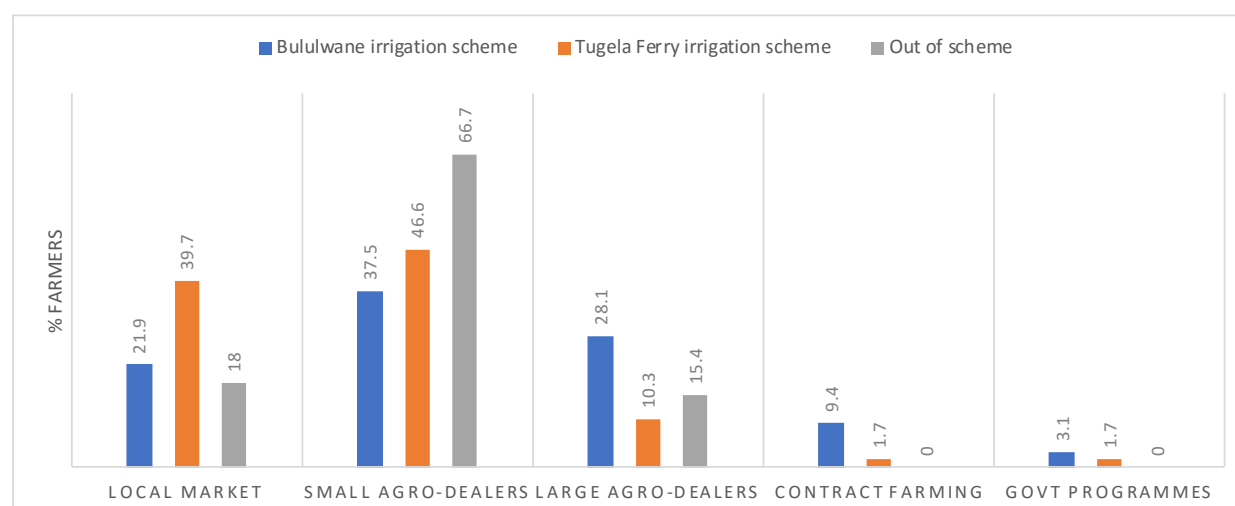
Not having capital in the form of finance to purchase inputs and pay for labour limited the farmers from operating efficiently. Many farmers in Bululwane irrigation scheme regarded expensive labour costs as a factor which prevented them from hiring more people. Unavailability or lack of access to adequate water was one of the factors that limited most farmers from operating efficiently especially the farmers in Bululwane irrigation scheme and the farmers outside the schemes. Most farmers in Tugela Ferry irrigation scheme were more water secure than others.

Table 7.28. Accessibility to inputs by farmers (%) – Bululwane and Tugela Ferry

	Bululwane irrigation scheme	Tugela Ferry irrigation scheme	Out of scheme
Lack of access to inputs as a constraint	96.90	81.10	80.00
Large (unaffordable) increase in input prices is a constraint	87.60	81.10	85.00
Limited or lack of farming knowledge and skills is a constraint	68.70	46.60	70.00
Lack of financial resources	81.30	87.90	70.00
Too high labour cost is a constraint	75.00	48.30	42.50
Unavailability or lack of access to adequate water is a constraint	93.80	43.10	85.00

Source: Survey data, 2016

As a result of high seed prices, some farmers have decided to use recycled seeds to reduce the production costs. In Bululwane irrigation scheme, 62.5% of the farmers use recycled seeds and in Tugela Ferry irrigation scheme, only 43.1% of the farmers use recycled seeds and similarly to those out of scheme. Farmers mainly depend on small agro-dealers, local market and large agro-dealers to purchase quality inputs. According to the survey, very few farmers were getting inputs from government. This is expected because farmers in both irrigation schemes mentioned that the seeds that they receive from government are not quality seeds.

**Figure 7.19.** Sources of inputs – Bululwane and Tugela Ferry

Source: Survey data, 2016

Without stable output markets, most farmers' time, energy and produce gets wasted. This then means that water gets wasted and other scarce resources. Farmers had a challenge of not having

a storage facility to store produce before it got sold. This then means that produce is harvested and is left out on the field and the sun easily destroys the produce. Not having market information was also a constraint to many farmers, especially those in Bululwane irrigation scheme. As a result, many of them planted their vegetables without even knowing if what they were planting had a market or not and whether the prices would be able to cover their production costs. Most farmers in the study areas depended on extension officers to transport their produce.

Table 7.29. Accessibility to output markets by farmers (%) – Bululwane and Tugela Ferry

	Bululwane irrigation scheme	Tugela Ferry irrigation scheme	Out of scheme
Lack of adequate storage facilities for vegetables or fresh produce is a constraint	87.50	70.70	57.50
Limited access to market information is a constraint	87.50	63.80	58.90
Lack of access to transport services for marketing agricultural produce is a constraint	81.20	80.70	47.30

Source: Survey data, 2016

The majority of the farmers sell their maize, beans, cabbage, spinach, onions and tomatoes at farm gate to hawkers and at roadsides. As reported earlier in Chapter 5, buyers come to the field with their own vehicles to choose and buy.

Table 7.30. Percentage of farmers selling through different channels – Bululwane and Tugela Ferry

	Maize	Cabbage	Spinach	Beans	Tomatoes	Onion	Chillies
Farm gate	35	27	46	50	60	35	27
Hawkers	39	24	21	5	33	18	45
Local shops	2	3	4	5	6	12	0
Shops in town	6	1	0	0	2	0	0
small informal agro-dealers	0	3	0	5	2	0	0
Large agro-dealer	2	3	0	0	4	0	0
Roadside	2	4	8	5	4	0	27

Source: Survey data, 2016

In Bululwane irrigation scheme, 59.4% of the farmers did not know the market requirements of their produce and that number dropped in the farmers in Tugela Ferry irrigation scheme. Majority of the farmers in Bululwane irrigation scheme failed to sell chillies because they did

not know the market requirements. In Tugela Ferry irrigation scheme, majority of the farmers failed to sell tomatoes because most farmers planted them at the same time and the markets were flooded at once with the same produce. The majority of the farmers outside the schemes struggled to sell cabbages.

Table 7.31. Crops that farmers failed to sell (%) – Bululwane and Tugela Ferry

		Bululwane irrigation scheme	Tugela Ferry irrigation scheme	Out of scheme
Which crop do you mostly fail to sell due to lack of market	Cabbage	22.2	30.4	55.6
	Tomatoes	11.1	50.0	22.2
	Maize	7.4	19.6	22.2
	Chilies	55.6	0.0	0.0
Do you know the market requirement for produce		59.4	34.5	20.0

Source: Survey data, 2016

In Bululwane irrigation scheme, most farmers based their decisions on what to plant based on market availability and based on availability of free seeds from government. At Tugela Ferry irrigation scheme, most farmers base their decisions on crop season and market access.

Table 7.32. How farmers choose which crops to plant (%) – Bululwane and Tugela Ferry

	Bululwane irrigation scheme	Tugela Ferry irrigation scheme	Out of scheme
Availability of market access	40.6	24.1	2.5
Availability of free seeds from government	31.3	10.3	25
Crop suitable based on soil sample	9.4	6.9	7.5
Crop season	18.8	58.6	65
Total	100	100	100

Source: Survey data, 2016

7.3.4 Average gross margins of crops in the study areas

The average gross margin for the different crop enterprises was calculated by subtracting average seed cost, fertilizer cost, manure cost, herbicides cost, pesticides cost, tractor cost, transport cost, hired labour cost and family labour cost from the average gross income.

Smallholder farmers in Tugela Ferry receive a positive gross margin per hectare compared to the farmers in Bululwane. This means that maize enterprises are more profitable in Tugela

Ferry compared to Bululwane. Farmers in Tugela Ferry invest more money in acquiring quality seeds, fertilizer and they more family labour intensive when compared to farmers in Bululwane. Farmers in Bululwane invest more money in pesticides and herbicides and they hire more labour.

Table 7.33. Maize gross margin (Rand) – Bululwane and Tugela Ferry

	Bululwane	Tugela Ferry
Maize gross income per ha	7168.33	50394.79
Total variable cost	11058.28	16017.92
Maize gross margin	-3789.75	32397.56
Maize gross margin excl. family labour cost	-974.62	39195.92

Source: Survey data, June 2016

The cabbage enterprise is more profitable in Tugela Ferry than in Bululwane, according to the gross margin analysis. This is a result of farmers in Bululwane investing less money in acquiring quality cabbage seeds and fertilizer. Farmers in Bululwane were also not investing much in pesticides and they relied mainly on family labour for farming.

Table 7.34. Cabbage gross margin (Rand) – Bululwane and Tugela Ferry

	Bululwane	Tugela Ferry
Cabbage gross income per ha	45736.46	71107.14
Total variable cost	7858.73	21438.78
Cabbage gross margin	19496.26	42946.79
Cabbage gross margin excl. family labour	36783.38	55259.05

Source: Survey data, 2016

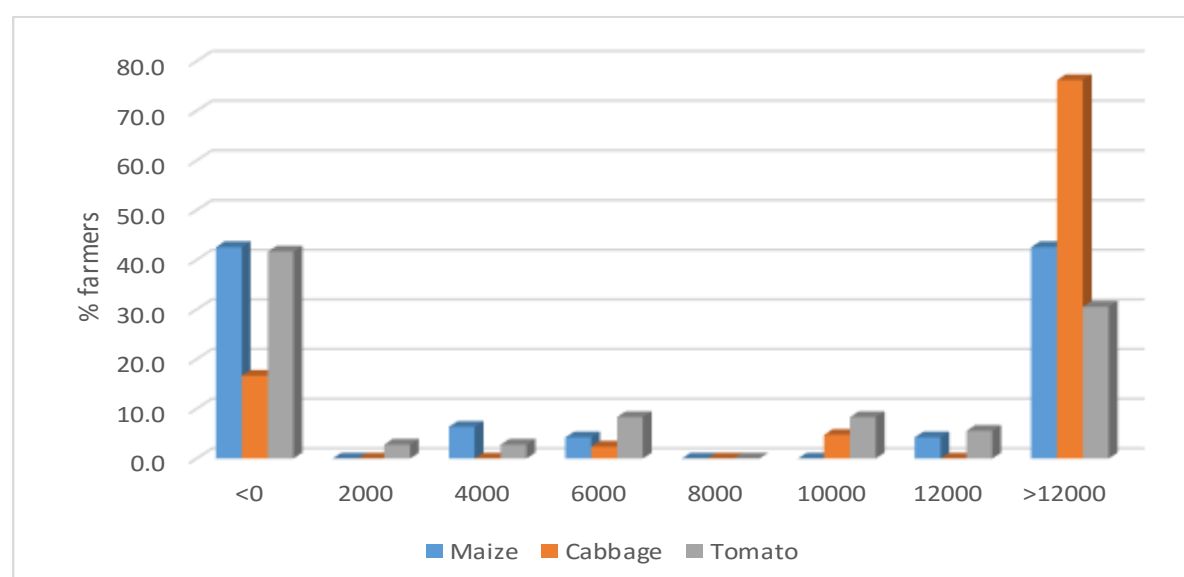
Farmers in Bululwane are more profitable in the tomatoes enterprise compared to the farmers in Tugela Ferry. Even though there are very few farmers planting tomatoes in Bululwane, perhaps they need to plant more tomatoes to increase their profitability.

Table 7.35. Tomatoes gross margin (Rand) – Bululwane and Tugela Ferry

	Bululwane	Tugela Ferry
Tomato gross income per ha	24084.57	20084.10
Total variable cost	4466.97	22192.65
Tomato gross margin	17827.00	804.53
Tomato gross margin excl. family labour	17846.09	6272.53

Source: Survey data, 2016

The majority of the farmers that planted cabbages had a gross margin greater than R12 000 and very few farmers had a negative gross margin. The majority of the farmers that planted tomatoes had a negative gross margin. More farmers obtained a positive gross margin for maize.

**Figure 7.20.** Gross margin above variable cost including family and hired labour cost – Bululwane and Tugela Ferry

Source: Survey data, 2015

7.3.5 Opportunities and challenges facing homestead food gardeners and small-scale irrigators

The following are the key challenges that present opportunities for farmers:

- Youth need more access to land and there needs to be programs that encourage them to start farming businesses.
- There are farmers that had the potential to diversify their sources of income with arts and crafts, especially in Nongoma. But farmers had no capital to purchase production

inputs. Farming is a high risk and low returns business, therefore in order for these farms to be sustainable, diversification is very important for farmers. They need to have something to fall back on when there are water challenges (drought) for example. So, it is important that all the skills that farmers have become utilised.

- High interest rates on loans and farmers having fear of debt. Farmers have been abused by the lenders who don't understand the farming business and they don't support farmers in cases of natural disasters. This then means that innovative micro-financing is necessary to deal with the challenge of high interest rates and farmers fear of borrowing. A kind of micro-finance that will have micro insurance incorporated in it.
- In Tugela Ferry many farmers borrowed money for agricultural purposes from loan sharks. This is not good for farmers because when the farmers are not able to sell their produce or if it gets destroyed by diseases, they cannot bounce back as the loan sharks charge high interest and they sometimes take farmers belongings if they don't pay back. This is very challenging for them as they don't have insurance for when things go wrong.
- Opportunities for water harvesting need to be explored so that farmers out of schemes can be also supported. Perhaps even other forms of affordable irrigation systems that farmers can use, i.e. solar powered irrigation schemes as many farmers complained about too high electricity bills.
- Farmers need to be trained on building relationships with customers. They need to be taught how to set up a production plan that will go opposite what other farmers are doing, so that they don't harvest their produce when the markets are flooded with what they have.
- Since most of the farmers have low levels of formal education, trainings must be made as simple as possible in order for farmers to be able to benefit from them.

7.4 Summary

The chapter aimed at determining the sources of livelihoods and opportunities for improving farming within available food value chains among farmers in homestead and smallholder irrigation farming. It applies the modified and enriched version of the sustainable livelihoods framework, integrating PsyCap to understand the extent to which farmers are surviving and making use of opportunities available to improve farming operations. The findings reveal that farming and public transfers in the form of social support grants are the dominant livelihood sources of smallholder farmers involved in irrigation. Farmers irrigating outside the schemes

take farming more as a subsistence activity while those in the schemes see it more as a source of income.

Findings in and around all the four schemes also show limited involvement of young people or youth in farming. Youth tend to be disinterested in farming, taking it more as an activity of adults or older people. A WRC report (iSineke Development (Pty) Ltd, 2004) also noted the same, that youth is generally not interested in agricultural production. Such a scenario does not augur well for continuity and sustainability of smallholder agriculture in South Africa. Until such a time when young people perception on agriculture is changed and efforts are put to make the sector attractive even for the youth, they will continue to be marginalized or to marginalize themselves from the sector.

Water reliability and adequacy are important to the livelihoods of farmers in smallholder irrigation. Currently availability and access to water is affected by drought, high cost of electricity lack of maintenance of the water related irrigation infrastructure. There seem to be differences between the schemes with farmers in Ndumo-B incurring the heaviest of the water cost compared to all the other schemes.

The findings also show the importance of informal sources of credit and markets to livelihoods of smallholders in small-scale irrigation. Inaccessibility of commercial banking institutions due to various challenges has seen the rise of informal institutions such as stokvel and loan sharks in bridging the finance gap in the rural areas. However, these provide credit at higher interest rates which potentially make the farmers more vulnerable in the long term. Local markets, especially nearby towns and van traders (hawkers) are key to marketing of crops produced by farmers in homestead and scheme irrigation. However, these markets are unpredictable, offer low prices and if not properly developed, they cannot be a long-term sustainable marketing strategy, especially if volumes of produce increase. Thus, marketing remains a key challenge since farmers cannot directly access lucrative fresh produce markets in Pietermaritzburg, Durban and Johannesburg. Closely related is the issue of storage. Farmers have challenges in storing their produce resulting in loss of value to theft or deterioration of the produce in terms of quality.

There are so many opportunities availed by the challenges facing homestead and smallholder farmers in scheme irrigation. These include the strengthening of the role of collective action institutions in marketing and integrated irrigation water management, use of different marketing strategies to enhance farmer linkages with high value markets, the opportunity to

run small farms in irrigation schemes as businesses, opportunities for water harvesting and the prospects of an expanded smallholder farming sector that enhance the participation of young people in farming, among others. This will enhance the contribution of smallholder irrigation to livelihoods in the rural communities.

8 EXPLAINING FARMERS' ASPIRATIONS AND GOALS TO EXPAND CROP PRODUCTION IN AND AROUND THE FOUR IRRIGATION SCHEMES

8.1 Introduction

Expansion and transformation of smallholder irrigation farming is one of South Africa's development strategy in the next 15 years. As highlighted in the literature review and previous chapters, farmers face several challenges that complicate the development of on-farm entrepreneurship. Despite their willingness to expand their operations, these challenges act as stumbling blocks in conceptualizing and practicing small-scale farming as small businesses. Thus, the purpose of this chapter is to establish the willingness and capacity of farmers in and around the four irrigation schemes in KwaZulu-Natal Province (Makhathini, Ndumo-B, Bululwane and Tugela Ferry) to expand⁹ their crop irrigation activities from homestead food gardens to irrigation plots and/or from one to more than one plot in the irrigation schemes. The objective is to be able to define the characteristics of smallholder irrigation farmers, including homestead food gardeners, which will drive breakthrough solutions in entrepreneurship among such farmers. The chapter also identifies inherent challenges, opportunities and incentives (such as access to suitable land, water and finance) as well as conditions for success (such as cooperation, collective action and coordination/collective governance of common resources) that will trigger expansion and entrepreneurship development.

The chapter first presents empirical results and analysis of opportunities and challenges for each type of farmer from Makhathini and Ndumo-B in Section 8.2 and 8.3. Empirical results and opportunities and challenges in expansion faced by farmers in Bululwane and Tugela Ferry are presented in Section 8.4 and 8.5. Section 8.6 gives a summary of the chapter.

⁹ Irrigation expansion can either be through intensification of production on the same land or increasing land under production. This study considers only one of these two and discusses expansion of irrigation activities in terms of increasing land under smallholder irrigation production.

8.2 The role of irrigation schemes to expand farming activities: empirical results from Ndumo-B and Makhathini

8.2.1 Willingness to expand farming activities

To expand farming operations in the rural areas, farmers' willingness and ability to expand are the key issues of interest, constrained by other policy and institutional factors. These issues are examined in this section step by step.

To understand their willingness, farmers were presented with a Likert scale format question to show their level of interest in expanding their crop irrigation activities. The question was "Would you be interested in expanding your farming operations, i.e. adding small-scale irrigation plots to your current gardening and rainfed farming operations or increasing your plots in the irrigation scheme?" The results show that the majority of small-scale irrigators in Makhathini and Ndumo-B (96.2%) are interested in expanding their farming operations (Figure 8.1).

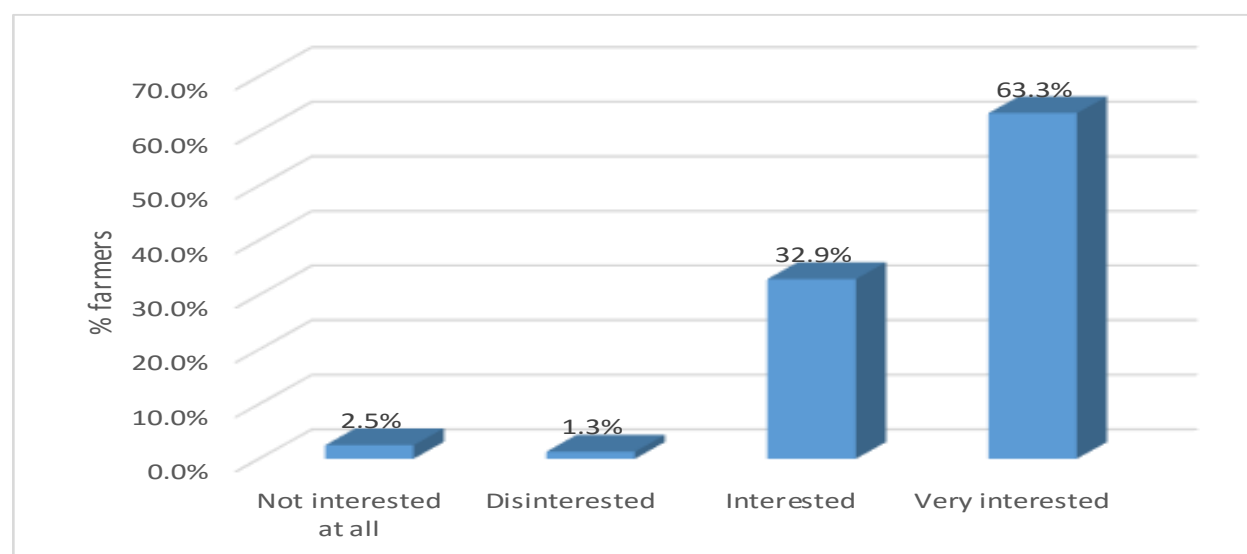


Figure 8.1. Interest in expanding farming operations – Makhathini and Ndumo-B

Source: Survey data, 2015

Further analysis shows that there are no significant differences between men and women farmers regarding their interest to expand farming activities. However, the results in Figure 8.2 show that a higher proportion of male than female farmers have a strong interest in the expansion of their farming activities. The trend is the same even for those not interested, with more female farmers (4.4%) indicating their lack of interest compared to male farmers (3%).

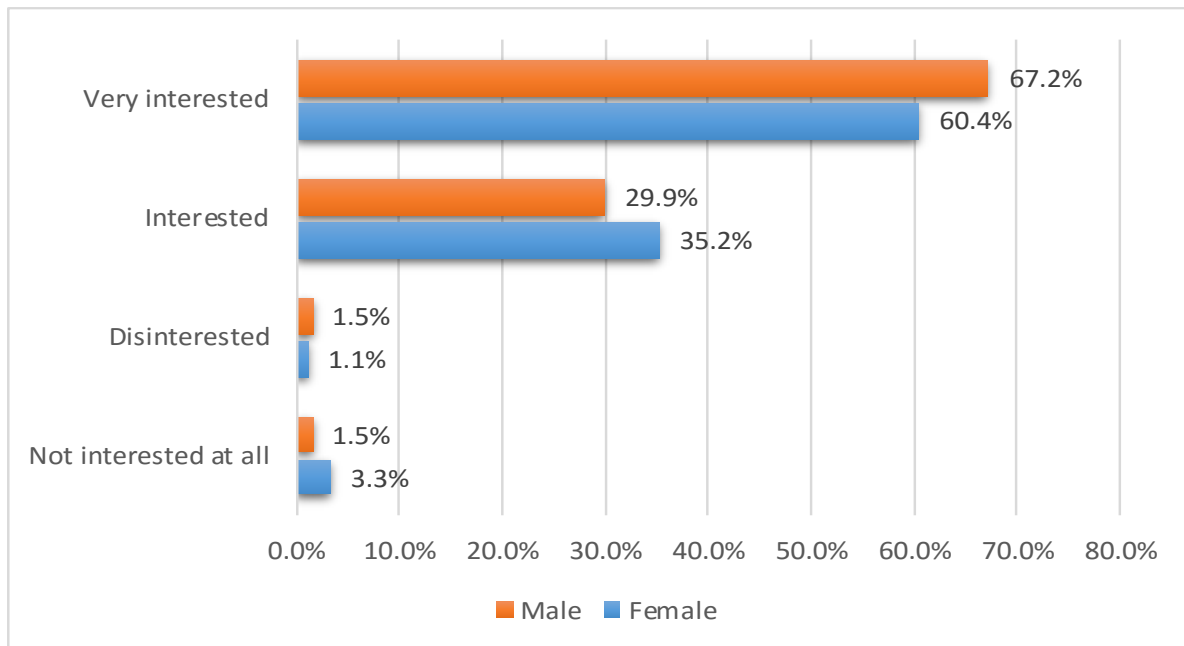


Figure 8.2. Gender and interest in expanding farming operations – Makhathini and Ndumo-B

Source: Survey data, 2015

As noted in Section 6.2.1, the mean age of the farmers in Ndumo-B and Makhathini is approximately 50 years which is similar to that in Bululwane and Tugela Ferry (see Table 8.3). Although correlation testing does not show any significant age difference between farmers who are interested and those not interested in expanding to more plots or irrigation farming in schemes, Table 8.1 below shows that farmers who are not interested in expanding in Ndumo-B and Makhathini are relatively older compared to the other group of farmers. However, the results become inconclusive when focusing on the other three types of farmers, as they do not establish any trend.

Table 8.1. Age and interest in expanding farming operations – Makhathini and Ndumo-B

I am interested in expanding my farming operations	N	Mean age	Std. Deviation	Minimum	Maximum
Very interested	100	49.21	11.917	26	78
Interested	52	48.52	11.416	20	72
Disinterested	2	40.50	4.950	37	44
Not interested at all	4	53.00	13.784	41	69
Total	158	48.97	11.709	20	78

Source: Survey data, 2015

Level of education determines one's ability to grasp and understand innovations and opens up one's mind to accept new ideas and challenges in business. However, the extent to which it affects one's desire to engage in more farming is uncertain. Certainly, in this study this was a

variable of interest. Descriptive statistics show no statistically significant difference in the number of years in formal education between farmers interested in expanding and those that are not interested. However, the average number of years of those not interested in expansion is slightly higher (4.7 years) compared to those interested (4.4 years). Hence, it would seem that expansion of farming operations is favoured by less educated farmers. Chapter 7 has shown that farmers that are more educated are more inclined to be engaged in non-farm economic activities and off-farm employment.

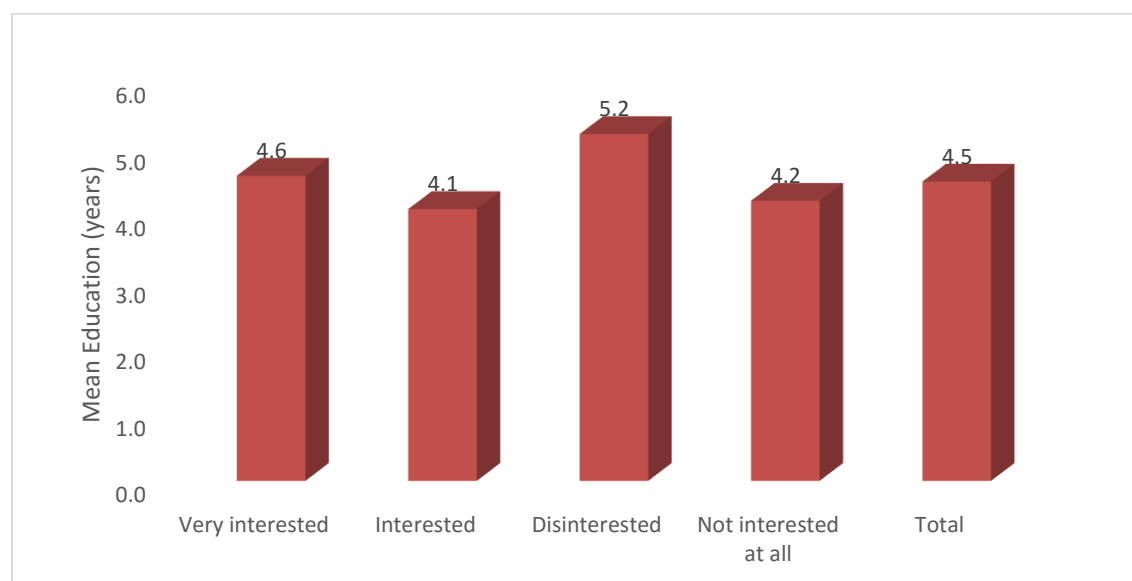


Figure 8.3. Formal education and interest in expanding farming operations – Makhathini and Ndumo-B

Source: Survey data, 2015

8.2.2 The capacity of farmers to expand crop irrigation farming

Even though the majority of farmers (96.2%) are willing and interested to expand farming operations, this has not been happening. Farmers were asked two further questions since expansion is a question of both willingness and ability. Firstly, they were supposed to respond to the question ‘If you are interested in expanding your irrigation farming operations, do you have the capacity to so?’ Capacity was asked regarding knowledge, different kinds of resources and mental stamina required to engage in such a process. Secondly, they were asked ‘If you are interested in expanding farming operations, what are the factors holding you up?’ The question was a multiple response question. Responses to these questions are summarized and reported in Table 8.2.

Table 8.2. Constraints to expansion of irrigation crop farming – Makhathini and Ndumo-B

Constraints to expansion of irrigation crop farming	Percent of farmers
Financial constraints	86.8
Land availability and security constraints	27.4
Lack of access to inputs and machinery	6.3
Water availability constraints	4.9
Too far away from scheme	0.3

Source: Survey data, 2015

The results show that 67.6% farmers in Makhathini and Ndumo-B report not having the capacity to expand irrigation crop farming while 32.4% indicated otherwise. However, all interested farmers, despite their willingness, reported several factors that are hindering them from expanding irrigation farming. Table 8.2 shows financial constraints (86.8%) and land availability and security constraints (27.4%) as the major factors that are holding back farmers in the two areas from expanding their irrigation crop farming. Only 6.3% and 4.9% farmers reported the lack of access to inputs/machinery and water availability constraints, respectively, as factors hindering their efforts in expanding their crop irrigation farming.

Discussions with farmers and stakeholders in Jozini revealed that the lack of access to financial resources and services may result in delay of crucial agricultural activities, poor yields and small profits from cropping enterprises. In fact, lack of financial resources, *ceteris paribus*, might be the difference between a successful and badly performing farmer. Access to credit is very minimal with less than half of the farmers reported to have accessed credit loans (see Chapter 7). Farmers use their financial resources and mainly support from government to sustain their irrigation farming activities. However, some small-scale irrigators particularly those outside of the irrigation schemes do not meet the necessary conditions that qualify them to receive support from government offered through Provincial DARD offices. The DARD is now targeting registered cooperatives, with a water permit and a business plan.

Land availability and security are major concerns, particularly for farmers in the two schemes. It was revealed that in the two schemes there is no more land to expand. Thus, scheme irrigators who are fully utilizing their existing land have no room for expansion within the scheme. In recognition of this challenge and the need to expand irrigation farming, Makhathini Master Plan has a provision for the expansion of Makhathini Irrigation Scheme from the current 4700 ha to 15000 ha. However, to date, the plans are still under discussion with very little on the ground. Land tenure security is also under threat for scheme irrigators in Makhathini. Makhathini Trust, which is a board tasked with running the affairs of the irrigation scheme, is

planning a programme to reallocate land in the scheme citing unfairness in the initial land allocation programme. This reallocation programme will result in some current scheme farmers losing their plots while new farmers will be incorporated. Farmers that farm as individuals will be mostly affected. This uncertainty on land issues always raises fears among all farmers regarding the security of their tenure.

Although only 4.9% reported water availability constraints as a hindering factor to expansion of irrigation farming, discussions with farmers and stakeholders showed that water scarcity is an issue of concern, certainly in the future (see Chapter 5 and 7). It was revealed that the expansion of Makhathini Irrigation Scheme is affected mostly by the adequacy and availability of water resources for such a huge project. A new programme, by the DRDLR, that is meant to respond to the current drought challenges, is currently hampered by lack of adequate water resources. The DRDLR is targeting approximately 200 ha of irrigable land under maize production. The DARD at the district level indicated that any expansion of irrigation activities depends on the availability of water. They said current irrigation schemes are actually at risk due to water scarcity.

The results also show that half of farmers interested in expanding irrigation crop activities in the two areas would want to irrigate individually while the other half would want to do so collectively with other farmers. Challenges with working collectively, especially lack of cooperation by some members, are cited as the major reasons by those that want to irrigate individually. Previous experience in cooperatives, where some farmers are late in paying for water fees or refuse totally to pay, resulting in water disconnections, have made some farmers sceptical about working collectively. However, challenges regarding collective action can be overcome given that most farmers (65%) are interested in being part of a collective action institution governing water use, while 74.7% are interested in taking part in training programme on collective management of irrigation schemes.

8.2.3 Determinants of farmers' aspirations to expand irrigation crop production

Given descriptive findings in Section 8.2.1 and 8.2.2 above, it is critical to establish empirically significant determinants of farmers' aspirations and goals to expand. Such an analysis reveals areas that current strategies and policy interventions should focus on. The results from the econometric modelling (see Table A1 in Appendix 3) show that five factors significantly affect smallholders' aspirations to expand. These are the PsyCap, access to credit, social networks, land tenure security and market access. None of the personal attributes of farmers (such as age,

gender and level of education) were significant in explaining the likelihood of interest in farming expansion. The results from previous chapters have shown that there were no significant differences among the farmers regarding their age, gender and education. Thus, the results in this section are not only in line with these findings but also show the existence of other compounded factors that affect farmers' desire to grow their farming operations.

The results show that PsyCap has a positive statistically significant effect on aspirations for expansion. Farmers with positive PsyCap endowment are 9% more likely to be interested in expanding. The results are similar to conclusions of most aspiration studies that show that aspirations in life are associated with self-confidence (Gutman and Akerman, 2008; Leavy and Smith, 2010). As shown in Chapter 3, self-confidence is one of the four constructs of PsyCap critical in defining the entrepreneurial characteristics of a farmer. Smallholders who are confident in themselves have the belief that they can succeed in whatever situation and this acts as a motivation to aspire for more in life. This highlights the importance of building positive PsyCap for effective smallholder agricultural transformation.

Access to credit also influences farmers' aspirations to expand. Farmers with access to credit are 4% more likely to be interested in expansion compared to those without access. Other studies also emphasize the importance of access to credit to financing and growth of smallholder farming (Machethe, 2004; Poulton *et al.*, 2006; Sinyolo *et al.*, 2016). Improving farmers' access to credit enhances their capacity to operate the land.

Membership to a social group positively influence farmers' interest in expansion. Members of social groups are approximately 5% more likely to aspire to expand their farming activities. Social networks are sources of inspiration, knowledge sharing and support for farmers. Leavy and Smith (2010) state that the extent of social-embeddedness will affect aspiration formation in people. This reinforces the need to support institutions that promote social interactions and learning in the communities such as farmer associations and cooperatives, as these will have a positive effect on smallholder aspirations.

Land security constraints negatively influence smallholder aspirations to expand. Farmers facing land tenure security constraints are 4% less likely to be interested in expansion compared to those without such constraints. Such farmers can be called discouraged farmers, frustrated by the system such that they have lost interest in farming. This could be linked to the existence of politics of patronage in land allocation and land disputes resolution, especially in the schemes. As noted in the earlier chapters, the management of land in South Africa's rural

communities is still under the control of tribal authorities and use is on a 'PTO' basis, whose authority gives them power to revoke the land use rights. Thus, there is a need for investing more time in building mechanisms meant to instil smallholder confidence in the land tenure system within the schemes. These could be functional and effective committees or systems for resolving land disputes. Ostrom and Benjamin (1993) indicated that the chances of farmer-managed irrigation schemes enduring without such conflict resolution mechanisms are close to none.

The travelling distance to the nearest town/market negatively statistically affect smallholder interest in expansion, i.e. the further away farmers are from the nearest town or market, the more unlikely they will aspire to expand their farming activities. Kosec *et al.* (2012) showed similar findings of the association of higher farming aspirations with improved communication and transport links with other localities. Expanding irrigation activities will result in increased marketable surplus which should be matched by accessible and profitable markets capable of handling the increased supply of produce. For the farmers, there is no point in increasing their marketable surplus if they are unable to sell it. Thus, improving smallholder access to markets should be made a priority in programmes meant to expand smallholder irrigation. One way to achieve this is to integrate the expansion programme into value chain development programmes such as Agri-Parks.

8.2.4 Determinants of farmers' ability to achieve their aspirations

The analysis for Makhathini and Ndumo-B also investigated factors affecting the ability to achieve farmer aspirations to expand. The results reveal that smallholder capacity to aspire for expanding crop irrigation activities is affected by social conflicts, resource endowment and access to markets.

Social conflicts experienced by smallholders regarding access to productive resources have a positive significant impact on farmers' ability to achieve their aspirations. A unit increase in local conflicts results in a 0.62 ha increase in the land that a farmer wants for expansion. Negative experience of smallholders due to conflicts in their community act as a push factors for farmers to exert more effort to achieve one's aspirations. This is mostly the case for smallholders who have an internal locus of control, who believe that they have the power to affect their own destiny, farmers who do not see obstacles as problems but a challenge that can be solved.

Access to assets, especially physical assets, positively impact on the farmers' ability to achieve their aspirations. Farmers endowed with physical assets such as livestock and farming equipment (pipes, sprinklers, water pumps, etc.), among others, want to expand with more land than those without assets. Livestock assets can be sold to meet immediate household needs including acquiring of inputs or other agricultural related investments (Rumosa-Gwaze *et al.*, 2009; Chaminuka *et al.*, 2014). This is critical since additional financial resources are required for expansion and the sale of livestock can generate the much-needed income for such investments. Kosec *et al.* (2012) show similar results that advance the thesis that wealthier people can invest to achieve their aspirations which is not the case for poor households. Furthermore, cattle also act as a source of draught power and together with ownership of farming equipment, it enhances the farmer's ability to operate bigger land sizes. Thus, building the smallholder household's resource base in Makhathini and Ndumo-B increases the chances of realizing their aspirations for expansion.

Access to markets does not only positively influence farmers' interest to expand but also their ability to achieve their aspirations. A one-minute increase in travelling time to the nearest town results in a 0.02 ha decrease in the land that a farmer wants for expansion. Market access can act as an incentive for farmers to aspire to increase land under production (Van der Heijden and Vink, 2013; Sinyolo *et al.*, 2016). In the two study areas, limited access to markets has resulted in the loss of produce and value and consequently, reduced land under production. Smallholders need readily accessible markets that offer competitive prices and hence decent returns to their farming. This will leverage their ability to increase land under production.

8.3 The role of irrigation schemes to expand farming activities: empirical results from Bululwane and Tugela Ferry

8.3.1 Willingness to expand farming activities

The field observations and the survey results suggest that smallholder farmers in Bululwane and Tugela Ferry also have aspirations to expand their farming operations. Some homestead and community food gardeners want to be part of the irrigation scheme. There are also farmers inside the irrigation scheme that are looking for more land to work on and wish to be commercial farmers one day.

According to the survey, the majority of the farmers that wish to expand are in the irrigation schemes. This was expected as farmers in the irrigation schemes realize the potential for agriculture, especially if their market challenges were to be solved. The study results show that

67.7% of the farmers were interested in expanding their farming operations in Tugela Ferry and Nongoma.

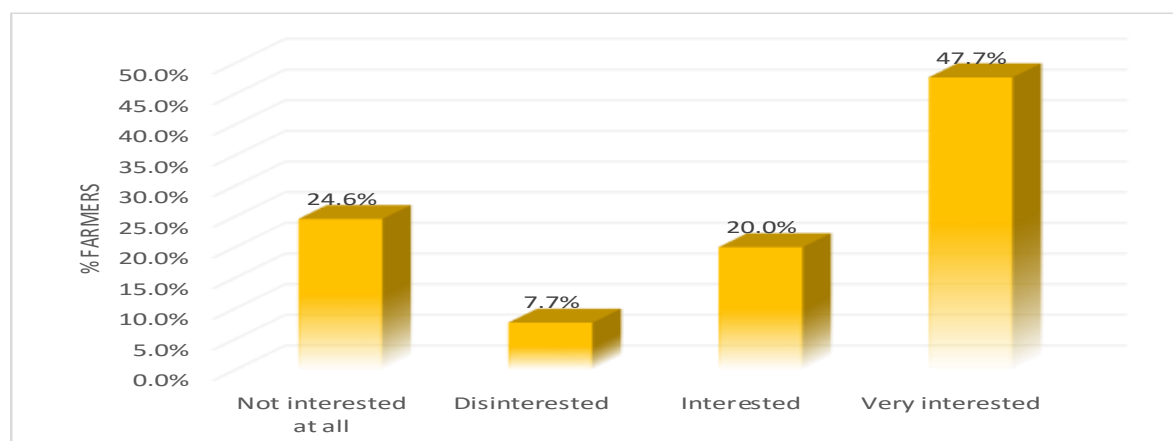


Figure 8.4. Interest in expanding farming operations – Bululwane and Tugela Ferry

Source: Survey data, 2016

There is no significant difference in willingness to expand farming operations between farmers of different sexes. This might be because males and females are afforded the same opportunities in the study areas, i.e. there is no gender discrimination in relation to opportunity to expand farming operations in and around the two schemes.

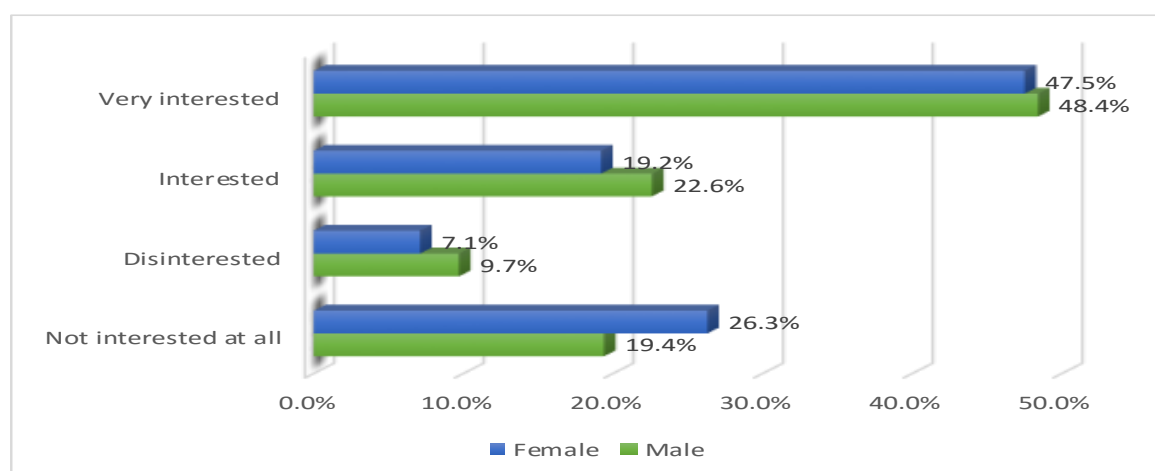


Figure 8.5. Gender and interest in expanding farming operations – Bululwane and Tugela Ferry

Source: Survey data, 2016

In the study areas, the statistical results indicated that age difference was not statistically significant when analysed in relation to the willingness to expand farming operations. However, farmers that were younger at an average age of 50 were more willing to expand their farming operations compared to those who were older (with an average age of 55). The age

bracket affects the nature of the relationship between age and willingness/interest to expand farming operations. Farmers who are 55 years or older are qualified for a pension grant and they receive it on monthly basis. In most cases, it was found that those farmers no longer had interest in acquiring more land for themselves, the most common reasons being sickness and old age.

Table 8.3. Age and interest in expanding farming operations – Bululwane and Tugela Ferry

Are you interested in expanding your farming operations?	N	Mean	Std. Dev	Min.	Max.
Not interested at all	32	56.1	14.3	29	87
Disinterested	10	54.4	10.5	42	70
Interested	26	50.3	14.7	19	75
Very interested	62	49.4	12.1	23	73
Total	130	51.6	13.3	19	87

Source: Survey data, 2016

The level of education was not statistically significant in explaining the willingness of farmers to expand their farming operations in the selected study areas. However, the descriptive statistics show very little difference between the level of education of those that wish to expand their farming operations and those that do not. Farmers with a slightly higher level of education were more interested to expand their farming operations compared to those that were less educated. Better educated farmers want to improve their livelihoods by acquiring more land and they are not satisfied by producing for subsistence.

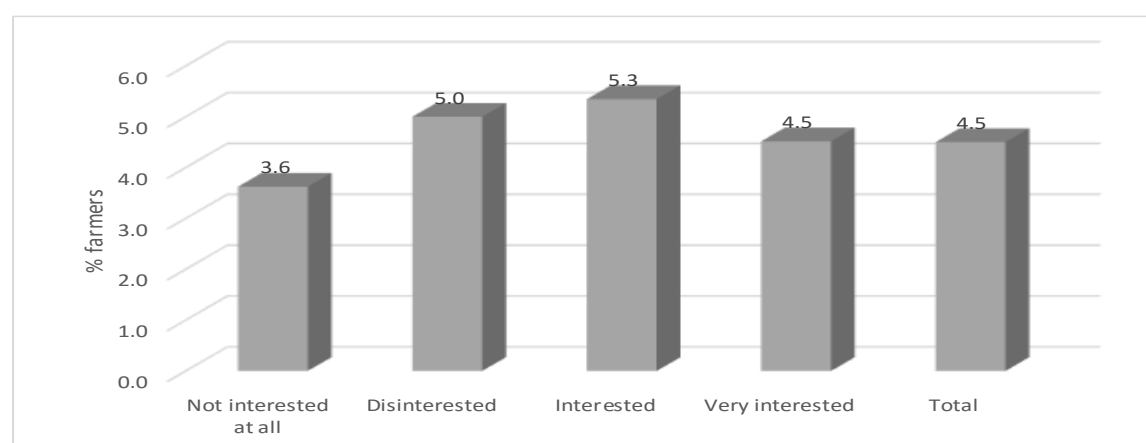


Figure 8.6. Formal education and interest in expanding farming operations – Bululwane and Tugela Ferry

Source: Survey data, 2016

8.3.2 The capacity of Bululwane and Tugela Ferry farmers to expand crop irrigation farming

As noted earlier, for expansion to happen, willingness and aspiration is not enough; it has to be accompanied by the necessary resources, managerial capacity and conducive institutional and policy framework. There is also a need for a mindset change so that the smallholder farmers will believe in themselves and be able to withstand the pressures of being a small farm business entrepreneur in a constantly changing environment.

In the two study areas, there were many factors that held back farmers that had goals of expanding their farming operation. Land availability was the most common challenge (59.1%) across farmers. This was expected as the irrigation schemes are usually full and available land outside the scheme usually has no water to irrigate. Financial constraint was the second most common challenge that smallholder farmers faced in the study areas. This was expected as smallholder farmers often find it difficult to borrow money from banks. As noted in Chapter 5 and 7, this has given rise to the saving groups (stokvels) that give its members credit but at higher interest rates than what banks would normally charge.

Table 8.4. Constraints to expansion of irrigation crop farming in Bululwane and Tugela Ferry

Constraints	Percent of farmers
Financial constraints	53.4
Land availability and security constraints	59.1
Lack of access to inputs and machinery	25.0
water availability constraints	13.6
Market constraints	15.9

Source: Survey data, 2016

Comparison by type of farmer shows that the majority of the scheme irrigators are facing land availability, financial and access to production input constraints, in order of importance. The majority of the homestead food gardeners are facing financial, land availability, water availability and access to production input constraints. Many community food gardeners face financial, land availability and water constraints. These challenges which are similar to those noted for Makhathini and Ndumo-B farmers, suggest key intervention areas that are needed to support farmers in achieving their expansion goals. Improving access to financial services, land, inputs, markets and water can solve most of the key farmer challenges. Finding more land can be more difficult to achieve as land with access to water is scarce, especially inside the scheme. However as elaborated in Chapter 7, this has given rise to plot rental market amongst

scheme irrigators, a practice that is unconstitutional according to the scheme regulations. The distance to the possible available plots might also be a challenge for most farmers.

Table 8.5. Constraints to expansion by type of farmer (%) – Bululwane and Tugela Ferry

What is holding you up from expanding your farming operations?	Scheme irrigators	Independent irrigators	Homestead food gardeners	Community food gardeners	Non-irrigators
Financial constraints	50.0	50.0	60.0	80.0	60.0
Land availability and security constraints	63.6	0.0	40.0	60.0	60.0
Lack of access to inputs and machinery	25.8	50.0	20.0	0.0	40.0
water availability constraints	12.1	50.0	20.0	20.0	0.0
Market constraints	19.7	0.0	10.0	0.0	0.0

Source: Survey data, 2016

During the focus group discussions, farmers mentioned that they face a physical and financial challenge to obtain inputs as they are physically inaccessible and cost-wise unaffordable. Very few farmers knew how to re-use seeds like tomato seed but most could re-use sweet potato leaves to re-plant. It has proven difficult for farmers to get good quality crops as they are expensive and as a result most of them buy poor seeds. As a result of that challenge, other farmers would depend on government seeds which in most cases are not suited to the farmers' needs.

8.3.3 Determinants of farmers' aspirations to expand irrigation crop production and ability to achieve their aspirations

The results of the ordered probit model (see Table A2 in Appendix 3) indicate that age, sex and household size have a statistically significant influence on willingness and ability to expand for smallholders in Bululwane and Tugela Ferry.

Age has a negative significant effect on the willingness and ability of farmers to expand their farming operations. This finding is consistent with findings by Sinyolo *et al.* (2017) who found a negative association between entrepreneurship/aspirations and age. With an aging smallholder farmer population in the study areas, these results indicate that old smallholder farmers are less interested or capable of expanding their farming operations and viewing farming as a business. Fischer and Qaim (2012) and Xaba and Masuku (2013) also noted that the aspirations of the entrepreneur as well as his mental capacity to cope with the challenges of his business activities and his mental and physical abilities to do manual work decreases

with age. Among those older smallholder farmers, who are approaching the time of retirement due to age, other goals might be more important than expanding farming operations. Therefore, in order for government to get a return on their investment in irrigation scheme expansion, they must carefully consider the age of the people that will participate in those schemes.

The sex of the farmer was statistically significant with a negative sign. This means that males in the two areas were less likely to be willing and able to expand compared to females, *ceteris paribus*. This is consistent with the findings by Sinyolo *et al.* (2017) who found that female-headed households were more entrepreneurial or had higher aspirations in agriculture than male-headed households as a result of the lack of options for women outside farming. This means that women are more committed to farming than their male counterparts. This can also be explained by the fact that males are considered to be mobile and spend more time looking for non-farm work than farm work. There are also cultural reasons that can explain these results. For example, in Msinga farming is still considered as a woman's duty and during focus group discussions some farmers indicated that males are sometimes verbally bullied by women in the schemes since it is considered as something for women only. More women are found to be the household heads in the rural areas and high unemployment forces them to work harder so that they can be able to feed their families. These findings are contrary to the findings by Pandolfelli *et al.* (2008) who found that men are more involved in groups related to income generation (e.g. productive groups) whereas women are more involved in home and child related groups. In the selected study areas, women participate in all groups as most households don't have male heads.

The household size negatively affects willingness and ability to expand. The result implies that household heads with many household members are less likely to be willing and able to expand, *ceteris paribus*. This finding is consistent with the findings by Sinyolo *et al.* (2017) who found that bigger households are less likely to be entrepreneurial or have less farming aspirations compared to smaller households. According to World Bank (2005) and Sinyolo *et al.* (2014), large household size may lead to lower income per capita if there are diminishing returns to additional labor in the household and larger households tend to have a higher share of dependents. Therefore, this finding is due to the fact that most family members are either working off-farm or are looking for employment off-farm and have little interest to work on-farm. Moreover, kinship links play an important part at every stage and in every aspect of entrepreneurial activity and farming aspirations. The farmer who has greater financial family support has a higher probability of becoming an off-farm entrepreneur and as a result work less

on the farm (Dutta, 2007). This finding is also an indication that smallholders do not operate in a vacuum when developing their businesses or making decisions about their next move. Seuneke *et al.* (2013) noted that farming families are less driven by ideas of growth and profit maximisation but instead, higher priority is given to survival, maintaining a rural life-style and passing a healthy farm on to the next generation.

8.4 Expanding farming operations in and around irrigation plots: opportunities and constraints in the four irrigation schemes

The policy by government to expand irrigation schemes has made it necessary to understand the factors that influence smallholder farmers' willingness and ability to expand farming operations. However, government goals to commercialize smallholders can't be achieved at the current state and if forced would yield little return both socially and economically. Expansion of farming activities is a preferred roadmap by most smallholder farmers, particularly scheme and independent irrigators. Relatively, few homestead food gardeners and more so community food gardeners are sceptical about the whole idea and hence have little interest. However, these could be individuals who follow a "wait-and-see" strategy and never show interest in something the first time they are told about it or they might be those farmers who believe they cannot cope up with the demands of collective management of irrigation schemes and hence would rather remain with their small gardens.

8.4.1 Psychological capital

PsyCap is an important asset to successful transformation of homestead food gardening to irrigation farming or from one to more than one plot in the schemes. This is quite critical for farmers in Makhathini and Ndumo-B. In general, homestead food gardeners are poorly endowed with PsyCap compared to community food gardeners, scheme and independent irrigators. The PsyCap of farmers in Tugela Ferry and Bululwane Irrigation Schemes is very positive and it shows that most farmers are committed to farming. The challenges that they are facing are beyond their control and they need partners who will work with them not for them. However, for all farmers there are three important aspects related to PsyCap that will reduce the interest and hence participation in expanded irrigated crop farming. These are resilience to or capacity to absorb the impact of shocks, willingness and ability to take risk and capacity to delineate goals in farming. Smallholder farmers are typically vulnerable due to small sizes, location of smallholders in dry land and fragile tropics, low technology, low capitalization and diverse non-climate stressors. The non-climate stressors include HIV/AIDS, agricultural policy

uncertainties, market failures and environmental degradation, among others. Adaptation options will involve technological developments, government programs/interventions, insurance/credit markets tailored to smallholder farmers, farm financial management and information provision.

Expansion of irrigation farming activities involves a lot of risk. Smallholder farmers in irrigation farming should be able to take a calculated risk and they should find ways of mitigating or reducing the effects of different forms of risk on their businesses.

The results from Tugela Ferry and Bululwane irrigation schemes suggest that farmers inside the irrigation schemes are more willing to expand their farming operations compared to those that are out of the schemes. Those farmers in the schemes see more potential in the work they are doing and have better access to water and productive land. Age and gender were important in determining their willingness to expand farming operations. Farmers that are not yet receiving pension grant are more willing to expand their farming operations. Farmers that have not yet reached the pension age need to be prioritized for possible expansion of farming operations as they have the passion and capacity to work on the land.

The aspirations and goals of farmers are to be as profitable as possible where they are so that they can be able to use those profits to improve livelihoods and expand farming operations. Otherwise, if the expansions are forced, then farmers will be worse off because of poor markets and loss. Even though farmers have a positive PsyCap, they still lack the skills and resources that they would need to strive in the whole value chain.

In previous chapters, the study raised questions and pointed out inherent challenges of running smallholder farming as a business: mindset, lack of record keeping culture and mixing farm and family operations. Long-term goals usually involve incurring an opportunity cost of foregoing benefits today for benefits to come in the future. It is clear from the findings that, owing to their poverty, most farmers are not willing to incur this cost and they make short-term survival maximizing decisions. However, for them to establish successful farming businesses, they should be willing to forego immediate benefits for achieving sustained and long-term benefits in the future. Budgeting and strict adherence to budgets can assist in this regard.

People in rural communities do not consider farming as a lucrative business compared to other businesses. Thus, most rural people engaged in farming do so because it is the only option available. If better opportunity arises in the future, they are eager to move quickly out of farming. This can be referred to as 'opportunistic farming'. Many 'opportunistic farmers' take

farming as an activity to hold on simply because there is nothing else to do. For these farmers, farming is not a preferred activity for making a living. This is an inherent problem with multi-dimensional implications. It negatively affects PsyCap and mindset. It destroys the incentive to identify ways and means to farm productively. The farmer can't be expected to have long-term interest to invest on the farm with a vision. It remains an economic activity that the farmer might abandon if any better opportunity comes up. Certainly, for young people this is even more pronounced with most of them preferring to migrate to nearby urban areas to do menial jobs. A substantial number of small-scale irrigators exhibit this mindset and should a better opportunity arise, such farmers will opt out.

8.4.2 Water

Water security is important in determining the goals and aspirations of farmers to expand crop irrigation activities. Yet, it remains one of the biggest threats to expansion of smallholder irrigation farming activities. Current institutional setup governing water sharing and management arrangements fails to support expanded irrigation activity in all the four schemes. Due to these institutional failures, farmers are equally divided over the issue of individual or collective irrigation farming. Lack of cooperation, i.e. lack of adherence to agreed cooperative rules and regulations, is cited as the major problem. Water disconnections due to failure by one or a few members to pay for water affect every member of the cooperative. Lack of transparency and nepotism in the cooperative leadership in the past have made most members lose faith in this institution. Hence, the decreased popularity of collective action among small-scale irrigators. Efforts must be targeted to reverse this attitude as the benefits of collective action far outweigh the negatives. Focus should also be put on how to enforce rules and regulations in collective institutions that manage water resources including exploring self-policing mechanisms that can be adopted by farmers.

Investments in infrastructure and equipment that increase water access, utilisation and efficiency are important in expanding irrigation farming operations. Such equipment includes water pumps, water meters, pipes and sprinklers. In Ndumo-B, this entails investment in a canal system and infrastructure that reduces the cost of accessing water. In all situations, a cost recovery approach should be implemented. Furthermore, government should also focus on institutional mechanisms of transferring ownership and responsibility of collective management of the schemes. Farmers should not only be beneficiaries of the irrigation scheme but also owners of the scheme with collective responsibility to manage and maintain the infrastructure.

An assessment of the available water sources is required that will cover the irrigation schemes as there were many community food gardens that were no longer functioning because of water scarcity. This will be useful especially in areas such as Bululwane Irrigation Scheme, where most of the scheme irrigators have rainfed land they are not utilizing.

8.4.3 Land

It is clear that current available land in Makhathini and Ndumo-B schemes would not be able to contain expansion of farming activities in the two schemes. This might entail an investment in the expansion of the current schemes or identification of other sites for such development. The results from Bululwane and Tugela Ferry irrigation schemes also suggest that land (with water) availability and financial constraints limit farmers' ability to expand their farming operations. Even though there are farmers that have dry land, they don't use it because of the drought. Earlier findings in this report alluded to such developments in Makhathini, although discussions are still in their infancy. However, before decisions to expand or come up with new schemes are taken, there is a need for an audit of farmers in the schemes and farmers interested in expansion. This audit will indicate how much land is available (or vacant) in the schemes, how much land is held by absentee farmers and how much is underutilised, among others. Matching of currently available land and land required for expansion is important in identifying the land gap, if any. The audit will bring forth challenges with land allocations and governing and instigating dialogue on the way forward among key role players, i.e. government, tribal authorities and farmers.

However, key to this process is to ensure that the rights to title of land in the schemes are transferable such that when farmers move to other more lucrative opportunities in the future, others can take up their place. This will ensure that the plots are productively utilised.

8.4.4 Access to financial capital

Expansion of smallholder irrigation demands an investment in proper machinery and farming implements. Farmers also need to buy recommended agricultural inputs and improved crop varieties. With more plots in or outside of the schemes, the demand for labour will increase in critical production periods such as planting, weeding and harvesting. Thus, there is a need for adequate working capital to increase enterprise productivity and performance. Since there are already existing mechanisms for assisting smallholder farmers, such as farmer support provided through the Land Bank, there is a need to explore how these mechanisms can be leveraged so that they effectively support smallholder irrigation farmers. The question will be

‘What are the options available through which farmers can access funds from different sources and to what extent have these been utilised?’ ‘What role can be played by retail shops, collective action institutions and other microfinance institutions in enhancing farmers access to credit?’

Future interventions should involve strong farmer representatives who can promote their interests. Farmers can be assisted to ensure that their current organisations and leadership become effective in representing their interests. This might entail training of the farmer leadership on governance and advocacy, among other areas. Access to capital can also be improved through contract farming. There is a need to assess possibilities of establishing more binding contractual arrangements with contractors that offer a ‘win-win’ situation on the part of the buyer and seller.

A focus needs to be put on stokvels as they play a huge role in the farmers’ livelihoods and it is more likely that when farmers expand their farming operations, they will get credit from stokvels. This is because stokvels don’t use land as collateral and they understand the situations farmers face. Stokvel members understand better the risks involved in farming and because they don’t lend money to get profits; they are suitable for most farmers as lenders. The financiers that need to provide smallholder farmers with financial services need to have in-depth working knowledge about the nature and functioning of smallholder farming sector and they need to work through collective action institutions such as stokvels. However, such financing should be provided at affordable competitive market rates and should be linked to production or agricultural value chains.

8.4.5 Markets

Expansion of smallholder irrigation farming will result in increased crop production and more marketable surplus. If this is not matched with improved market access and proper market distribution channels, farmers might be worse off due to low farm gate output prices. Middlemen will retain most of the profit margin from the sale of farmers’ own produce. Government as the custodian of policies in the country could adopt a phased approach where smallholder farmers are supported through different policy instruments to allow them to compete with established farmers in the food markets and then gradually weaned off to stand on their own. Ultimately, smallholder irrigation farmers should be able to use their advantage in numbers in procuring inputs and in crop production to outplay their competitors in the market. Collective action is the solution to solving most of smallholder farmers’ market access

challenges. Farmers should realize that there is power in numbers (the fortune at the bottom of the pyramid) and strengthening formal and informal collective action institutions is their gateway to the establishment of successful farming businesses.

When farmers don't have access to markets, they end up not yielding the expected profits and that discourages them in the future. If farmers were to expand their farming operations without changing the current financial and product market conditions, they will continue to make post-harvest losses which wastes food and water. Farmers, like any other business people, need to make profit to stay in business and to invest and expand the farm. They need to recognise this and take their small farms as businesses. In Tugela Ferry, where farmers pay to pump water, it is important that their produce reaches the markets at reasonable prices because if they make a loss than they would have to pay the production costs with the little money they have.

8.4.6 Participation of young people in farming

As noted earlier, there are many old and few young people involved in farming, yet younger farmers are more interested in the expansion of farming operations than older farmers. Older farmers might have little or no incentive to expand farming operations due to their old age. More young people, both male and female, are needed in the agricultural sector to transform subsistence smallholder farming into commercial smallholder farming. Young people are more suitable because they have fewer dependents and have the capacity to participate within the value chain. Young people hold the greatest opportunities for expansion and growing the smallholder agriculture sector and following on conclusions and recommendations made in previous chapters (6 and 7) there is a need for strategies to increase the participation of more young people into farming.

8.4.7 Promotion of women's participation in smallholder agriculture

The commitment of women farmers to farming and their interest in expansion is both an opportunity and a challenge. Women constitute most smallholder farmers (Altman *et al.*, 2009). However, their engagement in expanded irrigation farming is complicated by their heavy unpaid household responsibilities (Fontana and Natali, 2008; Kidder *et al.*, 2014) and disempowerment regarding ownership of the assets and equipment important to agricultural production (Sharaunga *et al.*, 2016). For most women farmers, there is a trade-off between high aspirations in farming and the ability to adequately continue conducting their other reproductive duties at the household level. However, smallholder agriculture research and policies tend to be silent on this issue. Increased farming activities demands more time

commitment from the farmer. For most rural women, this poses a challenge. Arguments are that most of the reproductive work that women do is for the good of the society and hence warrants public interventions (SOFA Team and Doss, 2011; Kidder *et al.*, 2014). Public interventions such as access to electricity, provision of affordable child care support services, improved access to health facilities, water access and other household labour saving technologies can considerably reduce time that women spend on unpaid care work. This will free time for women farmers to participate in expanded irrigation programmes.

8.5 Summary

Expanding smallholder irrigation is vital to the growth of the agricultural sector, promotion of smallholder farmer businesses and enhancement of rural livelihoods. Understanding farmer aspirations for irrigation expansion and their ability to achieve those aspirations is thus a critical part of realizing a radical transformation in the smallholder agriculture sector. The chapter has highlighted the opportunities and constraints to irrigation expansion and hence unlocking on-farm entrepreneurship among smallholder farmers in South Africa. Most importantly, it demonstrates the importance of building positive PsyCap, improving access to markets and credit and promoting the participation of women and young people in farming as key determinant of smallholder aspirations for expansion.

The chapter also showed that smallholder farmers' capacity to invest to realize their aspirations in the expansion is critical for on-farm entrepreneurship. As much as it is the duty of government and its partners to identify and develop irrigation schemes, farmers will certainly incur increased production and other costs. Building the household asset base can assist farmers to overcome this challenge and make better use of irrigation schemes. In the end, the chapter highlights the opportunities and challenges for expansion of irrigation activities in the four areas and makes recommendation for policy.

9 FORMULATION OF APPROPRIATE DEVELOPMENT PATHS FOR ESTABLISHING SUSTAINABLE FARM ENTERPRISES IN AND AROUND THE IRRIGATION SCHEMES IN KWAZULU-NATAL

9.1 Introduction

The chapter contributes to achieving the last objective of the study. It aims to formulate appropriate development paths to establish small farming businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes. The development pathways are expected to inform strategies for transforming smallholder irrigation farming and make it a significant economic contributor to rural livelihoods and local economies in South Africa. The chapter synthesizes findings from the previous chapters, namely, chapters 5-8.

Chapter 5 focused on the evaluation of natural, physical and financial capital endowment of farmers in the study areas. Its conclusions suggested that more intervention was required to enable farmers to utilise available resources and be competitive. It further reiterated the need for an integrated approach to resource management to run smallholder farming as a business and make it profitable. It has been observed, though, that it will remain an inherent challenge for many small farms to be conceived as businesses due to lack of record keeping culture and failure of farmers to distinguish family and farm operations.

Chapter 6 sought to assess farmers' endowment with key entrepreneurship drivers, i.e. human, social, psychological and institutional factors. It introduced PsyCap as an important livelihood asset that plays a crucial role in entrepreneurship development. It highlighted the importance and challenges of collective action institutions in rural KwaZulu-Natal, the importance of understanding PsyCap as a driving force to on-farm entrepreneurial spirit of farmers and institutional arrangements that are critical in developing smallholder irrigation farming in South Africa.

Chapter 7 highlighted the key determinants of sources of livelihoods and opportunities to improve contribution by farming within available food value chains. It revealed that irrigated agriculture together with public transfers are key livelihood sources for smallholder farmers. However, the irrigation activities are threatened by water insecurity as a result of the effects of drought, water loss and institutional factors (e.g. over-irrigation by some farmers, illegal water abstraction by others and the usual head-tail problems). The chapter further showed that farming is currently not an attractive economic activity for young people in South Africa.

Chapter 8 showed the importance of factors such as access to credit, land tenure security, market access, social networks and PsyCap to smallholder farmers' decision to expand their farming activities. It also showed that the smallholders' ability to achieve their aspirations is determined by their access to the markets, asset base and the motivation stemming from their current experience with conflicts regarding natural assets.

One of the key messages from the previous findings is that there is an inherent diversity and heterogeneity among smallholders which complicates the implementation of rural development interventions in the sector. This supports the tenet that 'one-size-fits-all' approach will not work when dealing with such farmers. The diversity and heterogeneity should be reflected in strategies and policies to support smallholder farming.

Cultivating on-farm entrepreneurship is the key driver identified at national level to have the potential to transform the small-scale agriculture sector in South Africa. Certainly, if identified challenges can be addressed, there are many farmers who can become more entrepreneurial in their approach to farming. However, it is clear that not all farmers can be supported and developed to transform this sector into emerging commercial farmers. Interest to expand farming activities is not enough; it has to be accompanied by ability and conducive institutional and policy framework. Those who have shown interest need to be supported by a resource base. This also has to be accompanied by a mindset change so that the smallholder farmers will believe in themselves and be able to withstand the pressures of being an entrepreneur in a constantly changing environment. Thus, development pathways are bound to be different for the different farmer typologies. The challenge for researchers and policy makers is finding the right balance, i.e. how far can we go to account for diversity and heterogeneity and how far can the policies be tailor-made or to what extent should interventions be specific to the different needs of farmers? Research on farmer typologies will give us directions on the way forward.

This chapter uses these findings and arguments to identify and recommend different development pathways for the respective typologies of farmers in and around the smallholder irrigation schemes. The rest of the chapter is organised as follows. The next section briefly presents and discusses the farmer typologies and the respective development domains for the study sites. Section 9.3 focuses on the potential priority areas for crop and livestock enterprises while Section 9.4 discusses the proposed development pathways for the different types of smallholders in and around the smallholder irrigation schemes. Section 9.5 elaborates the required policy/management changes while Section 9.6 establishes the role of rural

development role players in realizing the development pathways. The summary and recommendations from the chapter is given under section 9.7.

9.2 Farmer typologies and the respective development domains

In order to develop appropriate entrepreneurial development paths meant to establish sustainable businesses among smallholder farmers engaged in irrigation, it is imperative to develop and define the different typologies of farmers in the four irrigation schemes. As explained in the introduction, findings from the previous chapters have shown differences in smallholder farmers regarding their human, social, physical, financial, natural and PsyCap assets. Such differences confirm the heterogeneity among smallholder farmers and the need to align interventions and support to address specific challenges and needs of each group of farmers. The findings also demonstrate that it is possible to differentiate farmers based on their capital asset base and their entrepreneurial spirit. Chapter 8 showed the importance of PsyCap in determining farmers' aspirations to expand crop irrigation activities. A greater part of farmers' PsyCap can be determined by assessing their entrepreneurial spirit which shows their readiness to operate and manage their farm businesses and to develop into emerging entrepreneurs in the South African agricultural industry.

Closely related to the notion of typologies is the concept of development domains which recognises spatial differences in the implementation of development interventions. Hence, this section of the report is meant to establish the farmer typologies based on their asset base and entrepreneurial spirit and ascertain how these are related to different development domains.

9.2.1 Typologies based on the modified sustainable livelihoods framework

Understanding farmer heterogeneity and its implications on entrepreneurship is important for the success of the revitalization of smallholder irrigation in South Africa. Heterogeneity (in attitudes, objectives, decision-making or resources) affects a smallholder's entrepreneurial development process or their transition towards more commercial agricultural production (FAO, 2014). According to Chapoto *et al.* (2013), unpacking smallholder heterogeneity is critical in transition to commercial farming. Capturing smallholder heterogeneity assists in identifying and prioritizing strategies for improving market access for different types of smallholders (Torero, 2014). Indeed, for sustainable development, policy decisions in agriculture should account for spatial differences (Kruseman *et al.*, 2006; Torero, 2014) and farmer preferences (Wale and Yalew, 2007). Regarding technology development and agricultural extension for profitable farming, accounting for the dynamics of farmers'

heterogeneity will address the discrepancy between farmers' needs and the attributes of technologies developed and extended (Wale and Yalew, 2007). It can also improve the effectiveness of programmes by targeting policy interventions to regions or households with the greatest productive potential (Torero, 2014). To match farmers' needs with available support programmes, there is a need to understand their heterogeneity and the complexity of their farming systems. Ignoring farmer heterogeneity, whatever the source could be, has negative implications for the success of rural development policy and programmes.

Furthermore, despite the extensive literature on smallholder heterogeneity, there has been a limited attention on the implications of farmers' mindsets on farm/farmer typologies. This study contributes to this knowledge gap.

9.2.1.1 Developing and defining the farmer typologies based on the MSLF

Based on the MSLF which is elaborated in Chapter 3, several variables were identified for use in developing the farmer typologies. The MSLF places emphasis on the role of markets in shaping the lives of rural people. It identifies farmer entrepreneurship drivers as key in achieving effective farmer participation in high value food markets. These drivers are identified as livelihood assets and capabilities, livelihood strategies, policies and institutions and the vulnerability context within which a farmer operates. However, to gain better understanding of the different types of farmers in smallholder irrigation, focus should be on the endogenous factors that define the characteristics of each farmer. A total of 25 variables measuring the six livelihood assets in the MSLF were selected (see Table 9.1). Principal component analysis was employed to reduce the dimensionality of the variables which resulted in eight principal components or factors. Table 9.1 presents the results of this exercise.

Table 9.1. Factors used in developing farmer typologies based on the Modified Sustainable Livelihoods Framework

	Component							
	PC ₁	PC ₂	PC ₃	PC ₄	PC ₅	PC ₆	PC ₇	PC ₈
Gender of farmer or respondent	0.14	0.07	0.31	-0.01	-0.26	-0.05	0.59	0.19
Age of farmer	-0.08	0.09	0.02	-0.78	-0.02	0.03	-0.09	0.08
Level of education of farmer	0.10	0.01	0.01	0.83	-0.10	-0.03	0.05	0.09
Size of household	0.09	0.74	-0.04	0.11	0.04	-0.15	-0.13	-0.01
Income from remittance	-0.21	0.26	0.09	0.38	0.27	0.34	-0.20	-0.10
Income from temporary employment	-0.01	-0.05	-0.11	0.13	-0.17	0.11	0.18	0.58
Income from social support grants	0.03	0.56	-0.06	-0.18	-0.05	-0.39	-0.17	-0.03
Income from sale of crop produce (irrigation)	0.00	-0.06	0.70	-0.03	-0.15	0.00	0.02	-0.01
Income from livestock sales	-0.02	0.20	0.65	-0.04	0.08	-0.04	0.14	-0.01
Access to credit	0.11	-0.01	0.09	-0.16	-0.12	0.07	-0.67	0.24
Value of livestock assets (Rands)	-0.09	0.68	0.24	0.07	0.14	0.13	0.11	0.02
Value of physical assets (Rands)	0.02	-0.01	0.72	0.07	0.05	-0.05	-0.10	-0.02
Inadequate access to water	-0.09	0.03	-0.10	0.14	-0.23	0.11	0.04	0.57
Irrigable land size (ha)	0.23	-0.07	0.34	-0.02	-0.29	0.02	0.03	0.21
Dry land size (ha)	-0.07	0.62	-0.03	-0.18	-0.08	0.11	0.27	0.11
Membership to local producer group/ cooperative	0.04	-0.01	-0.06	-0.10	0.50	0.16	0.29	0.44
Membership to social groups	-0.02	-0.06	0.13	0.02	0.69	-0.20	0.01	0.01
Extension officers as a source of information	0.01	0.08	-0.16	-0.02	0.58	0.02	-0.08	-0.04
I am confident in myself as a farmer	0.75	-0.02	0.01	0.17	-0.07	-0.02	0.01	0.08
I am optimistic about the future of agriculture in my area	0.73	-0.11	0.06	0.14	-0.11	-0.09	-0.03	0.13
I am able to cope with shocks such as drought and other natural disasters	0.58	0.03	0.01	-0.10	0.27	0.19	0.15	-0.20
I enjoy new challenges and opportunities	0.72	0.09	0.00	-0.04	0.05	0.24	-0.09	-0.15
I would not be farming if I had an alternative source of income	0.11	-0.07	-0.08	-0.02	-0.07	0.75	-0.06	0.08
I am willing to take more risks than other farmers in my community	0.47	-0.02	-0.04	-0.13	-0.19	0.55	-0.02	-0.10
Variance	9.80	7.80	7.50	7.00	6.60	5.80	4.90	4.70

Notes: KMO = 0.64; Barlett Test of Sphericity = 0.00; Total variance explained = 54.2%

Source: Survey data, 2015 & 2016

PC₁ has positive loadings on most PsyCap indicators. It represents farmers with a positive PsyCap endowment. The farmers have high confidence in themselves, are optimistic, enjoy new challenges and opportunities and seem to have a greater ability to cope with vulnerability shocks. The principal component is thus named *ambitious and optimistic farmers*. PC₂ has positive loadings on size of household, livestock assets and income from social grant. The factor represents farmers with larger households that depend on social grants. The farmers are also more into livestock farming. This factor is thus named *social grant reliance and livestock*

farming. The third factor (PC₃) has positive loadings on income from the sale of irrigated crops and income from livestock. It represents farmer households that have diversified their livelihoods from just crop irrigation to mixed farming which includes livestock farming. The farmer households are also endowed with physical assets, allowing them a greater opportunity to diversify. The factor is thus named *mixed farming and physical assets endowment*.

PC₄ has a negative and positive loading on the age of the farmer and level of education, respectively. These are variables representing the human capital assets. This factor represents farmers who are *young and educated* and hence, it is named as such. The fifth factor (PC₅) has positive loadings on social capital indicators, i.e. membership to social groups and extension officers as sources of agricultural related information. This factor represents farmers with *access to information* and hence, it is named as such. PC₆ had positive loadings on two PsyCap indicators. The factor represents farmers who might not be involved in farming if they had an alternative and those farmers willing to take more risk than other farmers. Thus, the factor is named *risk taking and opportunistic¹⁰ farmers*. PC₇ represents most male farmers with limited access to credit. The factor has a negative loading on access to credit and a positive loading on gender of the farmer. It is thus named *limited access to credit*. The last principal component (PC₈) represents farmers with inadequate access to water for irrigation. As a result, they have diversified into off-farm employment, as a way of sustaining their livelihoods. The factor is thus named *water constrained and diversifying*.

The eight factors were subjected to a cluster analysis which resulted in six clusters of farmers in the four study sites. Figure 9.1 shows final cluster centres indicating the dominating factors in each of the clusters. The six clusters represent different farmer typologies among small-scale irrigators (Table 9.2).

¹⁰ This term is used here not in the sense of behavioural economics (opportunistic behaviour) but it is meant to characterize farmers who can take advantage of opportunities that arise.

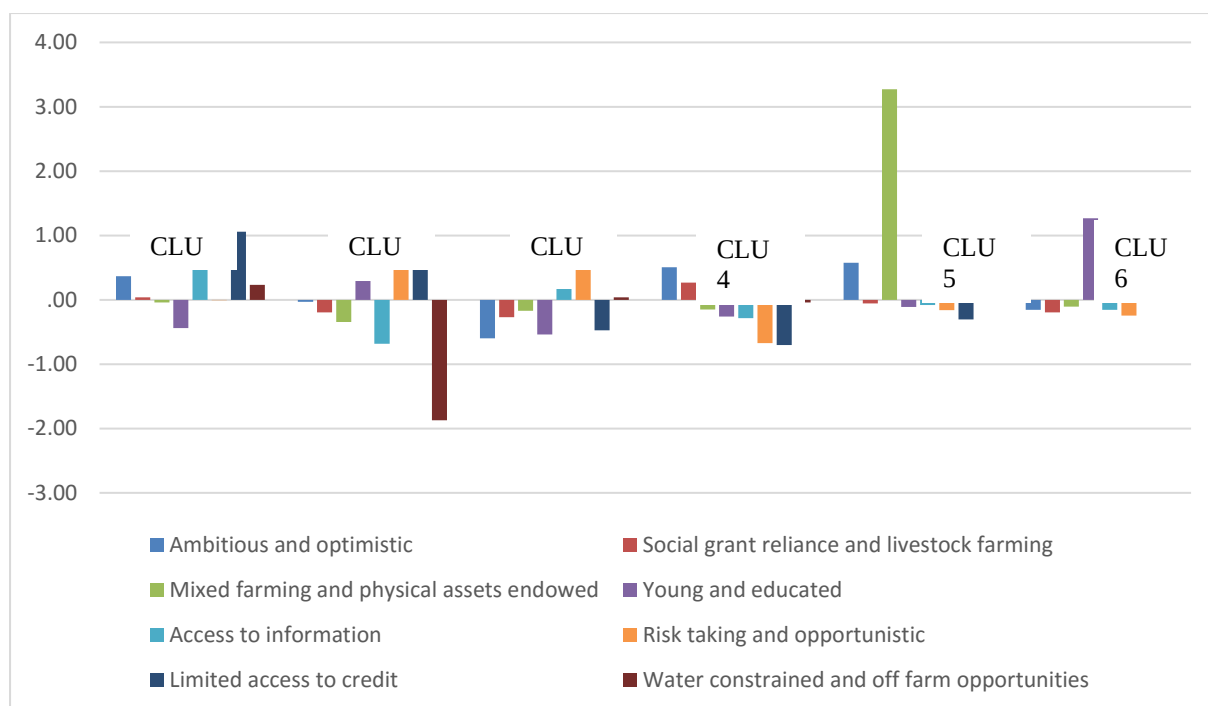


Figure 9.1. Final cluster centres for the variables included in the cluster analysis

Source: Survey data, 2015 & 2016

Table 9.2. Farmer typologies in and around the four irrigation schemes

Cluster	Farmer typology	Frequency	Percentage
Cluster 3	<i>Risk taking and opportunistic</i>	115	25.8
Cluster 4	<i>Ambitious, optimistic and social grant reliant</i>	108	24.2
Cluster 1	<i>Farmers with access to information but limited access to credit</i>	88	19.7
Cluster 6	<i>Young and educated</i>	88	19.7
Cluster 2	<i>Risk taking and opportunistic but limited access to credit</i>	33	7.4
Cluster 5	<i>Mixed farming and physical capital endowed</i>	14	3.1

Source: Survey data, 2015 & 2016

Cluster 3 (*Risk taking and opportunistic*)

The cluster constitutes 25.8% of sampled farmers. The farmers are elderly, mostly female and least educated when compared to farmers in other clusters. Unlike many studies in the risk literature, the results above suggest that these farmers are risk taking. Some aspects of their PsyCap are good, e.g. most have high confidence are willing to take more risk and are opportunistic, meaning they are prepared to take any opportunity in their way as long as it has

the potential to increase their income. However, the cluster has the second highest proportion of farmers who indicated that they are unable to cope with external shocks such as drought and other natural disasters. The major sources of livelihoods include social grants (60%), irrigation farming (22%) and remittances (13%). Remittances are probably from children or spouses working elsewhere. Access to credit is fair with 57.4% reporting to have accessed credit in the past 12 months before the survey. Livestock and physical assets are limited. Social capital is also fair with 60% being members of cooperatives, whilst 82.6% have access to extension officers. However, more than half of these farmers are not members of any other social groupings. Access to land and water is also a challenge.

Cluster 4 (*Ambitious, optimistic and social grant reliant*)

The farmers in this cluster constitute 24.2% of respondents in all the four study sites. The farmers have a positive PsyCap and can generally be described as ambitious and optimistic. Findings show that most of the farmers are committed to farming; they are not farming because there is nothing else to do. These farmers are mostly female, less educated and with relatively larger average household size compared to the other clusters. The dominant livelihood sources are social grants, contributing about 78% of the average total annual income for households in the cluster. Irrigation farming has only 18% share of the total average household income. Compared to other clusters, the group has the largest average income from social support grants with an annual income of approximately R31,000. This is expected given the large household sizes. Access to credit is higher among the farmers but social capital is limited. Livestock and physical assets are limited and farmers report that access to water is inadequate. Use rights of irrigated land is at an average of 1.23 ha, the second highest among all the clusters.

Cluster 1 (*Farmers with access to information but limited access to credit*)

The cluster constitutes approximately 19.7% of smallholder irrigation farmers in the study sites. The cluster has mostly male elderly farmers, with minimum education. Most are quite confident and optimistic in themselves and in the future of agriculture in their area, respectively. The group has the second highest percentage of farmers who are willing to take risks in farming, which is an inherent characteristic of entrepreneurs. Livelihood is dominated by social grants (67%) and irrigation farming (26%), contributing approximately 88% of average annual household income in the group. The group has the highest percentage of farmers involved in cooperatives, social groups and in constant contact with extension officers. Thus, access to information is supposed not to be a challenge to such farmers due to their

participation in different networking and information exchange platforms. Regarding physical capital, the group has the second highest average value of livestock assets but limited physical assets. The major constraints facing farmers in this cluster are lack of access to capital, inadequate access to irrigation water and limited physical assets.

Cluster 6 (*Young and educated*)

These are the young and educated farmers from larger families who constitute 19.7% of the studied farmers. The average age is about 37 years while average years of schooling is 10. They have a fairly positive PsyCap although about 28% and 34% indicate that they are unable to cope with external shocks and do not enjoy new challenges and opportunities, respectively. Livelihood sources are mainly social grants (50%), irrigation farming (32%) and remittances (12%). Access to credit is very limited while livestock and physical assets are low. Water seems to be a major challenge whilst land tenure security can be improved. Social capital (social networks and access to extension) is fair but it can still be improved, especially by increasing participation in social groups or cooperatives.

Cluster 2 (*Risk taking and opportunistic but limited access to credit*)

The cluster constitutes 7.4% of the study farmers. It has the highest proportion of farmers who are risk takers and second highest with regards to farmers who will not be farming if they had other alternative means of livelihoods. Such farmers often exert the minimum effort and they seek to engage in farming because it is the only available opportunity. They do not believe that farming is a lucrative business. The cluster has farmers who are relatively young compared to other groups but cluster 6. Though they have the second largest number of schooling years compared to other farmers, an average of 4.8 years of formal school show low levels of education. Their livelihoods are diversified and dominated by social grants (50%), temporary employment (27%) and irrigation farming (17%). Access to credit, physical assets and land is a challenge for this group of farmers. A significant proportion of these farmers also report water access challenges whilst social capital is limited.

Table 9.3. Characterisation of different farmer typologies

	<i>Risk taking and opportunistic (n=115)</i>	<i>Ambitious and optimistic; and social grant reliant (n=108)</i>	<i>Access to information but not credit (n=88)</i>	<i>Young and educated farmers (n=88)</i>	<i>Risk taking and opportunistic but limited credit (n=33)</i>	<i>Mixed farming and physical capital endowed (n=14)</i>	P-value
Human capital							
Farmer age	55.4	52.2	52.9	36.6	45.2	50.7	0.00
Gender (female)	92.2%	82.4%	36.4%	58.0%	75.8%	21.4%	0.00
Years of schooling	1.9	3.3	2.6	10.0	4.8	4.1	0.00
Household size	5.9	9.2	6.9	7.1	6.3	7.4	0.00
PsyCap							
I am confident in myself as a farmer	85.2%	97.2%	96.5%	97.8%	94%	100%	0.00
I am optimistic about the future of agriculture in my area	80%	97.2%	97.7%	93.2%	78.8%	100%	0.00
I am able to cope with shocks (drought, other natural disasters)	68.7%	74.1%	95.5%	61.4%	84.8%	71.5%	0.00
I enjoy new challenges and opportunities	71.3%	85.2%	92.0%	65.9%	90.9%	85.7%	0.00
I would not be farming if I had an alternative source of income	70.5%	25.9%	43.2%	40.9%	66.7%	50.0%	0.00
I am willing to take more risk than other farmers	66.1%	69.4%	70.4%	20.5%	78.8%	57.1%	0.00
Financial capital							
Income from remittance	2865	654	892	3315	1273	429	0.00
Income from temporary employment	115	61	268	82	7346	0	0.00
Income from social grant	13562	31002	16605	14042	13450	19071	0.00
Income from sale of irrigated crops	4909	7270	7019	8971	4608	37214	0.00
Income from sale of dryland crops	1039	315	1012	1414	409	643	0.59
Income from sale of livestock	40	423	877	220	15	5957	0.00
Access to credit	57.4%	63.0%	6.8%	25.0%	15.2%	71.4%	0.00
Physical capital							
Value of livestock assets (Rand)	26266	21408	53313	23151	23023	95983	0.00
Value of physical assets (Rand)	6571	7747	6850	8797	9893	122586	0.00
Natural assets							
Land owned (dryland) (ha)	0.19	0.32	0.97	0.10	0.26	0.34	0.00
Land owned (irrigated) (ha)	0.68	1.23	0.92	0.93	0.64	6.7	0.00
Inadequate access to water (Dummy)	76.5%	79.6%	88.6%	81.9%	75.7%	78.6%	0.07
Social capital							
Membership to a cooperative (Dummy)	60.0%	28.7%	86.4%	52.3%	27.3%	57.1%	0.00
Membership to a social group (Dummy)	47.8%	52.8%	81.8%	47.7%	36.4%	71.4%	0.00
Extension officers as a source of information (Dummy)	82.6%	69.4%	86.3%	70.5%	63.7%	71.5%	0.00

Cluster 5 (*Mixed farming and physical capital endowed*)

This cluster has 14 farmers constituting 3.1% of sampled farmers. This a cluster of more entrepreneurial irrigation farmers with a positive PsyCap. They are mostly male farmers, risk averse, less educated and coming from households with the second largest household size. The major livelihood sources for these farmers are crop irrigation (59%), social grants (30%) and livestock farming (9%). They are well endowed with both livestock and physical assets. The cluster has the highest proportion of farmers with access to credit. Irrigated land use rights are quite high at an average of 6.7 ha per farmer, compared to farmers in other clusters. Social capital is fairly high although approximately 43% are not members of any cooperative. Access to water is a major challenge, constraining agricultural production and productivity of these farmers.

9.2.1.2 The Modified Sustainable Livelihood Framework farmer typologies by study area and category of smallholder irrigation farming

Results in Table 9.4 show the different farmer typologies across the study areas. In Makhathini most farmers are classified as risk taking and opportunistic (33.2%), those with access to information but not credit (23.8%) and young and educated (20.6%). In Ndumo-B most small-scale irrigators are classified as those with access to information but not credit (28.4%), young and educated (21.6%), risk taking and opportunistic (16.7%) and ambitious, optimistic and social grant reliant (15.7%). In Bululwane most farmer are classified as ambitious, optimistic and social grant reliant (55%) whilst in Tugela Ferry and ambitious, optimistic and social grant reliant (38%) and risk taking and opportunistic (30%).

Buluwane has the largest proportion of ambitious, optimistic and social grant reliant farmers compared to other areas, whilst Ndumo-B has a bigger proportion of mixed farming and physical assets endowed farmers. Ndumo-B and Makhathini has fairly high percentages of young and educated farmers, while risk takers and opportunistic farmers are many in Makhathini and Tugela Ferry. The results are confirmed by findings from focus groups and observations of farmers in these areas. The results start to paint a picture of the kind of support that should be prioritized in each area.

Table 9.4. The Modified Sustainable Livelihood Framework farmer typologies per study area (% farmers)

	<i>Risk taking and opportunistic</i>	<i>Ambitious, optimistic and social grant reliant</i>	<i>Access to information but not credit</i>	<i>Young and educated farmers</i>	<i>Risk taking and opportunistic but limited credit</i>	<i>Mixed farming and physical capital endowed</i>
Makhathini (n=214)	33.2	15.0	23.8	20.6	7.0	0.5
Ndumo-B (n=102)	16.7	15.7	28.4	21.6	6.9	10.8
Bululwane (n=60)	10.0	55.0	8.3	15.0	11.7	0.0
Tugela Ferry (n=70)	30.0	38.6	4.3	18.6	5.7	2.9

Source: Survey data, 2015 & 2016

Similarly, comparison by category of smallholder irrigation farming show that most scheme irrigators are classified as ambitious, optimistic and social grant reliant, risk taking and opportunistic and young and educated.

Table 9.5. The Modified Sustainable Livelihood Framework farmer typologies per category of smallholder farmers (% farmers)

	<i>Risk taking and opportunistic</i>	<i>Ambitious, optimistic and social grant reliant</i>	<i>Access to information but not credit</i>	<i>Young and educated farmers</i>	<i>Risk taking and opportunistic but limited credit</i>	<i>Mixed farming and physical capital endowed</i>
Scheme irrigators (n=194)	21.6	33.0	13.4	20.6	5.7	5.7
Independent irrigators (n=70)	14.3	20.0	27.1	25.7	8.6	4.3
Homestead food gardeners (n=78)	38.5	16.7	15.4	16.7	12.8	0.0
Community food gardeners (n=54)	37.0	14.8	24.1	22.2	1.9	0.0
Non-irrigators (n=50)	26.0	18.0	36.0	10.0	10.0	0.0

Source: Survey data, 2015 & 2016

A different trend is shown among independent irrigators with over 50% falling within two categories of farmers without access to information and those that are young and educated. Such is expected of independent irrigators as most are not members of cooperatives and are not found in the same place and hence contact with extension services is limited. A diversity in

terms of farmer typologies can be seen among homestead food gardeners; significant percentage of homestead food gardeners are found across the different farmer typologies except the 'Mixed farming' group. However, most are classified as risk taking and opportunistic. A similar trend is also found with community food gardeners. None of the homestead and community food gardeners are classified as physical assets endowed mixed farmers.

The results are evident of the heterogeneity and complexity of rural development programming for smallholders. Even within one category of farmers the diversity is huge, posing a challenge to policy makers and development practitioners.

9.2.2 Farmers' entrepreneurial spirit typologies

If farmers are to become more entrepreneurial, they have to develop certain skills and functional capabilities that enable them to be more competitive (McElwee, 2006). As noted in Section 6.5, the concept of entrepreneurship as currently defined mindset cannot be applied to the case of smallholder farmers under investigation. For such farmers, entrepreneurship on the farm is the mindset and determination to combine available resources and strive to make a living from small-scale farming. It is about doing what you can do with what you have, instead of expecting government or other role players to address prevailing constraints. This understanding is more inclined to behavioural thinking (see Section 2.5). Constraints are always there; they only vary from farmer to farmer. Although farm entrepreneurship also largely depends on the external environment, the entrepreneurship spirit of an individual farmer (from within) is a key driver of farm entrepreneurship. As discussed in Chapter 8, entrepreneurship spirit is far much more than the human and social capital. It is embedded in their PsyCap endowment which is driven by their aspirations, hope, optimism, resilience and confidence, among others.

Farm entrepreneurship has three key dimensions, i.e. risk-taking, growth orientation and innovativeness. According to Vesala and Peura (2003), an entrepreneur should be able to engage in active, dynamic and competitive pursuit of economic growth. However, smallholder farmers are less able and less willing to take risk and experiment, owing to their location disadvantages, poor resource endowment, lack of access to information and institutional factors. Recent studies (McElwee, 2006; McElwee and Bosworth, 2010; Phelan and Sharpley, 2012; McElwee and Smith, 2012) have shown the importance of farmers' entrepreneurial skills and capabilities in farm entrepreneurship development. This section of the report provides an assessment of farmer typologies based on their entrepreneurship spirit. Using an approach

adapted from Phelan and Sharpley (2012), a set of questions were formulated to capture the entrepreneurial spirit and PsyCap of smallholder irrigation farmers in the study areas. Some of the questions have also been adapted from another WRC project (Jordaan and Grove, 2012). The criteria for developing the entrepreneurial questions is informed by the work of Chell (2008) in Phelan and Sharpley (2012) and covers attributes listed in Table 9.6.

Table 9.6. Criteria used to develop questions to assess farmer entrepreneurial spirit

Creativity	Resourcefulness	Risk propensity
Alertness	Persuasiveness	Social competence
Perception and interpretation	Self-efficacy	Adeptness Resilience
Business acumen	Self-confidence	Flexible
Social/market awareness	Leadership	Strategic competence
	Judgment	

Source: Chell (2008) in Phelan and Sharpley (2012)

Using PCA, a total of seven factors were extracted from a total of 20 variables. The results are presented in Table 9.7 below.

PC₁ represents farmers who are keen to take advantage of new farm business opportunities, persistent, emotionally stable and who believe in business planning. However, the same farmers are also risk averse and they are afraid of failure. Thus, the factor is named '*partially entrepreneurial*'. PC₂ has positive and negative loadings on how farmers deal with problems and information seeking behaviour, respectively. The factor represents farmers who are reactive in their response to problems, i.e. they deal with problems as they arise. They also have a negative information seeking behaviour. The factor is thus named *reactive and uninformed*.

The third factor (PC₃) represents farmers who take responsibility for solving their problems, able to manage themselves and cooperative. The factor is named *responsible and team player*. PC₄ represents farmers who view their farm as a profit-making entity and know how to manage their resource inventory. The principal component is named *business acumen*. PC₅ has positive loadings on passionate for farm business and ability to inspire and energize others. The factor is thus named *passionate and influential*. PC₆ presents farmers who are competitive, market-oriented and who believe in business planning. They are more entrepreneurial than PC₁.

Table 9.7. Factors used in developing farmer typologies based on entrepreneurial spirit

	Components						
	PC1	PC2	PC3	PC4	PC5	PC6	PC7
I produce mainly for household consumption	0.33	0.27	0.06	-0.14	-0.04	-0.50	0.14
I view my farm as a profit-making business	0.07	0.07	0.13	0.79	-0.04	0.21	0.00
I know what and when resources and materials are needed and where to get them	0.12	0.20	0.05	0.75	0.13	-0.05	0.07
I am passionate about my farm business	0.02	0.07	-0.01	0.09	0.87	0.10	0.02
I seek information that will help with tasks that I am working on	-0.08	-0.95	-0.13	-0.15	-0.06	-0.02	-0.02
I deal with problems as they arise rather than spend time to anticipate them	0.09	0.94	0.16	0.17	0.07	0.03	0.01
I work long and irregular hours to meet demands	0.15	0.07	0.00	0.24	0.00	-0.03	0.58
I have the ability to inspire and energize others	0.13	0.04	0.07	-0.02	0.87	-0.07	0.00
I am able to manage myself and my time	0.14	-0.01	0.75	0.09	-0.01	-0.06	0.13
I always take responsibility for solving problems that I face	0.15	0.16	0.76	0.01	-0.02	0.05	-0.01
I am willing to cooperate with others and network	0.13	0.10	0.71	0.08	0.10	0.07	-0.06
I possess persuasive communication and negotiation skills	0.28	0.24	0.35	0.35	-0.04	0.23	-0.01
I am very competitive in nature	0.15	0.16	0.10	0.15	-0.01	0.74	0.06
I welcome failures from which I am able to learn	0.25	0.07	-0.04	0.25	-0.02	-0.09	-0.63
I am willing to try new ideas even without full knowledge about the possible outcome	0.45	0.16	0.03	0.23	0.00	-0.19	0.33
I weigh my chances of succeeding or failing before I decide to do something	0.54	0.26	0.29	0.21	0.07	0.11	-0.18
If one problem is persistent, I try alternative approaches to address it	0.57	0.22	0.30	0.09	0.03	0.13	-0.23
I am keen to take advantage of new farm business opportunities	0.74	0.01	0.11	0.11	0.10	0.13	0.14
I think having a business plan is important for my farming operations	0.58	0.04	0.03	-0.21	0.06	0.50	0.12
I am able to emotionally cope when faced with a problem	0.64	-0.05	0.18	0.08	0.04	-0.16	-0.09
% Variance	12.57	10.89	10.34	8.58	7.85	6.50	5.09

Note: KMO = 0.76; Barlett's test of sphericity = 0.00; Total variance explained = 62%

Source: Survey data, 2015 & 2016

Using K-means cluster analysis, the results show that farmers could be grouped into two clusters regarding their entrepreneurial spirit. The two clusters show farmers who have a high and low entrepreneurial spirit. Figure 9.2 below show the final cluster centres for the retained clusters.

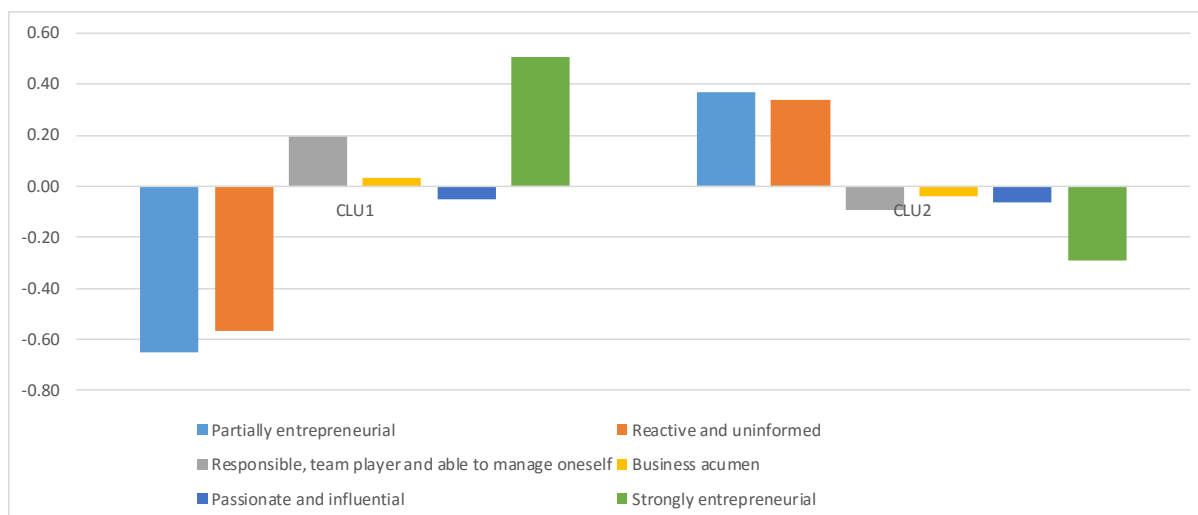


Figure 9.2. Entrepreneurial spirit: final cluster centre results

Source: Survey data, 2015 & 2016

Cluster 1 (High entrepreneurial spirit)

This cluster constitutes 38% of the sampled farmers and they are more entrepreneurial. They exhibit high entrepreneurial spirit. Three types of farmers dominate the cluster, i.e.

- Competitive, market-oriented and farmers who think that business planning is important in farm business management
- Responsible, able to manage one-self and cooperative
- Business acumen

All these are characteristics of an entrepreneur.

Cluster 2 (Low entrepreneurial spirit)

Cluster 2, which contains farmers that can be called doubting entrepreneurs (Lauwere *et al.*, 2002) constitute approximately 62% of the sampled smallholder irrigation farmers. The group has some farmers who are risk averse, reactive in the way they deal with problems and have a negative attitude towards information seeking. The farmers are also afraid of failure and do not view failure as a learning curve. These characteristics make them have low entrepreneurial spirit.

Comparisons between the different categories of farmers show that most smallholder irrigation farmers have low entrepreneurship spirit. Community food gardeners, followed by homestead food gardeners have the highest percentage of farmers with low entrepreneurship spirit. Although less than 50%, scheme irrigators fair better compared to other types of small-scale

irrigators. The results also show that non-irrigators have the highest proportion of farmers with a high entrepreneurship spirit. Comparison by area of study show that Tugela Ferry has the highest proportion of farmers with a high entrepreneurship spirit. Bululwane is worse-off compared to other areas with 73.3% of farmers having a low entrepreneurship spirit.

Table 9.8. Entrepreneurship spirit by category of smallholder farmers and area of study

	High entrepreneurial spirit (%)	Low entrepreneurial spirit (%)
Scheme irrigator	42.1	57.9
Independent irrigator	31.9	68.1
Homestead food gardeners	30.7	69.3
Community food gardeners	21.4	78.6
Non-irrigators	55.8	44.2
Makhathini	33.5	66.5
Ndumo-B	34.3	65.7
Bululwane	26.7	73.3
Tugela Ferry	64.3	35.7
Total	37.6	62.4

Note: The results show that the estimates are significantly different (at $p < 0.01$) in all cases.

Source: Survey data, 2015 & 2016

Farmers are heterogeneous in terms of their entrepreneurial skills and capabilities. These should be considered when designing support meant to grow smallholder irrigation into commercially oriented farming. Findings show the areas that should be addressed to enhance the entrepreneurship capabilities of smallholder farmers and help them built a character that is psychologically ready to participate in a dynamic and competitive economic environment.

All these findings show the importance of boosting PsyCap in the transformation of smallholder irrigation farming in South Africa. This supports the discussion and lessons in Section 6.5 and 6.6 and shows the need for future research and development interventions to view smallholders in the context of the adjusted and more relevant definition of entrepreneurship.

9.2.3 Typologies and the respective development domains

Development domains is a concept that recognises that rural development interventions cannot be applied as blanket solutions, but they need to consider differences between areas in agricultural potential, access to markets and labour endowment (Chamberlin, *et al.*, 2006; Pender *et al.*, 1999; Wood *et al.*, 1999; Pender, 2004; Pender *et al.*, 2004; 2006). The argument

is that rural development can be represented by assessing key factors which describe a given area's agricultural development capacity (Chamberlin, *et al.*, 2006). Based on the empirical findings above, we wish to further argue that the definition of development domains, which so far has been a spatial concept focusing on geographical location, has to account for farmers' PsyCap endowment and entrepreneurial spirit.

The concept of development domains emanates from efforts by researchers to deal with heterogeneity of small-scale farming households and communities. In South Africa, most policy decisions are made at the national, provincial and local municipality levels and the challenge is how to target rural development interventions given the vast diversity of development attributes of the different areas. The approach is similar to the argument behind defining farmer typology, the only difference being that it is broader. Chamberlin *et al.* (2006) emphasize that the comparative advantages of different communities are important in designing development interventions. In general, one would start by considering the development domains and zoom in to focus more precisely at the farmer typologies within the different domains. Thus, having found different farmer typologies, applying the notion of development domains makes it practically possible to design intervention across geographical space. This section of the report discusses development domains as they relate to the target communities and how this links with farmer typologies formulated above.

The first question is 'what are the key fundamentals that guide South African rural development planning?' These fundamentals represent conditions that affect rural development policy and planning in the country. The Agriculture Production Strategy (2011-2025) emphasizes key principles for the development of the agriculture sector in South Africa. The strategy emphasizes the need to stimulate spatial economic planning and market development aimed at creating space for smallholder farmers to grow their businesses. The Comprehensive Rural Development Programme (2011-2014) focused on several issues including land reform, infrastructure development in rural areas including recapitalization of irrigation schemes, enterprise development and creation of vibrant rural markets and credit facilities. Most policies meant for the development of rural areas in South Africa recognise the need to address issues of land tenure security and to develop skills meant to work the land.

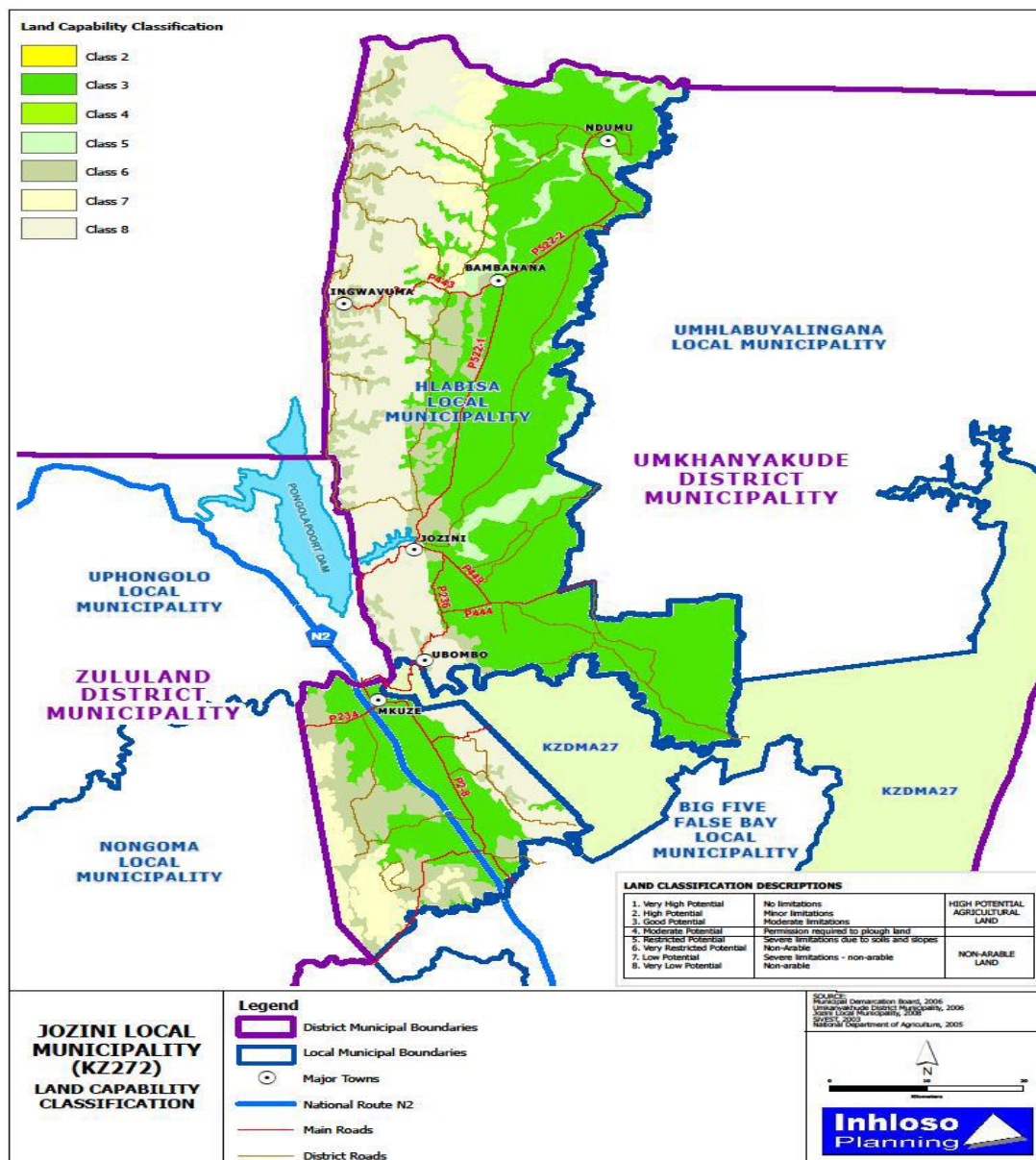
9.2.3.1 Jozini Local Municipality (Makhathini and Ndumo-B)

Agriculture potential

Agriculture is among the most dominant economic activities within Jozini Municipality. As noted in Chapter 4, the Pongola flood plain which runs on both sides of the Pongola river, also known as Makhathini Flats, has land with some of the highest agricultural potential in the KwaZulu-Natal province (Jozini Local Municipality, 2015). It has some of the best soils compared to the surrounding infertile grey aeolian sands found further away from the plain (KZN PDAAEA, 2006). It is within this belt that the major irrigation schemes, Makhathini and Ndumo, are located.

As noted in Chapter 2, the climate of Jozini is humid subtropical with a mean average rainfall of 600 mm per annum (Jozini Local Municipality, 2013). The high temperatures result in high ET which makes the heat the biggest climatic constraint to agricultural production, especially rainfed agriculture. However, there is a lot of potential for irrigated agriculture, especially along the floodplain, supported by the Pongolapoort or Jozini dam. According to KZN PDAAEA (2006), the dam can support more irrigation activities, i.e. there is potential to expand irrigation on the Makhathini flats by a further 6,000 ha. Currently, planning is underway for the development of a new 2,000 ha Gedleza Irrigation Scheme. In addition to scheme irrigation, the dam is also supporting more than 70,000 individual smallholder farmers (independent irrigators) that also derive their livelihoods from the floodplain.

The rest of the municipality has limited capacity for irrigation due to unavailability of water and poor soils. Ground water is an option although its extraction is not highly recommended given the effects on the greater environment (KZN PDAAEA, 2006). Dryland farming favours crops such as cotton which are more drought resistant compared to maize and groundnuts.



LAND CLASSIFICATION DESCRIPTIONS		
1. Very high potential	No limitations	HIGH POTENTIAL AGRICULTURAL LAND
2. High potential	Minor limitations	
3. Good potential	Moderate limitations	
4. Moderate potential	Permission required to plough land	NON-ARABLE LAND
5. Restricted potential	Severe limitations due to soils and slopes	
6. Very restricted potential	Non-arable	
7. Low potential	Severe limitations - non-arable	
8. Very low potential	Non-arable	

Source: Jozini Local Municipality (2015)

Figure 9.3. Jozini land capability classification

The land capability of the area depends on the availability of water and the richness of the soils. During interviews with stakeholders in the municipality, it was revealed that land for expansion of irrigation activities is available but water scarcity is the challenge. As indicated in Chapter 5, land is managed by tribal authorities and can be used on a ‘PTO’ basis. Potential agricultural land is highly valued in the municipality such that the Jozini Integrated Development Plan 2013-2014 indicates the need to protect such land (Jozini Local Municipality, 2013).

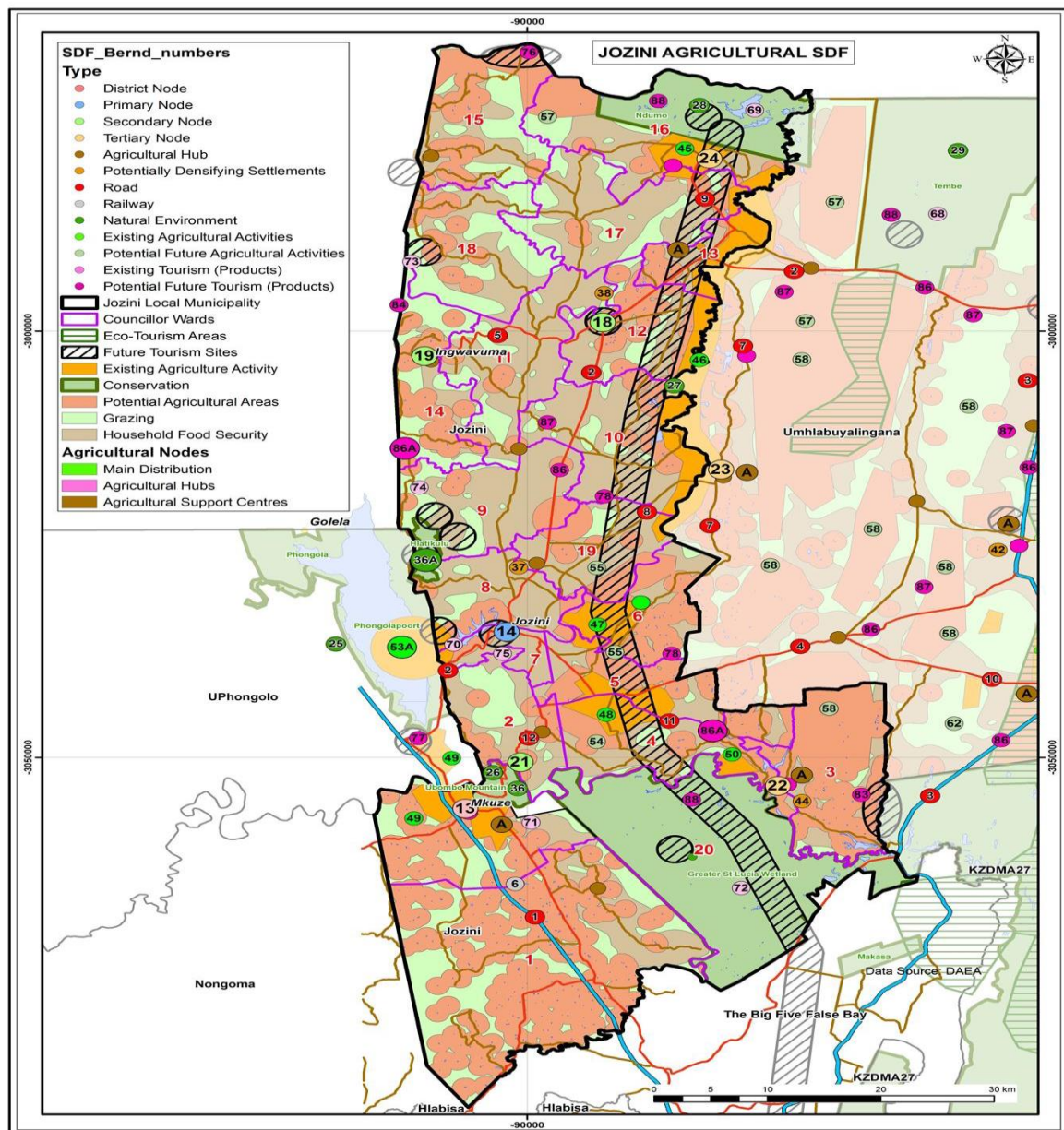


Figure 9.4. Jozini Agricultural Spatial Development Framework

Source: Jozini Local Municipality (2015)

Access to markets

Jozini is linked to the N2 by a paved road that also goes to Bhambanana and Ndumo. The tarred main roads are well maintained while secondary roads provide an extensive coverage of the area (KZN PDAAEA, 2006). The 2015-2016 Jozini Integrated Development Plan states that most of the secondary roads are gravel and are in a deteriorating condition and need maintenance (Jozini Local Municipality, 2015). The Department of Transport classified most rural roads in the municipality as dirt roads, those that were merely formed through blading. In wet conditions it is difficult to navigate in some parts of the municipality. This has resulted in poor transportation linkages and hence poor mobility (Jozini Local Municipality, 2015). However, the Makhathini and Ndumo-B irrigation schemes are along the main primary roads and can be fairly accessed up to a point by the paved road.

As noted earlier in Chapter 7, the major challenges with access to high value fresh produce markets are high transport cost, limited access to market information, low volumes of production, low quality of produce and in some cases lack of commitment from some farmers to adhere to an agreed marketing strategy. Since 2008 the integrated development plans for Jozini Municipality have emphasized the need to provide market for fresh produce. The plans concentrate on localized market access through provision or building of market stalls in identified locations. This is not to say farmers have no ambition to sell their produce in Durban and Johannesburg markets, but access to these markets is always a challenge. The nearest urban centres are Jozini and Pongola towns. Jozini town is located near Makhathini irrigation scheme while it is approximately 79 km from Ndumo-B irrigation scheme. Some communities in the municipality are at least 60 km away from the town using a gravel road such that accessing the markets in the town is a challenge. The town is quite small such that farmers sometimes travel up to 74 km to Pongola town to buy inputs.

The Makhathini Master Plan recognises that there are no formal markets available locally in the municipality or even district. Small-scale producers rely on selling their produce to local people, vendors, local shops and hawkers who come as far as from Durban and Johannesburg. However, the local demand/market is not enough to absorb the horticultural produce from small-scale irrigators in and around the irrigation schemes in the municipality. As reported earlier, in most cases farmers sell their produce at a reduced price and are charged transport cost by hawkers. Given that most farmers are producing horticultural crops that are highly perishable, they sometimes risk making huge losses by holding on to their crop. Cotton and sugarcane farmers are better organised through Makhathini Cotton and the South African Cane

Growers Association. However, transport costs are still high with sugarcane farmers paying as much as R5,000 per truck load, to transport their sugarcane to the milling company.

Population density

Statistics from the latest census data show that Jozini Municipality is the most populated municipality in uMkhanyakude District (Statistics SA, 2012a). It has a high population density of 54.2 people per square kilometre. High population density can have positive effects through stimulating the adoption of high labour-intensive crops, use of labour intensive land management practices and development of local markets, investment in infrastructure, technologies and institutions (Chamberlin *et al.*, 2006). Consequently, high population density can have negative environmental effects due to increased pressure on resources such as land, grazing areas and water.

Census data also show that most of the population in the municipality is between the ages of 15-64, which is the productive age group (Statistics SA, 2012b). This does not, however, mean that this resource is productively employed. General unemployment rate in the municipality stands at 44.1% and youth unemployment at 52.7% (Statistics SA, 2012a), which is higher than the national average of 39.7% (Stats SA, 2012). Thus, the municipality has the potential to grow because the cost of unskilled labour is likely to be cheaper. However, there is also pressure for employment creation for which the agricultural sector has the potential to absorb this labour force.

9.2.3.2 KwaNongoma Local Municipality (Bululwane)

Agriculture potential

Agriculture is considered the main economic sector in Nongoma Local Municipality. This sector comprises mainly subsistence farming by smallholder farmers (Nongoma Local Municipality, 2015). There is very little commercial farming. Less than a 5th of the land is considered high potential agriculture land with most farming activities happening on poor marginal lands that have limited access to water. The majority of the land which is rural is controlled by the Traditional Council (Nongoma Local Municipality, 2015) which retains overall powers on the land on behalf of the Ingonyama Trust Lands. Since 2007, land tenure in the municipality has moved from 'PTO' to lease agreements provided by Ingonyama Trust Lands (Centre for Law and Society, 2015). Inside the Bululwane Irrigation Scheme land is held on a 'PTO' basis. The current land tenure system has, however, resulted in many challenges

due to lack of land security, lack of guidelines to land allocation and competing uses between agriculture and residential, among others (Nongoma Local Municipality, 2015).

Figure 9.5 below shows the land capability in the municipality. Areas with highest potential are in the southern parts and a small band to the north of Nongoma town where Bululwane Irrigation Scheme is located. The terrain in the municipality is mostly dominated by deeply incised river valleys, ridges and steep land, making it difficult for any agricultural activities. More even plains are situated in the northern parts of the municipality. Rainfall around BIS is between 750-850 mm per annum and the climate is severe with high heat and moisture stress affecting choice of crops (Golder Associates Africa, 2015). The average temperature in the municipality is 19.5°C.

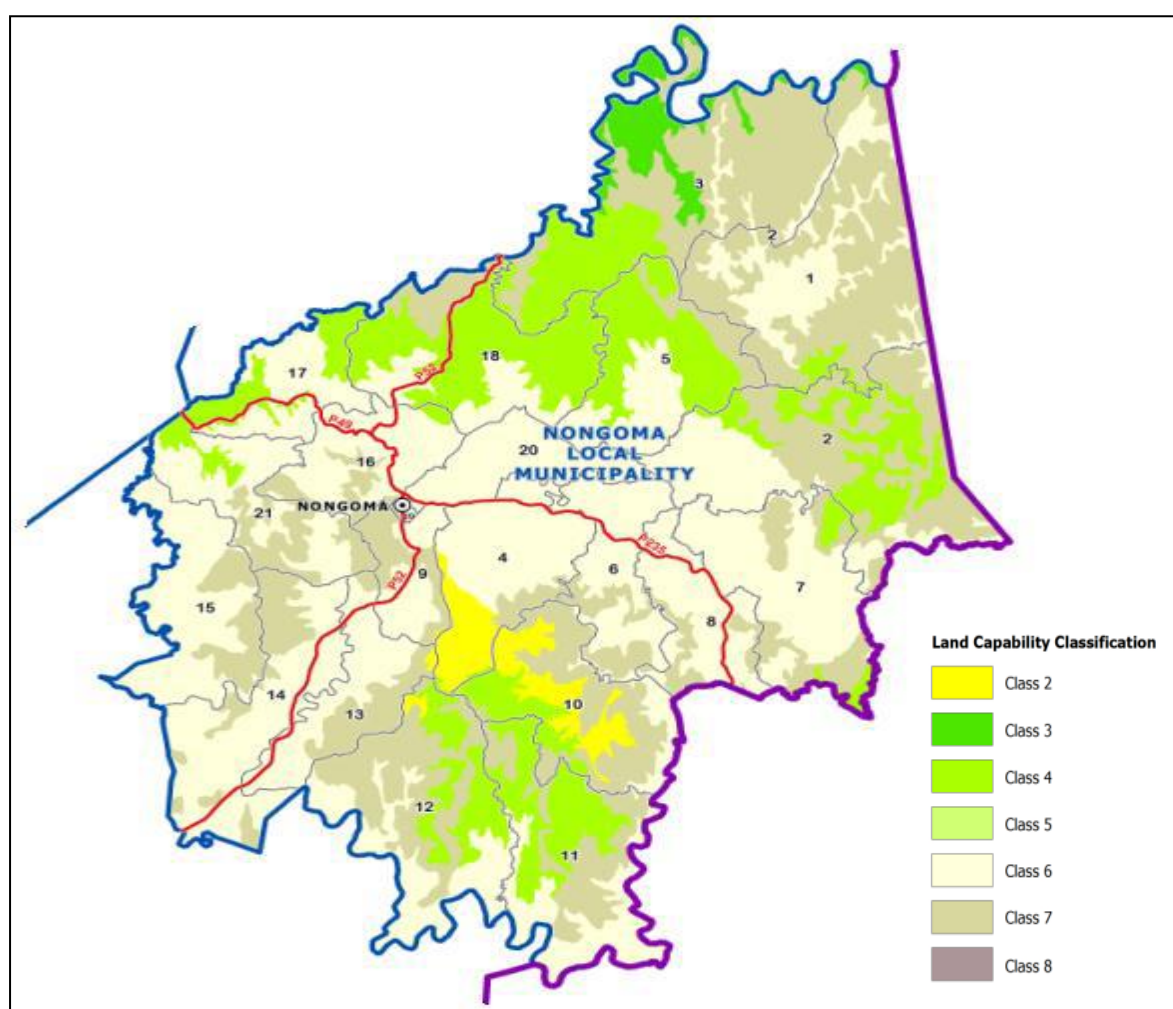


Figure 9.5. Nongoma land capability

Source: Nongoma Local Municipality (2015)

Access to markets

Nongoma is linked to other municipalities, i.e. Ulundi, Abaqulusi, uPhongolo and uMkhanyakhude district, through a network of roads. However, the road network that links the municipality with other towns or municipalities is described as poor. Roads in the municipality are described as poor which make some rural communities difficult to access. Nongoma town provides the nearest market for farm produce in the municipality. Other markets can be found in Ulundi (56 km from Nongoma), Richards Bay (187 km) and Durban (approximately 300 km).

As noted in Chapter 7, access to markets for farm produce is described as poor to non-existent. Smallholder farmers face challenges in terms of transport to carry their produce to Nongoma town. In their local communities there is no market for their produce. Nongoma IDP 2012-2013 identified lack of appropriate marketing support and the inability to market produce locally as major challenges. However, most of the agriculture activities are more subsistence and hence not market-oriented. Those producing for the market (such as Bululwane Irrigation Scheme farmers) face several challenges. Bululwane Irrigation Scheme is approximately an hour's drive to Nongoma on a paved road. Due to lack of transport farmers sell mostly to hawkers who come and buy from the fields at relatively low prices.

A recent market survey (2013/2014) revealed the following key issues regarding marketing of farm produce in the municipality:

- Market is only restricted to Nongoma town yet there are potential markets in Empangeni, Ulundi, Melmoth and Vryheid,
- Retailers demanding consistency, packaging and produce of better standard or quality,
- Lack of market information and skills among smallholder farmers,
- No transport for coordinated marketing and
- Lack of group action in marketing of produce.

Population density

Nongoma is the most populated municipality in Zululand District with an average population density of 87.7 people per square kilometre. Unemployment is officially pegged at 49.3% and youth unemployment (15-34 years) is 59.9%.

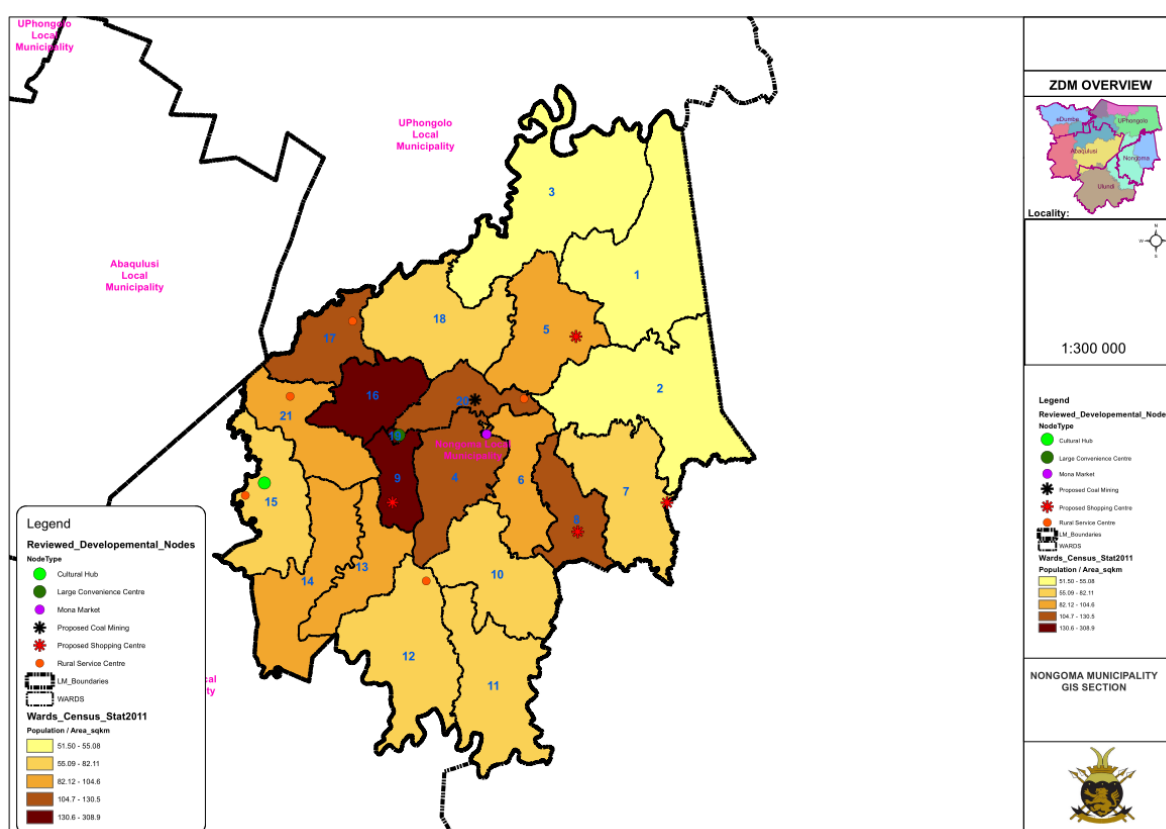


Figure 9.6. Nongoma population density by ward

Source: Nongoma Local Municipality (2015)

9.2.3.3 Msinga Local Municipality (Tugela Ferry)

Agriculture potential

Agricultural development and agri-processing are identified among the key drivers of economic growth in Msinga Local Municipality. Agriculture employs approximately 12.5% of the total labour force in the municipality. Most of this is subsistence farming with a few irrigation and/or commercial farming along the main water sources such as Tugela and Buffalo rivers and the area around Helpmekaar north of Pomeroy. Poor soils and adverse climatic conditions such as floods and high temperatures, mostly areas around Tugela Ferry, affect agricultural potential of the land. High temperatures of approximately 19°C increases ET. The average rainfall ranges mostly between 600 and 1000 mm per annum. Irrigation farming is an important option for transforming subsistence agriculture into commercially orientated farming.

Land capabilities in the municipality ranges between classes II and VIII with most of the land categorized as class VIII with no potential for sustainable agriculture production. Class VIII

areas are characterised by low soil fertility and steep slopes which affect agriculture potential in such areas. Areas in the northern part of the municipalities and areas along the main rivers are mostly classified as Class III, with a higher agriculture potential (Figure 9.7). The potential for scaling up agriculture depends on the availability of rainfall, good soils and good management. It is reported that even irrigation around Tugela and Mooi rivers is still threatened by water shortage, erratic rainfall patterns and limited land carrying capacity.

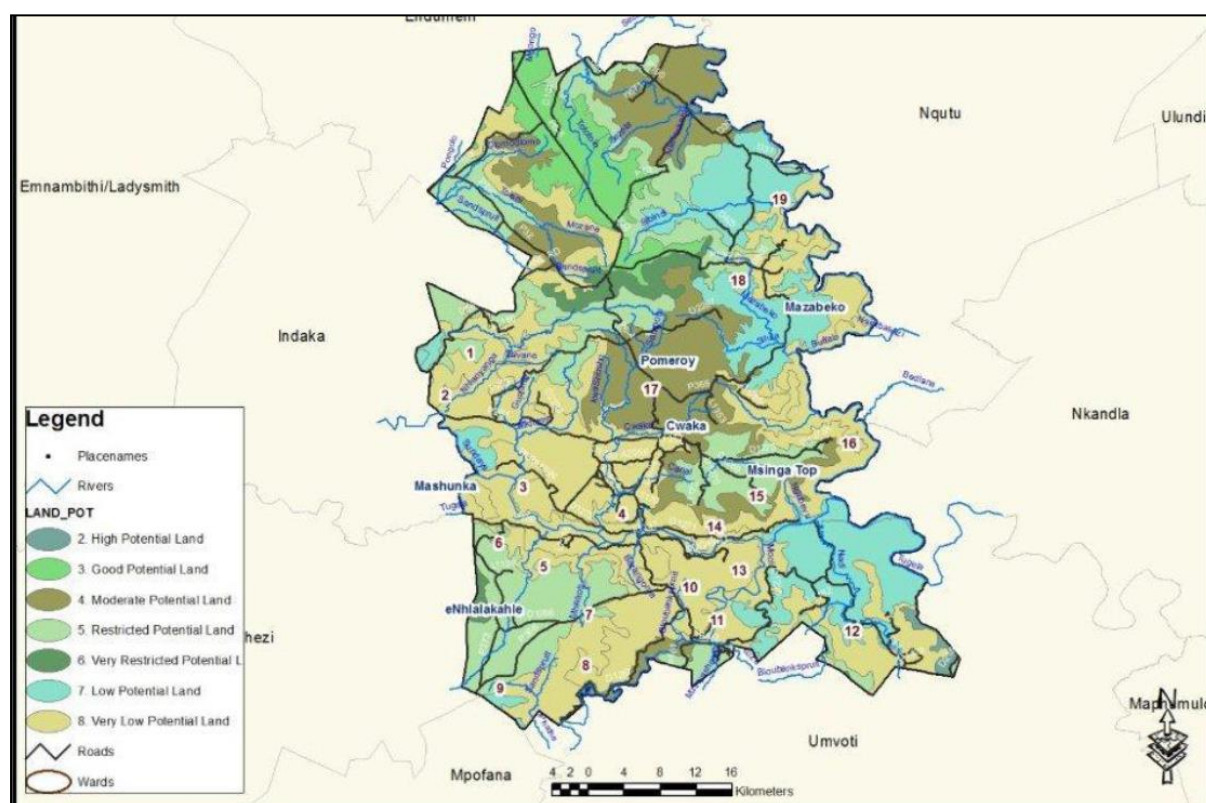


Figure 9.7. Map showing agricultural potential in Msinga Local Municipality

Source: Msinga Local Municipality (2014)

The municipality is largely rural, with approximately 69% land controlled by Traditional Authorities and held in trust by Ingonyama Trust (Msinga Local Municipality, 2014). Msinga Local Municipality is located in the deep gorges of the Tugela and Buffalo rivers. It is reported that negotiating and changing the current tenure of the land controlled by Ingonyama Trust Lands for investment and further development is quite difficult (Msinga Local Municipality, 2014).

Access to markets

Market access for agricultural produce is a priority area for development in Msinga. Planned interventions in 2014-2015 period included increasing commercial oriented agriculture and

improving homestead food gardening production practices in the rural areas. The R-33 is the primary development corridor linking the main economic areas in the municipality and with other towns such as Greytown and Dundee. Thus, this road is of primary importance for marketing of agricultural produce in and outside of the municipality (see Figure 9.8 below). However, the Msinga Local Municipality (2014) reports that the road is poorly maintained in some sections. The gravel roads in the municipality are also reported to be in poor condition.

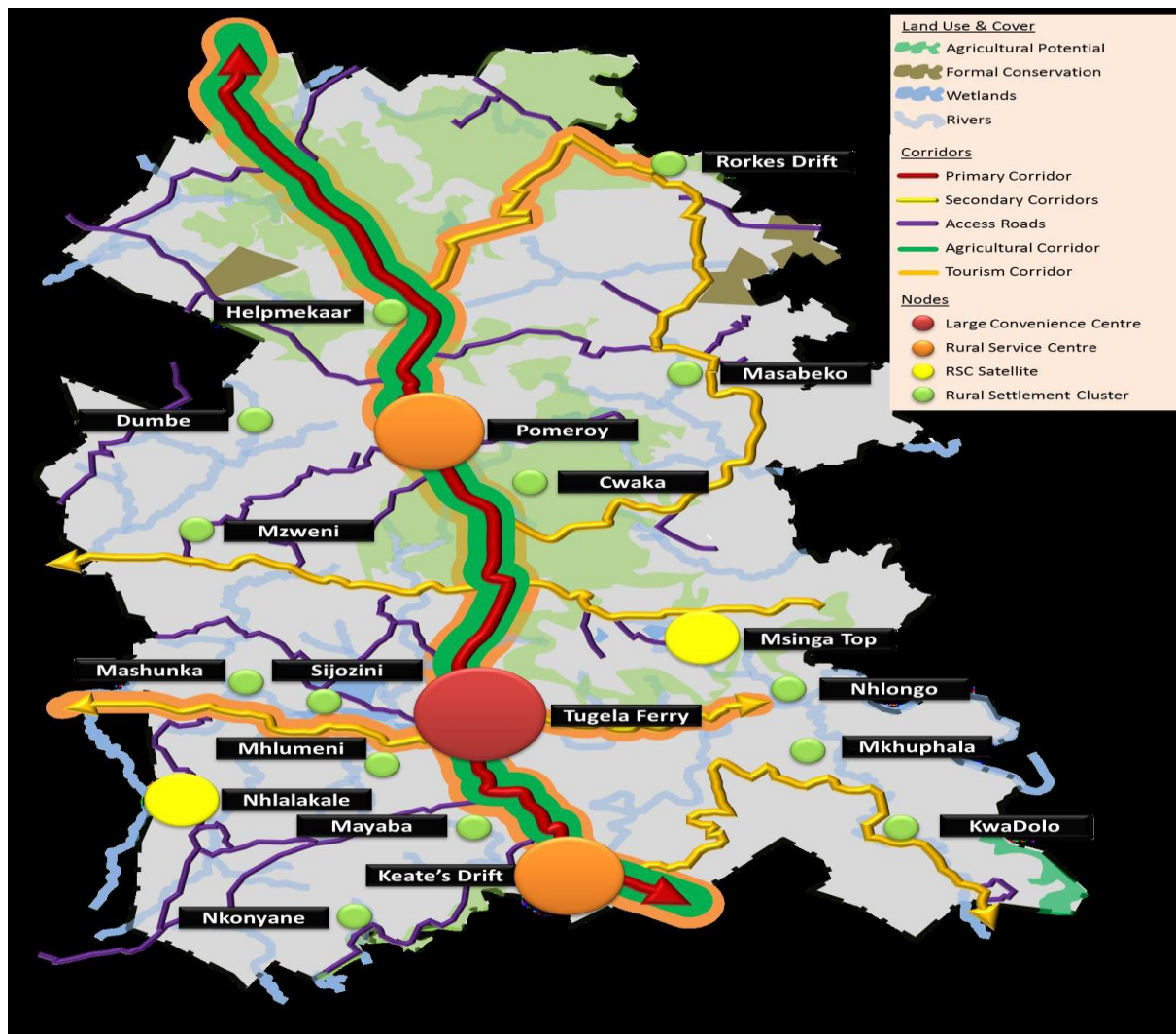


Figure 9.8. Msinga spatial development framework

Source: Msinga Local Municipality (2014)

The R-33 also represents a potential agricultural corridor in the province and the municipality. That is why the KwaZulu-Natal provincial government earmarked this corridor for establishment and expansion of agro-processing facilities (Msinga Local Municipality, 2014). Agro-processing opportunities exist for Chakalaka and other vegetables including tomatoes.

Such a development will increase market access by smallholder farmers in the municipality and even increase income due to reduced transaction costs.

Population density

Msinga has a total population of 177,577 and covers an area of 2,500 km² resulting in an average population density of 71 people per square kilometre. However, the population density is scattered all over the municipality with high densities along the R-33 highway and in settlement areas such as Tugela and Pomeroy, among others. Unemployment rate is 49.5% whilst youth unemployment is 58.2%.

9.2.3.4 How do the development domains link with farmer typologies?

The different typologies of smallholder farmers exist within the above defined development domains for each target community. Interventions to support each type of farmer will be suggested within the context and the development potential of the communities where farmers live. For example, most farmers in Tugela Ferry are defined within two clusters of farmers who are highly entrepreneurial but are greatly limited by adverse climatic conditions, adequacy of water and land and limited physical assets. According to the development domains of Msinga Local Municipality land around Tugela Ferry is regarded as low potential with a few patches of restricted potential. Thus, the potential for expansion might be limited but the typologies of farmers in the area make it possible to explore intensive agriculture farming practices. Since the outlook for the province establishes an agriculture corridor that cuts through the municipality from south to north, it is important to assess how farmers can benefit or participate in developing this corridor. Certainly, there will be opportunities for value addition and/ or linking farmer production to the agro-processing industries along this corridor.

Adequacy of water is a challenge for most farmers in Ndumo-B and Makhathini, especially those outside of the irrigation schemes. The development domain for Jozini shows that some potential exists in supporting irrigated agriculture activities along the Pongola floodplain. However, water management should be given priority due to several competing uses for water from Jozini dam. Any new expansion of irrigated farming activities should create space for absorbing the highly entrepreneurial homestead food gardeners, community food gardeners and independent irrigators with an interest in managing their farms as businesses and propensity to take part in collective action institutions. There is very little that can be done for dryland farmers who live further away from the floodplain. Improving market access for

farmers in Jozini should also focus on improving the road network that links the different communities to urban markets.

Description of the development domain in Nongoma Local Municipality shows that access to markets remains a challenge for smallholder farmers despite the numerous marketing opportunities existing in surrounding towns and municipalities. The farmer typologies can explain this phenomenon. Farmer typologies confirm that most farmers in Nongoma have low entrepreneurial spirit which is associated with lack of confidence, negative information seeking behaviour, risk avoidance and reluctance to pursue opportunities, among others. Hence, such farmers need to be assisted to realize and utilise the market opportunities surrounding their area.

9.3 Crop and livestock enterprises in and around the schemes

9.3.1 Crop enterprises of potential priority

9.3.1.1 Current crop production versus recommended

As noted in Chapter 7, a variety of crops, mainly horticultural, are currently under production in the four study areas. The most common crops are green maize, cabbage, tomatoes, beans and spinach. The top 10 include other crops such as onions, green pepper, cotton, sweet potatoes and chillies.

The Makhathini Master Plan indicates that water constraints and to some extent poor soil fertility has an effect on the range of crops that can be produced in Makhathini Flats. Meaningful production is only possible under irrigation and along the Pongola floodplain which is rich in highly fertile alluvial soils. Table 9.9 shows a range of crops that can be produced in Makhathini Flats at reasonable higher margins. The crops include field and horticultural crops. Given what is reported in Chapter 7, this means the current crop production practices in and outside Makhathini and Ndumo-B irrigation schemes are in line with expert recommendations made for the area.

Table 9.9. Potential irrigation crops – Makhathini and Ndumo-B

Avocado	Cowpeas	Pepper
Bananas	Cucumber	Peppers (capsicum)
Beans	Egg fruit	Pigeon peas
Cabbage	Granadillas	Potatoes
Carrots	Ground nuts	Pumpkin
Cassava	Guavas	Rice
Cashew nuts	Litchis	Squash
Chillies	Macadamia nuts	Sorghum
Cinnamon	Maize (winter)	Soybeans
Citrus	Mangoes	Sugarcane
Coconuts	Onions	Sweet potatoes
Cotton	Papaya	Tomatoes

Source: KZN PDAAEA, 2006

However, it is clear that production has focused on some and not all the recommended crops. Less of potatoes, litchis, squash, rice, carrots, soybeans, bananas, cinnamon and cucumbers are currently being produced. The reasons for lack of interest on such crops include lack of technical knowledge, poor performance of the crop in the past, required level of management, lack of markets and poor gross margins, among others. There are also crops (like calabash, butternuts and spinach) that were not recommended but are now under production in the area. Interviews with farmers revealed that some crops are grown out of demand expressed by particular clients and commitment to buy.

Bululwane Business Plan (2015) provides a range of crops that can be grown under irrigation in Bululwane irrigation scheme. The plan states that the crops were selected against a number of criteria which included adaptability of environment under irrigation, soil type, irrigation system, scheme location *vis a vis* potential markets, crop establishment cost, time to harvest, marketing opportunities, constraints and demand, perishability and crop gross margin. The process resulted in the selection of six crops recommended for Bululwane, i.e. cabbage, butternut, green maize, chillies, green pepper and sweet potatoes. Similar to Makhathini and Ndumo-B, the results in Chapter 7 show that in addition to these crops a significant proportion of farmers in Bululwane are also growing tomatoes, green beans, onions, spinach, potatoes and beetroot.

Table 9.10 below sought to establish the relationship between crops under production and farmer typology. The results show no significant difference between farmer typologies in terms of crops grown. However, it appears that a higher proportion of farmers who are into mixed

farming and are endowed with physical capital are growing chillies compared to other farmers, while cotton is grown mostly by farmers with access to information but not credit. Similarly, a higher percentage of farmers categorized as risk taking and opportunistic with limited access to credit grow cabbages compared to the other farmer typologies. The findings have implications on support for the different farmer typologies since some crops are capital intensive and require that farmers readily have access to credit to finance some of the farming operations.

Table 9.10. Crops under production by farmer typology (% farmers)

Crop	Access to information but not credit	Risk taking and opportunistic but limited credit	Risk taking and opportunistic	Ambitious and optimistic; and social grant reliant	Mixed farming and physical capital endowed	Young and educated farmers
Green Maize	34	33	40	45	43	30
Cabbage	20	52	35	45	29	38
Tomato	23	15	22	37	29	23
Beans	17	9	23	21	21	14
Spinach	9	21	16	16	7	18
Onion	9	12	10	10	7	7
Green Pepper	9	12	3	10	14	10
Cotton	18	3	7	4	0	6
Sweet Potato	6	0	10	7	0	6
Chillies	2	0	2	9	29	7
Calabash	1	0	4	4	0	3
Butternut	0	0	2	3	7	2
Yams	1	3	3	1	0	2
Beetroot	0	9	1	3	0	2
Potatoes	0	0	4	5	0	1
Carrot	0	0	1	1	0	1
Groundnut	1	0	2	0	0	1
Sugarcane	0	0	1	0	0	0
Brinjal	0	0	0	0	0	1
Lettuce	0	3	0	0	0	1

Source: Survey data, 2015 & 2016

9.3.1.2 Enterprise performance (gross margin)

This section discusses enterprise performances for the most common crops (Figure 9.9). Cabbage and maize have the highest gross margin per ha. Green beans has the least gross margin. The major costs across all enterprises are labour costs, especially family labour. Using these results, it appears that it makes economic sense for farmers to engage more into the production of cabbage, maize and green pepper. However, gross margin statistics presented in the Makhathini Master Plan and the Bululwane Business Plan show that the crop with the

potential for the highest gross margin is tomatoes followed by green pepper, beans, maize and then cabbage.

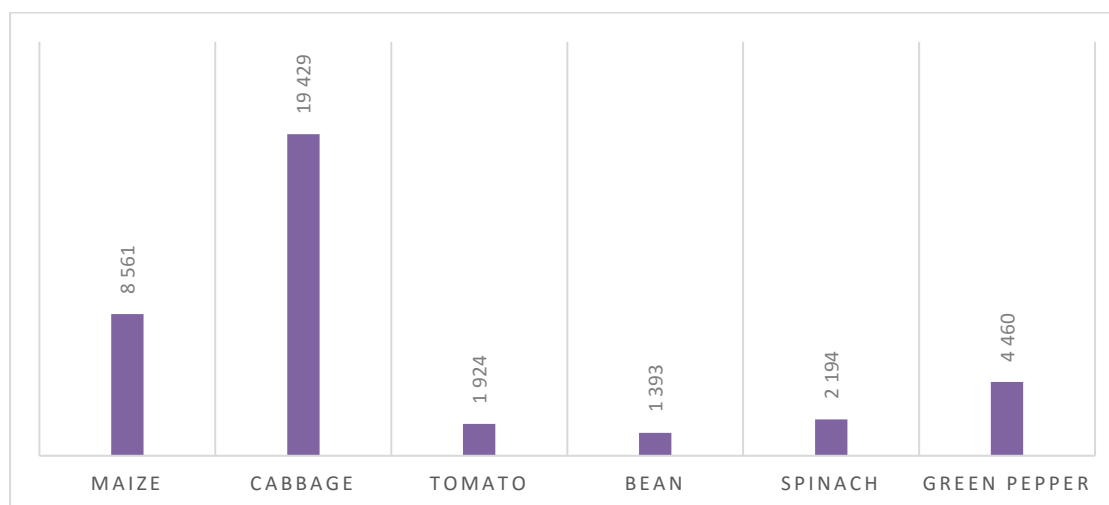


Figure 9.9. Crop gross margins, 2015/16 cropping season

Table 9.11 below shows gross margins of the common crops by category of small-scale irrigators. Scheme irrigators followed by independent irrigators have higher gross margins for most crops compared to other types of small-scale irrigators. Homestead food gardeners have the poorest enterprise performance for the most common crops. The results confirm expectations that scheme irrigators have a comparative advantage (in terms of knowledge, skills, equipment, access to water and access to credit) in the production of most of the crops compared to small-scale irrigators currently operating outside of the irrigation schemes.

Table 9.11. Gross margins of selected crops by category of small-scale irrigators

	Scheme irrigators	Independent irrigators	Homestead food gardeners	Community food gardeners
Maize gross income	31 348	17 433	10 641	4 444
Maize total variable cost	14 771	7 741	20 314	13 594
Maize gross margin	15 411	10 172	-4 624	-9 151
Cabbage gross income	52 462	41 348	27 312	39 067
Cabbage total variable cost	18 098	24 956	14 588	28 742
Cabbage gross margin	31 832	-16 009	-9 954	9 253
Tomato gross income	20 880	21 993	18 741	23 309
Tomato total variable cost	19 968	13 882	26 699	19 232
Tomato gross margin	2 274	4 499	-8 357	3 964
Bean gross income	17 755	12 531	7 902	29 550
Bean total variable cost	11 875	9 240	24 085	26 498
Bean gross margin	3 731	2 222	-22 139	3 052
Pepper gross income	31 743	29 511	13 580	24 653
Pepper total variable cost	12 578	13 340	42 910	26 403
Pepper gross margin	26 272	16 242	-22 540	-10 153

Source: Survey data, 2015 & 2016

Comparison of gross margins of common crops by farmer typologies show that young and educated farmers have a negative maize gross margin. Maize gross margins achieved by all the other farmer typologies are above the average shown in Figure 9.9 above. Some farmer typologies are doing very well in terms of performance of their cabbage gross margins. Three typologies have cabbage gross margins greater than R30,000 per ha while all the remaining typologies have positive cabbage gross margins. This confirms the above findings that cabbage is a crop that small-scale irrigators in the study areas are producing profitably.

Table 9.12. Gross margins of selected crops by farmer typology

	Access to informati on but not credit	Risk taking and opportuni stic but limited credit	Risk taking and opportunis tic	Ambitious and optimistic; and social grant reliant	Mixed farming and physical capital endowed	Young and educated farmers
Maize gross income	24 854	28 767	22 665	22 077	23 904	13 398
Maize total variable cost	11 145	9 485	18 946	9 720	11 121	16 142
Maize gross margin	14 234	12 478	5 344	12 212	15 060	-2 745
Cabbage gross income	54 556	25 638	41 606	52 393	48 693	48 176
Cabbage total variable cost	17 057	16 242	24 844	15 880	21 398	18 911
Cabbage gross margin	33 874	7 499	9 678	33 522	30 113	8 322
Tomato gross income	16 211	15 323	-	17 608	37 846	22 337
Tomato total variable cost	11 758	6 813	-	17 737	18 022	22 402
Tomato gross margin	803	5 840	-	-1 210	19 824	5 080
Bean gross income	15 823	31 623	16 599	23 486	5 792	10 590
Bean total variable cost	9 821	12 885	20 638	10 240	18 397	11 328
Bean gross margin	6 002	18 738	-5 137	7 067	-12 605	-3 053
Pepper gross income	6 094	15 623	42 489	12 912	90 000	38 728
Pepper total variable cost	8 292	23 754	61 440	11 441	20 178	20 598
Pepper gross margin	-2 198	-5 840	-54 200	8 945	80 270	17 380

Source: Survey data, 2015 & 2016

‘Mixed farming and physical capital endowed’ farmers' tomato enterprises are performing well above those of the other farmer typologies, while ‘ambitious and social grant reliant’ farmers have a negative tomato gross margin per ha. Only three of the six farmer typologies are performing well in bean production. The other three have negative bean gross margins. Similar results are also observed with green pepper.

Gross margins by study area show that Tugela Ferry has higher maize and cabbage gross margins compared to the other areas, while Bululwane farmers have higher tomato and bean gross margins. Ndumo-B farmers have higher green pepper gross margin compared to other areas. In general, farmers in Makhathini are performing badly in most of the common crops compared to farmers from the other areas (Table 9.11).

The results presented in this section show that the crop enterprise performance of small-scale irrigators differs among the farmers, typologies and by study area. This information can be quite important in designing targeted extension services for the different farmers. It will be vital to ascertain why some farmers are performing well and others are not. But as elaborated

in the first part of this section, a focus on labour management and use of inputs should be able to improve the crop production performance for most crops.

Table 9.13. Gross margins of selected crops by area

	Makhathini	Ndumo-B	Bululwane	Tugela Ferry
Maize gross income	14 260	19 808	7 168	50 395
Maize total variable cost	15 768	9 377	11 292	16 155
Maize gross margin	402	10 729	-3 790	32 398
Cabbage gross income	35 361	37 747	45 736	71 107
Cabbage total variable cost	20 756	22 370	6 991	21 139
Cabbage gross margin	8 229	15 215	19 496	42 947
Tomato gross income	17 367	22 951	24 085	20 084
Tomato total variable cost	29 107	16 767	4 807	22 173
Tomato gross margin	-11 740	3 568	17 827	805
Bean gross income	15 741	18 064	24 440	-
Bean total variable cost	17 151	12 398	6 403	-
Bean gross margin	-1 881	3 594	13 223	-
Pepper gross income	19 737	31 080	4 964	-
Pepper total variable cost	44 090	15 228	21 750	-
Pepper gross margin	-24 353	14 237	-11 750	-

Source: Survey data, 2015 & 2016

9.3.1.3 Crop enterprises that should be prioritized

The empirical results above suggest that there is a huge potential to grow many crops in the study areas. However, decisions on crops to be prioritized depend on the following:

- enterprises where the farmers have a comparative advantage in production given their resources,
- potential of earning higher profits,
- availability of greater market opportunities for the crop, and
- potential of more small-scale irrigators growing the crops so as to benefit from economies of scale in production and marketing of the crop.

Given the above considerations, tomatoes, green pepper, beans, green maize, cabbage, onion and spinach have to be prioritized in the four irrigation schemes. This does not mean farmers cannot grow other potential crops as long as they satisfy most of the considerations above.

9.3.2 Livestock enterprises of potential priority

Due to supplementary and complementary relationships in production, crop-livestock integration is a key strategy for profitable farming in sub-Saharan Africa. For that reason, this part of the report focuses on livestock enterprises.

The commonly owned livestock in the study areas are domestic chicken, goats and cattle. Of the three, cattle is considered as the most valuable asset given its several uses including its status as a symbol of wealth. Figure 9.10 shows similar trends of livestock ownership across all the four areas.

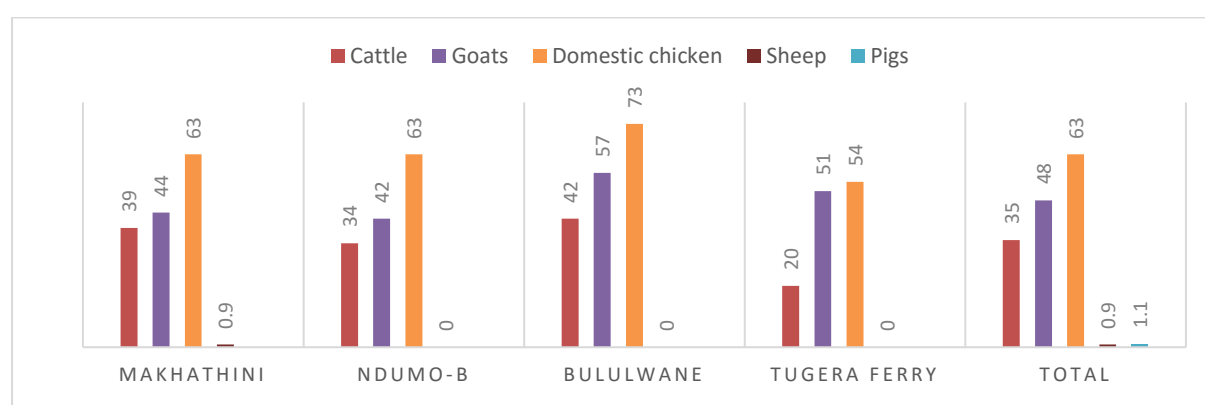


Figure 9.10. Livestock ownership across the study areas (% households)

Source: Survey data, 2015 & 2016

Average cattle ownership is significantly different among the different categories of small-scale irrigators. The results show that livestock ownership is highest among non-irrigators compared to irrigators. As shown in Figure 9.10 above, most small-scale farming households do not own cattle. The number of domestic chicken is also significantly different across the different categories of small-scale irrigating households. It seems domestic chicken is the most common type of livestock among community and homestead food gardeners. The results in Table 9.14 show that among small-scale irrigators community food gardeners followed by homestead food gardeners have the highest average number of domestic chicken. Scheme irrigators have the highest average ownership of goats compared to other small-scale irrigators outside the scheme.

Table 9.14. Mean number of livestock owned by category of small-scale producers

Producer category	Cattle	Goats	Domestic chicken
Scheme irrigators	4	5.9	8.3
Independent irrigators	4.7	5.1	8.1
Homestead food gardeners	4.2	5.4	9.2
Community food gardeners	3.8	4.3	10.6
Non-irrigators	13.1	8.1	20.9
Total	5.2	5.7	10.2
P-value	0.001	0.334	0.000

Source: Survey data, 2015 & 2016

Comparison across the different farmer typologies (Table 9.15) show differences in livestock ownership, especially cattle, across the different farmer typologies. 'Mixed farming and physical capital endowed farmers' have the highest average cattle ownership followed by those with 'Access to information but not credit'. Cattle ownership across the rest of the groups is quite low.

Table 9.15. Mean number of livestock owned by farmer typology

Farmer typology	Cattle	Goats	Domestic chicken
Risk taking and opportunistic	3.8	4.5	9.6
Ambitious and optimistic; and social grant reliant	2.7	6.2	8.7
Access to information but not credit	7.5	7.0	11.4
Young and educated farmers	3.2	4.7	11.4
Risk taking and opportunistic but limited credit	2.7	5.0	7.5
Mixed farming and physical capital endowed	13.9	2.7	4.1
P-value	0.000	0.235	0.261

Source: Survey data, 2015 & 2016

Figure 9.11 shows that livestock is mostly kept for consumption purposes whilst a significant percentage of farmers keep them as a form of wealth (31%). This is particularly true for cattle. Only 12% indicated that their objective is to generate income from sale of their livestock while 11% keep livestock for cultural reasons. Livestock such as cattle and goats play an important part in some of the traditional ceremonies in rural communities, e.g. lobola payment and rituals. Figure 9.11 shows that cattle are seldom kept for draught power.

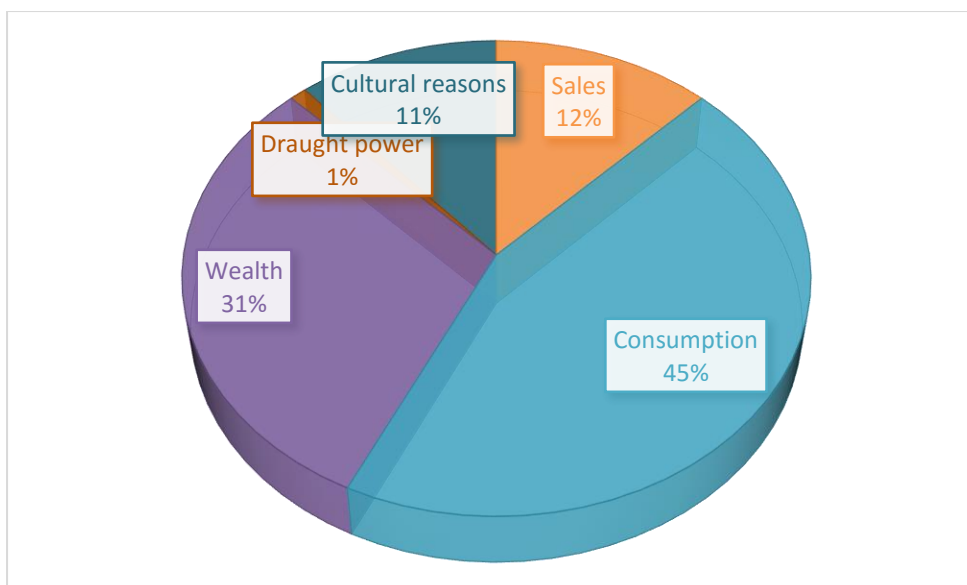


Figure 9.11. Uses of livestock for farmers – Bululwane and Tugela Ferry

Source: Survey data, 2016

Further results show several by-products (such as hides and skin, animal waste for organic fertilizer) that farming households enjoy from keeping livestock.

9.4 Towards on-farm entrepreneurial development pathways

9.4.1 Homestead and community food gardeners

Homestead and community food gardening are mainly for subsistence purposes. Although some homestead and community food gardeners earn an income, this study has shown that the scale of crop production and sales cannot make any significant economic contribution to the local economy. The gross margin analysis for major crops in Section 9.3.1.2 has shown that in economic terms homestead food gardening is performing poorly. This is mostly due to extensive use of inputs on smaller pieces of land. In fact, there is rarely a distinction between farming and family operations in homestead and community food gardening, while a significant proportion of farmers in these two groups do not view their farms as businesses. Profit making is rarely an objective or part of decision making for homestead and community food gardeners. Thus, the most realistic option available for transformation of homestead and community food gardening is a process that entails availing opportunities for those interested in expanding irrigation farming, to access more land, gain critical business and entrepreneurial skills, increase their scale of production and enhance access to more profitable markets. In defining this pathway for transformation, one has to be practical, using information from the above analysis to model interventions that account as much as possible for farmer

heterogeneity. However, according to Pender *et al.* (1999), there is so much heterogeneity among smallholder farmers such that it is practically impossible to develop agricultural policies that are specific to the different farmer situations. Thus, some degree of aggregation will have to still be implemented, also remembering that the pathways will be implemented within the existing development domains.

9.4.1.1 Targeting of homestead and community food gardeners for entrepreneurial transformation

Not all smallholder farmers are interested in becoming business owners or entrepreneurs. There is a common assertion that entrepreneurs are not born or made but being an entrepreneur begins with some inherent qualities and personalities which cannot be taught through formal education. The major question is 'how do you target homestead and community food gardeners with a better chance of becoming successful farm entrepreneurs?' An example of the filtering process informed by the study findings is suggested below. The same process can also be followed for community food gardeners.

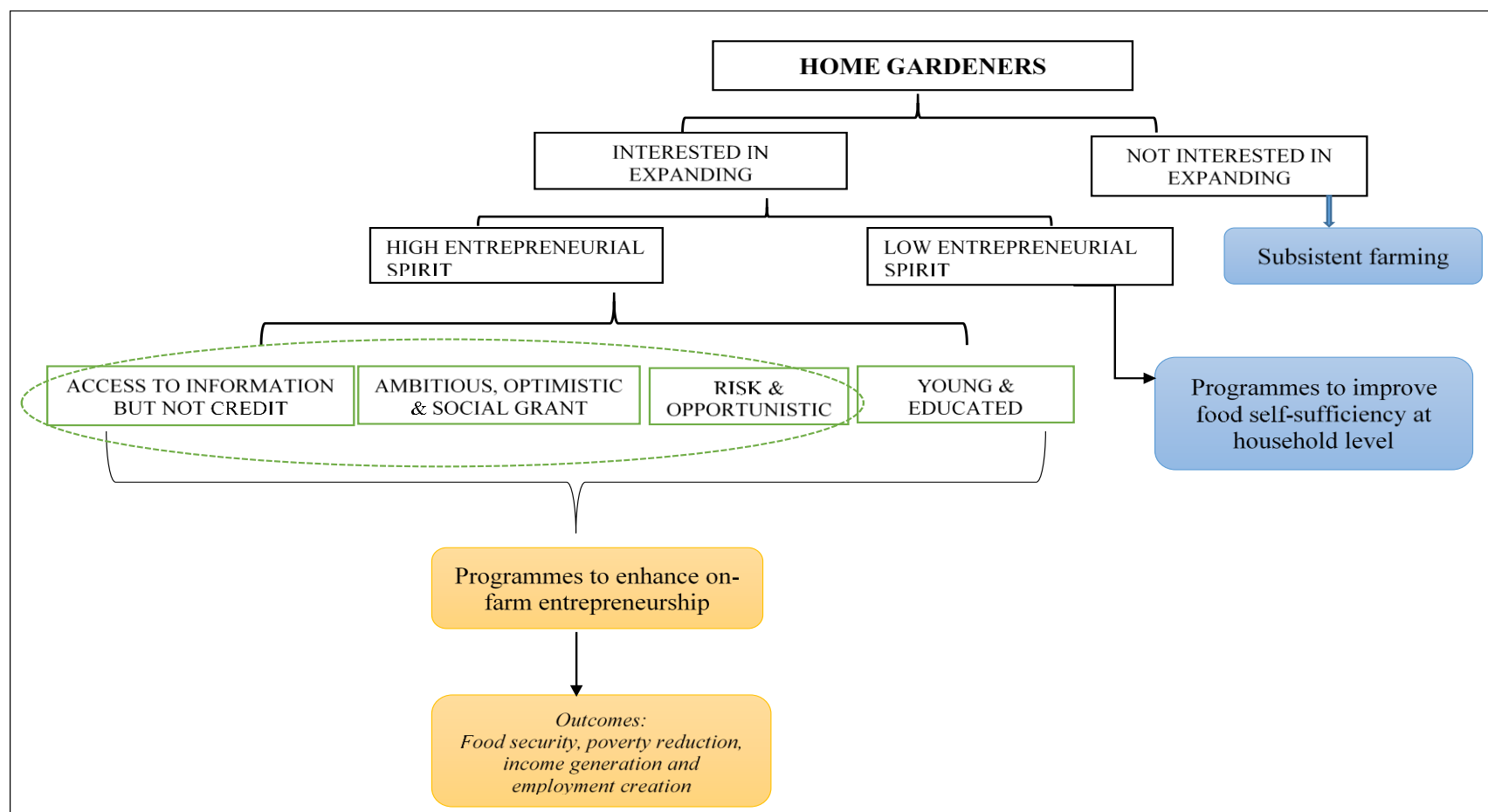


Figure 9.12. Development pathways for homestead food gardeners to transform to successful farm entrepreneurs

Source: Survey data, 2015 & 2016

As discussed above, the proposal is that transformation for homestead and community food gardening should focus more on farmers that have shown interest in expanding their irrigation farming activities and have a high entrepreneurial spirit. In targeting such farmers, the relevant stakeholders can focus on enhancing food security, increasing income, employment and enhancing the role of smallholder irrigation in the broader economy. The other homestead and community food gardeners can still be targeted with food security-related interventions meant to enhance food self-sufficiency at household level.

Thus, the process should start by identifying homestead and community food gardeners keen to expand their farming operations. These can then be assessed to determine their entrepreneurial spirit. Those with higher entrepreneurial spirit can be further disaggregated by their farmer typologies. Since there are no homestead and community food gardeners classified as mixed farming and physical capital endowed, cluster one to four can be grouped together to form a group of older and uneducated farmers. This means that entrepreneurship pathways can be formulated for two groups of homestead and community food gardeners, i.e. young educated and older uneducated. Such an approach is critical in achieving another objective, that of increasing the participation of the rural youth in farming.

9.4.1.2 Access to productive land

The following are considerations that should be made on how to improve access to productive land for homestead and community food gardeners:

- *Identify land suitable for expansion of irrigation activities.* This can be a new area or where possible an extension of irrigable land along the existing irrigation schemes.
- *Access to water and soil fertility should be key factors in deciding on the land.* However, it is important to note that soil fertility can still be improved by other land management strategies.
- In Makhathini and Ndumo-B, such land has to be near or along the Pongola floodplain. The Makhathini Master Plan confirms the existence of such land.
- In Bululwane, all options should be explored to convert the dryland in the scheme to irrigated land, which should be allocated to homestead and community food gardeners who meet the above criteria. The scheme has 500 ha of land of which only 182 ha, according to Bululwane Business Plan, is irrigable.
- Ensure that in allocation of land there is a deliberate attempt to make sure that young farmers also obtain a fair allocation in the new schemes.

- The challenge with most of the land in the rural communities is that its ownership, transfer, control and use rests with the traditional leadership. The traditional leaders make decisions regarding the land including allocation and type of ownership. The kinship relationships and cultural settings support such a system. It is important to understand that, once a piece of land (irrigable or rainfed) is allocated to a household, it is rarely taken away, whether it is being used or not. However, the prevailing problem is the uncertainty in the areas of lack of security of land tenure or the mindset that any time the land could be taken away. Moreover, the land allocated to smallholder farmers can neither be transferred nor used as a collateral as a result of which farmers are not able to access credit. Thus, there is a need to engage traditional leaders to facilitate rural land reform and allocation of unused land. Such engagement should be in the form of a consultative process involving all relevant stakeholders to develop proposals for harmonizing rural land tenure security and utilizing unused land. Such a process has to pave the way for legally allowing leasing, transferring and using the land as a collateral to make it a productive asset.

9.4.1.3 Skills development programme

This programme should focus on three critical areas of skills development, i.e.

- **Agricultural production/ farming** – On-farm entrepreneurship will demand that former homestead and community food gardeners engage in production of high value horticultural crops such as green maize, green beans, pepper, chillies and butternut, among others. Some of the crops have been grown, *albeit* at a lower scale but some will be new to them. Hence, a training programme should be designed for all crops recommended under Section 9.3.1.3.
- **Irrigation water management** – Scheme irrigation is different from irrigation in homestead and community food gardens. Water management is critical to the success of scheme irrigation farming. In line with the objective of improving water efficiency and sustainability of water resources, homestead and community food gardeners need the technical knowhow on how to manage and efficiently use water. Organisations such as WRC have developed training manuals for extension officers supporting smallholder irrigation farmers. The recommendation is to use such materials and others from sources such as FAO to design an irrigation management training manual adapted to suit the literacy levels, language and context of the target farmers.

- **Business and entrepreneurial skills** – Identified farmers should be equipped with a range of business and entrepreneurial skills which will enable them to manage their farms as a business and effectively participate in markets. The skills should cover:
 - record keeping,
 - distinguishing farm operations from family operations,
 - simple planning techniques including budgeting,
 - marketing and selling including negotiation,
 - pricing of produce,
 - time management,
 - post-harvest handling,
 - labour management (skills such as negotiating, scheduling and ways and means of reducing lurking), and
 - networking to take advantage of business opportunities.

9.4.1.4 Enhancing access to credit for new or expanded schemes

Access to credit is a challenge for most farmers, especially the new scheme irrigators. Expanding irrigation farming activities is only possible with adequate working capital to access production inputs and access services such as tractors and transport, among others. There is a need to explore strategies for increasing access to credit facilities by homestead and community food gardeners involved in the farm entrepreneurship transformation programme. The government should implement a ‘Revolving Credit Fund (RCF)’, to support the new scheme irrigation farmers. The RCF should take the form of the one currently being implemented for the prioritized schemes in KwaZulu-Natal Province. The current RCF targeting four schemes including Bululwane is supported by the government through the national DRDLR and the KwaZulu-Natal provincial DARD, managed by the Land Bank.

9.4.1.5 Enhancing access to farm mechanization services

Services and equipment such as tractors, ploughs, discs, ridgers, planters and trailers are all important in scheme irrigation. The government's current approach is that of supporting scheme-based mechanization facilities. The approach transfers the management including maintenance of the services and equipment into the hands of the farmers. To reduce the entrenched dependency syndrome, it is recommended that farmers not only manage and cover the maintenance of machinery but also contribute to the recovery of initial investment costs. If

these services and equipment are not utilised at their full capacity, they have to be rented out to generate income and facilitate the cost recovery.

9.4.1.6 Enhancing market participation

The Makhathini Master Plan elaborates a marketing strategy that, if implemented, has a higher probability of increasing smallholder irrigation farmers' access to markets. The strategy involves the development of marketing infrastructure that will connect farmers to both input and output markets. The suggested areas of investment include:

- packhouses for grading, packing and collection of produce,
- distribution hubs with cold rooms to facilitate marketing and distribution to local and distant markets, and
- a transport infrastructure including refrigerated transport.

Smallholder farmers can't be expected to afford to pay upfront for big infrastructural investment costs and neither can government afford to hand-out such infrastructure for free. To address this issue, the scheme business plans are expected to stipulate on who has to pay for the infrastructure, how costs have to be recovered, how ownership and management has to be transferred and how maintenance needs to be done. Bululwane Business Plan better articulates what needs to happen to the future of the scheme than the Makhathini Master Plan. Bululwane Business Plan dwells on a revolving cost recovery credit facility and it has provisions for training in overhead and capital cost recovery schemes. It also mentions the need to involve the youth to ensure rural job creation and succession plan in agriculture. The scheme is proposed to be managed by farmers with government playing an important part. On the other hand, Makhathini Master Plan does not make provisions regarding management transfer, ownership transfer, maintenance plan and cost recovery.

Though such investment on physical infrastructure in the irrigation schemes has an immense potential to enhance small-scale irrigators' livelihoods, its implementation has been not systematic but *ad hoc*. The implementation of this strategy should be part of a bigger plan with components connected at different levels, creating a value chain that will effectively benefit farmers and the local rural economy.

Nevertheless, identified homestead and community food gardeners can be better prepared to participate in markets if they are collectively organised (as cooperatives or other forms of producer associations) as this increases their bargaining power and ability to meet market demand for various agricultural products. New scheme irrigators should be encouraged to join

such collective action institutions to enhance their chances of accessing better product and input markets.

9.4.2 Independent irrigators

Independent irrigators around the scheme were once part of irrigation schemes and opted out of the schemes due to several challenges. However, others are far away from the schemes but near a water source or river. Hence, they have established their independent plots near, along or around the water source. The average irrigable land among independent irrigators is 1.7 ha. Some have as high as 10 ha for irrigation while others have as little as 0.1 ha. Former scheme irrigators are more business minded and their main objective in farming is income generation. However, a considerable number of independent irrigators conduct farming for subsistence purposes.

Independent irrigators often face a huge challenge related to extraction of water from the water source to their plots. This also represents a cost to agricultural production for this group of farmers. Most farmers use petrol or diesel water pumps to extract water from the rivers, canals, wells, or small dams to their plots. Water-related infrastructures such as water pumps, pipes and sprinklers, among others, is also a huge challenge. Frequent breaking down of water pumps is a common issue affecting production.

Similar to homestead and community food gardeners, pathways for transformation of independent irrigators should focus on farmers with a high entrepreneurial spirit. Figure 9.13 shows how such farmers should be targeted for the entrepreneurship programme. All independent irrigators with high entrepreneurial spirit, regardless of their interest to expand crop irrigation activities, should be targeted. Among this group, provided that prevailing institutional problems are addressed, those with less than 1 ha of irrigable land should be considered for allocation of more land on existing or new schemes. Those with more than 1 ha of land can be supported in-situ, i.e. on their existing land. However, the exception is independent irrigators not interested in expanding but have high entrepreneurial spirit. These farmers should be part of programmes that focus on non-farm economic activities. For independent irrigators with low entrepreneurial spirit, programmes have to be sought to unlock their PsyCap.

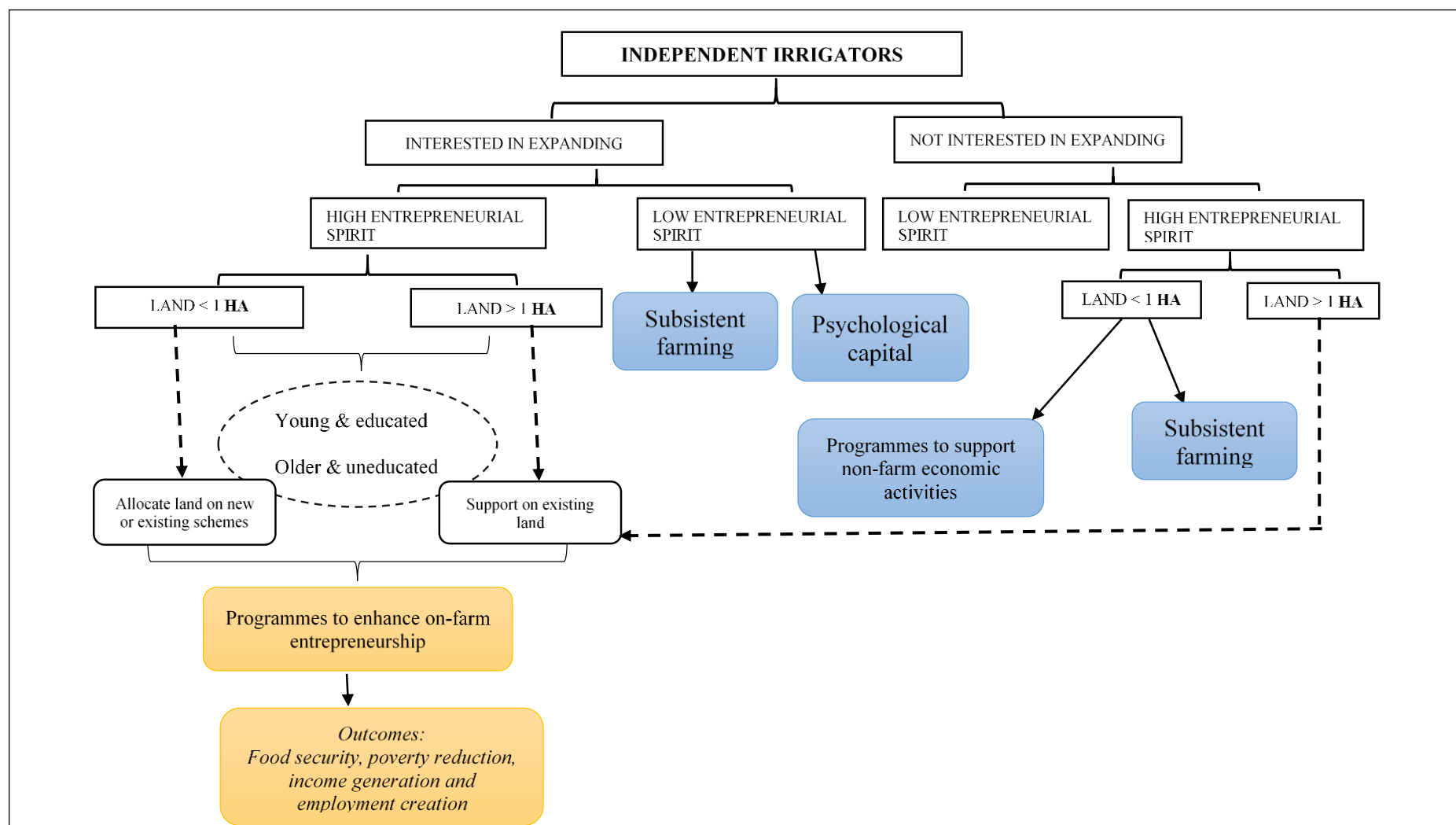


Figure 9.13. Independent irrigators with higher probability of developing into farm entrepreneurs

Source: Survey data, 2015 & 2016

9.4.2.1 Land clusters

Given the limited potential of new irrigation land available in the study communities, the proposed development pathway for independent irrigators has two strategies, i.e. give more land to promising farmers with limited land and enhance the productive capacity of promising farmers with more land. In identifying potential land for new schemes, considerations similar to those proposed under section 9.4.1.2 should be made.

Supporting the farmers on their existing land will be easier for independent plots that are close to the schemes and those that are close to each other. It is recommended that clusters of independent plots be identified and labelled. Each cluster should be analysed independently as suggested in Figure 9.13 above and needed support established. Clustering will make delivery of support services (such as extension and marketing) tailor-made, less costly and impactful. However, working with isolated independent irrigators is going to be a challenge.

9.4.2.2 Improving water supply for agricultural production

Physical water security, not water insecurity for institutional reasons which is relevant for scheme irrigators, is a critical component in the transformation of independent irrigators. It is proposed that the following should form part of the steps for improving access to water in independent irrigation:

- Solution to water-related challenges should be implemented per cluster. Each cluster of independent irrigators is unique depending on their water source. Hence, a water supply plan should be developed for each identified cluster.
- Conduct a cost benefit analysis of different strategies for pumping water for each cluster. Strategies might include:
 - Installation of electricity supply infrastructure near each cluster so that farmers will manage their electricity bill as a group. Lessons learnt from Ndumo-B irrigation scheme can be used to design effective electricity bill management strategy.
 - Designing of canal systems where possible to supply water to clusters.
 - Exploring use of solar system as an alternative source of energy for pumping water.
- Support farmers to obtain adequate equipment such as pipes and sprinklers.

9.4.2.3 Skills development

A similar strategy that is proposed for homestead and community food gardeners in Section 9.4.1.3 should also be implemented for independent irrigators. Focus should be given to training in sustainable and efficient utilisation of available water resources, skills to manage the farm as a business and any new crop production techniques.

9.4.2.4 Enhancing access to credit and high value markets

A similar approach as one proposed in section 9.4.1.4 and 9.4.1.6 should be followed. The approach should utilise revolving credit funds to improve access to credit by independent irrigators. The marketing strategy should focus on infrastructure development meant to reduce the transaction cost of accessing product markets, i.e. investment in packhouses, distribution hubs and roads. More efforts should also be made to better organize independent irrigators into effective collective action institutions that will enhance their participation in both input and output markets.

9.4.2.5 Focusing on economies of scale / reducing transaction costs

Individualism is too common among independent irrigators. To make farmers understand and appreciate the importance of collective action institutions and make them take advantage of economies of scale (in input purchase, access to services and product markets) and reduce transaction costs (in accessing inputs, services and markets), the clustering approach suggested above will create an institutional structure that can be utilised by independent irrigators. Independent irrigators can buy inputs in bulk and also sell their crops together to reduce on marketing costs and increase their bargaining power. This is not happening currently due to farmers' lack of trust and belief in collective action institutions such as cooperatives, owing to their bad experiences (e.g. mismanagement, nepotism, lack of accountability/transparency, etc.) in the recent past.

9.4.3 Scheme irrigators

Small-scale scheme irrigation is currently being conducted by farmers acting as individuals or part of a cooperative. The dynamics differ for each scheme. Makhathini has both individual farmers operating between 1-10 hectares of land and farmers in cooperatives allocated between 0.2-0.5 hectares of land. In Ndumo-B, though most of the farmers are in a cooperative, they act more as sole farmers in most of their operations. The cooperative exists mostly for the administrative management of the scheme. Each farmer has between 1-10 hectares of land. In Bululwane, farmers are organised in blocks, with each block forming a semi-autonomous

institution or cooperative to run the affairs of their members. Each farmer is allocated an average of 0.9 hectares of land. The same situation exists in Tugela Ferry irrigation scheme. Farmers are organised into blocks with each block having a committee to manage its affairs. Land allocated to each farmer is 0.1 hectares, but over the years some farmers have managed to increase their land through borrowing and negotiating with traditional authorities. From this description, it is clear that most scheme irrigation is modelled around the concept of cooperatives and land use rights vary widely depending on the scheme. This forms the basis for the development of pathways for transforming smallholder irrigation farming into commercial farming.

Allocating more land to current scheme plotters at this stage may not be a good idea. While there is little capacity to expand for some irrigation schemes, due to inadequate land, any decision that allocates additional land to existing plotters does not promote social justice or equity. Government priority should be on many rural black farmers in the communities surrounding the scheme, waiting for an opportunity to be allocated land for scheme irrigation. Thus, on-farm entrepreneurship development within the schemes should focus on other institutional issues, not expansion of land.

9.4.3.1 Entrepreneurship development for individual scheme irrigators

These are farmers operating individually in and around the schemes. They are common in schemes such as Makhathini and to a bigger extent in Ndumo-B. The key thing is that land operated by each farmer is at least 1 ha, allowing for meaningful agricultural production. Some of the farmers under this group are highly entrepreneurial and can be considered emerging commercial farmers when we consider their farm business management practices, level of production, crops produced, clients and market participation. However, some have low entrepreneurial spirit and are finding it difficult to manage their farming businesses due to the challenges discussed in previous chapters. Development pathways for this group of farmers should focus on the following (Figure 9.14):

- **Capacity building for full land utilisation** – Not all farmers are managing to operate their land to its full capacity. Issues such as failure of the farms to pay a decent wage which creates labour constraint, access to working capital and lack of knowledge affect the degree of land utilisation.
- **Intensification of production** – Farmers should be taught how to produce more on existing land.

- **Production of a diversified range of high value crops** – There are many high value crops that can be produced in existing schemes though the focus has been only on a few traditional horticultural crops. This group has to venture or increase scale of production on crops such as paprika, chillies, beetroot, etc. However, this should be accompanied by a clear marketing strategy. In this regard linkages with the new DARD programme, the Radical Agrarian Socio-Economic Transformation Programme (RASET), will enhance access to markets.
- **Promote efficient utilisation of water** – There is a need to introduce volumetric charging of water and cost calculations for each crop to reflect all water-related costs or charges.
- **Skills development** – There is a need for more focus on business and entrepreneurship skills development, especially on changing production technology and market demands.
- **Market transport support systems** – Transport has been the main challenge affecting market access. The marketing strategy as elaborated in section 9.4.1.6 is needed to enhance market linkages.
- **‘Buddie farmers’**: This concept would aim to promote peer farmer support mechanisms pairing highly entrepreneurial smallholder farmers to those having challenges in managing their farming businesses. Farmer-to-farmer mentoring can be used as a strategy of building farming and business knowledge of other farmers. Pairing does not necessarily have to be for farmers in the same scheme; it can be done in nearby schemes such as Ndumo-B and Makhathini. The purpose is to make the mentor and mentee ‘buddies’ over time.

Mentorship, which has to be the outcome of needs assessment, has the potential to equip black emerging farmers in South Africa with the necessary skills required to farm profitably. South Africa’s strategic policy documents such as “The Strategic Plan for South African Agriculture” (Department of Agriculture, 2001) and “Broad Based Black Economic Empowerment Framework for Agriculture” (AgriBEE, 2004), identify the development and implementation of mentorship programs as integral parts of rural development. Mentoring is a process whereby more experienced and successful person of wisdom helps a less experienced one to learn something the learner would otherwise have learnt less well, more slowly, or not at all (De Beer, 2005). It is not about managing the enterprise but helping empower less experienced farmers to do so (PAETA, 2004). Of

course, for a mentorship program to succeed, both parties need to agree on a viable and sustainable business plan for the farm, farm infrastructure and equipment, a dedicated farm-worker team and common vision of what they wish to attain (Terblanché, 2010). It is a voluntary relationship where both have to be convinced and willing to be part (SACGA, 2005).

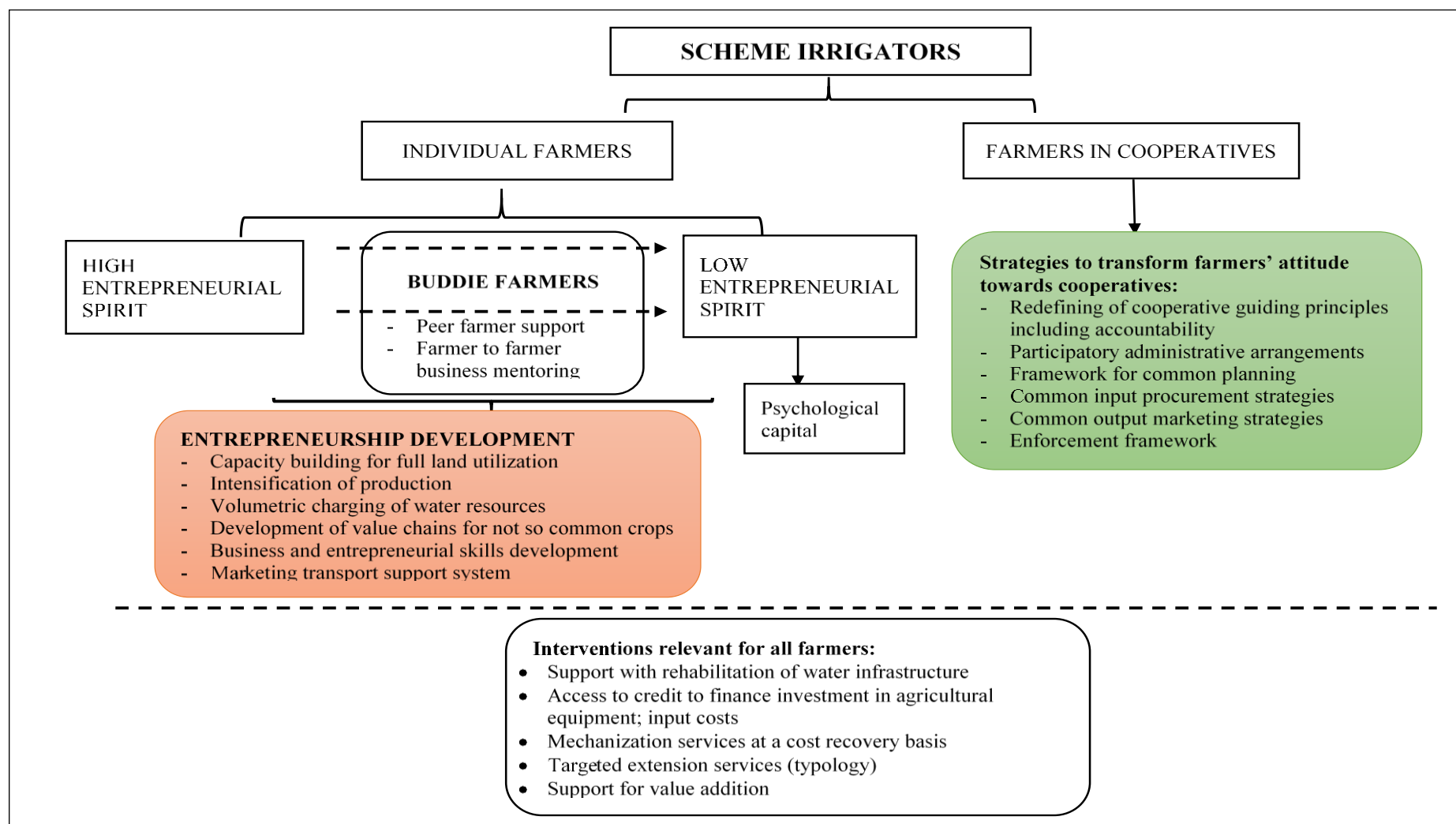


Figure 9.14. Entrepreneurship transformation programme for scheme irrigators

Source: Survey data, 2015 & 2016

9.4.3.2 Scheme cooperative transformation programme

Cooperatives are the current vehicle that government is using as an approach to manage and support smallholder irrigation farming in South Africa. However, as shown in the previous chapters, the need for the formation of most of these cooperatives emanated from the desire to receive government support and not to work together. There seem to be information asymmetry (some members are more informed than others) and lack of understanding of key functionality issues between members of the same cooperative. Hence, several challenges are encountered of which the key being the unwillingness of some members to abide to the guiding principles. However, this does not mean that cooperatives cannot not work in smallholder irrigation farming. The most important issue is to refocus the ideology, address governance and nepotism issues and position collectivism as the central pillar in a cooperative.

Given the small land sizes, mostly less than 1 hectare, allocated to individual members of cooperatives, concerns have been raised in the past regarding the possibility of commercial farming on such small pieces of land. Critics have suggested land consolidation as an alternative to increase the economic potential of such farmers. However, given the sensitivity of land owing to the history of the country, farmers feel such a move is designed to take away their land. No matter how noble the idea is, farmers' perceptions will affect the effectiveness of any approach that puts land consolidation as its central strategy. Thus, this study proposes an approach where smallholder irrigation farmers in cooperatives still retain their independence in terms of land and farming decisions but allow considerable room to engage and benefit from collective action. This will involve the transformation of smallholder farmer cooperatives into, not just administrative institutions but entrepreneurial transformative institutions that support farmers and the government to achieve their goals. The underlying advantage in collective action is that there are numerous economies of scale that allow one to be competitive and do things that otherwise were not possible as an individual. Below are the issues that should be addressed to transform and reposition the current cooperatives:

- **Enforcing cooperative principles including accountability** – This is meant to address governance problems and issues of mistrust between the executive and members. The process should be consultative and participatory. Ideally it should be facilitated by someone with extensive experience in governance and management of collective action institutions.

- **Transparent administrative arrangements** – This includes the administration of the day to day activities of the cooperatives and it entails defining the core costs and enforcing transparent procedures on how resources will be allocated. Compensation for the executive committee's time has to be negotiated. The most critical thing is that the cooperative members should be able to define and agree on these critical aspects so that their attitudes can change for the better. They need to own the process and its outcomes for the cooperatives to be successful collective action institutions in rural South Africa.
- **Framework for common planning** – Each cooperative should develop yearly plans, outlining activities of the cooperative, crop enterprise plans for the year, water infrastructure maintenance and networking engagements, among others. Commonly agreed upon plan will enable members to anticipate challenges ahead and develop solutions regularly.
- **Common input procurement strategies** – Through common planning it is possible to have common input procurement strategies and economies of scale in buying and transporting inputs to the farmers. For example, if it is expected that 20 members with a total of 10 hectares of land plan to plant maize in the summer, procurement of key inputs can be done through the cooperative as a group including engagement of tractor services.
- **Common output marketing strategies** – Group marketing and contract farming can be done as a collective to ensure that smallholder farmers benefit from their own produce and they get access to secured product markets. However, the issues of product quality and consistency of supply will have to be addressed.
- **Enforcement framework** – This is a very critical but difficult part of managing cooperatives. The ability of a cooperative to enforce agreed rules and regulations including actions for reprimanding offenders greatly affects its functionality. Members should agree on an enforcement mechanism and they all have to adhere and respect the rules.
- **Cooperative mentors** – These are similar to extension officers in functionality. They are supposed to offer advisory services to cooperatives, especially in the initial stages as they try to put all the structure in place. They should guide cooperatives and help whenever they face challenges. This and some of the above approaches can be piloted with a few cooperatives so that the results will be used to scale-up.

9.4.3.3 Support services for all scheme irrigators

The following are support services that need to be provided to all farmers currently in scheme irrigation.

Rehabilitation of water infrastructure – Current water infrastructure in some of the schemes studied (e.g. Makhathini) need rehabilitation. The infrastructure includes canals, connecting pipes and sprinklers. Damage to these have resulted in loss of water and water use inefficiencies. Farmers seem to be expecting maintenance to be done by government or other entities. Future strategies on how to collectively maintain water infrastructure should allow the farmers to take the leading role in managing such services.

Access to credit – Improving access to credit among small-scale scheme irrigators should be prioritized and the following consideration made:

- Avail information on existing credit or loan facilities. Some farmers just lack knowledge and are ignorant of the loan conditions and requirements.
- Negotiate with microfinance and small loan providers for better credit conditions for smallholder irrigation farmers.
- Initiate a platform for engagement between the farmers and the credit providers. Such a platform will dispel the myths around credit and allow credit providers to understand the needs and design services suitable to smallholder farmer situations.

Mechanization services at cost recovery – As part of the strategy of developing viable small-scale farming sector through irrigation schemes, government has supported the mechanization of the schemes. Tractors and all related equipment are provided to farmers to use and manage collectively. However, such support should be provided with a cost recovery plan, with management and ownership of the equipment gradually receded to the farmers in the long-term. The study shows that currently most farmers pay anything between R1800-2400 to hire tractor services per ha. This means it is possible for farmers to gradually contribute to the mechanization of their schemes. In the long-term the strategy will reduce the cost of tractor services for the farmers although some form of payment will still be required for maintenance of the equipment.

Targeted extension services on improving quality of crops – The challenge for smallholder farmers has always been how to consistently supply products as per the expectation of the market. Hence, the extension programme has to focus, among other things, on the market expectations in terms of the quality of crop and how farmers can actually achieve such quality

under their farming conditions. This will naturally call for engaging all the relevant market role players. In addition, *value addition* on agricultural produce should be promoted. Some of the value addition activities are relatively simple and can be done without big investment. Leaving the value adding activities that need considerable investment to future rural development programs, the relevant stakeholders have to identify those activities that can be done easily and quickly, given the farmers' resource endowment and local conditions. Interested and able farmers should be supported through their cooperatives, to establish small agro-processing industries for adding value to their crops. In areas such as Msinga, where potential has already been identified for developing an agricultural corridor, farmers can form part of the small agro-processing industries.

9.4.4 Actions to consider for young and educated farmers

The following areas should be prioritized when working with young and educated small-scale irrigators:

- *Enhancing social capital* – This group of smallholder farmers has limitations in terms of networking and interactions with other farmers. They should be integrated into cooperatives and social groups whilst a deliberate effort is made to increase their contact with extension officers. Effective networks are important for successful entrepreneurship. In this regard, there is still unexploited opportunity to navigate ways and means of utilizing information and communication technologies (social media) in creating social capital, especially for the rural youth.
- *Conduits for the smallholder irrigation transformation programme* – Young and educated smallholder farmers can be important conduits for the entrepreneurship transformation programme. By nature such farmers are expected to be quick learners and active and can assume roles of supporting their peers in terms of technical and market information. The transformation programme could be developed using these farmers as the engines of the change.
- *Integrated crop-livestock systems* – The presence of mixed farming coupled with physical capital endowment shows potential for integrated crop and livestock enterprises with this group of farmers. Development pathways should be able to position livestock farming in these mixed systems as a business. This means there is a need to explore how to: increase efficiency in livestock production, improve access to livestock product markets, improve access to livestock inputs and services and take advantage of the synergy (supplementary and complementary relationships) between

livestock and crop enterprises. Similarly, there is also a need to provide livestock management training. The cost of feed can be significantly reduced by using new methods of converting crop residues into livestock feeds for cattle, pigs or poultry.

- *Potential for increasing scale production* – Having use rights to large pieces of land means farmers can increase scale of production or explore production of other high value crops, to the extent that economies of scale holds.

9.4.5 Considerations for older and uneducated farmers

The following areas should be prioritized when working with older and uneducated small-scale irrigators:

- *Messaging* – The messages and technologies targeting older and uneducated should be tailor-made to suite their literacy levels.
- *Improve access to resources* – There is more commitment to farming within this group of farmers. However, access to resources is one of the major challenges constraining their growth. There is need for sustainable strategies to improve access to different resources.
- *Gender mainstreaming* – The majority of the small-scale irrigators in this group are female farmers, mostly household heads. Effective participation of such farmers in smallholder irrigation activities and consequently in on-farm entrepreneurship transformation is affected by other responsibilities that women have in the household. Such responsibilities, especially housekeeping activities, affect time spent by women on productive economic activities. Ignoring this aspect in the entrepreneurship transformation programme for small-scale irrigators in South Africa will negatively affect the impact of the programme. Hence, the pathways to entrepreneurship should be accompanied by strategies for reducing the heavy workload that women are exposed to at the household level. There is a lot of work that has been done by Oxfam International in this respect and this can provide lessons that can be applied to the smallholder irrigation sector in South Africa. For instance, the use of fuel-saving technologies to reduce time that women spent to collect fire wood; fetching water; facilities to take care and creating awareness. Women farmers also reiterated that the current irrigation equipment, especially the pipes are too heavy and shifting them from one position to another is a challenge for women farmers. Less labour-intensive technologies such as sprinklers should be supported.

- *Opportunistic* – Most farmers in this category are value-oriented and if such opportunities arise, they will easily move to value adding economic activities with higher economic returns. This characteristic provides an opportunity to target such farmers with support for developing small agro-processing businesses.

9.5 The required policy/management changes

9.5.1 What has to change in relation to extension services?

Following the empirical results and the discussions on entrepreneurship development pathways in Section 9.2-9.4 above, there is a need to provide demand-driven extension services for each type of farmer. Extension services should account for farmer typologies. The frequency of extension contact between the farmer and the extension officer should be increased. The clustering approach should make it easier to deliver extension services even to independent irrigators in faraway places. The extension approach should embrace technological developments in offering effective and relevant extension services. Use of cellphones as a key instrument in extension should be strengthened, especially to disseminate information without necessarily requiring physical meeting.

Our field observations suggest that extension officers in South Africa are overwhelmed with the number of farmers they currently serve and they lack hands-on farming experience; they lack the knowledge and they display poor engagement. As it has been elaborated above, agricultural extension has to be complemented with mentorship programs without replacing it. These two services are different in level of details, content and functionality. For instance, an extension officer is expected to serve many farmers unlike mentoring which is on a one-to-one basis. While the purpose of extension is addressing agronomic and related problems that farmers face, the purpose of mentorship is to multiply success. Extension services are often homogeneous, reactive and developed and implemented by government department. On the other hand, mentorship programs are tailor-made, proactive and demand-driven.

9.5.2 What has to change in relation to farm technology development and dissemination?

Based on the empirical findings, the following areas of intervention are identified as critical for farm technology development and dissemination:

- *Labour intensive technologies* – The largest group of farmers involved in smallholder irrigation are elderly people who face labour scarcity. Lack of financial capital and poor profitability of these farms is the fundamental problem. The sustainable solution is to

make smallholder farmers profitable so that they can pay for all costs and maintain household livelihoods.

- *Gender sensitive technologies* – Women constitute the greater majority of small-scale irrigators. Thus, it is paramount that any technology introduced to them should be gender-sensitive. It is important to consult the small-scale irrigators regarding a given technology before it can be deemed suitable for use. The bottom line is that any technology that increases the labour burden on women has a higher risk of not being adopted (Lubwama, 1999).
- *Livestock feed* – Technologies for processing of livestock feed from crop residues and its storage should be introduced as part of crop-livestock enterprise integration activities for farmers practicing mixed farming.

9.5.3 What changes are required in other avenues?

- *Farm typology* – policy and development interventions need to recognise and account for heterogeneity of smallholder farming systems, i.e. no ‘one size fits all’.
- *Entrepreneurial development* – more effort should be put in entrepreneurial skills development with a particular focus on building and developing positive PsyCap and enhancing entrepreneurial spirit.
- *Access to water* – Access to water and soil fertility should be key considerations, especially for homestead and community food gardeners. Water harvesting strategies should be explored for farmers outside of the schemes while an audit on the available water sources should be prioritized. There is also a need to promote collective management of water resources especially in the established irrigation schemes.
- *Access to land* – government and other relevant stakeholders should consultatively engage traditional leaders to facilitate rural land reform and allocation of unused land; to pave the way for legally leasing, transferring and using land as a collateral to make it a productive asset. Land audit in the schemes is also required to ensure full utilisation of available land resources.
- *Access to credit* – approaches to financing smallholder farmers should be revisited. Financial institutions and credit schemes should explore use of livestock as collateral and promote access to affordable credit. There is also a need to explore potential role of stokvels and microfinance institutions in offering affordable productive credit to smallholder farmers.

- *Access to markets* – there is a need to strengthen formal and informal collective action institutions (collective bargaining) that enhance smallholder access to markets. Access to markets can also be improved through linking programmes such as Comprehensive Agricultural Support Programme (CASP) and Agri-Parks to smallholder irrigation and explore contract farming.
- *Knowledge to action* – there is need to create a collective platform so that all stakeholders can be part of understanding the problem, developing the solutions and implementing the collective strategies.

For all these interventions and development pathways to materialize, there is a need for collective action by all the relevant role players.

9.6 The role of rural development role players in realizing the development pathways

9.6.1 Local and national government entities

Government through its various departments should play a facilitating and coordinating role in creating an enabling environment to support the development pathways. The role involves defining the institutional arrangements between the different players in the smallholder irrigation sector. Focus should be on the rules of engagement in the input and output markets and between farmers and institutions offering financial support and other related services. Government has to move away from agricultural input and other handouts and focus to enabling farmers sustain their own livelihoods. Furthermore, ensuring land tenure security is important for sustainable development of the smallholder irrigation sector. Land tenure security has an effect on the level of investment and commitment of other key stakeholders, e.g. the private sector. Efforts to improve tenure security should be made engaging the traditional leadership.

Government has another role of ensuring accountability of both state and non-state role players through facilitating effective monitoring and evaluation systems. It is important that support meant for farmers should actually reach the farmers. Promised services should be delivered as agreed. Currently, farmers' perception on those fronts are not positive.

9.6.2 Non-Governmental Organisations (NGOs)

NGOs (such as Lima Rural Development Foundation) are non-state role players that complement government efforts and contribute to the achievement of national objectives. In this regard, they should support government efforts and help enhance the contribution of

smallholder irrigation to the rural and national economy. There are many ways in which NGOs can contribute, including but not limited to:

- offering agricultural advisory services; they are better placed to understand farmers' needs and capabilities,
- capacity building of farmers in entrepreneurial skills,
- supporting farmers with on-farm business development,
- action research to inform government programmes, and
- organizing farmers so that they can take advantage of collective action institutions.

In all these activities, NGOs need to work closely with government and other stakeholders so as to avoid double dipping. Demonstration of value for money of programmes and services should be prioritized so that most of the resources are allocated to activities that generate impact.

9.6.3 The private sector

The private sector is profit-oriented and tends to be driven by this objective. However, the sector has a social responsibility to also contribute to the greater good of society. As part of this responsibility private sector businesses are expected to act in a manner that will enhance the welfare of the society they serve. The way smallholder irrigation is viewed by government posits it as a sector whose development will benefit, not only the individual farmers, but the local and national economy as a whole. Given the rising demand for food and increasing food prices, smallholder irrigation has the potential to grow the high value food market in the economy. The private sector can play the following roles:

- develop affordable, relevant and diversified technologies to support labour intensive agricultural production,
- allocate a quota in terms of food market share to support smallholder irrigation farmers. For example, retail shops such as Spar and Shoprite can commit to buy produce from small-scale irrigators. The challenge is to supply acceptable quality consistently,
- offer advisory and capacity building support to improve standards and product quality
- enter into mutually beneficial partnerships with government and other stakeholders to support the development of smallholder farmers.

9.6.4 New and existing financial organisations

Needless to say, access to credit is important in realizing the potential of smallholder irrigation. Thus, financial institutions, i.e. commercial banks and microfinance organisations, have a very important role in the transformation programme. To improve access to financial loans, financial institutions should:

- develop financing models that resonate with the situation of smallholder farmers. This will allow financial support for smallholder farmers, with limited risk to the credit provider,
- as indicated in section 9.5.3, explore the use of other assets other than land as a collateral, e.g. livestock; this has to be done accounting for the diversity of land tenure systems in rural South Africa,
- raise awareness among smallholder farmers on available financial services,
- bring the services closer to the farmers by opening outlets near their communities, and
- build farmers' capacity on financial and debt management.

9.6.5 Traditional leaders

Section 3.3 showed the need for more land to establish new or expand existing irrigation schemes. Most of the land in the rural areas of South Africa is controlled by traditional authorities. To support propositions made in Section 3.3, traditional leaders should cooperate, identify and provide land for smallholder irrigation development. Also, they have a role in supporting enforcement of agreed rules and regulations in the schemes and/or cooperatives.

9.6.6 New and existing collective action institutions

Collective action institutions are critical in the transformation of smallholder irrigation farming. The role of cooperatives in the sector has been extensively discussed in Section 3.3.3 (b). However, other collective action institutions such as WUAs also have an important role to play. In light of the functions of WUAs as stipulated under Schedule 5 of the National Water Act of 1998, the institutions should focus on the following roles:

- represent farmers on all water-related matters,
- operation and maintenance of existing water systems including rehabilitation of canals and other water infrastructure,
- compelling all users to install water meters that will allow volumetric monitoring of water use by farmers,

- coordination role in the recovery of irrigation water and other related payments from farmers, and
- resolution of local disputes among members or between members and non-members.

9.6.7 Other research and development role players

Other research and development role players include National Agriculture Research & Development Institutions such as universities and national research councils or centres, e.g. Agricultural Research Council. These institutions have a role to conduct research on smallholder irrigation development and use this to inform actions by government and its partners. The research issues (e.g. why land tenure systems in the rural South Africa are not changing at the required pace despite repeated calls for secured land tenure system?; what are the political economy reasons?; is there a need for a different concept of entrepreneurship for small-scale farmers? etc.) are complex and multidisciplinary, demanding an approach that looks at the system as a whole.

9.7 Summary

The chapter has shown that agricultural policies and interventions targeting smallholder farmers in irrigation have to account for their heterogeneity and the complexity of their farming system. The “one size fits all” approach does not work and technologies, extension services, farm management practices, innovations and development pathways have to speak to the heterogeneity. Heterogeneity in the smallholder irrigation sector happens at two levels, i.e. the farmer (including the household, resource endowments and other household characteristics) and geographic area or what can be called the spatial dimension of heterogeneity. At the farmer level complexities are introduced due to differences in resource endowments and ability of the farmers to identify and utilise available opportunities. This is further complicated by differences in positive psychological among the farmers. All these aspects cannot be ignored when designing policies and interventions targeted at smallholder irrigators. Ultimately, how the sector will respond to current initiatives and be successful in enhancing livelihoods and creating employment will depend on the compounded effects of all these factors on the farmer.

Transformation of the smallholder irrigation farmers and their development pathways should be context-specific, depending on farmer typology and development domains of each area. Spatial differences will impact on the potential growth of the smallholder irrigation sector in each rural area. Differences in the agricultural potential, institutions and infrastructure that

enhance (or otherwise) market access and access to livelihood assets affect the extent to which growth can be achieved in the smallholder irrigation sector for each area.

The chapter has spelt out pathways to the transformation of smallholder irrigation for the different types of smallholder irrigators. It has demonstrated that not all smallholder irrigators have the potential to be successful on-farm entrepreneurs and this forms the basis for the development of the different entrepreneurship development pathways. Certainly, interest, capability and commitment are key in the whole process and farmers not keen and who are content with their *status quo* cannot be forced to participate in the on-farm entrepreneurship (transformation) programme. Government and its partners should be able to identify interested farmers with high entrepreneurial spirit for the programme. This is not to say that those not interested in expanding their smallholder irrigation activities should be ignored but depending on who they are, their current level of production and land use rights, among other factors, can also be targeted. In sum, the proposed pathways have the potential to increase rural employment, income and food security. Entrepreneurial skills development, increasing farmers' participation in high-value markets, improving access to credit, securing access to water, intensifying crop production, integration of crop and livestock enterprises and enhancing positive PsyCap are the primary focus areas for the transformation of South Africa's smallholder sector.

10 VALIDATING THE ‘APPROPRIATE’ DEVELOPMENT PATHWAYS FORMULATED FOR EACH FARMER TYPOLOGY

10.1 Introduction

The report presents the results of the study on the testing of appropriate development paths for establishing sustainable businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes. It is the culmination of three years of research on appropriate entrepreneurial development paths for homestead food gardening and smallholder irrigation crop farming in KwaZulu-Natal Province. Chapter 9 of this report presented different pathways for entrepreneurial development specific to each type of small-scale producer. However, before making recommendations to policy makers and stakeholders alike, it is important to subject these empirical suggestions through a verification process with the study participants and key stakeholders. Such a process will show the extent to which the empirical evidence resonates or diverges from the views of small-farmers and the stakeholders regarding the best approach to improve smallholder irrigation performance and contribute to the NDP Vision 2030 objectives of increasing income, employment creation and food security.

Is the science-action disconnect because science does not have the solution or is it that the scientific solution is not politically correct or is it lack of political commitment and implementation? The answers to these questions are complex as the dis-connect is still prevalent and it requires collective engagement, accounting for the socio-economic and biophysical dynamics. Connecting scientific knowledge with political/policy decision making processes is an inherent challenge (Pregering, 2014; Young *et al.*, 2014; Knight *et al.*, 2008). The knowledge-policy gap, according to Knight *et al.* (2008), is mainly due to most researchers never planning for implementation but doing research for knowledge sake *per se*. No one owns the science-policy interface (Young *et al.*, 2014). Everyone is coming up with solutions from a reductionist perspective and no one is working towards mobilizing the implementation of a collective solution. According to Wale *et al.* (2009), the most important reason for this gap is lack of engagement of the relevant stakeholders, from the start of developing the research problem up to generating the knowledge for action.

Drawing from the literature, Cockburn *et al.* (2016) summarize the various reasons for the science-action gap in relation to land-use planning and management. Accordingly, the key challenges that make the dis-connect entrenched are:

- Failure to appreciate and engage all the relevant stakeholders in the knowledge generation, policy formulation and implementation. Each one is left to be done by a separate silo (department) and no one takes responsibility for the dis-connect. If scientific researchers do the research by themselves and expect their recommendation to be taken up by the relevant authorities, there is a clear lack of incentive to implement the recommended policy changes. There is no collective engagement; researchers are generating the knowledge that they think has the policy recommendations; all other relevant stakeholders are not part of the research problem development and knowledge generation process. It is given to the relevant role players as “take it or leave it” solution. How can the decision makers and implementers be expected to act on an agenda that they have never been part of?
- Inherent linear thinking that the scientific knowledge will bring policy change and impact on livelihoods;
- Political economy issues – egos of the respective role players in the respective silos; power imbalances; failure to collectively embrace the problem and the solution;
- Failure of the scientific solution to be politically correct;
- Insufficient attention to decision making/implementation processes;
- Insufficient reflection on underlying philosophies/assumptions;
- Failure to understand/appreciate the complexity of connecting knowledge with action holistically/system-wide;
- Mismatch between the knowledge and policy action required.

Various solutions (e.g. transdisciplinary research and stakeholder engagement) have been suggested to address the knowledge-action gap. The reality that needs no debate is the need for improved conversion of scientific knowledge to policy with rural development impacts. It is argued here that integrating farmers’ perspectives is a key input for impactful development pathways. By the same token, the relevant stakeholders have to verify/validate the scientific findings and recommendations. That is why this study is interrogating recommendations of the research team with inputs from farmers and other relevant rural development stakeholders. That is what is called “Testing appropriate development pathways”.

Testing of the proposed pathways is important because there seem to be a dis-connect between research recommendations and farmer expectations. To test the proposed development pathways, participatory validation processes (focus group discussions, workshops, interviews with rural development practitioners, etc.) are employed.

Farmers indicated a lack of feedback on the outcome of numerous studies involving them. This could also explain why years of research have resulted in little tangible outcomes on the farmers' lives. Thus, the main purpose of this chapter is to validate the findings, scrutinize the acceptability of the proposed development options by the communities and brainstorm on alternative entrepreneurial options for scaling up.

The rest of this chapter is structured as follows: Sections 10.2 and 10.3 provide farmers and stakeholder reactions on the importance and prevalence of various rural development challenges. Section 10.4 presents the results of each FGD per cluster in terms of the common challenges and proposed development options per farmer typology. The extent to which farmer development pathways compare with the findings of the research team is contained in Section 10.5. Finally, Section 10.6 closes the chapter with a discussion on the summary of possible ways forward.

10.2 Farmer and stakeholder reactions: Makhathini and Ndumo-B

Tractor services: The farmers confirmed that limited tractor services affect timeous conducting of important farming operations such as land preparation. Others indicated that they sometimes resort to using ox-drawn ploughs but due to the size of their land the process is time consuming and difficult to do. The tractors available for hiring are deemed expensive. The research proposed that private tractor service providers elsewhere must be invited to avail the much needed service at critical times such as planting season. However, in the workshop, it became clear in that such a recommendation would only work if the service provider (s) are prepared to offer such services a lower cost compared to existing charges. One farmer indicated that the PDARD used to provide tractor service in the past and demanded to know why this was stopped. A representative from the PDARD clarified why the government tractors are no longer available to Jozini farmers. According to her, the department provided only three tractors which were not sufficient enough to serve all the smallholder farmers in Jozini. Repair and maintenance of the tractors including fuelling became a challenge since farmers were not paying for the service. Thus, the service was stopped and is now only provided to the Jobe Zineshe Communal Estate because they are more organised and are able to bear the costs of operation and maintenance of the tractors. PDARD indicated that they will now work towards providing farmers with tractors again since research has highlighted the huge gap in tractor services.

Irrigation infrastructure: Farmers reiterated that the current irrigation equipment, especially the pipes are too heavy and shifting them from one position to another is a challenge for women farmers. They requested sprinklers as an option. Farmers reported that at some point DAFF requested a water permit from farmers in order for them to provide the sprinklers. However, to date the affected farmers have failed to raise the money needed to obtain the permit from Mjindi Farming. Thus, farmers supported the recommendation to involve PDARD as the mediator between Mjindi Farming and farmers on such matters.

Lack of trust and poverty of communication: The comments from farmers also showed a lack of communication and in some cases trust between the PDARD, farmers and Mjindi Farming. Farmers blame Mjindi Farming for withholding inputs (tractors, nursery and cold room) provided by the department to farmers. One farmer said, ‘Mjindi is taking over on everything that is meant for farmers’. It was clear that lack of communication and limited understanding of the role of Mjindi Farming in Makhathini irrigation scheme could be the reason why farmers felt that way. One farmer said, ‘if it’s a subsidy let it come directly to farmers and not through a third party’. To stop this blame game, one farmer supported the research recommendation that suggested the need for a working mechanism, understood by all, that facilitates how the inputs provided by PDARD to farmers are distributed.

Market access: Farmers confirmed the lack of access to the markets for their produce especially for crops such as spinach, onions, beetroot and other high value crops. Thus, they continue to plant maize since they are able to sell it. One farmer said ‘the market problem will only end if there is a processing plant near the farmers which buys directly from farmers in volumes’. The farmer also said there are two important things that are needed to address farmers’ challenges, i.e. mechanization and agro-processing. The PDARD official indicated that there is a new government program which will take smallholder farmers produce and sell it to government departments, the programme is known as Radical Agrarian Socio-Economic Transformation Programme (RASET). However, this programme is set to start only in 2018.

Expansions of the irrigation schemes: One farmer asked about the progress that has been made regarding the irrigation scheme expansion programme. Farmers supported the recommendation to investigate areas with water that can be converted into irrigation schemes as the current existing schemes are saturated. Sukumasenze Cooperative chairperson from Ndumo reported that they have approximately 350-400 hectares of land available to open their own irrigation scheme in Makhanisi area. He said, ‘we are pleased to see you since researchers always come here for interviews and never inform us about the findings of their studies. Our cooperative is

registered and requires training so that we can have knowledge on how to manage it as a successful business’. He indicated their readiness to engage in irrigation farming.

Focus on rainfed agriculture: The councillor suggested that the research should not only be focused in irrigation schemes but also in the dry lands or places far from the scheme. ‘The research is good but what about the many farmers practicing rainfed agriculture who live far away from the schemes. Research is also needed on them’. He indicated the need for boreholes and water tanks to improve the livelihoods of those practicing dryland farming. The team is pleased to report that the new UKZN research project that has just been approved for funding by the WRC and starting in 2018 entitled “Entrepreneurial development for establishing small farming businesses and employment by youth in rainfed crop farming” will address this gap. This is a testimony that this project is not planning to end with a project report but continue to engage the relevant stakeholders for collective action. It also re-enforces the point that the new project is derived from the field experiences of the existing project.

Other issues: Farmers also supported the following recommendations:

- The investigation of the feasibility and efficiency of solar systems as an alternative power source for operating the water pumps or engines. This would reduce the high cost of electricity paid by farmers especially in Ndumo-B. The discussions also revealed that cost of water and its related charges for Makhathini scheme irrigators has increased from R2,500/ha/year recorded in 2014 to R3,200/ha/year. Farmers complain that these charges are still too high for them.
- The need for research and knowledge-driven solutions for controlling pests such as the armyworm.

Overall, the farmers appreciated the fact that researchers came back to report on their findings. The research team was also able to clarify to some farmers that the project makes recommendations for adoption by all relevant stakeholders including government. However, the researchers have no power on which issues that will eventually be addressed or strategies that will ultimately be implemented. The research team leader also explained to the farmers that there will be more engagements at provincial and national levels that will happen to discuss the findings of the study. Farmers wished there was a way they could be informed about the outcome of those discussions because ultimately, they want to know how they are going to be supported in the issues raised in the report.

10.3 Farmer and stakeholder reactions: Tugela Ferry

Relevance of training services: One of the research findings was that farmers find some of the trainings provided to them irrelevant. PDARD officials emphasized that farmers should be specific in terms of the training they found not relevant and going forward they have to identify their training needs. They also mentioned that most of the farmers who complain about not receiving trainings are those who do not attend meetings organised by the department for farmers. One of the reasons indicated by PDARD and Lima officials on the issue of irrelevant trainings is that some farmers do not apply farm training into their farming activities because they still believe in their indigenous knowledge when it comes to farming. This raised the question of whether or not indigenous knowledge is valued and is also integrated in trainings or other strategies for assisting smallholder farmers.

Dependency syndrome: PDARD and Lima officials raised their concerns about farmers being too dependent on inputs provided by the Department. Asisukume Msinga Cooperative Director encouraged other farmers to grow their farming businesses. ‘We need to first address the issue of negativity about the cooperatives because they are successful if farmers are dedicated and willing to work together. Farmers need to stop being dependent on government farming inputs because these things sometimes take time to reach them. This dependency is due to the fact that most farmers do not save for future farming activities after selling their produce (i.e. use “hand-to-mouth” method). The Department cannot subsidize farmers forever; they need to grow at some point, be confident and assist each other. Post-harvest loss is a major challenge in tomato marketing. Postharvest losses occur due to unavailability of markets. As a result, there is a need to promote agro-processing to avoid throwing away produce’ said Madondo. Her cooperative is willing to buy maize from Msinga farmers and process it into mealies to resolve the problem of market access.

A Lima official also touched on the grant dependency syndrome among the farmers and reiterated the need to track down the outcome of the grants provided to smallholder farmers. ‘There was support for some and not all farmers this year and it will be good to track those who are doing things for themselves. Input subsidy reduces the farmers’ incentive to keep farming records because the costs are incurred by government’. However, the official indicated that the few successful Tugela Ferry farming entrepreneurs keep their farming records because they understand the importance of saving to cover future farming costs. The tracking is meant

to check how grants and input subsidies have affected on-farm entrepreneurial spirit and dependency syndrome.

The importance of encouraging farmers to be independent was emphasised during the discussions. It was reported that some farmers are becoming too dependent on the Edaname farming project yet it is said to be a five-year project. The company distributes farming inputs amongst farmers to grow vegetables and sell the produce directly to the market for them. The big question was what will happen to farmers when this Edaname project ends. Farmers were, therefore, encouraged to use government support to establish themselves as successful farmers instead of being dependent on one source.

Cooperatives: Discussion also focused on the need for farmers to change their mindset regarding forming cooperatives and learn to work together to progress and manage farming profitably. ‘Farmers have the capacity to improve their farming business, the problem is they are not united. They need to work together for them to succeed and be assisted easily. We have successful cooperatives (e.g. Asisukume Msinga) that have shown the importance of working as a team’ said a PDARD official.

An official from Lima made a proposal that researchers need to look at how the cooperatives have evolved throughout the project timeline and what are the variances between different cooperatives. The research team leader responded and indicated the importance of such a process. However, he indicated that it is usually difficult to track evolution when using cross section data.

Irrigation infrastructure and maintenance: One-woman farmer asked when the department is going to install irrigation engine at Sampofu as they requested a long time ago to reduce water shortage. The PDARD official responded and said ‘People built homesteads in that place. As a result, it is difficult to tell people to move because you need to compensate them for relocating which is very costly. Therefore, we cannot provide the engine given the above reason’. As noted in the presentation farmers agreed that there is a need for better irrigation equipment. A PDARD official and a farmer mentioned that some of the problems in the research findings were resolved or have changed during the study period (2014-2017). For example, the unavailability of tractor services is resolved since each block has its own tractor now.

Regarding the issue of who should take the responsibility of operation and maintenance (O&M) costs for the irrigation infrastructure, this is what one farmer had to say: ‘If someone buys a car it comes with a service plan’. He indicated that the strategy for O&M should be worked from

that basis. This is one of the indications for the entrenched nature of farmers' dependency syndrome, i.e. if someone buys a car through bank finance, the owner is supposed to repay the loan (cost recovery in the case of the irrigation schemes), arrange for insurance and service plan. The point that most farmers seem to miss is that government's financial resources are scarce and free hand-out is not sustainable. At the end of the day, farmers have to own their livelihoods.

Access to credit: In line with one of the research recommendations, Lima reported they are currently providing credit loans to farmers at 5% interest. The loan is in the form of inputs bought from a local agro-dealer.

Pest control: PDARD reported that they have qualified staff who are able to advise farmers on the pesticides needed to address their pest challenges. However, they indicated that any new pest outbreaks such as the armyworm would take time to come up with an appropriate solution since there is a lot research that needs to be done at national level. In such cases the PDARD official indicated that they use their knowledge to recommend something that might work in controlling the pests.

Access to water: Limited water access for some farmers in the scheme was blamed on water sharing challenges. It was reported that farmers do not work and coordinate together and hence those at the tail end of the canal distribution have water access challenges. It was recommended that farmers should start working together to realize that transformation needed in smallholder irrigation.

Health services: Regarding the recommendation for mobile health services for those exposed to the risks of chemicals, one community leader responded that farmers need to take responsibility for their own health. He felt that the recommendation was not necessary.

Young people involvement in farming: One of the farmers thanked the UKZN team for coming back to report the project's findings, which was the first time they received feedback from researchers. Moreover, he called for research that will identify how young people can be encouraged to take part in agriculture value chain opportunities. He said, 'youth are left behind yet they also need support in farming'. The new WRC project mentioned on pages 5-6 will investigate this issue further to come up with policy relevant knowledge.

The research team leader responded to some of the farmers questions and reiterated the need for location specific recommendations in the project. He indicated that sometimes farmers tend to exaggerate their situation during interviews, hoping to receive some support. He emphasized

that what was presented are just snippets of the findings and the research report goes much into detail and deeper than what was presented. In conclusion, the farmers and stakeholders were happy with the overall research findings and recommendations and the opportunity availed for them to validate these findings. However, they requested to be informed or updated on the progress of the engagement of other stakeholders at provincial and national level in future. The major concern that was identified during the workshop is that of the blame game between the farmers and PDARD. PDARD complains that farmers are too dependent on government and farmers complain that government is not doing enough to help them. There seemed to be less coordinated communication on working programmes between PDARD, Lima and Edamame who work with the same farmers. They all work in isolation and only invite each other on events. There is very little coordination. The other thing that came out clear from the workshop is that farmers need to also take their work more seriously and constantly engage stakeholders when they need support in new initiatives they have without expecting everything to be done for them.

10.4 The test results: farmer challenges and possible ways forward

10.4.1 Cluster 1: Farmers with access to information but limited credit

- a. Lack of inputs** – Farmers are of the view that input support is skewed towards sugar cane farmers. Some indicated that they lack inputs such as fertilizers and seeds while others mentioned that even if they access credit to buy the inputs, they do not have anywhere nearby to do so. They either go to Mjindi or travel to Pongolo town to access inputs. The problem is that Mjindi usually does not have the inputs (fertilizers, seeds and chemicals) that they want and Jozini town does not have an agro-dealer selling them either.

Possible way forward: There is need for agro-dealers in Jozini town so that farmers can easily access their inputs. The remaining question, though, is why are they not there if there is this lucrative business opportunity?

- b. Failure in water infrastructure** – There is frequent unavailability of water at critical times mostly in the summer. Some of this challenge is due to problems with the water infrastructure, i.e. the pipe leaks and engines breakdown. Such challenges at times result in unavailability of water for days or even weeks. Sometimes farmers are not informed of the problem by Mjindi who have the responsibility to repair any broken-down in water infrastructure in the scheme.

Possible way forward: Engage with Mjindi on the issue.

- c. **Soils** – Farmers have a challenge of soil that becomes salty and makes it difficult for them to plant.

Possible way forward: Farmers need white lime to treat the soil. The remaining questions: Who has to pay it? How should it be accessed? Who is working on it?

- d. **Market problems** – According to farmers in this group, there are no markets to sell their produce. Umhlosinga Development Agency (UDA) is the only option but even with them there are still challenges. Sometimes money from the sale of crops are not paid timeously. Farmers sell as a group through their cooperative. The major challenge is that there are many smallholder farmers producing for the same market at the same time which creates an imbalance (surplus) that plays against the farmers

Possible way forward: Farmers expect that leadership should help them solve this problem. However, this does not necessarily say much. Rather they need to produce with intervals as irrigation would allow them to do so.



Figure 10.1. FGD with farmers in Cluster 1 from Makhathini

- e. **Land and water** – Land availability is not a challenge for homestead food gardeners in this group but water is. They illegally use tap water that is provided by government for the purposes of drinking to do gardening for lack of choice. Their homesteads are not close to any river, irrigation scheme or any other water source.

Possible way forward: Farmers could not come up with any possible solution. However, from the discussions it is clear that issues of collective management of water will have to be addressed.

- f. **Fencing** – Stray animals are a problem due to livestock farmers that cut the fence. Addressing this issue is difficult because traditional authorities are not cooperating much. According to the farmers, they tend to support the people with the cattle that would have destroyed the crops of farmers in the scheme or with homestead food gardens. Thus, farmers are not compensated for the damage caused or loss. They indicate that the involvement of the police would worsen the situation and will most likely result in more social and even dangerous conflicts in the community.

Possible way forward: Farmers could hire guards and contribute towards the cost but this depends on the profitability of their crop enterprises, which is the sole source of the money. It all comes back to the need for markets that reward farmers through better prices for their crops.

- g. **Agricultural extension services** – Farmers indicate that they do not receive much extension advice from Mjindi, who concentrate mostly on water-related issues. They indicate that in the past extension officers from the Department of Agriculture used to assist them. However, these days they seem to have decided to concentrate on farmers in rainfed agriculture. There is a sense of being neglected by the relevant stakeholders including extension officers. One farmer said ‘The Department of Agriculture left us and Mjindi does not help that much; so who will help us?’.

Possible way forward: The Department of Agriculture should revert to the previous arrangement where they work with all farmers, i.e. the schemes and those in rainfed agriculture.

- h. **Credit** – Farmers only get access to credit through stokvels who charge 20% monthly interest. Farmers that are not part of those stokvels borrow money from people who are part of the stokvels. Most farmers have access to consumption credit and not production.

Possible way forward: Financial institutions that provides production credit, with a special focus on smallholders.

10.4.2 Cluster 2 and 3: Risk taking and opportunistic farmers

- a. **Problems with accessing tractor services** – Tractor services are limited and this affects timeous conducting of farming operations such as land preparation and planting. Mjindi has only 2 tractors servicing the whole scheme and there is a long queue on the waiting list. Farmers lose profits because of the delay in tractor services since time is the essence of farming. Due to limited tractor services, the cost of land preparation is relatively high. At the moment farmers pay R650/ha for slashing, R850/ha for cultivating, R750/ha for discing and R500/ha for ripping. As a cooperative the costs are lower since they are divided among a number of farmers. However, these costs are not affordable individually.

Possible way forward: In the long-term farmers need to be assisted to procure their own tractor. In the meantime, government and other stakeholders can help by availing subsidized tractor services when needed. Farmers note that once the tractors are procured by government, they are willing to pay for the services and the maintenance.

- b. **Fencing** – Fencing is available and Mjindi has also constructed some gates on entrance into the scheme. However, farmers noted about the livestock especially cattle that come inside the scheme because sometimes the sugar cane truck drivers destroy the gates or leave them open when they enter or exit the scheme. Farmers also mentioned that cattle owners don't care if their cattle eat their produce and sometimes they threaten the farmers if they complain about that. They openly graze their livestock in the schemes, increasing chances of the cattle straying and destroying crops in the field.

Possible way forward: Since there is an institutional element to this, farmers suggested that a law is needed to prevent this. The problem is difficult to solve due to huge potential for conflicts and fighting among community members. There is a system in neighbouring areas where farmers can take cows they find on their plots to the government (Skidi- local term for the place where animals are kept) and owners of those animals will have to pay government (R50 per day) and the affected farmers. Farmers think a similar approach can help them. However, the place where this happens is very far. Ultimately, what is needed is engagement between the farmers, truck drivers and livestock owners. There is a need to engage with the traditional authority to see ways and means of enabling farmers to access and manage grazing land collectively.

- c. **Challenges in accessing markets** – Farmers report that they have no markets for their produce and end up selling to hawkers (van traders) who give them low prices. For

example, a 25 kg of beans is sold for R50 yet in the market it can fetch R150. Those producing cabbages complained that UDA is now paying them very little for their produce (R18 for 10 heads of cabbage). What makes it worse is that farmers are not aware of prices until after the produce has been sold. They feel reaped off by agents from UDA yet they incur huge cost to produce, transport (R300-R400 per bakkie load) and load the produce. This is unlike sugarcane farmers who have a set market with guaranteed prices. Farmers indicate that their source of income is farming. If they don't get good markets for their produce, they are unable to make profit and hence will continue to have the other challenges. The hawkers benefit at the expense of the farmer. One farmer said 'We incur all the cost from land preparation, buying inputs, hiring labourers, water charges and harvesting, yet the hawkers reap the benefits'.

Possible way forward: Farmers prefer a fixed price for their produce. They are engaging with Mjindi and UDA to address the market access issue and come up with a collective solution to the problem.

- d. **Weeds and pest problems** – Farmers complain of weeds and pests that are affecting their produce and reducing their yield drastically. The weeds and pests are resistant to the herbicides and pesticides currently available to the farmers. For example, there is a weed called *Sandanezwe* (triffid weed) which has been resistant to round-up herbicide that farmers have been using. There is also a pest that cuts the plants between its roots and the stem. Farmers indicate that recommendations from extension officers have not worked and it seems as if their knowledge of these weeds and pests is limited.

Possible way forward: Farmers suggested the need for research to find effective chemicals to deal with the weeds and pests in their plots. This will also help save money from buying unnecessary chemicals that don't work. Government should also bring expertise with knowledge of managing insects and pests to help farmers.

- e. **Water** – Farmers indicate that the cost of water is high and Mjindi charges them for all hectares held in the scheme, whether used or not. Also, farmers report that Mjindi closes the water without notifying them or telling them why and they don't compensate them if their plants die. No one penalizes Mjindi if they are the ones at fault.

Possible way forward: Though farmers have given a possible way forward to address this problem, there is a need to harmonise and streamline payment for water services across schemes.

- f. **Maintenance of water infrastructure** – Farmers have challenges in maintaining water infrastructure such as taps when they breakdown. Mjindi Farming engineers provide advice in terms of the repairs and parts needed and also provide the expertise and labour for installation once the parts have been bought. However, farmers bear the cost of buying the new pipe or tap, etc. If they do not immediately have the money to buy the parts which is often the case due to problems related to common-pool resources, then water is cut from their field until such a time when the money is available. This greatly affects their farming operations and hence profit.

Possible way forward: Provided that their farming is profitable, farmers are willing to pay for water infrastructure maintenance and repair.

- g. **Theft** – Stealing of produce from the fields is quite common. The problem is worse in fields owned by women due to their inability to defend themselves. Even if they report the thieves to traditional authorities and police, the system is lenient to them and are rarely punished for their crimes. These are literally prevailing law enforcement problems.

Possible way forward: This problem seems to be inherent. Farmers have tried various options such as reporting the matter to traditional authorities but still nothing comes out of their efforts.

- h. **Inadequate land** – Most of the farmers have limited access to adequate land for agricultural production, with most having between 0.1 to 0.2 ha. This limits production and potential for growing their small farm businesses, earning more income and a chance for improving their lives. Despite the promises from the Ingonyama Trust Lands to provide more irrigation land to farmers, this has not materialized. Another programme of reallocation of irrigation land to households that were displaced when the irrigation scheme was established has also not materialized. The current land they possess was given by traditional authorities. Land was allocated per household with no discrimination between male and female headed households. Once allocated, the land remains in the authority of the household from generation to generation. However, this does not necessarily mean that land becomes a private property of the household.

Possible way forward: Establish more irrigation land as planned. Renting is possible. One can rent as much land as they can. It depends on their money (R3,500 per ha per season). However, one must first check water debts against the land to be rented. Otherwise, Mjindi can cut water supply anytime.

- i. **Health concerns for women** – Women use different chemicals in farming exposing themselves to different health risks that require constant check-ups, especially on their reproductive health. However, due to the demands of farming, they hardly visit the health facilities since they spend most of their time in the fields. Though this point was raised specifically by women, it is not exclusively their problem.

Possible way forward: Mobile clinics – having medical testing for exposure to dangerous chemicals has to be done in the blocks of the irrigation schemes. This will reach every farmer and might help to identify those affected in the early stages.

- j. **Financial problems** – Access to credit is mostly through Stokvels. The credit is not free but accrues an interest every month (30%). At the banks, credit is available only for those who are formally employed and those who can present a collateral. The challenge is that as farmers they do not harvest consistently due to inadequate water and other problems, hence it is difficult to plan and always find themselves in financial and cashflow constraints.

Possible way forward: Utilise the cooperative savings. The cooperative money can be borrowed and returned by individual members with low interest charges. The same resources can be used to finance water equipment management, especially that which benefits all cooperative members.

- k. **Inputs** – Farmers buy their inputs far away in Pongola because they don't always get what they want at Mjindi. Lack of fertilizer and water contributes to their failure.

Possible way forward: Farmers want the DARD to come back because they are the ones that used to help them with transport to buy inputs far away. Avenues need to be explored to engage the private sector in input supply businesses.

- l. **Credit** – Farmers don't borrow money from banks. Previously, the chicken frying franchise, KFC, used to loan them with inputs and they paid back with produce. They liked that system.

Possible way forward: The potential of contract farming needs to be explored.

10.4.3 Cluster 4: Ambitious, optimistic and social grant reliant farmers

- a. **Water problems** – Farmers note that whether there is irrigation water reaching their plots or not, they still pay for water and the charges are too high. Mjindi can simply cut water if you don't pay. Sometimes Mjindi would shut-down water for a whole week and would not

report to the farmers what the problem is and yet farmers have to pay a full cost of water for the whole month.

Possible way forward: Volumetric metering is the solution especially for farmers who irrigate as individuals. A different solution is needed for farmers who irrigate as cooperatives because volumetric water charging system will be difficult to implement and manage, especially the collective monitoring and enforcement of agreed principles. This is, by and large, due to farmers' failure to collectively address common pool resources problems.



Figure 10.2. FGD with smallholder farmers in Cluster 4 (Makhathini)

- b. **Market problems** – Farmers sell as individuals and secure markets at the right time and place is a pervasive challenge. The municipality built a storage facility in a central location for farmers to store and sell their produce some eight or so years ago (see Figure 10.2). The facility was intended also as a central marketing place of farmers' produce. However, since it was built nothing has ever worked due, mainly, to lack of proper planning. The building is just a white elephant.

Possible way forward: If this project was properly planned engaging the relevant stakeholders, it would have created an opportunity to establish a warehouse receipt system. There is a plan by the research team to engage the Department of Agriculture

and other relevant stakeholders on the reasons why the building is not being used after such an investment and what can be salvaged.

- c. **Tractor problems** – The problem is that there are a few people with tractors for hiring. Hence, farmers end up waiting for days before their plots are prepared.

Possible way forward: There is need for more tractor services. Farmers have noted that tractor services by private companies are unaffordable.

- d. **Fencing** – Farmers' crops are often destroyed by animals, mostly cattle. The fence is destroyed in some areas resulting in theft and vandalism. Even if the fence is repaired, some people just destroy it. People also openly graze their cattle in the scheme and this worsens the problem.

Possible way forward: The police and authorities should enforce the laws and help curb this problem by arresting or punishing the perpetrators. Regarding the grazing of cattle in the irrigation scheme, the issue is far complicated since there is a huge potential for conflicts.

- e. **Finance** – When asked where how they got their current inputs, farmers revealed that they use the little money they have or borrow from stokvels which charge approximately 20% interest on loans. They don't borrow from other financial institutions because they cannot meet the demands of collateral and the high interest rates.

Possible way forward – According to farmers, Stokvels are their only solution. However, it will be good to have a cooperative based stokvel.

- f. **Land** – Land allocated in the scheme remains within the family and is rarely taken away from the farmer. For farmers in homestead food gardening, there is land that is not being used but there is not enough water. Homestead food gardeners in this group report that they were once organised as a group by the DARD so that they could be assisted with inputs. However, they never receive the input support they were looking for and hence the group disbanded.
- g. **Gender** – Women farmers in the group reported having challenges trying to balance farming and other care tasks expected of them. The most difficult tasks that suffer at home because of them participating in the irrigation schemes are cleaning, washing clothes and caring for their children.

Possible way forward: Interventions have to be gender sensitive.

- h. **Cooperatives** – Farmers in this group are of the view that cooperatives help a lot since they reduce the burden of financial contribution because the obligation will be divided among many farmers.

10.4.4 Cluster 5 – Mixed farming and physical capital endowed farmers

- a. **Water** – Farmers are facing a drought in their community food garden. They suspect there might be underground water but they are not sure about it. The drought has caused them to move from their large and fertile field to other small plots near the Pongola river in search of water.

Possible way forward: No feasible solution because as long as there is drought and Jozini dam is not full, there will always be a challenge. Water harvesting has to be practiced more.

- b. **Markets** – The markets for farm produce are far in areas such as Durban. Thus, farmers end up selling to hawkers individually. The hawkers do not pay them enough for their produce. For example, they pay R30 for 15 kg of green beans and farmers expect to get R80-R150. Private companies sometimes do provide or promise contracts for certain produce.

Possible way forward: Although they are now organised as a cooperative they are yet to be registered. They have tried to call UDA to assist with marketing their produce but they received no response as yet.



Figure 10.3. FGD with Cluster 5 farmers in Makhana, Ndumo

- c. **Inputs** – Farmers find it difficult to find inputs close to them and they travel to Pongola.
Possible way forward: They propose that they need agro-dealers close to their area. Why and how that has not materialized is a big question for further investigation. According to an official from Mjindi Farming, the market is not attractive enough for private firms to open inputs supply shops in Jozini.
- d. **Tractor** – Farmers obtain tractor services from Ndumo-B irrigation scheme and sometimes they take long to help them.
Possible way forward: They need closer tractor services to make it accessible and timely. Farmers are in the process of forming their cooperative. They indicate that the idea came up because they need to position themselves to also receive support from government. However, they think communication and working as a group is tough. Their combined land is more than 50 ha, a requirement by the DARD for a cooperative to receive tractor support from government.
- e. **Fencing** – Farmers said that livestock destroys their produce due to poor fencing. Currently, they mostly use shrub fencing. The area they use is shared with livestock.
Possible way forward: They propose fencing of the portion they use for farming. They said it won't cause conflict between the community and them since they are the owners of some of the livestock. The challenges are the resources.
- f. **Pump** – Farmers mentioned that they are paying a lot of money to buy petrol and/ or diesel for the pump (R3,000 per hectare).
Possible way forward: Farmers suggested a solar pump would help them to reduce the expenses. A company called Accentia is doing a pilot in an area close to them (Ndumo-B irrigation scheme) and they seem to appreciate the idea.
- g. **Credit** – Farmers use stokvels or borrow among each other to access credit. Stokvels charge between 20-40% interest per month. The challenge is that sometimes the farmers do not harvest anything or much and hence are unable to pay back the loans.
Possible way forward: Farmers said they prefer to be given inputs as a loan and pay with produce. Those with livestock concur that cattle can be used as a collateral.
- h. **Land** – Farmers wish for a scenario where they can irrigate the whole year just like their counterparts in the schemes. They reported that land for irrigation can be borrowed or rented to another person depending on their agreement. Women in the community are given land even if they do not have a husband.
Possible way forward: The capacity of the irrigations schemes should be increased.

- i. **Gender** – Women farmers in the group indicate that they carry a heavy burden due to their other home responsibilities. They are dividing their time between house duties, taking care of the children and farm work. Men divide their time between farming and looking after their livestock.

Possible way forward: Development and awareness interventions to reduce burden on rural women.

10.4.5 Cluster 6 – Young and educated farmers

- a. **Water** – Farmers mentioned that Mjindi charges for water even if they didn't use any. They indicate that the challenge emanates from the water infrastructure (engines and underground pipes) in the scheme which is old, resulting in constant breakdowns of the underground pipes. However, Mjindi indicated that it is too expensive to replace the whole system. Furthermore, farmers indicated that Mjindi sometimes delay to open water. For example, they are supposed to open water from 6 am-6 pm but they open it at 10 am when the heat of the sun is already high. Homestead food gardeners mentioned challenges with water. Some illegally extract water from the canal or from the tap water provided by government.

Possible way forward: The water system needs rehabilitation. Homestead food gardeners in the group think that getting tanks would assist them with reducing water shortages.

- b. **Tractor** – They hire tractors from private individuals who take time to reach their places. This delays farming activities.

Possible way forward: Farmers suggested that getting their own tractor that they can share amongst themselves would be a better option. Farmers in homestead food gardening also requested tractor services.

- c. **Markets** – Farmers report challenges in marketing of their produce. Some do have access to formal markets like Pick and Pay, Spar and Shoprite. However, such shops only buy a small amount of their produce. Some homestead food gardeners sell their produce at pension points. Farmers felt they are being robbed or cheated by the UDA which was introduced to them by the Department of Rural Development. They buy a 20 kg sack full of cabbages for only R18 from farmers. They feel that they do not have to be treated like commercial farmers who produce in large quantities with smaller per unit production costs.

They mentioned that sometimes van drivers want money in advance to transport produce but the farmers only receive money after they have sold their produce. The key challenges to benefit from mainstream market – supplying the quantity and quality of the product demanded by the market consistently. These services are limited or unavailable and are not available on time and the services are expensive.

Possible way forward: All these and other stakeholders must come together and arrive at contextually relevant solutions.

- d. **Transport** – Farmers indicated that they incur high transport costs to carry their produce to the markets and also to buy inputs in town. Previously, extension officers from the Department of Agriculture used to assist them by using the vans for the department but now Mjindi has been assigned to them and the department no longer assists farmers in Makhathini irrigation scheme as it used to.

Possible way forward: Farmers want the Department of Agriculture to come back because Mjindi is failing on its own (due to lack of resources). They want the department to help them with free transport for their produce like before. They also propose the establishment of an Agri-Village selling all inputs that farmers require (fertilizers, sprayer, knapsack, seeds, etc.).

- e. **Land** – Farmers leasing irrigation land from the Ingonyama Trust Lands risk to have water cut off or in the worst-case scenario, land taken away from them, if they fail to service their lease.

Possible way forward: Farmers leasing irrigation land have to make sure that they can service their lease before they sign the agreement.

- f. **Credit** – Farmers with livestock sell some of their livestock to get money to buy inputs. Those with no livestock borrow money from loan sharks at a 30% monthly interest rate and they take their property if they default on payment. Homestead food gardeners indicated that they have little working capital. They finance themselves.

Possible way forward: There is need for a government supported credit loan scheme.

- g. **Fencing** – Farmers need fencing. Although the fencing is sometimes repaired, some people cut it and steal.

Possible way forward: Farmers suggested using fencing that is different or unique that will expose those that steal and use it in their homesteads.

- h. **Women** – Women find it difficult to engage in crop farming activities and keep up with the house chores like washing clothes and cleaning the yard.

Possible way forward: Development and awareness intervention to reduce burden on rural women.

10.5 To what extent do farmer development pathways compare with the findings of the research team?

Table 10.1. Comparison between researchers' findings and farmers' views on entrepreneurship development pathways

Item	Researchers' recommended development pathways	Farmers' preferred pathways	Comments
Land	- Expansion of irrigation land to target independent and homestead food gardeners regardless of their cluster. - Those not interested should be supported on existing land. - Engagement of traditional authorities on how to improve land tenure security for all farmers.	- Independent irrigators suggest possible consolidation of their land to establish small schemes in their current areas of operation. - Homestead food gardeners did not suggest moving into allocated plots as an option despite the water challenges they are facing. - Scheme irrigators with very small land allocation (0.1-0.2 ha) propose to be allocated land in new schemes and renting of land as options to increase their land sizes.	Some similarities between farmers and research team's suggestions exist. The major difference can be seen regarding scheme irrigators. Research team suggested irrigation expansion in terms of intensive farming and not increasing land sizes for farmers in the schemes contrary to farmers' proposal. Although farmers did not have any proposed way forward for dealing with land tenure security, discussions with Cluster 6 revealed land tenure challenges for those whose land is leased from Ingonyama Trust Lands.
Skills development	Skills development to focus on production of high value crops,	Only Cluster 2 & 3 suggested the need for expertise and knowledge to deal with weeds and pests.	It seems lack of skills is not a major issue per the farmers' views. None mentioned

Item	Researchers' recommended development pathways	Farmers' preferred pathways	Comments
	irrigation water management and business and entrepreneurial skills.		any business or entrepreneurial skills gap as a challenge to farming operations.
Access to credit	- Explore the use of stokvels as a strategy for financing smallholder farmers. - Implement a Revolving Credit Fund to support old and new scheme farmers.	- Utilise stokvels or form a cooperative stokvel controlled by farmers which will offer low interest rates. - Input loans schemes which are paid through produce. - Government supported credit loan scheme.	Research team and farmers' suggestions are similar. Farmers are unable to meet the requirements of banks or microfinance institutions which is the reason for their proposal to use stokvels.
Farm mechanization	- Enhancing access to farm mechanization services such as tractor services. - Support with mechanization services at cost recovery.	- Avail more tractor services at critical periods such as land preparation. - Farmers prepared to meet the cost of getting the service or of maintenance if supported with tractors.	Proposals are similar except that there is no clarity on where the initial investment cost can come from.
Market access	Investment in pack houses, distribution hubs and transport infrastructure.	- Engage with authorities to discuss pricing of their produce. - Authorities should commission and open already existing marketing infrastructure to utilisation by farmers.	The differences between the two sets of proposals is that the former is more long-focused and the latter are short-term immediate solutions to try and deal with the

Item	Researchers' recommended development pathways	Farmers' preferred pathways	Comments
		Organize themselves into cooperative.	problem. Both sets of proposals are needed to improve farmers' access to markets.
Cooperative transformation	- Transform and reposition cooperatives as the central strategy for enhancing farming and farmer livelihoods. - Address farmers' negative attitudes towards cooperatives.	- Form cooperatives to receive support from government. - Independent irrigators believe that cooperatives are important in smallholder farming.	Farmers and research team agree that cooperatives in principle are important in transforming smallholder farming. The key challenge is how to make them work for smallholder farmers, redefining their formation and management.
Water	- Volumetric charging of water for individual farmers in scheme - Water harvesting techniques for farmers outside of the scheme.	- Change to volumetric metering to reduce unnecessary water charges in the scheme - No solution given by independent irrigators in Cluster 5 as they are at the mercy of the rains.	Suggested strategies are similar but research team gave one more proposal for farmers outside of schemes.
Rehabilitation of water infrastructure	Support with rehabilitation of water infrastructure.	- Provided that their farming is profitable farmers propose to use part of their profit to maintain water infrastructure. - Engage authorities managing water resources such as Mjindi Farming.	Strategies are similar although the farmers' proposals are more specific and show that farmers are willing to own the problem. However, initial support will be needed for

Item	Researchers' recommended development pathways	Farmers' preferred pathways	Comments
			rehabilitation of infrastructure. This can also be done on a cost recovery basis.
Gender mainstreaming	Promote technologies that reduce the labour burden on women.	- Find house help to free more time for women to participate in productive economic activities - Mobile clinics to improve women farmers access to health services and reduce risks posed by agro-chemicals they use	The first proposals from the research team and farmers resonate with each other. Farmers also suggested another pathway related to their health which is critical for farming.
Extension services	- Promote demand-driven extension services - Use of mobile phones as a key extension tool to disseminate information. - Increase number of extension officers and refresher courses.	DARD to reengage and start providing extension services to all farmers regardless of whether they are in the scheme or not	Proposals are similar. Research team make more comprehensive suggestions on improving agricultural extension services.
Crop and livestock	Promote crop and livestock integration for farmers practicing mixed farming.	Find ways in which livestock and crop production co-exist	Similar pathways

Item	Researchers' recommended development pathways	Farmers' preferred pathways	Comments
Transport and inputs	Investment in transport infrastructure to assist farmers to procure inputs and sell their produce.	- Establishment of Agri-Village selling all inputs required by farmers - PDARD to assist farmers with transport as they used to in the past	Similar proposals. Research team is aware of the establishment of agri-parks in districts with study areas and thus propose an investment in transport infrastructure to link farmers to these areas
Theft	No suggestion as it didn't come out from the survey.	Farmers believe there is no solution since their numerous efforts to engage authorities have failed. The law should be enforced and punish those destroying the fence	Research team did not include this aspect in their proposed development pathways. Enforcement problems need to be addressed.
Fencing	No suggestion as it didn't come out from the survey.	- Farmer could hire guards to prevent destruction of their fence and agreed to contribute towards the cost - Use fencing that is unique to expose the thieves - Fencing needed by independent irrigators	Research team did not include this aspect in their proposed development pathways

Item	Researchers' recommended development pathways	Farmers' preferred pathways	Comments
Soils	No suggestion as it didn't come out from the survey.	Cluster 1 suggested that farmers should use white lime to curb the problem of soil alkalinity	Research team did not include this aspect in their proposed development pathways as it didn't come out during the research.
Power	- Installation of electricity supply infrastructure near each cluster of independent irrigators - Designing of canal systems where it is possible to supply water to clusters. - Exploring use of solar system as an alternative source of energy for pumping water.	Independent irrigators suggested that they need assistance with solar installations to reduce cost on fuel	Similar proposals although research team gave other alternative options to reduce the cost of pumping water for independent irrigators

10.6 Possible ways forward from the discussions with farmers

10.6.1 Short to medium term areas for action

- Improving communication and engagement between the farmers and Mjindi Farming. There seems to be some ongoing blame game among the farmers, the district DARD offices and Mjindi farming. This has to be addressed as immediately as possible. Independent consultants/NGOs can serve as mediators to make sure that Mjindi and the department are fulfilling its mandate to the best interest of the farmers.
- Addressing tractor services problems. This entails availing more tractors and also linking the farmers to the service where they are absent. Inviting private sector suppliers of the tractor service during planting season is a possible alternative.
- Availability of inputs – Conduct feasibility research on input value chains to understand issues with suppliers of agricultural inputs such as Venchem and why they closed their outlets in Jozini or why they do not open shops in the area. Invite private sector to establish businesses and come up with input distribution models with a win-win situation on the part of the businesses and the farmers. The most important factor is to bring the service closer to the farmers than it is right now. For example, agro-dealers in Pongolo can have agents in Jozini with farmers placing orders and agents delivering orders to the farmers in their fields.
- Engage local health facilities with propositions for mobile health services specifically for testing and immunizing against health problems linked to chemicals that farmers frequently use.
- Engaging the traditional leaders to enforce agreed upon community measures for redressing or compensation of farmers facing problems of theft and crop destruction by livestock.
- Farmers can form watch committees whose role will be to patrol the fields on a rotation basis when their produce is about to be harvested. This might involve engaging husbands and local youth to provide the services.
- Establish a mutual relationship between farmers and livestock owners regarding how crop residues can be fed to livestock without vandalizing the fence. The proposal can even include a simple way of compensation.
- The DARD to send expertise to investigate pests and recommend effective pesticides and herbicides.

10.6.2 Long-term areas for action

- Installation of solar systems to reduce costs of pumping water for independent irrigating farmers. There is a need for a cost benefit analysis to check the net worthiness of such an investment. Also, check with those who are already using such a system and get some lessons learnt.
- Markets – engage policy makers (and critically assess how farmers in Makhathini will benefit from the proposed Agri-Park in Mkuze) and explore the possible pricing systems that can benefit the smallholder farmers and protect them from commercial farmers who produce large quantities at lower prices. How will the Agri-parks work? Can price subsidies work? Is there any potential for warehouse receipts and contract farming?
- Land reform – going forward, in establishing new schemes there is need to think of meaningful minimum hectarage that should be allocated to each smallholder. There is a need to engage the traditional leadership on this and investigate the willingness of farmers to relocate to redistributed farms under land reform.
- Improving access to credit – There is a need for constructive debate among key stakeholders on what solution would work for both the private sector and smallholder farmers. This is because farming is risky with no insurance, income flow is not consistent and that farmers do not meet currently required collateral conditions. The question is what other models can be used to finance smallholder farmers? Is microfinance a solution for rural smallholder farmers in South Africa? Is there any potential for stokvels?
- Collectively, there is scarcity of strategic and long-term planning.

11 CONCLUSIONS, POLICY IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS

11.1 Recap of the purpose of the research

In South Africa, most smallholder irrigation schemes are found where the incidence of poverty is the highest, presenting an attractive opportunity for the development of local livelihoods. The expansion of smallholder irrigation is thus identified in the NDP Vision 2030 as critical to creating employment, increasing income and food security. Ideally, irrigation is expected to boost productivity and income by providing adequate water throughout the growing season, thus contributing to higher yield, making water available/accessible and providing a more secure supply of fodder for livestock and reducing production risk and the need for farm output diversification, thereby encouraging farmers to gain the benefits of greater specialisation and commercialisation.

Despite the investments made so far, the literature shows that the performance of smallholder irrigation in SA is poor. The sector has failed to make a meaningful contribution to food security and employment creation. This poor performance has been attributed to, among other factors, the failure of existing agricultural development programs to develop the human and social capital to effectively manage the schemes, engage in productive agriculture and participate in high value markets. Inevitably, this has led to the inability to take advantage of the huge potential and opportunities presented by smallholder irrigation to transform rural economies.

It is also high time to understand the possible unintended consequences and disincentives linked to welfare policies such as social grants. To show the way forward, research needed to be carried out which is based on real situations on existing irrigation schemes where solutions are practically achievable. Since it is acknowledged that the situation on all smallholder irrigation schemes is complex and diverse, it was imperative to follow a holistic approach incorporating the natural, human, social, physical, financial and PsyCap endowments presently available or potentially accessible or the constraints thereof.

The wide gap between actual and desirable performance of irrigation schemes necessitates proper institutional reforms and comprehensive plans for implementation, starting from micro-level (plotters level) so that productivity can be improved and livelihoods enhanced. To this end, this project aimed to provide a series of research result-based advices to the relevant stakeholders to give the beneficiaries a jumpstart on planning for their farm as a business. Its purpose is to review and synthesize the stock of knowledge and evaluate appropriate development paths. To this end, the following specific objectives were pursued:

- To evaluate natural, physical and financial assets with specific attention to irrigation farming potential;
- To evaluate human and social assets with particular attention to entrepreneurial spirit and management capabilities within incentives of secure land tenure, water use rights and leadership in organisational structures;
- To determine sources of livelihoods and opportunities to improve contribution by farming within available food value chains;
- To determine the aspirations and goals of farmers to expand irrigation crop production from homestead food gardens to irrigation plots and/or from one to more than one irrigation plot; and
- To formulate and test appropriate development paths for establishing sustainable farming businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes.

In South Africa, agricultural development has been placed at the core for rural development and smallholder development in particular. However, the role of smallholder agriculture to poverty reduction has been by and large negligible. Smallholder farmers face various challenges with land and water and the institutions governing them being amongst those challenges. The land and water use rights and the challenges therein are little understood at local levels in the rural areas and also their impact on productivity and entrepreneurial spirit. Taking a bundle of rights approach to measure both land and water use rights, this study examined farmers' perceptions of their use rights. It further investigated other challenges related to access to input and output markets that hinder smallholder development.

The project is expected to impact society (livelihoods in the rural areas), the South African economy, human health and the environment. It aims to contribute towards changing the imperative that farming is the lowest source of livelihood for homestead food gardeners and smallholders (Backeberg and Sanewe, 2010). Hence, it was felt necessary to assess if the same scenario as observed in other studies holds for homestead food gardeners and smallholder producers in Makhathini, Ndumo-B, Tugela Ferry and Bululwane. The conceptual bases for the design, analysis and interpretation of the results was drawn from the body of work including the sustainable rural livelihoods approach (Scoones, 1998; Carney *et al.*, 1999; De Satgé and Holloway, 2002; Ellis and Freeman, 2005); wealth at the bottom of the pyramid (Prahalad and Hammond, 2002; London, 2009); rural entrepreneurship, innovation & farmers' entrepreneurial spirit (McElwee, 2006; 2008; Drucker, 1985; Kirzner, 1973); complexity economics (Arthur, 1999); water productivity (Yokwe, 2009); and access to small-scale irrigation water, water

scarcity and water use security (Senyolo *et al.*, 2014). Integrating all of these concepts was found critical to lay out the mechanisms and understand the challenges holding up rural people for transforming smallholder agriculture.

The literature has fallen short in conceptualizing, defining and measuring entrepreneurship that is suitable for agriculture and more specifically, smallholder agriculture. With this gap in mind, this study sought to identify avenues of making the concept relevant to smallholder agriculture. This study made an empirical contribution to the limited and scarce literature on smallholder entrepreneurship. Moreover, the study provided more information about the drivers of and the barriers to entrepreneurship development for smallholder farmers, including farmers' aspirations to expand their farming operations. For the government's strategy to be successful, more understanding is needed on the relevance of the mainstream concept of entrepreneurship to smallholders, implications of farmer heterogeneity, aspirations of farmers to expand irrigation farming and management and efficient utilisation of irrigation water resources.

The rest of this chapter is structured as follows: Section 11.2 provides the conclusions, drawing from the empirical results. The policy implications and recommendations are contained in Section 11.3. Finally, Section 11.4 presents future research directions, drawing from field experiences and knowledge gaps identified in the literature.

11.2 Conclusions

Irrigation infrastructure remains underdeveloped in the study areas, making it difficult for the producers to grow the high-value crops which usually have high water demands. High cost of electricity and the condition of water-related infrastructure is threatening water security. In areas such as Bululwane Irrigation Scheme, there were many community food gardens that were no longer functioning because of physical water scarcity. Asymmetry regarding government's support to the Makhathini and Ndumo-B irrigation schemes was observed. Farmers in Makhathini irrigation scheme enjoy government support in the form of a subsidy that reduces their cost of accessing water and yet the same cannot be said about farmers from Ndumo-B Irrigation Scheme.

The range of crops that farmers grow is widely diversified but cabbage, green maize and beans are the most important. There is market for cabbages even locally although farmers could earn more if they can sell in high value markets. Farmers struggle to access markets that will provide them with favourable prices for their produce and others sometimes don't even have a market to sell to, which often leads to post-harvest losses. Hawkers/van traders play an important role in the marketing of produce from the four irrigation schemes. However, this comes at a cost to farmers, lower farm gate prices. Farmer participation in markets is at the tail end only as producers; they do not process or add value to any produce; all crops (even other enterprises) are sold raw.

Frequent drought has impacted smallholder farmers (livestock and crop producers) severely, especially since most of them are fulltime farmers and depend on farm income to feed their families. As a result of this, most farmers have had to rely on social grants. The shortage of water caused by drought has made access to irrigated land even harder especially by young people. However, due to the old age of most occupying farmers, interested young people have the opportunity to rent land that old or sick people are not able to utilise.

Despite huge investments, irrigation schemes still underperform or collapse. Institutional/government/market failures have made smallholders in South Africa the way they are. Current institutional arrangements governing water sharing and management fail to support expanded irrigation activity in all the schemes. Due to these failures, farmers are divided over the issue of individual or collective irrigation farming. Lack of cooperation and lack of adherence to agreed cooperative rules and regulations is cited as the major problem. Lack of secure access to water affects every member of the cooperative. Lack of transparency and perceived nepotism in the cooperative leadership in the past have made most members lose faith in this organisation which is one of the most important reasons for the decreased popularity of collective action among smallholder irrigators. Collective action is hindered by poor relations among farmers and buyers, characterised by low levels of trust, lack of norms of reciprocity and poor reputation for farmers when it comes to meeting their market obligation in terms of volumes and quality. As far as smallholder irrigation goes, the major problem is the lack of capacity to collectively manage the irrigation scheme. Collective water infrastructure management is a key factor in smallholder irrigation for which collective action organisations will have a key role to play.

A large number of farmers, especially the youth, have low interest in agriculture in general and smallholder farming in particular, as it is said not to generate quick and hassle-free returns on investment. The lack of interest in farming by young people as expressed by smallholder farmers can potentially hinder the transition from smallholder farming to commercial farming. There is limited involvement of young people in farming. Farming, an economic activity perceived to be “not sexy” by the youth, is taken to be a grown-ups occupation that does not bring quick return. This is not good news for the future of agriculture as it raises a question of succession plan.

Although there are many old and few young people involved in farming, findings show that younger farmers are more interested in the expansion of farming operations than older farmers. Older farmers might have little or no incentive to expand farming operations due to their old age. Young people hold the greatest opportunities for expansion and growing the smallholder farming sector. Elderly and uneducated individuals dominate in smallholder farming, indicating the

deteriorating labour productivity, output and motivation to adopt innovative technologies that can increase overall water productivity.

People in rural communities do not consider farming as a lucrative business compared to other businesses and they do not believe that farming provides opportunities for employment creation and income generation. Thus, most rural people engaged in farming do so because it is the only option available. If better opportunity arises in the future, they are eager to move out of farming. This can be referred to as ‘opportunistic farming’. Many of these farmers take farming as an activity to hold on simply because there is nothing else to do. For these farmers, farming is not a preferred activity for making a living. This is an inherent problem with multi-dimensional implications. It negatively affects PsyCap and mindset. It destroys the incentive to identify ways and means of farming productively. Under these circumstances, the farmer can’t be expected to have long-term interest to invest on the farm with a vision. It remains an economic activity that the farmer might abandon if any better opportunity comes up. Certainly, for young people this is even more pronounced with most of them preferring to migrate to nearby urban areas to do menial jobs. A substantial number of smallholder irrigators exhibit this mindset and should a better opportunity arise, such farmers will opt out.

For homestead and community food gardeners, farming is a source of food and to a lesser extent income. For scheme and independent irrigators, farming is more of an income generating activity, the major income earner in the household. There are a few opportunities for earning off-farm income through temporary employment (mostly in the schemes) and salaried jobs. According to the survey results from Bululwane and Tugela Ferry irrigation scheme, most of the farmers would rather be engaged in other forms of income sources rather than farming if they had the opportunity to do so. Owing to their poverty, most farmers tend to make short-term survival maximizing decisions.

Transformation and successful on-farm entrepreneurial development paths depend mainly on transformation of farmers’ mindsets. However, changing mindsets is complicated as the behaviour is entrenched over a long period of time and it is a process that requires collective effort from all stakeholders, particularly those in education, extension and public transfers. The potential to transform homestead food gardening and smallholder farming would depend on the attributes of farmers (resource endowments, objectives in farming, constraints, opportunities and mindsets). Smallholder irrigation offers a better chance to run small farms as businesses. It allows farming of certain crops that would have otherwise been impossible under rainfed conditions.

Expansion of farming activities (e.g. introducing high value crops and double cropping) is a preferred roadmap by most smallholder farmers, particularly scheme and independent irrigators.

Relatively, few homestead food gardeners and more so community food gardeners are sceptical about further expansion. However, these could be individuals who follow a “wait-and-see” strategy and never show interest in something the first time they are told about it or they might be those farmers who believe they cannot cope up with the demands of collective management of irrigation schemes. The results from Tugela Ferry and Bululwane irrigation schemes suggest that farmers inside the irrigation schemes are more willing to expand their farming operations compared to those that are out of the schemes. Those farmers in the schemes see more potential as they have better access to water and productive land. Age was more important than gender in determining their willingness to expand farming operations, i.e. farmers that are not yet receiving pension grant are more willing to expand their farming operations.

It is clear that current available land in Makhathini and Ndumo-B schemes would not be able to contain expansion of farming activities in the two schemes. This might entail an investment in the expansion of the current schemes or identification of other sites for such development. Land (with secured supply of water) availability and financial constraints limit farmers’ ability to expand their farming operations in Bululwane and Tugela Ferry Irrigation Schemes. Even though there are farmers that have land, they often don’t use it because of the drought. There is an informal land market in the rural areas surrounding the schemes, including land leasing and renting. The emergence of this market points to the existence of farmers who cannot farm their land any more for various reasons including limited finance, lack of labour, incapacity due to illness and holder absentee, among others. The problem is the uncertainty in the areas of lack of security of land tenure or the mindset that any time the land could be taken away. Moreover, the land allocated to smallholder farmers can neither be transferred nor used as a collateral as a result of which farmers are not able to access credit.

Building positive PsyCap enhances farmer aspirations to expand irrigation farming. PsyCap has proven to be an important asset to successful transformation of homestead food gardening to irrigation farming or expanding from one to more than one plot in the schemes. The importance of PsyCap in explaining heterogeneity in farmer typologies, aspirations and the entrepreneurial spirit of smallholders is quite evident from the findings. In general, homestead food gardeners are poorly endowed with PsyCap compared to community food gardeners, scheme and independent irrigators. However, this is conditional on their capacity to absorb the impact of shocks, willingness to take risk and capacity to delineate goals in farming. It is the innate entrepreneurship spirit and the PsyCap that enables farmers to reach commercial targets. Thus, the poverty of this livelihood asset has negative implications for on-farm entrepreneurship development. Low PsyCap endowment is entrenched and hence difficult to address with short-term and isolated

actions. Moreover, even though some farmers have a better positive PsyCap endowment, they still lack the skills and resources that they would need to remain profitable in the whole value chain.

Though smallholders have limited access to production credit, the current rural financial markets composed of unregulated informal organisations, are making smallholders more vulnerable by extending short-term consumption credit at exorbitant interest rates. This negatively affects their capacity to invest and realize their aspirations in irrigation expansion and hence on-farm entrepreneurship. Thus, improving access to input and production finance is important for the expansion of irrigation farming. However, this is not possible with rural financial markets which are currently dominated by informal organisations (stokvels and loan sharks) that offer consumption credit at very high interest rates.

If farmers were to expand their farming operations without changing the current financial and product market conditions, they will continue to make post-harvest losses. When farmers don't have access to markets, they end up not yielding the profits that they had expected and that discourages them in the future. Collective organisations such as cooperatives, if supported and transformed in the way they function, are vital instruments for enhancing smallholder linkage and participation in high value markets. Given the scale of production, resource endowment and the current competition in the markets, the smallholder farmers' greatest unexploited opportunity remains in their numbers – wealth at the bottom of the pyramid. Collective action organisations (such as cooperatives and farmer groups) have a role in reducing transaction costs and improving access to inputs and services, especially to homestead food gardeners and other smallholder irrigators. Group marketing enhances farmer bargaining power. However, successful collective action will depend on the development of trust among the role players and leaders of the organisations.

Smallholders and their context do not conform to the common neoclassical paradigm underpinning the mainstream concept of entrepreneurship. Profit maximisation is not always the primary objective of most smallholders. Farmers often exhibit satisficing behaviour which is contrary to the ideals of mainstream entrepreneurship. Entrepreneurship is a mindset referring to the question of taking one's destiny in his/her hands. As dependency mindset has been the result of many years of surviving on unearned income (mainly social grants and remittances), changing smallholder farmers' mindset will take time. Farmers' mindset is one critical resource that determines farming decisions and behaviour and hence entrepreneurial spirit. The system of continued hand-outs and farmers' expectations for continued support for recurrent maintenance costs cripples the entrepreneurial spirit and the rural community in the long run.

Farmers who possess more positive PsyCap were more persistent and productive despite prevailing constraints and challenges (such as market access). It was noted, however, that the majority of farmers had less confidence in themselves (endowments and capabilities) because over time they have developed a dependency syndrome, expecting that government has to do everything for them. This syndrome reduces self-confidence of smallholder farmers, depletes positive PsyCap and hinders their potential to become large commercial farmers.

The findings demonstrate that smallholder farmers face many challenges like drought, pests and crop diseases, scarce land with water, market availability, old age, low levels of education, availability of quality infrastructure like good roads within the schemes and good cellphone network connections, lack of finance and access to quality inputs. Farmers indicate that government input support programmes do not address their real challenges/needs in terms of timeliness and quality of the services. The major challenge for most smallholders was access to land with water and physical infrastructure. Due to these challenges, the contribution of smallholder agriculture to total family income is low and the major contributor to smallholder farmers' total income is social grant.

In Makhathini irrigation scheme, the tenure system that exists for water is the agency control tenure system which was criticized by smallholders as it is not inclusive in water-use decision - making. In Bululwane and Tugela Ferry irrigation schemes, the tenure system that was used is the customary water tenure system and water is managed by scheme committees and not WUAs. In all the schemes, land is collectively used and managed by local groups or traditional authorities under customary tenure. It is not clear what benefits privatization of individual land title would bring to improve productivity or investments in land when commons are governed collectively and effectively. The results indicate that land titling alone will not be sufficient to increase access to formal credit as smallholders indicated that collateral is not the only limitation but issues of not having a consistent monthly income and lack of formal credit history.

Heterogeneity in the smallholder irrigation sector happens at two levels, i.e. the farmer (including differences in livelihood assets endowment, access and participation in key organisations and other features) and geographic area or what can be called the spatial dimension of heterogeneity. At the farmer level complexities are introduced due to differences in resource endowments and ability of the farmers to identify and utilise available opportunities. This is further complicated by differences in positive PsyCap endowment among the farmers. Spatial differences will impact on the potential growth of the smallholder irrigation sector in each rural area. Differences in the agricultural potential, institutions and infrastructure that enhance (or otherwise) market access and access to livelihood assets affect the extent to which growth can be achieved in the

smallholder irrigation sector for each area. Six farmer typologies have been identified in smallholder irrigation in South Africa. These are risk taking and opportunistic farmers, ambitious, optimistic but social grant reliant farmers, young and educated, farmers with access to information but limited access to credit, risk taking and opportunistic but with limited access to credit and mixed farming and physical capital endowed farmers.

Most of the developed pathways proposed by the research team compare quite well with those proposed by farmers with some minor differences in specificity and detail. One major difference between the two recommendations is that while the research team makes long-term suggestions, farmers' suggestions are of immediate and short-term nature. This could be attributed to the short-term decision horizon of the farmers, most of them being below the poverty line.

11.3 Policy recommendations

The study makes several recommendations for transforming and improving homestead food gardening and smallholder irrigation in South Africa. This section presents the major recommendations of the study. However, these should be read together with several farmer typology and study area specific recommendations presented as part of Chapter 9 and 10 of the report.

More intervention is required to better utilise the available capital assets and increase the competitiveness of smallholder farmers. Public focus should not only be on the physical and financial assets but also on social, human and psychological assets. Strategies must be holistic in nature, taking into account the important connections and complementarities of the various forms of capital. The activities of different players involved in the smallholder producer sector should be coordinated and integrated so that they support each other. Strong working relationships based on trust and good business ethics should be encouraged among farmers and other role players in the farm product value chain. Above all, a rational and integrated approach to management in all these areas is needed to run smallholder farming as a business and make it profitable.

Although smallholder irrigation farming can make a contribution to poverty alleviation in rural areas, it would have to be supplemented by the development of wide-ranging programs which not only develop agriculture but also improve skills to take advantage of non-agricultural income sources. Strategies need to focus on wide-ranging approaches inclined towards developing and improving skills outside agriculture given the plethora of income sources that the farmers may engage in to further enhance their livelihoods. The use of welfare grants for agricultural purposes may be a strong signal for the development practitioners, governmental and non-governmental organisations to mobilize resources earmarked towards farmers.

Government should promote mentorship programmes for smallholder farmers. This could involve large-scale commercial producers motivating smallholder farmers and giving advice on how they can succeed in a competitive agricultural industry, or the more experienced and entrepreneurial smallholder producers mentoring their fellow new- and less established smallholders. Farmers can also learn marketing by selling their produce with that of their mentors to increase volumes.

It is also important to build public-private partnerships around farmer development initiatives. The private sector should become an integral part of developing smallholder producers through, for example, local procurement of their products and services and offering input and credit schemes for smallholder entrepreneurs. In this regard, contract farming can be tested. Contract farming should be encouraged between smallholders and private players. Contractors would bring in expertise and training programmes for contracted farmers and through social networks, information will flow to other farmers. This has a potential to improve production and marketing in the long run. This should be accompanied by tailor-made training, so that the producers work towards meeting the qualities and quantities required by the market consistently. Smallholders have a responsibility in the development of a mutual relationship of trust between them as the sellers and the buyers. Smallholders should be enabled to adhere to industry standards which allow consistent production and delivery of high-quality produce.

Related to input support, government must give seeds to irrigating farmers in intervals or in a coordinated manner so that they don't all harvest at the same time and flood the market with the same produce. There must be a database of van traders that smallholder farmers can use to call them when their produce is ready. By increasing competition among van traders, farmers can receive better prices for their produce. However, there is a need to improve the road network in the rural areas and within the scheme for easy access.

There is a need to find ways to reduce high transaction cost of marketing farmer produce. Ultimately, smallholder irrigation farmers should be able to use their advantage in numbers in procuring inputs and in crop production and marketing. Farmers and other value chain role players should realize that there is power in numbers and strengthening formal and informal collective action organisations is their gateway to the establishment of successful farming businesses. Thus, group marketing should be explored to improve the role of collective action organisations such as cooperatives and farmer groups. For example, in consultation with cooperatives and farmer groups, government should negotiate and enter into partnerships with agricultural input suppliers and major markets for crop produce for packages or deals aimed at cooperatives or farmer groups that benefit both the farmer and the supplier or buyer, to facilitate access to inputs and reduce high transaction cost of marketing crop products beyond the local markets.

There is a need to improve the role of collective action organisations such as farmer groups to reduce transaction costs and facilitate access to inputs and services that are otherwise inaccessible for cost or other reasons. Crop quality and standards together with value addition will enhance the competitive advantage of farmers in the market. Branding will also be important in marketing, especially if the products are organic and produced through a process that is environmentally friendly.

More effort is needed to involve smallholder farmers who have years of primary production experience but have never been involved in the value chain of the food they produce. To achieve this, farmers would have to learn more specialised skills to be able to understand the markets through working closely with extension agents and agricultural economists. In addition, farmer trainings need to be translated into isiZulu so that they can be able to understand what they are taught and be able to implement. To understand markets, farmers need to be taken to fresh produce markets and they need to practically see how they work and assess how they can engage with such markets. Government could adopt a phased approach where smallholder farmers are supported through different policy instruments to allow them to compete with established farmers in the food markets and then gradually weaned off to stand on their own.

Entrepreneurial activity is a continuous process rather than a once off individual event and as such, surveys specifically designed to measure individual participation (in entrepreneurial activities – farming and non-farming included) across a range of phases are important. This allows for the measurement and assessment of current entrepreneurship levels among smallholder irrigation farmers, adaptation and redefinition of entrepreneurship in the context of smallholder agriculture, entrepreneurial intentions, nascent and new farming business activity, progression into established business ownership and the reasons for business discontinuance (if any).

Evaluation of capital endowment of farmers in four irrigation schemes suggests that more intervention is required to address land- and water right issues for smallholders in South Africa. One of the inherent challenges in this regard is the ‘unquestionable’ and absolute power of traditional leaders on land. There is a perception by the small producers in the rural areas that at any time the traditional leader can take away the land, change the tenure arrangement or put in place a new land use policy. Public focus has to be on creating the incentives to develop the relevant human/social/psychological traits and skills. The incentive issues (land tenure security, water use rights, market access, access to credit and information, technological development and leadership in cooperatives) need to be addressed regarding PsyCap. Social and psychological endowments will be boosted if those entrenched institutional bottlenecks on issues highlighted above are addressed. This will be critical in unlocking rural entrepreneurial spirit and management

capabilities in the context of smallholder irrigation schemes. The current agency control tenure system needs to be more inclusive in decision making as it affects smallholders' production.

Government through DAFF, DRDLR and their strategic partners should support farmers with training to enhance their capacity in operating their farms as a business and value addition. Smallholder farmers should get training on the importance of farm record keeping and distinguishing farming and family operations. These are the pre-requisites to run small farms as businesses and to enable farmers use irrigation water productively to produce marketable surplus. Farmers also need to be trained on how they can effectively apply integrated pest management and crop rotation.

Resources should be mobilized to assist farmers in a pilot value addition project that will serve as a learning centre for all farmers in each scheme and around. If the right infrastructure is in place, space and time values (values added or created by simply making the products available at the right place and time) can be achieved with not much investment except strategic thinking and coordination. Strategies for entrepreneurial development should deal with how to link farmers with high value markets for key crops such as green maize, cabbage, beans, tomatoes, chillies and green pepper. Improving market access to smallholders can be done through empowering them to demand the right market information and programs that promote linkages to high value markets.

The attitudes of young people towards farming needs to be changed and the policy of the government should deliberately create conditions that encourage young people to be involved in farming not only as workers but also as owners of farming businesses. The long-term focus should be on developing entrepreneurial spirit from young ages, an idea that emphasizes the ability of the education curriculum to develop positive PsyCap among children. When motivated, young people will be able to achieve much more in farming and when they can farm profitably, the issue of succession plan can be addressed. If established smallholders can run their farming profitably, the perception will change over the long term. Changing mindsets has to be a long-term objective targeting the youth in the rural areas. Supporting the involvement of young people and educated farmers is important not only for the growth of smallholder irrigation in South Africa but also for rural job creation and ensuring succession plan in agriculture.

Entrepreneurship should be conceived differently in smallholder agriculture to make it relevant to this sector. To achieve the objectives set in the NDP Vision 2030 as related to smallholder agriculture, strategies and programmes aimed at smallholder irrigation should redefine entrepreneurship in the context of smallholders. There is a need to integrate PsyCap and

behavioural economic principles in explaining and measuring on-farm entrepreneurship. Such a definition is provided in Chapter 6 section 6.5.

PsyCap has to be identified as a key livelihood asset that should be nurtured among smallholders. Without self-confidence, optimism, hope and resilience, it is hard to promote the management of small farms as businesses.

There is a need to design strategies (e.g. experience sharing platforms with successful farmers and rewarding excellence in sustainable farming, education curricula for children and young adults) for developing and improving positive PsyCap, reducing dependency syndrome and enhancing entrepreneurial spirit among small-scale farmers and homestead food gardeners. This will transform homestead food gardening and smallholder irrigation into profitable agribusinesses. It will be a long-term strategy of building the spirit of on-farm entrepreneurship and reducing dependency syndrome among ordinary South Africans and hence smallholder farmers. The social grant programs need to be revisited to address their unintended consequences: killing farmers' self-confidence and entrenching a mindset that government has to do everything. Experience sharing platforms with successful farmers and rewarding excellence in sustainable farming can reduce dependency syndrome, improve PsyCap and enhance entrepreneurial spirit.

Changing smallholder dependency mindset starts with changing their income structure to make them earn most of their living. Concerted collective efforts to change the household income structure will make them own their own living which will, in turn, make them believe in themselves and their endowments. Government and other stakeholders can only provide seed funding and seed support. Long-term, the collective vision of the stakeholders has to be to enable smallholders handle their farming activities themselves individually and/or collectively.

There is need for government to evaluate the input support programme in terms of its impact on agricultural production and productivity. Government should consult more with farmers so that appropriate support is provided. Similarly, there is a need to follow up on recipients of government's tenders on input support and ensure that contractual agreements are adhered to in the execution of such tenders.

More needs to be done to improve transparency, accountability and management capacity in the governance and operations of collective action organisations, be they water governance or commodity and marketing associations. Collective management of water resources needs to be embedded in entrepreneurial development strategies. The focus should be on how to make collective management of water resources effective whilst improving access to water resources through lowering of costs. The traditional exclusive focus on the infrastructural investment has to be accompanied by a focus on local institutional/organisational building and establishing effective

collective water governance structures. This can be done, for instance, by adopting a “revolving committee system” to improve trust and self-confidence. Farmers have to be entitled not only to use the schemes but also to contribute to cost recovery, own and manage the schemes and contribute to regular maintenance. Training and mentoring scheme irrigators on collective management of common-pool resources (like irrigation water) will play an important role to improve the operations of the institutions and assist with development of internal control and reporting systems to enhance accountability. This can be achieved through overseeing and mentoring of current and future revolving committee members until their systems are operational. Establishing collective water governance structures will make everyone participate, create sense of belongingness and finally develop collective capacity to manage issues of common interest.

Furthermore, government should also focus on institutional mechanisms of transferring ownership and responsibility of collective management of the schemes. Farmers should not only be beneficiaries of the irrigation scheme but also owners of the scheme with collective responsibility to manage and maintain the infrastructure.

Cooperatives as a form of collective action organisations are important in developing smallholder irrigation. To reverse farmers’ negative attitudes, in addition to the transformation in the management of such organisations which is key, there is also a need to revisit the way they were formed. Government should not impose cooperatives on farmers but let farmers recognise the need for collective action and let them make most of the decisions in their formation and management. The need for cooperatives or other forms of collective action organisations has to come from farmers themselves. They have to own and manage the process as well as the outcome thereof.

Increasing social capital in society can help people avoid conflict, create forum for negotiations and dispute resolution mechanisms, exploit gains from increased specialisation and increase knowledge about the physical and social factors important in the production and marketing of agricultural produce. Increasing cooperation and coordination requires investment in and maintenance of social capital. This can be enhanced through increasing farmers’ knowledge regarding the importance of honouring contracts and delivering in time. This will help increase output and enhance successful coordination for collective action.

Policies should promote the development of rural financial markets that can improve access to affordable agricultural production credit. There is a need for adequate working capital to increase enterprise productivity and performance. Since there are already existing mechanisms for financing smallholder farming, such as farmer support provided through the Land Bank and MAFISA, there is a need to explore how these mechanisms can be leveraged so that they

effectively support smallholder irrigation farmers. Linking access to finance to proof of permanent employment, ownership of a regularly serviced bank account and in the case of commercial banks, collateral, might not be appropriate for most smallholders. There is a need to develop financing models that resonate with the situation of smallholders, accounting for their typologies. It is thus important to ascertain the role that can be played by retail shops, collective action organisations and other microfinance organisations in enhancing farmers' access to credit.

A focus needs to be put on stokvels as they play a huge role in the farmers' livelihoods and it is more likely that when farmers expand their farming operations, they will get credit from stokvels. This is because stokvels don't use land as collateral and they understand the situations farmers face. Stokvel members understand better the risks involved in farming. Because they don't lend money to make profits, they are more suited to most farmers as lenders. The financiers that need to provide smallholder farmers with financial services need to have in-depth working knowledge about the nature and functioning of smallholder farming sector and they need to work through collective action organisations such as stokvels.

Future interventions should involve strong farmer representatives who can promote their interests. Farmers can be assisted to ensure that their current organisations and leadership become effective in representing their interests. This is critical to address the poverty of services that smallholders receive from various stakeholders. This might entail training of the farmer leadership on governance and advocacy, among other areas. There is a need to assess possibilities of establishing more binding contractual arrangements with contractors that offer a 'win-win' situation on the part of the buyer and seller.

A provincial body of scheme committees is needed so that smallholders capacitate each other based on the challenges they frequently face related to water, land and markets. This body would also need to be involved in the policy formulation and implementation. The roles and responsibilities of scheme committees should be reflected in the policy as a body that reports to the traditional authorities with regards to land matters. Scheme committees should be empowered and be urged to encourage young people to participate in farming. Scheme committees should also be involved in decision making of new policies as they are the first point of contact for many smallholders when it comes to land and water related issues.

Future on-farm entrepreneurial development paths should be pursued based on the nature of the development domains (farmer typology) as each type of farmer would require different types of technology and other factors of production. Agricultural policies and interventions targeting smallholder farmers in irrigation have to account for their heterogeneity and the complexity of their farming system. The "one size fits all" approach does not work; technologies, extension

services, farm management practices, innovations and development pathways have to be tailor-made and speak to the heterogeneity. Transformation of the smallholder irrigation farmers and their development pathways will have to be context-specific, depending on farmer typology and development domains of the respective farmer typology. Recognizing heterogeneity in smallholders will enhance the impact of rural development policies and programs. This is why more targeted entrepreneurial development paths have been provided for each typology in Chapter 9 and 10. However, heterogeneity is always a double-edged sword. On the positive side, if there is capacity to formulate and implement tailor-made policy, it facilitates impactful interventions/strategies. On the other hand, it complicates policy design and implementation as putting in place a portfolio of policies is too much demanding capacity-wise. Hence, there is a need to find the right when needed when designing and implementing context-specific programmes.

Before decisions to expand or to come up with new schemes are taken, there is a need for an audit of farmers in the schemes and farmers interested in expansion. This audit will indicate how much land is available (or vacant) in the schemes, how much land is held by absentee farmers and how much is underutilised, among others. Matching of currently available land and land required for expansion is important in identifying the land gap, if any. The audit will bring forth challenges with land allocations and governing and instigating dialogue on the way forward among key role players, i.e. government, tribal authorities and farmers. However, key to this process is to ensure that the rights to title of land in the schemes are transferable such that when farmers move to other more lucrative opportunities in the future, others can take up their place. This will ensure that the plots are productively utilised. Actions will be required to enable farmers utilise the land at its full capacity so as to expand their operations or other farmers interested in smallholder irrigation given the opportunity.

While it may not be possible to have the farmers access the desired land type, it may, however, be possible that policy instruments may be put in place to ensure the security of land ownership that farmers are currently using. First, there is a need to consultatively engage traditional leaders to facilitate rural land reform and allocation of unused land, to pave the way for legally leasing, transferring and using the land as a collateral to make it a productive asset. Then, mechanisms for resolving land-related conflicts within the schemes should instil confidence in farmers' land holding and use rights.

There has to be a better enabling socioeconomic environment to enhance participation of women in smallholder irrigation. Land user rights have to be awarded directly to more female farmers while increased targeting of women for market participation may increase the impact of policy

interventions that aim at improved market access. With male household heads having higher levels of on-farm entrepreneurial competencies, entrepreneurial skills training needs to target female farmers. For new irrigation schemes in the future young women must also be given priority.

For expansion of irrigation farming activities to happen, smallholder farmers should also be able to take calculated risk and they should find ways of mitigating or reducing the effects of different forms of risk on their businesses. Expansion of smallholder irrigation farming will result in increased crop production and more marketable surplus. It demands more investment in fixed assets and recommended agricultural inputs. This should be matched with improved market access and proper market distribution channels. Thus, irrigation expansion should be integrated within existing value chain development programmes such as Agri-Parks.

In Chapter 10, there are three aspects which the research team did not make any recommendations on, but which were quite important in the farmers' views. These include how to deal with the problems of theft of produce and fence, vandalization of the fence and alkaline soils. It will be important to consider these challenges in relation to the development pathways as they pose a threat to smallholder irrigation production.

There is a need to develop and promote the integration of livestock production with crop production to take advantage of the synergy and enhance on-farm entrepreneurship. This will further grow the local economy, create more employment opportunities and increase income from farming activities.

As part of a rural extension package, farmers should be empowered with a range of skills. The skills development programme should focus on:

- Agricultural production/farming – technical skills in production of different types of high value crops.
- Water management – involving the development of irrigation management training manual adapted to suit the literacy levels, language and context of the target farmers. For rainfed farmers this will entail training in water harvesting strategies.
- Business and entrepreneurial skills (record keeping, importance and ways of distinguishing farm operations from family operations, simple planning techniques including budgeting, marketing and selling including negotiation, pricing of produce, time management, post-harvest handling, labour management and networking).

Several issues need addressing in relation to extension services. There is a need to provide demand-driven extension services for each type of farmer. The extension approach should

embrace technological developments to remain effective and relevant. The use of cellphones as a key instrument in extension should be strengthened, especially to disseminate information without necessarily requiring physical meeting. The number and capacity of extension agents has to increase to reduce burden, enhance engagement with farmers and remain relevant and effective. To this end, extension agents should receive refresher training that includes new knowledge.

In relation to farm technology development and dissemination, there is a need for labour intensive and gender sensitive technologies. Also, technologies for processing of livestock feed from crop residues and its storage should be introduced as part of crop-livestock enterprise integration activities for farmers practicing mixed farming. For improved communication, ICT should be enhanced and promoted, especially mobile network connection in rural areas need upgrading.

In sum, the government should move away from exclusive focus on investment in physical irrigation infrastructure and work on other complementary organisations, skills, services and inputs, engaging other stakeholders. Entrepreneurial skills development, increasing farmers' participation in high-value markets, improving access to credit, securing access to water, intensifying crop production, integration of crop and livestock enterprises and enhancing positive PsyCap should be the primary focus areas for entrepreneurial development and transformation of South Africa's smallholder sector. Moreover, building the household physical capital base, i.e. livestock and agricultural-related assets, can assist farmers to realize and make better use of irrigation schemes. However, it is important to recognise that farmers not keen and who are contend with their *status quo* cannot be forced to participate in the on-farm entrepreneurship (transformation) programme. Government and its partners should be able to identify interested (willing) and able farmers with high entrepreneurial spirit for the programme.

Local and national government entities, NGOs (such as Lima Rural Development Foundation), the private sector, new and existing financial organisations, traditional leaders, new and existing collective action organisations, and research and development role players (such as universities and national research councils or centres) have their respective roles in realizing development pathways in smallholder irrigation. To address smallholder challenges, there is a need for collective action by all the relevant role players. The various role player activities and processes need to be coordinated and integrated and engage all relevant role players/stakeholders, along the value chain of developing and implementing the interventions. To facilitate conversion of knowledge to action, there is an urgent need for collective engagement of the relevant stakeholders from the start of developing the research problem up to generating the knowledge for action and implementation of the recommendations.

11.4 Future research directions

The field observations, the literature review and the focus group discussions suggest the following areas for future research:

- Impact assessment of on-going and/or completed projects/programs/policies by DAFF or other stakeholders, with the aim of generating lessons for the future,
- Rural youth unemployment in South Africa and how the unemployed rural youth can be part of the rural economy?
 - Is aging an evolving rural development problem in South Africa?
 - Who is going to take over small farms? Succession plans?
- To what extent are agricultural policies/programs/projects and interventions targeting smallholders tailor-made? Could failure to account for heterogeneity be the reason for the slow progress?
- The political economy of the challenges of changing the knowledge stock to action:
 - the knowledge-action disconnect,
 - researchers' exclusive focus on completion of their research projects,
 - “What action and how?”, after the completion of the research project?
 - Completing a research project with a report should not be considered adequate.
 - Poverty of implementation; Whose responsibility is implementation?
 - Lack of collective engagement of local people and implementers in formulating and conducting research,
 - How do we ensure conversion of scientific knowledge to policy with rural development impacts?
 - How do we create a collective platform so that the relevant stakeholders can be part of understanding the problem, developing the solutions and implementing them?
 - How can the collective action be initiated, managed and materialized?
- The impact of the social grant program on rural livelihoods in South Africa:
 - Is there a need to redesign the program?
 - Is increasing the number of social grant beneficiaries and the amount of money going to this program really a success story?
 - Should it continue to be a major income source and smallholder farming a supplement? How can smallholder farmers' income structure be changed to make farming the primary income source?
 - Is there a need to link it with programs such as work for food?

- Working with a psychologist/behavioural specialist developing behavioural entrepreneurship index/PsyCap index and relating them with proportion of earned income; explaining the proportion of earned income using census data from Statistics South Africa;
- Explaining farm income as a proportion of total household income for smallholders using census data;
- Linking the extent to which farmers utilise their resources at their full capacity with the proportion of earned income and proportion of farm income;
- Linking diversification strategies with the proportion of earned income; and
- Revealed preference-based entrepreneurship index/PsyCap index & linking them with the proportion of earned income.

Going forward, there is a need for entrepreneurial scales and terms to be officially translated and validated in isiZulu and other African languages to minimise misrepresentation and improve data reliability and validity. More research insights could have been gathered if the study had covered more number of irrigation schemes across the country. Future studies could consider using panel data instead of cross-sectional data. Collecting data over a longer period of time could have enabled the team to understand both spatial and temporal dimensions of the cause and effect relationships.

Future studies could compare water usage according to entrepreneurial rankings of the farmers. A comparison of entrepreneurial rankings and productive use of water across different age groups would also be insightful. More research insights could have surfaced in researching whether or not young smallholder farmers faced unique challenges, constraints or opportunities relative to older farmers. This study could have benefited from a larger sample of non-irrigators, community food gardeners and independent irrigators. It is suggested that an extensive study be conducted to determine the entrepreneurial development paths of subsistent farming all the way to commercial farming. The detailed comparison of these paths between independent irrigators, scheme irrigators, community food gardeners and non-irrigators would be insightful.

Although the study has highlighted the importance of PsyCap of farmers in rural areas, the concept needs further behavioural, economic and theoretical underpinning and empirical investigation. One possibility is comparison of PsyCap among commercial, smallholder and subsistence farmers. Qualitative research that examines the social or psychological foundations of entrepreneurial mindsets is another avenue for the future. Research on areas such as evaluating the quality of training programs, comparing outcomes of trained versus non-trained smallholders and evaluating the contribution of entrepreneurship toward curbing unemployment at the macro level still needs to be conducted.

Research is needed to test young people's level of entrepreneurial spirit to ensure that irrigation expansion programs by government become a success. Research is needed to find out the difference in income and productivity between farmers selling to retailers or supermarkets and those selling to van traders or informal markets. Moreover, it is important to explore more on how they can be assisted in reaching these markets simultaneously, taking into account the potential of using information and communication technologies to link smallholders with clients.

Future research can be pursued to empirically and contextually test the validity and relevance of the definition of entrepreneurship proposed in this study under different locations and smallholder typologies.

Future research can expand the aspirations topic and look at the broader spectrum of farmer aspirations and how they influence other important farming aspects such as crop productivity, land use decisions, water productivity and on-farm entrepreneurship. Further research is needed on the impact of easy consumption credit on the growth of smallholder farming and the possibility of regulating informal organisations offering this credit. The major question is how to incentivize these organisations to shift focus to the provision of affordable production credit.

REFERENCES

- Adesina, A., Langyintuo, A., Bugo, N., Makinde, K., Bigirwa, G. and Wakiumu, J. 2014. Improving farmers' access to agricultural inputs and finance: approaches and lessons from Sub-Saharan Africa. In: Hazell, P. and Rahman, A. (eds.) *New Directions for Smallholder Agriculture*. Oxford, United Kingdom: Oxford University Press.
- Agrawal, A. 1995. Dismantling the divide between indigenous and scientific knowledge. *Development and change* 26 (3):413-439.
- AgriBEE. 2004. Broad based black economic empowerment for agriculture: discussion document.
- Ahmed, M.F.U. and Rahman, S.L. 2004. Profile and use of multi-species tree crops in the homesteads of Gazipur district, central Bangladesh. *Journal of sustainable agriculture* 24 (1):81-93.
- Aida, T. 2011. Social capital as an instrument for common pool resource management: A case study of irrigation management in Sri Lanka.
- Aktar, W., Sengupta, D. and Chowdhury, A. 2009. Impact of pesticides use in agriculture: their benefits and hazards. *Interdisciplinary toxicology* 2 (1):1-12.
- Alanen, A. R. (1990). Immigrant gardens on a mining frontier. In M. Francis, & R. Hester (Eds.), *The meaning of gardens* (pp. 160-165). Cambridge: MIT Press.
- ALDEP Monitoring Unit. (1982). Planning and statistics, Ministry of Agriculture, Gaborone.
- Ali, H. 2010. *Fundamentals of irrigation and on-farm water management*. Springer Science & Business Media.
- Ali, M. and Talukder, M. 2008. Increasing water productivity in crop production – a synthesis. *Agricultural water management* 95 (11):1201-1213.
- Ali, M. and Tsou, S. 2000. The integrated research approach of the Asian Vegetable Research and Development Center (AVRDC) to enhance micronutrient availability. *Food and Nutrition Bulletin* 21 (4):472-481.
- Aliber, M. and Hart, T.G. 2009. Should subsistence agriculture be supported as a strategy to address rural food insecurity? *Agrekon* 48 (4):434-458.
- Allen, V.G., Baker, M.T., Segarra, E. and Brown, C.P. 2007. Integrated Irrigated Crop – Livestock Systems in Dry Climates. *Agronomy Journal* 99 (2):346-360.
- Al-Said, F., Ashfaq, M., Al-Barhi, M., Hanjra, M.A. and Khan, I. 2012. Water productivity of vegetables under modern irrigation methods in Oman. *Irrigation and Drainage* 61 (4):477-489.

- Alsos, G. A., Ljunggren, E. and Pettersen, L.T. 2003. Farm based entrepreneurs: What triggers the start-up of new business activities *Journal of Small Business and Enterprise Development*, 10 (4): 435-443.
- Altman, M., Hart, T. and Jacobs, P. 2009. Household food security status in South Africa. *Agrekon* 48 (4):345-361.
- Andrew, M., Ainslie, A. and Shackleton, C.M. 2003. *Land use and livelihoods*. Programme for Land and Agrarian Studies, University of the Western Cape Cape Town.
- Ansari, S., Munir, K and Gregg, T. (2012). Impact at the 'bottom of the pyramid': the role of social capital in capability development and community empowerment. *Journal of Management Studies* 49(4),813-842.
- Appadurai, A. 2004. The capacity to aspire. In: Rao, V. and Walton, M. (eds.) *Culture and public action*. Washington D.C: World Bank.
- Ariely, D. 2008. *Predictably irrational: the hidden forces that shape our decisions*. New York: HarperCollins.
- Arthur, W.B. 1999. Complexity and the economy. *Science* 284 (5411):107-109.
- Arthur, W.B. 2013. Complexity economics: a different framework for economic thought. *Complexity Economics*, Oxford University Press (forthcoming).
- Ashley, C. and Carney, D. 1999. *Sustainable livelihoods: Lessons from early experience*. Department for International Development London.
- Audretsch, D.B. 2009. The entrepreneurial society. *The Journal of Technology Transfer* 34 (3):245-254.
- Avolio, B.J. and Luthans, F. 2006. *The high impact leader: moments matter in accelerating authentic leadership development*. New York: McGraw-Hill.
- Bacha, D., Namara, R., Bogale, A. and Tesfaye, A. 2011. Impact of small-scale irrigation on household poverty: empirical evidence from the Ambo district in Ethiopia. *Irrigation and Drainage* 60 (1):1-10.
- Backeberg, G.R. 2003. Water usage and irrigation policy. The Challenge of Change: Agriculture, Land and the South African Economy. Nieuwoudt, L. & Groenewald, J. (eds). University of Natal Press, Pietermaritzburg, South Africa. 2003:149-70.
- Backeberg, G.R. 2006. Reform of user charges, market pricing and management of water: problem or opportunity for irrigated agriculture? *Irrigation and Drainage* 55 (1):1-12.
- Backeberg, G.R. and Sanewe, A.J. 2010. Towards Productive Water Use and Household Food Security in South Africa. *Paper presented at the 6th Asian Regional Conference of ICID, 10-16 October 2010, Indonesia*.

Baddeley, M. 2017. *Behavioural Economics*. Oxford University Press.

Bagson, E. and Kuuder, C.J.W. 2013. Assessment of a smallscale irrigation scheme on household food security and leisure in Kokoligu; Ghana.

Bainville, S. 2017. Land rights issues in Africa: the contribution of agrarian systems research in Burkina Faso. *The Journal of Peasant Studies* 44 (1):261-285.

Baker, A.H. and Izard, H.V. 1991. New England farmers and the marketplace, 1780-1865: A Case Study. *Agricultural History* 65 (3):29-52.

Bakker, K. 2012. Water security: research challenges and opportunities. *science* 337 (6097):914-915.

Baloyi, J.K. 2010. *An analysis of constraints facing smallholder farmers in the Agribusiness value chain: A case study of farmers in the Limpopo Province*.

Bardsley, P. and Harris, M. 1987. An approach to the econometric estimation of attitudes to risk in agriculture. *Australian Journal of Agricultural and Resource Economics* 31 (2):112-126.

Barker, R. and Molle, F. Perspectives on Asian irrigation. Conference on Asian Irrigation in Transition – Responding to the Challenges Ahead. Asian Institute of Technology, Bangkok, Thailand, 2002.

Barney, J. 1991. Firm resources and sustained competitive advantage. *Journal of Management* 17 (1):99-120.

Bauernschuster, S., Falck, O. and Heblich, S. 2010. Social capital access and entrepreneurship. *Journal of Economic Behaviour & Organization* 76 (3):821-833.

Bayani, E.M. 2000. Reducing micronutrient malnutrition: policies, programmes, issues and prospects – dietary diversification through food production and nutrition education. *Food and Nutrition Bulletin* 21 (4):521-526.

Bayer, W., Alcock, R., Dladla, F., Gilles, P., Masondo, M., Mkhize, P., Mtshali, E. and Ntombela, L. 2003. A study of indigenous livestock management in rural KwaZulu-Natal, South Africa. South Africa: Mdukatshani Rural Development Project.

Becker, R.F. 1984. Vegetable gardening in the United States: a history, 1565-1900. *HortScience (USA)*.

Bediako, J. and Debrah, K 2007. Finding a sustainable linkage between the emerging farmer and formal markets: The case of Pick ‘n Pay and the Zanyokwe farmers in the Eastern Cape of South Africa. AAAE Conference, 2007. 26-28.

Beedell, J. and Rehman, T. 2000. Using social-psychology models to understand farmer’s conservation behaviour. *Journal of Rural Studies*, 16 (1): 117-127.

- Bellemare, M.F. 2013. The productivity impacts of formal and informal land rights: Evidence from Madagascar. *Land Economics* 89 (2):272-290.
- Bembridge, T. 2000. *Guidelines for rehabilitation of small-scale farmer irrigation schemes in South Africa*. Water Research Commission.
- Bennie, A.T.P, Strydom, M.G. and Very, H.S. 1998. Use of computers models for agricultural water management on an ecotone level. WRC Report No. TT 102/98. Water Research Commission
- Bendor, J., Mookherjee, D. and Ray, D. 2001. Aspiration-based reinforcement learning in repeated interaction games: An overview. *International Game Theory Review* 3 (02n03):159-174.
- Benhin, J.K. 2008. South African crop farming and climate change: An economic assessment of impacts. *Global Environmental Change* 18 (4):666-678.
- Bentley, A. 1998. *Eating for victory: Food rationing and the politics of domesticity*. University of Illinois Press.
- Bernard, T. and Seyoum Taffesse, A. 2014. Aspirations: An approach to measurement with validation using Ethiopian data. *Journal of African Economies* 23 (2):189-224.
- Bernard, T. and Taffesse, A.S. 2012. Measuring aspirations: discussion and example from Ethiopia. *International Food Policy Research Institute Discussion Paper* 1190.
- Bernard, T., Dercon, S., Orkin, K. and Taffesse, A.S. 2014. The future in mind: aspirations and forward-looking behaviour in rural Ethiopia. London: Centre for Economic Policy Research.
- Bhardwaj, S. and Singh, R. 2015. From farmer to agripreneurs: a case study of Tumkur district. *International Journal of Management, MIT College of Management* 3 (1): 43-47.
- Bhatti, M. and Church, A. 2001. Cultivating natures: homes and gardens in late modernity. *Sociology* 35 (2):365-383.
- Bidogeza, J., Berentsen, P., De Graaff, J. and Lansink, A.O. 2009. A typology of farm households for the Umutara Province in Rwanda. *Food Security* 1 (3):321-335.
- Biggs, E.M., Bruce, E., Boruff, B., Duncan, J.M., Horsley, J., Pauli, N., McNeill, K., Neef, A., Van Ogtrop, F. and Curnow, J. 2015. Sustainable development and the water-energy-food nexus: A perspective on livelihoods. *Environmental Science & Policy* 54:389-397.
- Binswanger, H.P. 1981. Attitudes toward risk: Theoretical implications of an experiment in rural India. *The Economic Journal* 91 (364):867-890.
- Binswanger-Mkhize, H.P., Meinzen-Dick, R. and Ringler, R. 2010. *Policies, Rights and Institutions for Sustainable Management of Land and Water Resources*. SOLAW Background Thematic Report - TR09.

- Biswas, S.K., Rahman, S., Kobir, S.M.A., Ferdous, T. and Banu, N.A. 2014. A review on impact of agrochemicals on human health and environment: Bangladesh perspective. *Plant environmental development* 3 (2):31-35.
- Blum, A. 2009. Effective use of water (EUW) and not water-use efficiency (WUE) is the target of crop yield improvement under drought stress. *Field Crops Research* 112 (2):119-123.
- Boahene, K. 1996. Rationality and Decision-Making of Small Farmers: The Case of Ghana. *Journal of Interdisciplinary Economics* 7 (2):81-93.
- Boelens, R., Dourojeanni, A. and Hoogendam, P. 2005. Improving water allocation for user communities and platforms in the Andes. *Lessons for Institutional Design*:183.
- Bohnet, I. and Zeckhauser, R. 2004. Trust, risk and betrayal. *Journal of Economic Behaviour & Organization* 55 (4):467-484.
- Börgers, T. and Sarin, R. 2000. Naive reinforcement learning with endogenous aspirations. *International Economic Review* 41 (4):921-950.
- Bouman, B. 2007. A conceptual framework for the improvement of crop water productivity at different spatial scales. *Agricultural Systems* 93 (1):43-60.
- Boussard, J.-M. 1992. *The impact of structural adjustment on smallholders*. Food and Agriculture Organisation.
- Bradstock, A. 2006. Land reform and livelihoods in South Africa's Northern Cape province. *Land Use Policy* 23 (3):247-259.
- Briggs, J. 2005. The use of indigenous knowledge in development: problems and challenges. *Progress in development studies* 5 (2):99-114.
- Bromley, D. W. 1982. *Improving irrigated agriculture: Institutional reform and the small farmer*. Working Paper no. 531. Washington, DC: World Bank.
- Brown, C. and Hansen, J. 2008. Agricultural water management and climate risk. *International Research Institute for Climate and Society, Palisades, New York, USA* 19.
- Bryan, E., Deressa, T.T., Gbetibouo, G.A. and Ringler, C. 2009. Adaptation to climate change in Ethiopia and South Africa: options and constraints. *Environmental Science & Policy* 12 (4):413-426.
- Bryceson, D.F. 2002. The scramble in Africa: reorienting rural livelihoods. *World development* 30 (5):725-739.
- Bugri, J.T. 2008. The dynamics of tenure security, agricultural production and environmental degradation in Africa: Evidence from stakeholders in north-east Ghana. *Land Use Policy* 25 (2):271-285.

- Cai, C.-t., Luo, J.-s. and Nan, Y.-z. 2004. Energy and Economic flow in homegardens in Subtropical Yunnan, SW China: A case study on Sanjia village. *The International Journal of Sustainable Development & World Ecology* 11 (2):199-204.
- Cai, X., Molden, D., Mainuddin, M., Sharma, B., Ahmad, M.-u.-D. and Karimi, P. 2011. Producing more food with less water in a changing world: assessment of water productivity in 10 major river basins. *Water International* 36 (1):42-62.
- Cai, X., Yang, Y.-C.E., Ringler, C., Zhao, J. and You, L. 2011. Agricultural water productivity assessment for the Yellow River Basin. *Agricultural water management* 98 (8):1297-1306.
- Camp, K.G.T., A.D. Manson & J.M.B. Smith. 1995. Soil Potential and Land Capability. Cedara: KwaZulu-Natal Department of Agriculture.
- Carney, D., Drinkwater, M., Rusinow, T., Neefjes, K., Wanmali, S. and Singh, N. 1999. Livelihoods approaches compared. *DFID, London*. < www.livelihoods.org/info/docs/lacv3.pdf 1:2007.
- Carr, E.R. 2008. Men's crops and women's crops: The importance of gender to the understanding of agricultural and development outcomes in Ghana's central region. *World Development* 36 (5):900-915.
- Carter, M.R., Little, P.D., Mogues, T. and Negatu, W. 2012. Poverty traps and natural disasters in Ethiopia and Honduras. *World development* 35 (5):835-856.
- Carter, S. and Rosa, P. 1998. Indigenous rural firms: farm enterprises in the UK. *International Small Business Journal* 16 (4):15-27.
- Carver, C.S., Scheier, M.F. and Segerstrom, S.C. 2010. Optimism. *Clinical psychology review* 30 (7):879-889.
- Carver, T. 1911. Large-Scale and Small-Scale Farming. *Publications of the American Statistical Association* 12 (93):488-489.
- CAWMA. 2007. *Water for Food, Water for Life: A Comprehensive Assessment of Water Management in Agriculture (CAWMA)*. London: Earthscan and Colombo: International Water Management Institute.
- Census of Commercial Agriculture. 2008. *Agricultural Statistics South Africa. Statistics South Africa*. Available at <http://www.statssa.gov.za> [Accessed 2 March 2014].
- Centre for Law and Society. 2015. Land Rights Under the Ingonyama Trust. Cape Town, South Africa: Centre for Law and Society.
- Cetindamar, D., Gupta, V.K., Karadeniz, E.E. and Egrican, N. 2012. What the numbers tell: The impact of human, family and financial capital on women and men's entry into entrepreneurship in Turkey. *Entrepreneurship & Regional Development* 24 (1-2):29-51.

- Chakravarty, I. 2000. Food-based strategies to control vitamin A deficiency. *Food and Nutrition Bulletin* 21 (2):135-143.
- Chamberlin, J., Pender, J. and Yu, B. 2006. *Development domains for Ethiopia: Capturing the geographical context of smallholder development options*. Intl Food Policy Res Inst.
- Chambers, R. and Conway, G. 1992. *Sustainable rural livelihoods: practical concepts for the 21st century*. Institute of Development Studies (UK).
- Chaminuka, P., Udo, H.M., Eilers, K.C. and Van der Zijpp, A. 2014. Livelihood roles of cattle and prospects for alternative land uses at the wildlife/livestock interface in South Africa. *Land Use Policy* 38:80-90.
- Chandramouli, P., Meti, S. K., Hirevenkangoudar, L. V. and Hanchinal, S. N. 2007. Comparative Analysis of Entrepreneurial Behaviour of Farmers in Irrigated and Dry Land Areas of Raichur District of Karnataka. *Karnataka Journal of Agricultural Sciences*; 20(2):320-222.
- Chapoto, A., Mabiso, A. and Bonsu, A. 2013. Agricultural commercialisation, land expansion and homegrown large-scale farmers: Insights from Ghana.
- Chazovachii, B. 2012. The impact of small-scale irrigation schemes on rural livelihoods: the case of Panganai Irrigation Scheme Bikita District Zimbabwe. *Journal of Sustainable Development in Africa* 14 (4):217-231.
- Chell, E. 2008. *The entrepreneurial personality: A social construction*. Routledge.
- Chiangmai, C.N. 2017. Creating efficient collaboration for knowledge creation in area-based rural development. *Kasetsart Journal of Social Sciences*.
- Chipfupa, U. 2018. *Entrepreneurial development pathways in smallholder irrigation farming in KwaZulu-Natal: typologies, aspirations and preferences*. PhD, University of KwaZulu-Natal.
- Clayton, S. 2007. Domesticated nature: Motivations for gardening and perceptions of environmental impact. *Journal of environmental psychology* 27 (3):215-224.
- Cockburn, J, M. Rouget, R. Slotow, D. Roberts, R. Boon, E. Douwes, S. O'Donoghue, C.T. Downs, S. Mukherjee, W. Musakwa, O. Mutanga, T. Mwabvu, J. Odindi, A. Odindo, S. Proche, S. Ramdhani, J. Ray-Mukherjee, M. Sershen, C. Schoeman, A.J. Smit, E. Wale and S. Willows-Munro. 2016. How to build science-action partnerships for local land-use planning and management: lessons from Durban, South Africa. *Ecology and Society* 21(1): 28-69.
- Cole, G. 1993. Gardening for victory; Victory gardens in American popular periodicals during World War II. *The North Dakota Quarterly* 61 (3):163-176.
- Coleman, J.S. 1988. Social capital in the creation of human capital. *American journal of sociology* 94:S95-S120.
- Collum, P. J (1995). Production of vegetable crops. Third edition. APS press, USA.

- Conway, G., Carsalade, H., Oniang'o, R., Toulmin, C., Hazell, P., Pingali, P., Arnold, T., Karuku, J., Badiane, O. and Ngong'i, N. 2014. Small and growing entrepreneurship in African agriculture: A Montpellier Panel report. *African Journal of Food, Agriculture, Nutrition and Development* 14 (4):2-26.
- Cotula, L. 2006. *Land and water rights in the Sahel: tenure challenges of improving access to water for agriculture*. IIED.
- Cousins, B. 2013. Smallholder irrigation schemes, agrarian reform and 'accumulation from above and from below' in South Africa. *Journal of Agrarian Change* 13 (1):116-139.
- Coutu, D.L. 2002. How resilience works. *Harvard Business Review* 80(5):46-55.
- Cromie, S. 2000. Assessing entrepreneurial inclinations: Some approaches and empirical evidence. *European journal of work and organizational psychology* 9 (1):7-30.
- Crosby, C.T., De Lange, M., Stimie, C.M. and Van der Stoep, I. 2000. A review of planning and design procedures applicable to small-scale farmer irrigation projects. WRC Report No. 578/2/00. Water Research Commission
- Cuervo, A. 2005. Individual and environmental determinants of entrepreneurship. *International Entrepreneurship and Management Journal* 1 (3):293-311.
- DAFF. 2012. Strategic plan for smallholder support – 2011-2014/15. Pretoria: DAFF, Pretoria.
- DAFF. 2014. Updating smallholder irrigation database: KwaZulu-Natal smallholder irrigation database. DAFF: Pretoria, South Africa.
- DAFF. 2015. Irrigation strategy for South Africa 2015. Pretoria, South Africa: DAFF.
- Dalton, P.S., Ghosal, S. and Mani, A. 2016. Poverty and aspirations failure. *The Economic Journal* 126 (590):165-188.
- Dalton, P.S., Jimenez, V.H.G. and Noussair, C.N. 2017. Exposure to poverty and productivity. *PloS one* 12 (1):e0170231.
- Dam, J.C. and Malik., R.S. 2003. Water productivity of irrigated crops in Sirsa District. Integration of remote sensing, crop and soil models and geographical information systems. WATPRO final report, 173, India.
- Daniels, R.C., Partridge, A., Kekana, D. and Musundwa, S. 2013. Rural Livelihoods in South Africa.
- Darnton-Hill, I. 1997. Developing Industrial-Governmental-Academic Partnerships to Address Micronutrient Malnutrition. *Nutrition reviews* 55 (3):76-81.
- Darroch, M. and Mushayanyama, T. 2006. Smallholder farmers' perceptions of factors that constrain the competitiveness of a formal organic crop supply chain in Kwazulu-Natal, South Africa: economics. *South African Journal of Economic and Management Sciences* 9 (4):498-520.

- Davis, A. 2000. Transport and sustainable rural livelihoods in Zambia: a case study. *Transport Research Laboratory, Zambia*.
- Davis, K. 2008. Extension in sub-Saharan Africa: Overview and assessment of past and current models and future prospects. *Journal of International Agricultural and Extension Education* 15 (3):15-28.
- Dawnay, E. and Shah, H. 2005. *Behavioural Economics: Implications Seven Principles for Policy-makers*. New Economics Foundation.
- De Beer, J. 2005. Mentoring Skills: Course material. *CE@ UP, University of Pretoria*.
- De Klerk, M., Drimie, S., Aliber, M., Mini, S., Mokoena, R., Randela, R., Modiselle, S., Vogel, C., De Swardt, C. and Kirsten, J. 2004. Food security in South Africa: key policy issues for the medium term.
- De Lange, M. 1994. Small scale irrigation in South Africa. Pretoria, South Africa: Water Research Commission of South Africa.
- De Lange, M., J. Adendorff & C.T. Crosby. 2000. Developing Sustainable Small-Scale Farmer Irrigation in Poor Rural Communities: Guidelines and Check Lists for Trainers and Development Facilitators. WRC Report No. 774/1/00. Water Research Commission
- De Pee, S., Bloem, M.W., Gorstein, J., Sari, M., Yip, R. and Shrimpton, R. 1998. Reappraisal of the role of vegetables in the vitamin A status of mothers in Central Java, Indonesia. *The American journal of clinical nutrition* 68 (5):1068-1074.
- De Satgé, R. and Holloway, A. 2002. *Learning about livelihoods: insights from Southern Africa* (Vol. 1). Oxford; Oxfam.
- De Wolf, G. 1992. *The beginnings. In Keeping Eden: A history of gardening in America*. Boston: Bulfinch Press.
- Deininger, K., Ali, D.A., Holden, S. and Zevenbergen, J. 2008. Rural land certification in Ethiopia: Process, initial impact and implications for other African countries. *World Development* 36 (10):1786-1812.
- Dela Cuadra, A.C. 2002. The Philippine micronutrient supplementation programme. *Food and Nutrition Bulletin* 21 (4):512-514.
- Delgado, C. 1999. Sources of growth in smallholder agriculture in sub-Saharan Africa: The role of vertical integration of smallholders with processors and marketers of high value-added items. *Agrekon* 38:165-189.
- Denby, K., Movik, S., Mehta, L. and Van Koppen, B. 2016. The 'trickle down' of IWRM: A case study of local-level realities in the Inkomati Water Management Area, South Africa. *Water Alternatives* 9 (3):473.

Denison, J. and Manona, S. 2007a. A rough guide for irrigation development practitioners: Principles, approaches and guidelines for the participatory revitalisation of smallholder irrigation schemes. WRC Report No TT 308 (07). Water Research Commission.

Denison, J. and Manona, S. 2007b. Principles, approaches and guidelines for the participatory revitalisation of smallholder irrigation schemes, concepts and cases. Water Research Commission.

Denison, J., Murata, C., Conde, L., Perry, A., Monde, N. and Jacobs, T. 2015. Empowerment of women through water use security, land use security and knowledge generation for improved household food security and sustainable rural livelihoods in selected areas of the Eastern Cape. Gezina: Water Research Commission.

Denison, J., Dube, S.V., Masiya, T.C., Moyo, T., Murata, C., Mpyana, J., Van Averbeke, L.L. and Van Averbeke, W. 2016. Smallholder irrigation entrepreneurial development pathways and livelihoods in two districts in Limpopo Province. WRC Report No. 2179/1/16. Water Research Commission.

Dennis, W. 2000. Research mimicking policy: Entrepreneurship/small business policy research in the United States. *The Blackwell handbook of entrepreneurship*:64-82.

Department for International Development (DFID). 2001. Contribution of irrigation to sustaining rural livelihoods. Wallingford.: KAR Project R 7879, MDS 0537.

Department of Agriculture. 1994. Report on the investigation into arrear land rentals and water charges on the Makhathini irrigation scheme. Pretoria, South Africa.: Department of Agriculture, Pretoria.

Department of Agriculture. 2001. The Strategic Plan for South African Agriculture. Pretoria

Department of Economic and Social Affairs. 2009. World survey on the role of women in development: Women's control over economic resources and access to financial resources, including microfinance.: New York, United Nations.

Department of Health 2001: Initial Results of the Fifth National Nutrition Survey. DOH web site, the government of Philippines, <http://www.doh.gov.ph/nutriupdate/tabcontents.htm>

Department of International Development (DFID) 2001. Sustainable Livelihood Framework.

Department of Water Affairs and Forestry (DWAF) 1997. White paper on a National Water Policy for South Africa. Pretoria, South Africa: Department of Water Affairs and Forestry.

Department of Water Affairs and Forestry. 2001. Strategic environmental assessment for water use in the Usutu-Mhlathuze water management area. Social Component Scoping Exercise. Pretoria, South Africa: Department of Water Affairs and Forestry.

Díaz-Pichardo, R., Cantú-González, C., López-Hernández, P. and McElwee, G. 2012. From farmers to entrepreneurs: The importance of collaborative behaviour. *The Journal of Entrepreneurship* 21 (1):91-116.

- Diirro, G.M., Ker, A.P. and Sam, A.G. 2015. The role of gender in fertiliser adoption in Uganda. *African Journal of Agricultural and Resource Economics* 10 (2):117-130.
- Dillon, J.L. and Scandizzo, P.L. 1978. Risk attitudes of subsistence farmers in Northeast Brazil: A sampling approach. *American Journal of Agricultural Economics* 60 (3):425-435.
- Dirwayi, T.P. 2010. Application of the sustainable livelihoods framework to the analysis of the provincial growth and development plan of the Eastern Cape: a case study of the massive food production programme in the Nkonkobe Municipality and Buffalo City Municipality.
- Djurfeldt, A.A. 2013. African re-agrarianization? Accumulation or pro-poor agricultural growth? *World development* 41:217-231.
- Dollinger, M. J. 2003. *Entrepreneurship – Strategies and Resources*. Pearson International Edition, New Jersey.
- Dorward, A 2001. Pro-poor livelihoods: Addressing the market/private sector gap. Sustainable Livelihoods Seminar on ‘Private Sector and Enterprise Development’, Crown Plaza Hotel, Manchester (www.wye.ac.uk/AgEcon/ADU/staff/dorward/ModMktsPrivateSector.pdf), 2001.
- Drucker, P.F. 1985. Innovation and Entrepreneurship Practice and Principles, Harper & Row, New York, pp. 207-243.
- Du Plessis, G. and Lekganyane, E. 2012. The role of food gardens in empowering women: A study of Makotse Women’s Club in Limpopo. *Journal of Social Development in Africa* 25 (2).
- Duflo, E., Kremer, M. and Robinson, J. 2008. How high are rates of return to fertilizer? Evidence from field experiments in Kenya. *The American economic review* 98 (2):482-488.
- Durlauf, S.N. 2012. Complexity, economics and public policy. *Politics, Philosophy & Economics* 11 (1):45-75.
- Dutta, S. 2007. Non-Farm Entrepreneurship of Farmers in West Bengal: A LISREL/Logit Analysis. *Indian Economic Review*:231-253.
- Earl, P.E. 2005. Economics and psychology in the twenty-first century. *Cambridge Journal of Economics* 29 (6):909-926.
- Economic Development Department 2011. The New Growth Path: framework. Pretoria: Economic Development Department.
- Ellis, F. 2000. The determinants of rural livelihood diversification in developing countries. *Journal of Agricultural Economics* 51 (2):289-302.
- Ellis, F. and Freeman, H.A. 2005. Conceptual framework and overview of themes. *Rural livelihoods and poverty reduction policies*:3-15.

- Etzioni, A. 2011. Behavioural economics: towards a new paradigm. *American Behavioural Scientist* 55 (8): 1099-1119.
- EU 2000. Water Framework Directives. Available at: http://ec.europa.ec/environment/water/water-framework/index_en.html
- European Commission. 2003. Green paper: Entrepreneurship in Europe. Brussels: European Commission.
- Fal, M., Sefolo, T., Williams, A., Herrington, M., Goldberg, J. and Klaasen, M. 2009. State of entrepreneurship in South Africa. In Report of the First National Bank (FNB) conference centre. *Paper presented at the*, Sandton (Gauteng), South Africa.
- Fanadzo, M. 2012. Revitalisation of smallholder irrigation schemes for poverty alleviation and household food security in South Africa: A review. *African Journal of Agricultural Research* 7 (13):1956-1969.
- Fanadzo, M., Chiduza, C. and Mnkeni, P. 2010a. Overview of smallholder irrigation schemes in South Africa: Relationship between farmer crop management practices and performance. *African Journal of Agricultural Research* 5 (25):3514-3523.
- Fanadzo, M., Chiduza, C., Mnkeni, P., Van der Stoep, I. and Stevens, J. 2010b. Crop production management practices as a cause for low water productivity at Zanyokwe Irrigation Scheme. *Water SA* 36 (1):27-36.
- FAO. 1997. Irrigation potential in Africa: a basin approach. Food and Agricultural Organisation of the United Nations. Pretoria: Food and Agriculture Organisation.
- FAO. 2000a. Affordable irrigation technologies for smallholders: Opportunities for technology adaptation and capacity building. Programme formulation Report No. 6. Rome, Italy: IPTRID Secretariat, Food and Agriculture Organisation.
- FAO. 2000b. Crop Evapotranspiration. Guidelines for computing crop water requirements. Water Resources, Development and Management Service. Irrigation and Drainage Paper, No 56.
- FAO. 2000c. Socio economic impact of smallholder irrigation development in Zimbabwe: Case study of ten irrigation schemes. Harare: Food and Agriculture Organisation.
- FAO. 2000d. Women in community forestry. Rome: Food and Agriculture Organisation. Rome
- FAO. 2001. Agricultural investment and productivity in developing countries. Food and Agriculture Organisation. Rome.
- FAO. 2009. AO and traditional knowledge: the linkages with sustainability, food security and climate change impacts. Rome: Food and Agriculture Organisation. Rome
- FAO. 2009. A review of experiences of establishing emerging farmers in South Africa: Case lessons and implications for farmer support within land reform programmes. *Capacity Development in Food and Agriculture Policies* (3). Food and Agriculture Organisation. Rome.

- FAO. 2011. The state of the world's land and water resources for food and agriculture (SOLAW) – Managing systems at risk., Rome and Earthscan, London. Food and Agriculture Organisation of the United Nations.
- FAO. 2014. Understanding smallholder farmer attitudes to commercialisation – The case of maize in Kenya.
- FAO. 2016. Governing Tenure Rights to Commons: A guide to support the implementation of the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security. Governance of tenure technical guide no 8. Rome.
- Faris, S. 1999. Seeking entrepreneurial origins: Are entrepreneurs born or made. *Kaufmann Center for Entrepreneurial Leadership, Kansas City*.
- Faurès, J.-M. and Santini, G. 2008. Water and the rural poor: interventions for improving livelihoods in sub-Saharan Africa. *Water and the rural poor: interventions for improving livelihoods in sub-Saharan Africa*.
- Fenske, J. 2011. Land tenure and investment incentives: Evidence from West Africa. *Journal of Development Economics* 95:137-156.
- Fenwick, L.J. and Lyne, M.C. 1999. The relative importance of liquidity and other constraints inhibiting the growth of small-scale farming in KwaZulu-Natal. *Development Southern Africa* 16 (1):141-155.
- Fiedler, J.L., Dado, D.R., Maglalang, H., Juban, N., Capistrano, M. and Magpantay, M.V. 2000. Cost analysis as a vitamin A program design and evaluation tool: a case study of the Philippines. *Social Science & Medicine* 51 (2):223-242.
- Finerman, R. and Sackett, R. 2003. Using home gardens to decipher health and healing in the Andes. *Medical anthropology quarterly* 17 (4):459-482.
- Finney, C. 2013. Water abstraction charges as a water management tool. *Irrigation and Drainage* 62 (4):477-487.
- Fischer, E. and Qaim, M. 2012. Linking smallholders to markets: determinants and impacts of farmer collective action in Kenya. *World development* 40 (6):1255-1268.
- Flint, M. L. 2002. Pest Notes: Whiteflies. California: Agriculture and Natural Resources, University of California.
- FNB (First National Bank). 2009. The state of entrepreneurship in South Africa. Sandton, South Africa.: First National Bank.
- Fontana, M. and Natali, L. 2008. Gendered patterns of time use in Tanzania: Public investment in infrastructure can help. *Paper prepared for the IFPRI Project on 'evaluating the long-term impact of gender-focused policy interventions', New York: IFPRI*.

- Fort, R. 2008. The homogenization effect of land titling on investment incentives: evidence from Peru. *NJAS-Wageningen Journal of Life Sciences* 55 (4):325-343.
- Foxcroft, M., Wood, W., Kew, K., Herrington, M. and Segal, N. 2002. Global Entrepreneurship Monitor South African Report. <http://www.gbs.nct.ac.za/gbswebb/userfiles/gemsouthafrica2000pdf>.
- Francis, E. 2002. Rural livelihoods, institutions and vulnerability in north west province, South Africa. *Journal of Southern African Studies* 28 (3):531-550.
- Francis, M. 1995. Childhood's garden: Memory and meaning of gardens. *Children's Environments*:183-191.
- Francis, M. and Hester, R.T. 1990. *The meaning of gardens: Idea, place and action*. Mit Press.
- Frederick, H.H. and Kuratko, D.F. 2010. *Entrepreneurship: theory, process, practice*. 2nd Asia-Pacific. Australia: Cengage Learning.
- Freeman, H.A. and Omiti, J.M. 2003. Fertilizer use in semi-arid areas of Kenya: Analysis of smallholder farmers' adoption behaviour under liberalized markets. *Nutrient Cycling in Agroecosystems* 66 (1):23-31.
- Friedman, S.R., Kippax, S.C., Phaswana-Mafuya, N., Rossi, D. and Newman, C.E. 2006. Emerging future issues in HIV/AIDS social research. *AIDS* 20 (7):959-965.
- Frumkin, H. 2003. Healthy places: exploring the evidence. *American journal of public health* 93 (9):1451-1456.
- Gasson, R. and Errington, A.J. 1993. *The farm family business*. Cab International.
- Gaston, K.J., Warren, P.H., Thompson, K. and Smith, R.M. 2005. Urban domestic gardens (IV): the extent of the resource and its associated features. *Biodiversity and conservation* 14 (14):3327-3349.
- Geetha, K. 2007. *Impact of bharatiya agro-industries foundation (baif) programmes on livelihoods of women beneficiaries in north Karnataka*. UAS, Dharwad.
- GEM. 2011. The global entrepreneurship monitor. *2011 Global Report, GEM 2011*, 7.
- Genicot, G. and Ray, D. 2014. Aspirations and inequality. National Bureau of Economic Research.
- Genicot, G. and Ray, D. 2017. Aspirations and inequality. *Econometrica* 85 (2): 489-519.
- Gentner, D. and Stevens, A.L. 2014. *Mental models*. Psychology Press.
- Gladwell, M. 2006. *The tipping point: how little things can make a big difference*. Little, Brown.
- Gleick, P.H., Christian-Smith, J. and Cooley, H. 2011. Water-use efficiency and productivity: rethinking the basin approach. *Water International* 36 (7):784-798.

Golder Associates. 2014. Four prioritised irrigation schemes in KwaZulu-Natal: *status quo* report for Ndomu B irrigation scheme. Report submitted to KZN Department of Rural Development and Land Reform (Report No. 13615728 – 12646 – 6).

Golder Associates Africa. 2015. *Four prioritized irrigation schemes in KwaZulu-Natal: Feasibility Assessment and Business Plan report for Bululwane Irrigation Scheme*.

Gollin, D. 2014. Smallholder agriculture in Africa: An overview and implications for policy. *IIED Working Paper. IIED, London*.

Gomo, T. 2010. Assessing the performance of smallholder irrigation in South Africa and opportunities for deriving best management practices. MSc thesis. Pietermaritzburg: University of KwaZulu-Natal.

Goodwin, N., Nelson, J.A., Ackerman, F. and Weisskopf, T. 2009. Microeconomics in Context ME Sharpe. *New York*.

Goswami, R., Chatterjee, S. and Prasad, B. 2014. Farm types and their economic characterisation in complex agro-ecosystems for informed extension intervention: study from coastal West Bengal, India. *Agricultural and Food Economics* 2 (1):5.

Gray, C. 2002. Entrepreneurship, resistance to change and growth in small firms. *Journal of Small Business and Enterprise Development* 9 (1):61-72.

Groenewald, J.A. 1993. Resource use entitlement, finance and entrepreneurship in Sub-Saharan Smallholder agriculture. *Agrekon* 32 (3):122-128.

Gutman, L. and Akerman, R. 2008. *Determinants of aspirations [wider benefits of learning research report no. 27]*. Centre for Research on the Wider Benefits of Learning, Institute of Education, University of London.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. 2010. *Multivariate data analysis*. Seventh United States of America. Pearson Prentice Hall.

Hallam, A., Bowden, A. and Kasprzyk, K. 2012. *Agriculture and Climate Change: Evidence on Influencing Farmer Behaviours*. Scottish Government, Social Research.

Hansson, H., Ferguson, R., Olofsson, C. and Rantamäki-Lahtinen, L. 2013. Farmers' motives for diversifying their farm business – The influence of family. *Journal of Rural Studies* 32:240-250.

Harper, D. 2003. The foundations of entrepreneurship and economic growth. London: Rutledge.

Harvey, C.A., Rakotobe, Z.L., Rao, N.S., Dave, R., Razafimahatratra, H., Rabarijohn, R.H., Rajaofara, H. and MacKinnon, J.L. 2014. Extreme vulnerability of smallholder farmers to agricultural risks and climate change in Madagascar. *Phil. Trans. R. Soc. B* 369 (1639):20130089.

Hasnip, N., Mandal, S., Morrison, J., Pradhan, P. and Smith, L. 2001. *Contribution of irrigation to sustaining rural livelihoods-literature review*. HR Wallingford, Wallingford, UK.

- Hassan Comfort, Janice Olawoye and Vicent Nnadozie, 2002. Impact of International Trade and Multinational Corporations on the Environment and Sustainable Livelihoods of Rural Women in Akwa-Ibom State Niger Delta Region, Nigeria <http://www.gdnet.org> 18th August, 2008 pp.1-7.
- Hazell, P.B., Poulton, C., Wiggins, S. and Dorward, A. 2007. *The future of small farms for poverty reduction and growth*. Intl Food Policy Res Inst.
- Hazell, P and Rahman, A. 2014. Introduction. In: Hazell, P. and Rahman, A. (eds.) *New directions for smallholder agriculture*. Oxford, United Kingdom: Oxford University Press. pp 1-12
- Hébert, R.F. and Link, A.N. 1989. In search of the meaning of entrepreneurship. *Small business economics* 1 (1):39-49.
- Heckman, J. 1979. Sample selection bias as a specification error. *Econometrica* 47: 153-161.
- Heeg, J. and Breen, C.M. 1982. *Man and the Pongolo floodplain*. National Scientific Programmes Unit: CSIR.
- Hegney, D.G., Buikstra, E., Baker, P., Rogers-Clark, C., Pearce, S. Ross, H. 2007. Individual resilience in rural people: A Queensland study, Australia. *Rural Remote Health* 7(4):620-632.
- Herrington, M. 2011. Entrepreneurship: how can obstacles be overcome. In: Mbeki, M. (ed.) *Advocates for change: how to overcome Africa's challenges*. Johannesburg: Picador Africa.
- Herrington, M. and Kew, J. 2014. GEM 2013 South African report: twenty years of democracy. *University of Cape Town: South Africa*.
- Herrington, M., Kew, J. and Kew, P. 2008. Global Entrepreneurship Monitor: 2008 South African Report.
- Herrington, M., Kew, J. and Kew, P. 2009. Tracking entrepreneurship in South Africa: a GEM perspective, Available at <http://www.gsb.uct.ac.za/files/Gembook2009.pdf> [Accessed 5 June 2015].
- Hmieleski, K.M. and Carr, J.C. 2008. The relationship between entrepreneur psychological capital and new venture performance.
- Hodgson, S. 2004. *Land and Water--the Rights Interface*. Food and Agriculture Organisation.
- Hodgson, S. 2016. Exploring the concept of water tenure. *FAO Land and Water Discussion Paper (FAO) eng no. 10*. Food and Agriculture Organisation.
- Holbrook, T.M. 1996. Reading the political tea leaves: A forecasting model of contemporary presidential elections. *American Politics Quarterly* 24(4):506-519.
- Holden, S.T. and Ghebru, H. 2016. Land tenure reforms, tenure security and food security in poor agrarian economies: Causal linkages and research gaps. *Global Food Security* 10:21-28.

- Hookoomsing, D. and Essco, P. 2003. *Promoting female entrepreneurship in Mauritius: Strategies in training and development*. SEED Working Paper no. 58: Series on Women's Entrepreneurship Development and Gender Equality – WEDGE. International Labour Office, Geneva and ILO Antananarivo.
- Hussain, I., Turrall, H., Molden, D. and Ahmad, M. 2007. Measuring and enhancing the value of agricultural water in irrigated river basins. *Irrigation Science* 25: 263-282.
- Hussein, K. 2004, Livelihood approaches compared: A multi-agency review of current practices.
- IFAD. 2012. Sustainable smallholder agriculture: feeding the world, protecting the planet Rome: International Fund for Agricultural Development.
- iSineke Development (Pty) Ltd. 2004. Potential of sustainable irrigation in black developing communities. WRC Report No. 1138/1104. Water Research Commission.
- Jackman, D. 2015. *The Compliance Revolution: How Compliance Needs to Change to Survive*. John Wiley & Sons.
- Jaganyi, J., Salagae, M. and Matiwane, N. 2009. Integrating Floodplain Livelihoods into a Diverse Rural Economy by Enhancing Co-operative Management: A Case Study of the Pongolo Floodplain System, South Africa. Water Research Commission.
- Jagwe, J.N. and Machethe, C. 2011. Effects of Transaction Costs on Choice of Selling Point: A Case of Smallholder Banana Growers in the Great Lakes Region of Central Africa. *Agrekon: Agricultural Economics Research, Policy and Practice in Southern Africa* 50 (3):109-123.
- Janmaat, J. 2004. Calculating the cost of irrigation induced soil salinization in the Tungabhadra project. *Agricultural Economics* 31 (1):81-96.
- Jayne, T.S., Mather, D. and Mghenyi, E. 2010. Principal challenges confronting smallholder agriculture in sub-Saharan Africa. *World Development* 38 (10):1384-1398.
- Jozini Local Municipality. 2009. Integrated development plan (IDP) review 2008/09. Jozini Local Municipality.
- Joemat-Petterson T. 2012. National Budget Speech. Pretoria. South Africa.: Department of Agriculture, Forestry and Fisheries.
- Jordaan, H. and Grové, B. 2012. An economic analysis of the contribution of water use to value chains in agriculture. WRC Report.
- Jordaan, H., Grové, B. and Backeberg, G.R. 2014. Conceptual framework for value chain analysis for poverty alleviation among smallholder farmers. *Agrekon* 53 (1): 1-25.
- Joubert, R. 2012. Huge projects promised for KZN. *Farmers' Weekly*. Pretoria, South Africa.
- Jozini Local Municipality 2013. Jozini Local Municipality Integrated Development Plan 2013/14. KwaZulu-Natal. In: Municipality, J.L. (ed.).

- Jozini Local Municipality. 2015. Jozini integrated development plan 2015/16. KwaZulu-Natal: uMkhanyakhude District.
- Juma, C. 2014. Complexity, innovation and development: Schumpeter revisited. *Policy and Complex System* 1 (1).
- Juma, C. and Spielman, D. 2014. Farmers as Entrepreneurs: Sources of Agricultural Innovation in Africa. New Directions for Smallholder Agriculture. Oxford University Press.
- Junankar P.N. 1982. Neo-Classical Economics and Indian Agriculture: An Econometric Analysis of Production Behaviour. In: Development Economics. Palgrave Macmillan, London
- Kahan, D. 2012. Farm Management Extension Guide. Entrepreneurship in Farming. FAO. Rome.
- Kahan, D. 2013. *Managing risk in farming*. Rome, Italy: FAO.
- Kähkönen, S. 1999. *Does social capital matter in water and sanitation delivery? A review of literature*. World Bank, Social Development Family, Environmentally and Socially Sustainable Development Network.
- Kamau, G. and Almekinders, C. 2009. From strangler to nourisher: how novice rice farmers turned challenges into opportunities. *Innovation Africa: enriching farmers' livelihoods*.
- Kanbur, S.M. 1979. Of risk taking and the personal distribution of income. *Journal of political economy* 87 (4):769-797.
- Karaan, A. and Mohamed, N. 1998. The performance and support of food gardens in some townships of the Cape Metropolitan Area: an evaluation of Abalimi Bezekhaya. *Development Southern Africa* 15 (1):67-83.
- Karam, F., Kabalan, R., Breidi, J., Rouphael, Y. and Oweis, T. 2009. Yield and water-production functions of two durum wheat cultivars grown under different irrigation and nitrogen regimes. *Agricultural water management* 96 (4):603-615.
- Karandikar, R., Mookherjee, D., Ray, D. and Vega-Redondo, F. 1998. Evolving aspirations and cooperation. *journal of economic theory* 80 (2):292-331.
- Katundu, M., Hendriks, S., Bower, J. and Siwela, M. 2010. Can sequential harvesting help small holder organic farmers meet consumer expectations for organic potatoes? *Food quality and preference* 21 (4):379-384.
- Keller H. 2003. Handbook for Home Gardening in Cambodia: The Complete Manual for Vegetable and Fruit Production. Phnom Penh, Cambodia: Helen Keller Worldwide;
- Kherallah, M and Kirsten, J.F. 2002. The new institutional economics: applications for agricultural policy research in developing countries. *Agrekon* 41(2):110-133
- Kibirige, D. 2013. *Impact of Human Dimensions on Smallholder Farming in the Eastern Cape Province of South Africa*. University of Fort Hare.

- Kidder, T., Mapandi, Z. Ortega, H. 2014. Not 'women's burden': how washing clothes and grinding corn became issues of social justice and development. *Gender & Development* 22(3):495-513.
- Kiesling, F.M. and Manning, C.M. 2010. How green is your thumb? Environmental gardening identity and ecological gardening practices. *Journal of Environmental Psychology* 30 (3):315-327.
- Killebrew, K. and Wolff, H. 2010. Environmental impacts of agricultural technologies.
- Kilpatrick, K. 2011. Supporting Irrigation for Food Security in Malawi. Oxfam International, United Kingdom.
- Kirsten, J.F. and Van Zyl, J. 1998. Defining small-scale farmers in the South African context. *Agrekon* 37 (4):551-562.
- Kirzner, I. 1973. *Competition and entrepreneurship*. Chicago: University of Chicago Press.
- Knight, A.T., Cowling, R.M., Rouget, M., Balmford, A., Lombard, A.T. and Campbell, B.M. 2008. Knowing but not doing: selecting priority conservation areas and the research-implementation gap. *Conservation biology* 22 (3):610-617.
- Knudson, W., Wysocki, A., Champagne, J. and Peterson, H.C. 2004. Entrepreneurship and innovation in the agri-food system. *American Journal of Agricultural Economics* 86 (5):1330-1336.
- Kosec, K., Hameed, M. and Hausladen, S. 2012. Aspirations in rural Pakistan. *Pakistan Strategy Support Program Working Paper*. Washington, DC: International Food Policy Research Institute.
- Krantz, L. 2001. The sustainable livelihood approach to poverty reduction: An introduction. Swedish international development cooperation agency division for policy and socio-economic analysis. *Unpublished manuscript*.
- Kruseman, G., Ruben, R. and Tesfay, G. 2006. Diversity and development domains in the Ethiopian highlands. *Agricultural systems* 88 (1):75-91.
- Kughur, P.G. 2012. The effects of herbicides on crop production and environment in Makurdi Local Government Area of Benue State, Nigeria. *Journal of Sustainable Development in Africa* 14 (4):23-29.
- Kumar, B.M. and Nair, P.R. 2004. The enigma of tropical homegardens. *New vistas in agroforestry*. Springer.
- Kumar, B.M. and Nair, P.R. 2006. Tropical homegardens: A time-tested example of sustainable agroforestry. Springer, Dordrecht, the Netherlands.
- Kumar, N. 2012. The resource dynamics of early internationalising India IT firms. *Journal of International Entrepreneurship* 10(3):255-278

- Kuo, F.E. and Faber Taylor, A. 2004. A potential natural treatment for attention-deficit/hyperactivity disorder: evidence from a national study. *American journal of public health* 94 (9):1580-1586.
- Kyei-Baffour, N. and Ofori, E. 2006. Irrigation development and management in Ghana: prospects and challenges. *Journal of science and technology (Ghana)* 26 (2):148-159.
- KZN PDAEA. 2002. Makhathini development plan 2002. Towards and Agricultural Development Plan for the Makhathini flats. A report prepared for the KwaZulu-Natal. The Provincial Department of Agriculture and Environmental Affairs. Durban, South Africa.
- KZN PDAEA. 2006. Makhathini Master Plan. The Provincial Department of Agriculture and Environmental Affairs. Durban, South Africa.
- KZN PDAEA. 2012. Annual report 2011/2012. The Provincial Department of Agriculture and Environmental Affairs. Durban, South Africa.
- KZN PDAEA. 2014. Makhathini flats gets R270 million cash injection from KwaZulu-Natal Government. Press release, The Provincial Department of Agriculture and Environmental Affairs, Durban, South Africa.
<http://www.kzndae.gov.za/Portals/0/EVENTS/2014/MAKHATHINI%20FLATS%20GETS%20R270%20MILLION%20CASH%20INJECTION%20FROM%20%20KZN%20GOVERNMENT.pdf>. (Accessed 18 November 2014).
- Ladzani, W.M. and Van Vuuren, J.J. 2002. Entrepreneurship training for emerging SMEs in South Africa. *Journal of Small Business Management* 40 (2):154.
- Lambert, C. 2006. The marketplace of perceptions. *Harvard Magazine* 108 (4):50.
- Land Bank. 2011. Land and agricultural development bank of South Africa: Information Manual.
- Lankford, B. 2005. Irrigation, livelihoods and river basins. In: Ellis, F.a.F., H (ed.) *Rural livelihoods and poverty reduction policies*. London and New York: Routledge.
- Lankford, B., Pringle, C., Dickens, C., Lewis, F., Mander, M., Chotray, V., Goulden, M., Nxele, Z. and Quayle, L. 2011. Hydrological modelling of water allocation, ecosystem services and poverty alleviation in the Pongola floodplain, South Africa. *Journal of environmental planning and management* 54 (9):1237-1260.
- Lans, T. 2009. *Entrepreneurial competence in agriculture: Characterisation, identification, development and the role of the work environment*.
- Lans, T., Van Galen, M., Verstegen, J., Biemans, H. and Mulder, M. 2014. Searching for entrepreneurs among small business ownermanagers in agriculture. *NJAS-Wageningen Journal of Life Sciences* 68:41-51.
- Lautze, J. and Hanjra, M.A. 2014. *Water Scarcity*. New York: Routledge.

- Lautze, J., Cai, X. and Matchya, G. 2014. Water Productivity. In: Key concepts in water resource management: A review and critical evaluation. Lautze, J. Ed. Routledge: New York, pp. 57-73.
- Lauwere, C.K., Enting, I., Vermeulen, P. and Verhaar, K. 2002. Modern Agricultural Entrepreneurship. Paper prepared for presentation at the 13th International Farm Management Congress, Wageningen, The Netherlands, July 7-12, 2002
- Leavy, J. and Smith, S. 2010. Future farmers: youth aspirations, expectations and life choices. *Future Agricultures Discussion Paper* 13:1-15.
- Lee, S.H. and Phan, P. Initial thoughts on a model of rural entrepreneurship in developing countries. World entrepreneurship forum, 2008. 14-15.
- Leighton, A. 1976. *American gardens in the eighteenth century: "for use or for delight"*. University of Massachusetts Press.
- Ligthelm, A. 2013. Confusion about entrepreneurship? Formal versus informal small businesses. *Southern African Business Review* 17 (3):57-75.
- Liu, Z. and Liu, L. 2016. Characteristics and driving factors of rural livelihood transition in the east coastal region of China: a case study of suburban Shanghai. *Journal of Rural Studies* 43: 145-158.
- Livingston, G., Schonberger, S. and Delaney, S. 2014. Right place, right time: the state of smallholders in agriculture in sub-Saharan Africa. In: Hazell, P. and Rahman, A. (eds.) *New Directions for Smallholder Agriculture*. Oxford, United Kingdom: Oxford University Press.
- London, T. 2009. Making better investments at the base of the pyramid. *Harvard business review* 87 (5):106-113.
- Lorentzen, J. 2010. Low-income countries and innovation studies: A review of recent literature. *African Journal of Science, Technology, Innovation and Development* 2 (3):46-81.
- Louw, A., Jordaan, D., Ndanga, L. and Kirsten, J.F. 2008. Alternative marketing options for small-scale farmers in the wake of changing agri-food supply chains in South Africa. *Agrekon* 47 (3):287-308.
- Lubwama, F.B. 1999. Socio-economic and gender issues affecting the adoption of conservation tillage practices. *Kaumbutho, PG and Simalenga TE, (eds):*155-160.
- Luthans, F. 2004. Human, social and now positive psychological capital management: investing in people for competitive advantage. *Organizational Dynamics* 33 (2): 143-160.
- Luthans, F., Avey, J.B., Avolio, B.J. and Peterson, S.J. 2010. The development and resulting performance impact of positive psychological capital. *Human resource development quarterly* 21 (1):41-67.

- Luthans, F., Avolio, B.J., Avey, J.B. and Norman, S.M. 2007. Positive Psychological Capital: Measurement and Relationship with Performance and Satisfaction. *Personnel Psychology* 60:541-572.
- Luthans, F., Luthans, K.W. and Luthans, B.C. 2004. Positive psychological capital: Beyond human and social capital. *Business horizons* 47 (1):45-50.
- Luthans, F., Youssef, C.M. and Avolio, B.J. 2007. *Psychological capital: Developing the human competitive edge*. Oxford University Press Oxford.
- Luthans, F., Youssef-Morgan, C.M. and Avolio, B.J. 2015. *Psychological capital and beyond*. New York: Oxford Press.
- Lynd, R.S. and Lynd, H.M. 1929. Middletown; a study in contemporary American culture.
- Lyons, T.S. 2002. Building social capital for rural enterprise development: Three case studies in the United States. *Journal of Developmental Entrepreneurship* 7 (2):193.
- Machethe, C., Mollel, N., Ayisi, K., Mashatola, M., Anim, F. and Vanasche, F. 2004. Smallholder irrigation and agricultural development in the Olifants River Basin of Limpopo province: management, transfer, productivity, profitability and food security Issues. WRC Report No. 1050/104. Water Research Commission.
- Machethe, C.L 2004. Agriculture and poverty in South Africa: Can agriculture reduce poverty. Paper presented at the Overcoming Underdevelopment Conference held in Pretoria, 2004. 29.
- Machingura, C. 2007. An analysis of factors that can be used to identify successful smallholder farmers: A case study of Mbhashe and Ngqushwa. *Unpublished Master's thesis, University of Fort Hare, Alice*.
- Madulu, N.F. 2000. Poverty, conflicts and water resource use in Tanzania. 3rd Waternet/WARFSA Symposium on Water Demand Management for Sustainable Development. Dar es Salaam, 2000. 30-31.
- Magingxa, L.L., Alemu, Z.G. and Van Schalkwyk, H.D. 2009. Factors influencing access to produce markets for smallholder irrigators in South Africa. *Development Southern Africa* 26 (1):47-58.
- Makoni, F.S., Manase, G. and Ndamba, J. 2004. Patterns of domestic water use in rural areas of Zimbabwe, gender roles and realities. *Physics and Chemistry of the Earth, Parts A/B/C* 29 (15):1291-1294.
- Maluleke, J. 2016. *Entrepreneurship 101: tackling the basics of business start-ups in South Africa*. Auckland Park, South Africa: Blackbirds Books.
- Malzbender, D., Goldin, J., Turton, A. and Earle, A. Traditional water governance and South Africa's "National Water Act"—tension or cooperation. International workshop on 'African water laws: plural legislative frameworks for rural water management in Africa, 2005. 26-28.

- Manona, C. 1999. De-agrarianisation and urbanisation of a rural economy: Agrarian patterns in Melanie in the Eastern Cape. *Afrika-studie Centrum Working Paper* (32).
- Maroyi, A. 2013. Use and management of homegarden plants in Zvishavane district, Zimbabwe. *Tropical Ecology* 54 (2):191-203.
- Maslow, A.H. 1943. A theory of human motivation. *Psychological review* 50 (4):370.
- Masten, A.S. and Reed, M.G. 2002. Resilience in development. In: Snyder, C. and Lopez, S. (eds.) *Handbook of positive psychology*. Oxford, UK: Oxford University Press.
- Masuku, M.B. and Xaba, B. 2013. Factors affecting the productivity and profitability of vegetables production in Swaziland. *Journal of Agricultural Studies* 1 (2):37-52.
- Mathieu, R., Freeman, C. and Aryal, J. 2007. Mapping private gardens in urban areas using object-oriented techniques and very high-resolution satellite imagery. *Landscape and urban planning* 81 (3):179-192.
- McElwee, G. 2005. Developing entrepreneurial skills of farmers. *A Literature Review of Entrepreneurship in Agriculture*. Available on the ESoF-website: http://www.esofarmers.org/documents/ESoF-literaturereview_000.pdf.
- McElwee, G. 2006. Farmers as entrepreneurs: developing competitive skills. *Journal of Developmental Entrepreneurship* 11 (03):187-206.
- McElwee, G. 2008. A taxonomy of entrepreneurial farmers. *International Journal of Entrepreneurship and Small Business* 6 (3):465-478.
- McElwee, G. and Bosworth, G. 2010. Exploring the strategic skills of farmers across a typology of farm diversification approaches. *Journal of Farm Management* 13 (12):819-838.
- McElwee, G., Smith, R., 2012. 'Illegal diversification in the farming community? RUSource www.nationalrural.org/organisation <http://hdl.handle.net/10059/804>.
- McKeown, R., Hopkins, C.A., Rizi, R. and Chrystalbridge, M. 2002. *Education for sustainable development toolkit*. Energy, Environment and Resources Center, University of Tennessee Knoxville.
- Meinzen-Dick, R. 2014. Property rights and sustainable irrigation: A developing country perspective. *Agricultural water management* 145:23-31.
- Mekonnen, D.A. and Gerber, N. 2016. The effect of aspirations on agricultural innovations in rural Ethiopia Bonn: Centre for Development Research.
- Mendola, M. 2007. Farm household production theories: a review of "institutional" and "behavioural" responses. *Asian Development Review* 24 (1): 49-68.

- Migot-Adholla, S., Hazell, P., Blarel, B. and Place, F. 1991. Indigenous land rights systems in sub-Saharan Africa: a constraint on productivity? *The World Bank Economic Review* 5 (1):155-175.
- Millat-e-Mustafa M, Hall J. B., Teklehaimanot Z. 1996. Indigenous management techniques in Bangladesh home gardens. *International Tree Crops Journal* 10 (3):215-228.
- Miller, C. 2004. In the sweat of our row: Citizenship in American domestic practice during WWII – 2 Victory Gardens. *The Journal of American Culture* 26(2): 395-409.
- Ming, Z. and Zuguang, H 2013. The entrepreneurial psychological capital and the study of entrepreneurship. Information Management, Innovation Management and Industrial Engineering (ICIII), 2013 6th International Conference on, 2013. IEEE, 135-137.
- Mitchell, B. 2004. Motives of entrepreneurs: A case study of South Africa. *The Journal of Entrepreneurship* 13 (2):167-183.
- Mkhabela, T. 2005. Technical efficiency in a vegetable based mixed-cropping sector in Tugela Ferry, Msinga District, KwaZulu-Natal. *Agrekon* 44 (2):187-204.
- Mnkeni, P., Chiduza, C., Modi, A., Stevens, J., Monde, N., Van Der Stoep, I. and Dladla, R. 2010. Best management practices for smallholder farming on two irrigation schemes in the Eastern Cape and KwaZulu-Natal through participatory adaptive research. WRC Report No. TT 478/10. Water Research Commission.
- Modiba, M.D. 2009. *An entrepreneurial framework to enhance the agricultural sector in a district of the Limpopo Province*. North-West University.
- Molden, D. and Sakthivadivel, R. 1999. Water accounting to assess use and productivity of water. *International Journal of Water Resources Development* 15 (1-2):55-71.
- Molden, D., Oweis, T., Steduto, P., Bindraban, P., Hanjra, M.A. and Kijne, J. 2010. Improving agricultural water productivity: between optimism and caution. *Agricultural water management* 97 (4):528-535.
- Molden, D., Oweis, T.Y., Pasquale, S., Kijne, J.W., Hanjra, M.A., Bindraban, P.S., Bouman, B.A.M., Cook, S., Erenstein, O., Farahani, H., Hachum, A., Hoogeveen, J., Mahoo, H., Nangia, V., Peden, D., Sikka, A., Silva, P., Turrall, H., Upadhyaya, A. and Zwart, S. 2007. Pathways for increasing agricultural water productivity. London, UK: Earthscan; Colombo, Sri Lanka: International Water Management Institute.
- Molden, D., Oweis, T.Y., Steduto, P., Kijne, J.W., Hanjra, M.A., Bindraban, P.S., Bouman, B.A.M., Cook, S.J., Erenstein, O. and Farahani, H. 2007. Pathways for increasing agricultural water productivity. *Water for Food Water for Life: A Comprehensive Assessment of Water Management in Agriculture*. Taylor and Francis AS.
- Montshwe, B.D. 2006. *Factors affecting participation in mainstream cattle markets by small-scale cattle farmers in South Africa*. University of the Free State.

- Mookherjee, D., Ray, D. and Napel, S. 2010. Aspirations, segregation and occupational choice. *Journal of the European Economic Association* 8 (1):139-168.
- Morakinyo, A.T., Adeboye, O.B. and Awogbuyi, O.T. 2013. Environmental effects of application of fertilizers and pesticides on water and soil in Ibadan, Nigeria. *Journal of Emerging Trends in Engineering and Applied Sciences* 4 (6):773-777.
- Morgan, S.L., Marsden, T., Miele, M. and Morley, A. 2010. Agricultural multifunctionality and farmers' entrepreneurial skills: A study of Tuscan and Welsh farmers. *Journal of Rural Studies* 26 (2):116-129.
- Moriarty, P., Butterworth, J., Van Koppen, B. and Soussan, J. 2004. Water, poverty and productive uses of water at the household level. *Beyond Domestic* 19.
- Morris, M., Kelly, V., Kopicki, R. and Byerlee, D. 2007. Fertilizer use in African agriculture: Lessons learned and good practice guidelines. The World Bank. *Agriculture and Rural development* 39037.
- Moskow, A. 1999. Havana's self-provision gardens. *Environment & Urbanization*, 11(2): 127-134.
- Mpandeli, S. and Maponya, P. 2014. Constraints and challenges facing the small-scale farmer in Limpopo province, South Africa. *Journal of Agricultural Science* 6 (4).
- Msinga Local Municipality. 2014. Msinga Local Municipality Integrated Development Plan 2014/15. KwaZulu-Natal: uMzinyathi District.
- Muchara, B. 2011. Analysis of food value chains in smallholder crop and livestock enterprises in the Eastern Cape Province of South Africa. University of Fort Hare, South Africa.
- Muchara, B. 2015. *The Economics of Smallholder Irrigation Water Management: Institutions, Water-Use Values and Farmer Participation in Kwazulu-Natal, South Africa*. PhD, University of KwaZulu-Natal.
- Muchara, B., Ortmann, G., Wale, E. and Mudhara, M. 2014. Collective action and participation in irrigation water management: A case study of Mooi River Irrigation Scheme in KwaZulu-Natal Province, South Africa. *Water SA* 40 (4):699-708.
- Mudhara, M. 2010. Agrarian transformation in smallholder agriculture in South Africa: A diagnosis of bottlenecks and public policy options. Conference paper presented at 'Overcoming inequality and structural poverty in South Africa: Towards inclusive growth and development', Johannesburg, 2010. 20-22.
- Muthamia, J., Mugendi, D. and Kung'u, J. 2011. Within-Farm Variability in Soil Fertility Management in Smallholder Farms of Kirege Location, Central Highlands of Kenya. *Innovations as Key to the Green Revolution in Africa*. Springer.
- Mutiro, J. and Lautze, J. 2015. Irrigation in Southern Africa: Success or failure? *Irrigation and Drainage* 64 (2): 180-192.

- Nair, P. 2001. Do tropical homegardens elude science, or is it the other way around? *Agroforestry Systems* 53 (2):239-245.
- Namara, R.E., Hanjra, M.A., Castillo, G.E., Ravnborg, H.M., Smith, L. and Van Koppen, B. 2010. Agricultural water management and poverty linkages. *Agricultural water management* 97 (4):520-527.
- Narayan, D. 1997. Voices of the Poor: Poverty and Social Capital in Tanzania. Environmentally Sustainable Development Studies and Monographs Series 20. World Bank Conference in Atlanta, GA. World Bank Publications, Washington, DC.
- National Planning Commission. 2011. *National Development Plan Vision 2030: Our future – make it work*. Pretoria: Pretoria National Planning Commission. Available at: <http://www.info.gov.za/issues/national-development-plan/> [Accessed 20 July 2013].
- NEPAD (New Partnership for Africa's Development). 2003. Comprehensive Africa Agriculture Development Program (CAADP). South Africa: New Partnership for Africa's Development.
- Ngorora, G. and Mago, S. 2013. Challenges of rural entrepreneurship in South Africa: insights from Nkonkobe Municipal area in the Eastern Cape Province. *International Journal of Information Technology and Business Management* 16 (1):1-11.
- Nicol, A. 2000. *Adopting a sustainable livelihoods approach to water projects: implications for policy and practice*. Overseas Development Institute London.
- Nieuwoudt, W. and Backeberg, G. 2011. A review of the modelling of water values in different use sectors in South Africa. *Water SA* 37 (5):703-710.
- Njuki, J., Mapila, M., Zingore, S. and Delve, R. 2008. The dynamics of social capital in influencing use of soil management options in the Chinyanja Triangle of southern Africa. *Ecology and society* 13 (2).
- Nkechi, A., Emeh Ikehukwu, E. and Okehukwu, U.F. 2012. Entrepreneurship development and employment generation in Nigeria: Problems and prospects. *Universal Journal of Education and General Studies* 1 (4):88-102.
- Noel, S., Phuong, H.T., Soussan, J. and Lovett, J.C. 2010. The impact of domestic water on household enterprises: Evidence from Vietnam. *Water Policy* 12 (2):237-247.
- Nongoma Local Municipality. 2015. Nongoma Local Municipality Integrated Development Plan 2015/16. KwaZulu-Natal: Zululand District.
- Obi, A., Gidi, L., Balogun, T., Mujuru, N., Fakunle, F., Avuletey, R., Onomu, R., Kibirige, D., Mcata, B. and Lesala, M. 2016. Appropriate entrepreneurial development paths in the transition from homestead food gardening to smallholder irrigation crop farming in the Eastern Cape Province of South Africa. WRC Report No. 2178/1/16. Water Research Commission.
- Okpachu, A., Okpachu, O. and Obijesi, I. 2014. The Impact of Education on Agricultural Productivity of Small Scale Rural Female Maize Farmers in Potiskum Local Government, Yobe

State: A Panacea for Rural Economic Development in Nigeria. *International Journal of Research in Agriculture and Food Sciences*. Vol 2.

Oladele, O.I. and Mudhara, M. 2016. Empowerment of women in rural areas through water use security and agricultural skills training for gender equity and poverty reduction in KwaZulu-Natal and North West Provinces. WRC Report No. 2176/1/16. Water Research Commission.

Olawale, F. and Garwe, D. 2010. Obstacles to the growth of new SMEs in South Africa: A principal component analysis approach. *African Journal of Business Management* 4 (5):729.

Oliver, D.M., Fish, R.D., Winter, M., Hodgson, C.J., Heathwaite, A.L. and Chadwick, D.R. 2012. Valuing local knowledge as a source of expert data: Farmer engagement and the design of decision support systems. *Environmental Modelling & Software* 36:76-85.

Oni, S., Maliwichi, L. and Obadire, O. 2011. Assessing the contribution of smallholder irrigation to household food security, in comparison to dryland farming in Vhembe district of Limpopo province, South Africa. *Afr. J. Agric. Res* 6 (6):1991-1637X.

Oosterbaan, R. 1988. Effectiveness and social/environmental impacts of irrigation projects: A critical review. *ILRI Annual Report* 1988:18-34.

Ortmann, G.F. and King, R.P. 2007. Agricultural cooperatives I: History, theory and problems. *Agrekon* 46 (1):18-46.

Osterwalder, A., Pigneur, Y. and Tucci, C.L. 2005. Clarifying business models: Origins, present, and future of the concept. *Communications of the association for Information Systems* 16 (1): 1.

Ostrom, E. 1998. A behavioural approach to the rational choice theory of collective action. *The American Political Science Review* 92(1)1-22.

Ostrom, E. and Benjamin, P. 1993. Design principles and the performance of farmer managed irrigation systems in Nepal. *Manor, S. y J. Chambouleyron (eds.)* 1993:53-62.

Ouédraogo, E., Mando, A. and Zombré, N. 2001. Use of compost to improve soil properties and crop productivity under low input agricultural system in West Africa. *Agriculture, ecosystems & environment* 84 (3):259-266.

Oweis, T. and Hachum, A. 2006. Water harvesting and supplemental irrigation for improved water productivity of dry farming systems in West Asia and North Africa. *Agricultural water management* 80 (1):57-73.

Oxfam. 2014. Hidden hunger in South Africa: the faces of hunger and malnutrition in a food-secure nation. Oxfam International

Oxford English Dictionary 1989. *Oxford English Dictionary*. 2nd Ed. Oxford University Press.

Ozgen, E. and Minsky, B.D. 2007. Opportunity recognition in rural entrepreneurship in developing countries. *International Journal of Entrepreneurship* 11:49.

- Pacey, A. 1978. Gardening for better nutrition. Second edition. London.
- PAETA. 2004. Mentorship review: towards a model for mentorship in agricultural development in South Africa. Primary Agricultural Education and Training Authority,
- Pandeti, C.M. 2005. *A study on entrepreneurial behaviour of farmers in Raichur district of Karnataka*. UAS, Dharwad.
- Pandolfelli, L., Meinzen-Dick, R. and Dohrn, S. 2008. Gender and collective action: motivations, effectiveness and impact. *Journal of International Development* 20 (1):1-11.
- Passioura, J. 2006. Increasing crop productivity when water is scarce – from breeding to field management. *Agricultural water management* 80 (1):176-196.
- PDAEA. 2013. KZN irrigation schemes more than 10 hectares. The Provincial Department of Agriculture and Environmental Affairs, KwaZulu-Natal
- PDARD. 2011, ERP Management Advisory Committee Quarterly Report, The Provincial Department of Agriculture and Rural Development, Mahikeng, Northwest Province
- Pender, J. 2004. Targeting rural investments in the highlands of northern Ethiopia. USAID/Ethiopia. Environment and Production Technology Division, International Food Policy Research Institute, Washington, DC Processed.
- Pender, J., Jagger, P., Nkonya, E. and Sserunkuuma, D. 2004. Development pathways and land management in Uganda. *World development* 32 (5):767-792.
- Pender, J., Place, F. and Ehui, S. 1999. Strategies for sustainable agricultural development in the East African Highlands. In: A. Knox McCullough, S. Babu and P. Hazell (eds.), *Strategies for Poverty Alleviation and Sustainable Resource Management in the Fragile Lands of Sub-Saharan Africa*. Proceedings of the International Conference held from 25-29 May, 1998 in Entebbe, Uganda. Food and Agriculture Development Centre (DSE/ZEL), Feldafing, Germany.
- Pender, J., Place, F. and Ehui, S. 2006. *Strategies for sustainable land management in the East African highlands*. Washington, D.C: Intl Food Policy Res Inst.
- Pereira, L.S. 1990. The role of irrigation in mitigating the effect of draught. ICID, New Delhi.
- Pereira, L.S., Cordery, I. and Iacovides, I. 2002. Coping with Water Scarcity. UNESCO, Paris.
- Perret, S. 2003. Assessing the economic viability of smallholder irrigation scheme in South Africa: Prospective analysis and local empowerment. *Final report for Department of water Affairs and forestry*.
- Perret, S.R. 2001. New water policy, irrigation management transfer and smallholding irrigation schemes in South Africa: institutional challenges.
- Perret, S.R. 2002. Water policies and smallholding irrigation schemes in South Africa: a history and new institutional challenges. *Water Policy* 4 (3):283-300.

- Phelan, C. and Sharpley, R. 2012. Exploring entrepreneurial skills and competencies in farm tourism. *Local Economy* 27 (2):103-118.
- Pienaar, L. and Traub, L. 2015. Understanding the smallholder farmer in South Africa: towards a sustainable livelihoods classification. 2015 Conference, 9-14 August 2015 Milan, Italy. International Association of Agricultural Economists.
- Place, F. 2009. Land tenure and agricultural productivity in Africa: A comparative analysis of the economics literature and recent policy strategies and reforms. *World Development* 37 (8):1326-1336.
- Poole, N. and De Frece, A. 2010. A review of existing organisational forms of smallholder farmers' associations and their contractual relationships with other market participants in the East and Southern African ACP region.
- Posel, D. and Rogan, M. Inequality, social comparisons and minimum income aspirations: Evidence from South Africa. Rhodes University, Grahamstown.
- Pote, P.P.T. 2008. *Technical constraints to smallholder agriculture: case study of Nkonkobe Municipality, Eastern Cape, South Africa*. University of Fort Hare.
- Poulton, C., Dorward, A. and Kydd, J. 2010. The future of small farms: New directions for services, institutions and intermediation. *World development* 38 (10):1413-1428.
- Poulton, C., Kydd, J. and Dorward, A. 2006. Overcoming market constraints on pro-poor agricultural growth in Sub-Saharan Africa. *Development Policy Review* 24 (3):243-277.
- Prahalad, C.K. and Hammond, A. 2002. Serving the world's poor, profitably. *Harvard business review* 80 (9):48-59.
- Pregering, M. 2014. Framing of science-policy interactions and their discursive and institutional effects: examples from conservation and environmental policy. *Biodiversity and Conservation* 23: 1-21.
- Preisendörfer, P., Bitz, A. and Bezuidenhout, F.J. 2012. In search of black entrepreneurship: Why is there a lack of entrepreneurial activity among the black population in South Africa? *Journal of Developmental Entrepreneurship* 17 (01):1250006.
- Prendergrast, J., Foley, B., Menne, V. and Isaac, A.K. 2008. *Creatures of habit? the art of behaviour change*. The Social Market Foundation, London.
- Qadir, M., Boers, T.M., Schubert, S., Ghafoor, A. and Murtaza, G. 2003. Agricultural water management in water-starved countries: challenges and opportunities. *Agricultural water management* 62 (3):165-185.
- QUNO. 2015. Small-scale farmer innovation systems: a review of current literature. Geneva: Quaker United Nations Office.

- Rahman, M., Firdissa, T., Bwalya, B., Lund, T. and Ghulam, R. 2007. Livelihood diversification in rural Uganda: Impact of Africare's development activities on the livelihoods of Nyabyumba community. *Int. J. Sustain. Crop Prod* 2 (6):36-43.
- Rajalahti, R., Janssen, W. and Pehu, E. 2008. *Agricultural innovation systems: From diagnostics toward operational practices*. Agriculture & Rural Development Department, World Bank.
- Rakodi, C. 1999. A capital assets framework for analysing household livelihood strategies: Implications for policy. *Development policy review*, 17(3): 315-342.
- Rasul, G. 2014. Food, water and energy security in South Asia: a nexus perspective from the Hindu Kush Himalayan region☆. *Environmental Science & Policy* 39:35-48.
- Ray, D. 2006. Aspirations, poverty and economic change. *Understanding poverty* 409421.
- Reinders, F.B. 2011. Irrigation methods for efficient water application: 40 years of South African research excellence. *Water SA* 37 (5):765-770.
- Renko, M., Kroeck, K.G. and Bullough, A. 2012. Expectancy theory and nascent entrepreneurship. *Small Business Economics* 39 (3):667-684.
- Renwick, M., Joshi, D., Huang, M., Kong, S., Petrova, S., Bennett, G., Bingham, R., Fonseca, C., Moriarty, P. and Smits, S. 2007. Multiple use water services for the poor: assessing the state of knowledge. *Winrock International, IRC Water and Sanitation Centre, International Water Management Institute* www.winrockwater.org.
- Richards, S.T. and Bulkley, S. 2007. Agricultural entrepreneurs: The first and the forgotten?
- Ringler, C., Bhaduri, A. and Lawford, R. 2013. The nexus across water, energy, land and food (WELF): potential for improved resource use efficiency? *Current Opinion in Environmental Sustainability* 5 (6):617-624.
- Rishbeth, C. 2004. Ethno-cultural representation in the urban landscape. *Journal of Urban Design* 9 (3):311-333.
- Roth, M. and Haase, D. 1998. Land tenure security and agricultural performance in Southern Africa. USAID.
- Roy, J. and Crow, B. 2004. Gender relations and access to water: what we know about social relations and women's time allocation. CGIRS Working Paper 2004-5. Centre for Global International and Regional Studies,
- Rukuni, M. 2011. Traditional Agriculture: How can productivity be improved? *Advocates for Change: How to overcome Africa's Challenges*. Johannesburg: Picador Africa:207-232.
- Rumosa-Gwaze, F., Chimonyo, M. and Dzama, K. 2009. Communal goat production in Southern Africa: a review. *Tropical Animal Health and Production* 41: 1157-1168.
- SACGA. 2005. Report on the SA Cane Grower's Association's mentorship programme for development of new black farmers. South African Cane Growers Association,

- Salami, A., Kamara, A.B. and Brixiova, Z. 2010. *Smallholder agriculture in East Africa: trends, constraints and opportunities*. African Development Bank Tunis.
- Saldivar-Tanaka, L. and M. Krasny. 2004. Culturing community development, neighbourhood open space and civic agriculture: The case of Latino community gardens in New York City. *Agriculture and Human Values* 21:399-412.
- Sanginga, P.C. 2009. *Innovation Africa: enriching farmers' livelihoods*. Earthscan.
- Savitha, M. 2010. An economic analysis of livelihood systems for rural community in chitradurga district of katrnataka state. UAS, Dharwad,
- Schaefer, V.A. 2009. and Meece, J.L. Facing an uncertain future: Aspirations and achievement of rural youth. Annual Meeting of the American Educational Research Association. San Diego, CA, 2009.
- Schnurr, M.A. 2012. Inventing Makhathini: Creating a prototype for the dissemination of genetically modified crops into Africa. *Geoforum* 43 (4):784-792.
- Schreiner, B., Tapela, B. and Van Koppen, B. 2010. Water for agrarian reform and rural poverty eradication: Where is the leak. Proceedings of the conference on Overcoming Inequality and structural poverty in South Africa: Towards inclusive growth and development, 2010. 1-23.
- Schulze, R.E. 1997. South African Atlas of Agrohydrology and Climatology: Contribution Towards a Final Report to the Water Research Commission on Project 492: Modelling Impacts of the Agricultural Environment on Water Resources. WRC Report No. TT82-96. Water Research Commission.
- Schumpeter, J. 1951. Essays on entrepreneurs, innovations, business cycles and the evolution of capitalism, edited by Richard V. Clemens. *Neuaufgabe, Originaldruck: Essays Cambridge, Mass* 2009.
- Schumpeter, J.A. 1934. *The theory of economic development: an inquiry into profits, capital, credit, interest and the business cycle*. Transaction Publishers.
- Schumpeter, J.A. 1950. Capitalism, Socialism and Democracy. Harper & Row, New York.
- Schumpeter, J.A. 1961. The Theory of Economic Development. Oxford University Press, New York.
- Schwarz, I., McRae-Williams, P. and Park, D. 2009. Identifying and utilising a farmer typology for targeted practice change programs: A case study of changing water supply in the Wimmera Mallee. *Extension Farming Systems Journal* 5 (1):33.
- Scoones, I. 1998. Sustainable rural livelihoods: a framework for analysis. Brighton.
- Sebopetji, T.O. 2008. An application of probit analysis to factors affecting small-scale farmers decision about credit: A case study of greater Letaba local municipality, Limpopo Province. University of Limpopo,

Seligman, M.E. 1998. *Learned optimism*. Pockets Books. New York.

Seligman, M.E.P. 2002. *Authentic happiness: using the new positive psychology to realize your potential for lasting fulfilment*. New York: Free Press.

Sen, A. 1981. *Poverty and famines: an essay on entitlement and deprivation*. New York, USA: Oxford University Press.

Sen, B. 2005. Indigenous knowledge for development: Bringing research and practice together. *The International Information & Library Review* 37 (4):375-382.

Senanayake, R., Sangakkara, U., Pushpakumara, D. and Stamp, P. 2009. Vegetation composition and ecological benefits of home gardens in the Meegahakiula region of Sri Lanka. *Tropical Agricultural Research* 21 (1).

Seuneke, P., Lans, T. and Wiskerke, J.S. 2013. Moving beyond entrepreneurial skills: Key factors driving entrepreneurial learning in multifunctional agriculture. *Journal of Rural Studies* 32:208-219.

Shaba, A.K., Edriss, A., Mangisoni, J. and Phiri, M. 2017. Tobacco contractual arrangements in Malawi and their impact on smallholder farmers.

Shackleton, C.M., Paumgarten, F. and Cocks, M.L. 2008. Household attributes promote

Shackleton, C.M., Shackleton, S.E. and Cousins, B. 2010. The role of land-based strategies in rural livelihoods: The contribution of arable production, animal husbandry and natural resource harvesting in communal areas in South Africa. *Development Southern Africa* 18 (5):581-604.

Shah, T. and Van Koppen, B. 2006. Is India ripe for integrated water resources management? Fitting water policy to national development context. *Economic and Political Weekly*:3413-3421.

Shane, S. and Venkataraman, S. 2000. The promise of entrepreneurship as a field of research. *The Academy of Management Review* 25(1):217-226.

Sharaunga, S., Mudhara, M. and Bogale, A. 2016. Effects of 'women empowerment' on household food security in rural KwaZulu-Natal province. *Development policy review* 34 (2):223-252.

Sharma, B., Molden, D. and Cook, S. 2010. *Water use efficiency in agriculture: Measurement, current situation and trends*. Managing water and fertilizer for sustainable agricultural intensification. Chapter 3.

Shatanawi, M.R. 2005. Future options and research needs of water uses for sustainable agriculture. *Water Use Efficiency and Water Productivity*:21.

Shillington, L. 2008. Being (s) in relation at home: socio-natures of patio 'gardens' in Managua, Nicaragua. *Social & Cultural Geography* 9 (7):755-776.

- Siddiqi, A. and Anadon, L.D. 2011. The water-energy nexus in Middle East and North Africa. *Energy policy* 39 (8):4529-4540.
- Sikwela, M.M. 2013. The impact of farmer support programmes on market access of smallholder farmers in the Eastern Cape and KwaZulu-Natal Provinces, South Africa. PhD thesis, University of Fort Hare.
- Simon, H.A. 1955. A behavioural model of rational choice. *The quarterly journal of economics* 69 (1):99-118.
- Simon, H.A. 1959. Theories of decision-making in economics and behavioural science. *The American economic review* 49 (3):253-283.
- Simons, J.C. and Buitendach, J.H. 2013. Psychological capital, work engagement and organisational commitment amongst call centre employees in South Africa. *SA Journal of Industrial Psychology* 39 (2):1-12.
- Singh, A.P. 2013. Factors influencing entrepreneurship among farming community in Uttar Pradesh. *Indian Journal of Commerce and Management Studies* 4 (3):13.
- Sinyolo, S., Mudhara, M. and Wale, E. 2014. The impact of smallholder irrigation on household welfare: The case of Tugela Ferry irrigation scheme in KwaZulu-Natal, South Africa. *Water SA* 40 (1):145-156.
- Sinyolo, S., Mudhara, M. and Wale, E. 2016. To what extent does dependence on social grants affect smallholder farmers' incentives to farm? Evidence from KwaZulu-Natal, South Africa. *African Journal of Agricultural and Resource Economics Volume* 11 (2):154-165.
- Sinyolo, S., Mudhara, M. and Wale, E. 2017. The impact of social grant-dependency on agricultural entrepreneurship among rural households in Kwazulu-Natal, South Africa. *The Journal of Developing Areas* 51 (3):63-76.
- Sitko, N.J., Chamberlin, J. and Hichaambwa, M. 2014. Does smallholder land titling facilitate agricultural growth? An analysis of the determinants and effects of smallholder land titling in Zambia. *World Development* 64:791-802.
- Sjaastad, E. and Bromley, D.W. 1997. Indigenous land rights in Sub-Saharan Africa: Appropriation, security and investment demand. *World Development* 25 (4):549-562.
- Sjaastad, E. and Cousins, B. 2009. Formalisation of land rights in the South: An overview. *Land Use Policy* 26 (1):1-9.
- Small, L.E. and Svendsen, M. 1992. A framework for assessing irrigation performance. *Irrigation and drainage systems* 4 (4):283-312.
- Smith, M. 1992. CROPWAT, a computer program for irrigation and water management. Food and Agriculture Organisation Irrigation and Drainage Paper No. 46. Food and Agriculture Organisation. Rome, Italy.

- Smith, L.E. 2004. Assessment of the contribution of irrigation to poverty reduction and sustainable livelihoods. *International Journal of Water Resources Development* 20 (2):243-257.
- Smiths, S., Van Koppen, B., Moriarty, P. and Butterworth, J. 2010. Multiple-use services as an alternative to rural water supply services: A characterisation of the approach (this issue).
- Soemantri, A., Pollitt, E. and Kim, I. 1985. Iron deficiency anaemia and educational achievement. *The American journal of clinical nutrition* 42 (6):1221-1228.
- Solon, F., Fernandez, T.L., Latham, M.C. and Popkin, B.M. 1979. An evaluation of strategies to control vitamin A deficiency in the Philippines. *The American journal of clinical nutrition* 32 (7):1445-1453.
- Sørensen, J.B. and Sharkey, A.J. 2014. Entrepreneurship as a mobility process. *American Sociological Review* 79 (2):328-349.
- Soukup, A., Maitah, M. and Svoboda, R. 2015. The concept of rationality in neoclassical and behavioural economic theory. *Modern Applied Science* 9 (3):1.
- Soule, M.J. 2001. Soil management and the farm typology: Do small family farms manage soil and nutrient resources differently than large family farms? *Agricultural and Resource Economics Review* 30 (2):179-188.
- Statistics South Africa. 2014. Provincial Profile: KwaZulu-Natal. Pretoria, South Africa.
- Stats SA. 2012a. Census 2011: Statistical Release (Revised) - P0301.4. Statistics South Africa, Pretoria.
- Stats SA. 2012b. Census 2011: Statistical Release (Revised). Statistics South Africa, Pretoria.
- Stevens, J.B., Van Heerden, P.S., Buys, F. and Laker, M.C. 2012. Training material for extension advisors in irrigation water management. WRC Report No. TT 539/12. Water Research Commission.
- Stimie CM, Kruger E, De Lange M, And Crosby CT. 2010. Agricultural Water use in Homestead Food Gardening Systems. Volume 1. WRC Report No. TT 430/09. Water Research Commission
- Suleiman, S. 2010. *Irrigation job creation and food security*. Available at: <http://suleimansblog.blogspot.com/2010/12/irrigation-job-creation-and-food.html>.
- Svubure, O., Ahlers, R. and Van Der Zaag, P. 2011. Representational participation of informal and formal smallholder irrigation in the Zimbabwe water sector: A mirage in the Mzingwane catchment. *African Journal of Agricultural Research* 6 (12):2843-2855.
- Tadić, L. and Tadić, Z. 2009. Impacts of Irrigation on the Environment. International Symposium on Water Management and Hydraulic Engineering, 2009.
- Taylor, V. 1997. The application of simulation modelling in hydrological conflict resolution: Pongola catchment case study. University of Kwa-Zulu Natal, Pietermaritzburg, South Africa.

- Terblanché, S. 2010. Mentorship as a key factor in land reform projects. Faculty of Natural and Agricultural Sciences, Department of Agricultural Economics, Extension and Rural Development, University of Pretoria, USA.
- Thamaga-Chitja, J. M. and Morojele, P. 2014. The context of smallholder farming in South Africa: Towards a livelihood asset building framework. *Journal of Human Ecology*, 45(2): 147-155.
- Thapa, G. and Gaiha, R. 2014. Smallholder farming in Asia and the Pacific: challenges and opportunities. In: Hazell, P. and Rahman, A. (eds.) *New direction in smallholder agriculture*. Oxford, United Kingdom: Oxford University Press.
- Thomas, E. and Van Damme, P. 2010. Plant use and management in homegardens and swiddens: evidence from the Bolivian Amazon. *Agroforestry Systems* 80 (1):131-152.
- Thompson, S. 2005. Digestible difference: food, ethnicity and spatial claims in the city. In: Guild, E. and Van Selm, J. (eds.) *International migration and security: Opportunities and challenges* New York: Routledge: London.
- Thornton, P. 2013. *Brilliant Economics: making sense of the big ideas*. United Kingdom: Pearson.
- Tice, P.M. 1984. *Gardening in America, 1830-1910*. Strong Museum.
- Timmer, C.P. 2012. Behavioural dimensions of food security. *Proceedings of the National Academy of Sciences* 109 (31):12315-12320.
- Timmons, J. A. 1999. *New Venture creation: Entrepreneurship for the 21st Century*. Fifth Edition. McGraw-Hill International Editions, Boston.
- Tollens, E.F. 2006. Market information systems in sub-Sahara Africa challenges and opportunities. The Intl. Assoc. of Agri. Economists Conference, Australia,
- Torero, M. 2014. Targeting investments to link farmers to markets: a framework for capturing the heterogeneity of smallholder farmers. In: Hazell, P. and Rahman, A. (eds.) *New directions for smallholder agriculture*. Oxford, United Kingdom: Oxford University Press.
- Toulmin, C. 2008. Securing land and property rights in sub-Saharan Africa: The role of local institutions. *Land Use Policy* 26:10-19.
- Tucker, D.M. 1993. *Kitchen gardening in America: A history*. Iowa State University Press Ames.
- Tversky, A. and Kahneman, D. 1974. Judgment under uncertainty: Heuristics and biases. *science* 185 (4157):1124-1131.
- Tyson, L. D. A., Petrin, T. and Rogers, H. 1994. Promoting entrepreneurship in Eastern Europe. *Small Business Economics*, 6(3): 165-184.

Uddin, M., Rahman, M., Mannan, M., Begum, S., Rahman, A. and Haq, M. Plant biodiversity in the homesteads of saline area of southeastern Bangladesh. Proc. National Workshop on Agroforestry Research, 2002. 54.

UMkhanyakude District Municipality. 2003. Local economic development initiative. Haley Sharpe Southern Africa (Pty) Ltd, Institute of Natural Resources,

UMkhanyakude District Municipality. 2012. Integrated development plan (IDP), annual review final (2011/12).

UNESCO-WWAP, 2003. Water for people, water for life: The United Nations World Water Development Report. UNESCO and Berghahn Books.

United States Department of Agriculture (USDA). 2011. United Nation Children's fund, the state of the world's children. United States Department of Agriculture.

USAID. 2013. USAID Water and Development Strategy 2013-2018. US Agency for International Development's (USAID).

USG 2013. Irrigation: How farmers irrigate fields. Available on line: URL:<http://ga.water.usgs.gov/edu/iriquicklook.html>.

Van Averbeke, W. 2008. Best Management Practices for Small-scale Subsistence Farming on Selected Irrigation Schemes and Surrounding Area Through Participatory Adaptive Research in Limpopo Province. WRC Report No. TT 344/08. Water Research Commission.

Van Averbeke, W. 2012. *Performance of smallholder irrigation schemes in the Vhembe District of South Africa*. Problems, Perspectives and Challenges of Agricultural Water Management. Dr. Manish Kumar (Ed.). InTech.

Van Averbeke, W. 2013. Improving plotholder livelihood and scheme productivity on smallholder canal irrigation scheme in the Vhembe district of Limpopo province. WRC Report No. TT 566/13. Water Research Commission.

Van Averbeke, W. and Khosa, T. 2011. Smallholder irrigation schemes in South Africa with a focus on Dzindzi Canal Irrigation Scheme in Limpopo: dynamic smallholders amidst contested policy priorities. *Strategies to support South African smallholders as a contribution to government's second economy strategy* 2:145-162.

Van Averbeke, W. and Mohamed, S. 2006. Smallholder farming styles and development policy in South Africa: The case of Dzindi Irrigation Scheme. *Agrekon* 45 (2):136-157.

Van Averbeke, W., Denison, J. and Mnkeni, P. 2011. Smallholder irrigation schemes in South Africa: A review of knowledge generated by the Water Research Commission. *Water SA* 37 (5):797-808.

Van Averbeke, W., Harris, A., Mbuti, C. and Bennett, J. 1998a. An analysis of land, livelihoods, governance and infrastructure in two settlements in former Ciskei. *Report for Land Reform Research Programme II*.

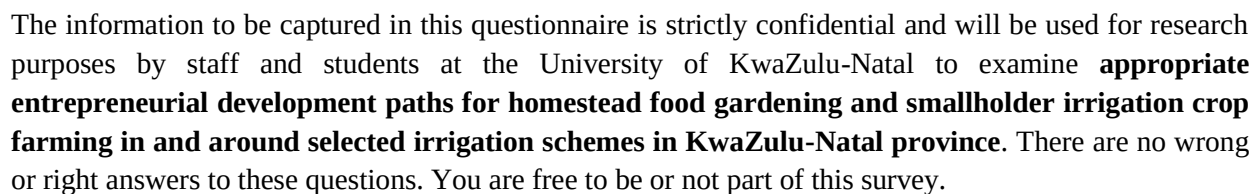
- Van Averbeke, W., M'Marete, C.K., Igodan, C. and Belete, A. 1998. An investigation into food plot production at irrigation schemes in central Eastern Cape. WRC Report No. 719/1. Water Research Commission. pp 98.
- Van den Eynden, V. 2004. Use and Management of Edible Non crop Plants in Southern Ecuador. Ph. D. Thesis at Ghent University, Belgium.
- Van der Heijden, T. and Vink, N. 2013. Good for whom? Supermarkets and smallholder farmers in South Africa-A critical review of current approaches to increasing access to modern markets. *Agrekon* 52 (1):68-86.
- Van der Ploeg, J.D. 2003. *The virtual farmer: past, present and future of the Dutch peasantry*. Uitgeverij Van Gorcum.
- Van Koppen, B., Smits, S., Moriarity, P., Penning de Vries, F., Mikhail, M. and Boelee, E. 2009. Climbing the water; adder: Multiple use services for poverty reduction. The Hague, the Netherlands: IRC International Water and Sanitation Centre.
- Van Niekerk, J., Stroebel, A., Van Rooyen, C., Whitfield, K. and Swanepoel, F. 2011. Towards redesigning the agricultural extension service in South Africa: views and proposals of smallholder farmers in the Eastern Cape. *South African Journal of Agricultural Extension* 39 (2):47-56.
- Vesala, H.T. and Vesala, K.M. 2010. Entrepreneurs and producers: Identities of Finnish farmers in 2001 and 2006. *Journal of Rural Studies* 26 (1):21-30.
- Vesala, K.M. and Jarkko, P. 2008. Understanding Entrepreneurial Skills in the farm context. Research Institute of Organic Agriculture FiBL, CH-Frick.
- Vesala, M., Peura, J. and McElwee, G. 2007. The split entrepreneurial identity of the farmer. *Journal of Small Business and Enterprise Development* 14: 48-63.
- Vink, N. and Van Rooyen, J. 2009. *The economic performance of agriculture in South Africa since 1994: Implications for food security*. Development Planning Division, Development Bank of Southern Africa.
- Vogl, C.R., Vogl-Lukasser, B. and Puri, R.K. 2004. Tools and methods for data collection in ethnobotanical studies of homegardens. *Field methods* 16 (3):285-306.
- Wale, E. 2012. Addressing the information problem in agriculture via agrobiodiversity: Streamlining the issues, challenges and policy questions. *African Journal of Agricultural Research* 7 (30):4187-4197.
- Wale, E. and Yalew, A. 2007. Farmers' variety attribute preferences: implications for breeding priority setting and agricultural extension policy in Ethiopia. *African Development Review* 19 (2):379-396.
- Wale, E., Chishakwe, N. and Lewis-Lettington, R. 2009. Cultivating participatory policy processes for genetic resources policy: lessons from the Genetic Resources Policy Initiative (GRPI) project. *Biodiversity and Conservation* 18 (1):1.

- Wallace, J.S. 2000. Increasing agricultural water use efficiency to meet future food production. *Agriculture, Ecosystems and Environment* 82: 105-119.
- Wang, J., Huang, J., Zhang, L., Huang, Q. and Rozelle, S. 2010. Water governance and water use efficiency: the five principles of WUA management and performance in China. *JAWRA Journal of the American Water Resources Association* 46 (4):665-685.
- Wani, S.P., Rockström, J. and Oweis, T.Y. 2009. *Rainfed agriculture: unlocking the potential*. CABI.
- Wannasai, N. and Shrestha, R.P. 2008. Role of land tenure security and farm household characteristics on land use change in the Prasae Watershed, Thailand. *Land Use Policy* 25 (2):214-224.
- Webb, N.L. 2000. Food-gardens and nutrition: Three Southern African case studies. *Journal of Family Ecology and Consumer Sciences* 28 (1):62-67.
- Wells, N.M. and Evans, G.W. 2003. Nearby nature: A buffer of life stress among rural children. *Environment and Behaviour* 35:311-330.
- Wezel, A. and Bender, S. 2003. Plant species diversity of home gardens of Cuba and its significance for household food supply. *Agroforestry Systems* 57:37-47.
- WHO. 1995. Physical status: the use and interpretation of anthropometry. WHO Expert Committee Geneva.
- WHO/UNICEF. 2006. Meeting the water and sanitation target: the Urbana and rural challenge of the decade. WHO/UNICEF, Geneva.
- Wiggins, S., Argwings-Kodhek, G., Leavy, J. and Poulton, C. 2011. Small farm commercialisation in Africa: Reviewing the issues. *Future Agricultures*.
- Wilkinson, N. and Klaes, M. 2012. *An introduction to behavioural economics*. Palgrave Macmillan.
- Wilson, P., Harper, N. and Darling, R. 2013. Explaining variation in farm and farm business performance in respect to farmer behavioural segmentation analysis: implications for land use policies. *Land Use Policy* 30 (1):147-156.
- Wood, S., Sebastian, K., Nachtergaele, F., Nielsen, D. and Dai, A. 1999. Spatial Aspects Of The Design And Targeting Of Agricultural Development Strategies. Environment and Production Technology Division Discussion Paper 44. International Food Policy Research Institute, Washington, DC, USA.
- Woodhouse, P. 2012. Reforming land and water rights in South Africa. *Development and Change* 43 (4):847-868.

- World Bank. 1993. *Water Resource Management Policy Paper* Available at: <http://siteresources.worldbank.org/INTWRD/214571111579063201/20424649/WRMExSumof1993Water-Policy.pdf>.
- World Bank. 2004. 'Water resources sector strategy: strategic Directions for World Bank Engagement'. <http://documentworldbank.org/curated/en/2004/01/3886596/water-resources-sector-strategy-strategic-directions-world-bank-engagement>
- World Bank. 2005. *Uganda Policy Options for Increasing Crop Productivity and Reducing Soil Nutrient Depletion and Poverty*. Report No. 32971-UG.
- World Bank. 2007. *World Development Report 2008*. The World Bank, Washington, DC, USA.
- Woyessa, Y., Pretorius, E. and Van Heerden, P. The application of SAPWAT model in irrigation water management planning for the Sand-Vet irrigation scheme: contribution towards an integrated catchment management system. Proc. of the 2004 Water Institute of Southern Africa (WISA), Biennial Conf, 2004. 1273-1279.
- WRC. 2014. Knowledge Review 2014/2015. From knowledge to action. Water Research Commission of South Africa. Pretoria
- WRC. 2016. SAPWAT 4.0. Computer program for estimating irrigation water requirements of crops, farms and drainage regions in South Africa. Water Research Commission.
- Xaba, B.G. and Masuku, M.B. 2013. Factors Affecting the Productivity and Profitability of Vegetables Production in Swaziland. *Journal of Agricultural Studies* 1(2):37-52.
- Yokwe, S. 2009. Water productivity in smallholder irrigation schemes in South Africa. *Agricultural water management* 96 (8):1223-1228.
- Young, R. 2005. Determining the Economic Value of Water: Concepts and Methods, Resources for the Future, Washington DC. ISBN 1891853988:374.
- Young, R.A. and Loomis, J.B. 2014. *Determining the economic value of water: concepts and methods*. Routledge.
- Youssef, M., Sandhu, M.S. and Jain, K.K. 2007. Relationship between psychological characteristics and entrepreneurial inclination: A case study of students at University Tun Abdul Razak (Unitar). *Journal of Asia Entrepreneurship and sustainability* 3 (2):1.
- Zafirovski, M. 2013. Beneath rational choice: Elements of 'irrational choice theory'. *Current Sociology* 61 (1):3-21.
- Zhang, L., Zhu, X., Heerink, N. and Shi, X. 2014. Does output market development affect irrigation water institutions? Insights from a case study in northern China. *Agricultural water management* 131:70-78.
- Zimmerman, M.A. and Chu, H.M. 2013. Motivation, success and problems of entrepreneurs in Venezuela. *Journal of Management Policy and Practice* 14 (2):76.

Zoebl, D. 2006. Is water productivity a useful concept in agricultural water management?
Agricultural water management 84 (3):265-273.

Appendix 1. Household Questionnaires



Would you like to participate in this survey? 1 = Yes 2 = No

Date		Farmer ID*	
Village name		Ward No.	
Irrigation scheme		Type of farmer	
Questionnaire code		Enumerator	

*Farmer code: 1-Scheme irrigators 2-independent irrigators 3-Home gardeners 4-Community gardeners
5-Rainfed farmers

1. What is the total number of your household members? _____

Please complete table below *Record household head* details in the first row*).

[illegible]

Key

Relation to household head¹ 1=Household head 2=Spouse 3=Daughter /son 4=Other (specify, e.g. cousin)	Age² 1=Male 0=Female	Marital status³ 1=Single 2=Married 3=Divorced 4=Widowed	Main occupation⁵ 1=Fulltime farmer 2=Regular salaried job 3=Temporary job 4=Unemployed 5=Self-employed 6=Student	7=Retired 8=Aged/permanently sick 9=Infant (under age) 10=Other (specify)

* Household head refers to the household head that stays in the household for 4 or more days per week

10. How many years of experience in farming do you have? _____

Have you ever taken training/education related to irrigation listed below?

Skills	10. 1=Yes 0=No	12. If Yes, who offered the training?
a. General crop/vegetable production		
b. Land preparation		
c. Fertiliser application		
d. Herbicide application		
e. General irrigation practices		
f. Irrigation scheduling		
g. Irrigation water management		
h. Agricultural commodity marketing		
i. Packaging of fresh produce		
j. Processing of farm produce		
k. Pricing of products		
l. If other (please specify)		

Complete table below and indicate extent to which you agree with the following statements

Statement	13. Indicate extent to which you agree with the statement
a. I attend all training sessions that are held in Makhathini/Ndumo-B	
b. I fully understand the information provided in the training sessions	
c. I am able to put into practice all the advice I receive from the training	

1= Strongly agree 2= Disagree 3= Neutral 4= Agree 5 = strongly agree

14. What kind of indigenous knowledge have you acquired (inherited) over the years from other farmers, your network, own experience and from your forefathers? Please fill in the following:

15. According to your own observation, to what extent are the following selected statements true regarding indigenous knowledge?

Statement	Response
a. Indigenous practices improve soil fertility and soil structure	
b. Indigenous practices reduce all forms of environmental pollution	
c. Indigenous practices are more efficient in reducing pests and diseases infestation	
d. Indigenous practices reduce input costs of production	
e. Indigenous practices increase value addition for the agricultural produce	
f. Indigenous practices increase farmers' income with low cost	
g. Indigenous practices are transitionally difficult to sustain	
h. Indigenous practices increase crop/vegetable production and productivity	
i. Agricultural professionals lack adequate knowledge on indigenous knowledge	
j. Agricultural professionals fail to appreciate the importance of indigenous knowledge	
k. Agricultural extension workers fail to appreciate the importance of indigenous knowledge	
l. Agricultural extension workers lack adequate knowledge on indigenous	

1= Strong agree 2= Agree 3=Neutral 4=Disagree 5=Strongly disagree

B. FARMING IMPLEMENTS, INFRASTRUCTURE AND OTHER HOUSEHOLD ASSETS

Infrastructure	1. Are you satisfied with the state of the following infrastructure in your farming area?
a. Road accessibility	
b. Markets	
c. Electricity	
d. Agricultural water supply	
e. Drinking water supply	
f. Drinking water supply	

1=Strongly dissatisfied 2=Dissatisfied 3=Neutral 4=Satisfied 5=Strongly satisfied

Complete following table on ownership and access to assets

Assets	2. Own the asset as individual 1=Yes 0=No	3. Own the asset as a group 1=Yes 0=No	4. Current value per unit (R)	5. Have access to asset through hiring and borrowing?
a. Cell phone				
b. Radio				
c. Television				
d. Personal computer				
e. Block, tile house				
f. Block, zinc house				
g. Block, thatch house				
h. Round pole and mud or shack				
i. Fridge/freezer				
j. Bicycle				
k. Motorbike				
l. Trailer/cart				
m. Water tank				
n. Motor vehicle in running order				
o. Generator				
p. Plough				
q. Planter, harrow or cultivator				
r. Wheelbarrow				
s. Tractor				
t. Other (specify)				

Complete table below on livestock ownership

Type of livestock	6. Number owned	7. Current value per unit (R)
a. Cows		
b. Calves		
c. Oxen		
d. Sheep		
e. Goats		
f. Domestic chickens		
g. Others (please specify)		

C. INCOME AND FINANCIAL STATUS

1. Are any of your household members receiving a government grant? 1=Yes 0= No

If yes complete the table below

Grant	2. Number of people receiving	3. Number of years receiving grant
a. Child grant		
b. Old persons grant		
c. Disability grant		
d. Foster child grant		
e. Care dependency grant		

Complete table below on sources of household income

Income source	4. Source of income 1=Yes 0= No	5. Rank of income source (see codes below)	6. Estimate % of total household income
a. Remittances			
b. Arts and craft			
c. Permanent employment			
d. Temporary employment			
e. Welfare grant			
f. Crops – irrigated			
g. Crops – rainfed			
h. Livestock			
i. forestry			
j. fishing			
k. Other (please specify)			

Rank codes 1. Always 2. Often 3. Sometimes 4. Rarely 5. Not at all

7. If Yes on 4h and/or 4i, do you pay fees to utilise these resources? 1=Yes 0=No

8. Please specify amount and unit/duration. **Amount**.....**Unit/Duration**.....

9. If No, do you need permission to utilise these resources? 1=Yes 0=No

10. Do you have any form of savings? 1=Yes 0=No

11. If yes to 10 above, which type of saving? 1=Formal 2= informal (e.g. stokvel) 3=both

12. Have you ever taken credit or used any loan facility in the past 12 months? 1=Yes 0=No

13. If yes in what was the main source of credit/loan?

1= Relative or friend 2= Money Lender 3= Savings club (stokvel) 4= Input supplier 5=Output buyer 6= Financial institution (Specify name of institution.....)

14. If No to 12 above, please specify the reason(s) (multiple answers possible) 1= The interest rate is high

2= I couldn't secure the collateral 3= I have got my own sufficient money 4= It isn't easily accessible

5= I am risk averse 6=other, please specify.....

15. If you took credit or loan what was the purpose of the loan/credit?

1= Family emergency 2= Agricultural purposes 3= Other (specify.....)

16. Were you able to pay back the loan/credit in time? 1=Yes 0=No

17. Did you receive funding or any other sources of credit support from government in the past 12 months?

1=Yes 0=No

D. WATER AVAILABILITY AND IRRIGATION

Complete section for farmers in irrigation schemes and independent irrigators

	Questions	Response
1	How far away is your household to the irrigation scheme? (km)	
2	What type of irrigation system are you using for crop grown? 1=Sprinkler 2=Flood irrigation 3=bucket system 4=Center pivot 5=other please specify	
3	How is water pumped to reach your irrigation plot(s)? 1 = Gravity 2 = Electric pump 3 = Diesel pump 4 - Hosepipe 5 - Watering can/bucket, etc. 6 - Other (specify).....	
4	How many functional sprinklers do you own?	
5	If you are a member of irrigation scheme, what is your position along the primary canal? 1 = Head 2 = Middle 3 = Tail	
6	What effect does your position in 5 have on you operation? 1. Very Positive 2. Positive 3. Neutral 4.Negative 5.Very Negative	
7	How do you rate water accessibility to your plot(s)? 1. Very Good 2. Good 3. Neutral 4. Bad 5.Very Bad	
8	Indicate months of the year when you are able to do irrigation, i.e. when water is available in the main canal?	1 - Jan 2 - Feb 3 - Mar 4 - Apr 5 - May 6 - June 7 - July 8 - Aug 9 - Sept 10 - Oct 11 - Nov 12 - Dec
9	On average how many days per week do you irrigate your crops? (indicate number)	[][]
10	What are the average irrigation hours per day (this week)?	
11	Amount paid for water fee during this season (Rand per year)	
12	How much are you willing to pay irrigation water for hectare of irrigated land? A. 600-800 B. 801-1000 C. 1001-1200 D. 1201-1400 E. 1401-1600 F. 1601-1800	
13	How do you feel about the water distribution schedule in general? 1 = Strongly satisfied 2 = Satisfied 3 = Neutral 4 = Dissatisfied 5 = Not satisfied	
14	Do you participate in the maintenance of the canals in the scheme? 1=Yes 0=No	
15	If Yes to 13, how do you contribute? 1= management 2=labour 3= funds contribution	
16	How would you rate the overall scheme management? 1= Very good 2=Good 3=Neutral 4=Bad 5= Very bad	
17	Do you see existing committees as effective to ensure compliance to regulations (ukulandelwa kwemthetho) on water users? 1=Don't know 2=Not effective 3=Neutral 4=Effective 5=Very effective	

18. I find it difficult to pay for water/electricity/diesel. 1=Strongly agree 2=Agree 3=Neutral 4=Disagree 5=Strongly disagree

19. What is the maximum amount of money you are willing to pay for water per hectare of irrigated land?
_____ (Rand/ha/month)

20. If maximum amount is zero, why don't you want to pay anything? 1 = Irrigation water should be provided free of charge 2 = I am not satisfied with the existing irrigation service 3 = I do not have enough money 4 = I know that the money will not be used properly 5 = It is the responsibility of the government to provide 6 = Only those irrigating a lot should pay 7 = Only those that are making more money should pay 8 = Other reasons, specify _____

21. How often do disputes (conflicts) occur among farmers or between blocks on water issues?
1 = Never 2 = Occasionally 3 = I don't know 4 = Often 5 = Very Often

22. If your answer is 4 or 5, what are the main reasons for water-related disputes? _____

23. Mention challenges faced with irrigation: 1= Hard to operate 2= Poor management 3= Underutilised 4= Inadequate water 5= Not profitable 6= Not productive 7= High costs of repairing and rehabilitation 8= Others (Multiple answers possible)

24. What do you think are the possible solutions for the above mentioned challenges? _____

B40. Is there any other issue you would like to inform us about on water use in agriculture? _____

E. CROPPING PATTERNS AND AGRICULTURAL PRODUCTION

	Question		Response
1	Total size of land operated (hectares)?	Irrigated land	
		Rainfed (dryland) land	
2	Of the irrigated land please indicate land area per means of ownership (in ha)	owned	
		leasing or renting	
		borrowed	
		received from the chief on a temporary basis	
		any other (please specify	
3	Of the rain fed please indicate land area per means of ownership (in ha)	owned	
		leasing or renting	
		borrowed	
		received from the chief on a temporary basis	
		any other (please specify	

4. Generally, are you satisfied with the present security of ownership of your own land? a) Dryland.... b) Irrigated.....
 1=Strongly dissatisfied 2=Dissatisfied 3=Neutral 4=Satisfied 5=Strongly satisfied

5. Do you find it difficult to make land use decisions due to the land tenure system? 1= Yes 0= No

6. If yes, please give details.....

7. Are you looking for another plot to rent or borrow? 1= Yes 0= No

8. If Yes to 7, what amount would you be willing to pay for 0.25 hectare of?

a) good quality plot in the scheme? _____ c) rain-fed good quality plot? _____
 b) poor quality plot in the scheme? _____ d) rain-fed poor quality plot? _____

9. To what extent do you agree or disagree with the following?

1=Strongly agree 2=Agree 3=Neutral 4=Disagree 5=Strongly disagree

Indicator	Response
a. I know my legal rights (i.e. guaranteed power/claims)	
b. I am able to exercise my rights over land (i.e. the rights to use and exclude others from land)	
c. I am free to choose what to produce on my plot	
d. I can use this land for more than 10 years if I want to	
e. There are no threats of eviction (ubungozi bokuxoshwa) from my land	
f. I can transfer land to family members if I want to	
g. I can transfer land to people not related to me if I want to	
h. I always find it easy to approach the police if there is conflict on land	
i. I always find it easy to approach the traditional (informal) courts	
j. I believe I will be treated fairly by the police at any given moment	
k. I believe I will be treated fairly by the traditional courts in any given court case	

10. Are you willing to relocate to a different area or community to utilise bigger plots of land? 1=Yes 0=No

11. Please support your answer in 10. _____

12. What are the key challenges you are facing in relation to land? _____

Did you experience the following natural hazards in the last production season? (Circle all applicable)

Natural hazard	13. How frequent have you experienced natural hazards in the last 10 years 1=never 2=rarely 3=sometimes 4=often 5= never	14. If experienced any hazard, what impact does this have on crop production
Drought		
Floods		
Hailstorm		
Floods		
Any other (please specify)		

15. How interested are you in farming perennial crops?

1= Very interested 2= Interested 3= Neutral 4= Slightly interested 5= Not interested at all

16. What is the reason for your answer? _____

Complete table for crops grown in 2016 (Please indicate units of produce for each crop)

Crop Code A	17. Water source 1=irrigation 2=rain-fed	18. Area under production (ha)	19. Quantity harvested (units/ha)	20. Quantity consumed	21. Quantity sold	22. How many times did you sell?	23. Total amount received?	24. Market outlet Code B	25. Market distance from farm

Code A 1=Maize 2=Beans 3=Cabbage 4=sugercane 5=Carrot 6=Spinach 7=Butternut 8=Calabash 9=Pepper 10=Sweet potato 11=Tomato 12=Chillies 13=Other (specify).....

Code B 1= Farm gate; 2= Hawkers 3= Local shops 4= Shops in town 3= Contractors; Roadside 5= small informal agro-dealer 6= large agro-dealers 6= Others (Please specify).....

For crops sold as shown in table above, please indicate the price for each output per unit in Rand

Crops (Code A)	Unit of output	Time of selling Code C	Price/ unit peak	Price/ unit off season	Total Revenue		Did you know the price prior to going to the market 1-Yes, 2-No	Source of market price information Code D	Days taken to sell crop in the market? Code E
					Peak	Off			
	26	27	28	29	30	31	32	33	34

Code C 1=Immediate after harvest (within one week) 2=between 2-4 weeks 3=between 5-12 weeks 4=more than 12 weeks

Code D 1=Radio 2=TV 3=Dept of Agriculture Extension Officer 4=Fellow farmer 5=Cooperative 6=NGO 7=Contracting agency 8=Hawker 9=Other (specify).....

Code E 1= up to 1 day 2= 2-3 days 3= 4-5 days 4= more than 5 days

For crops sold this season as shown in table above, please indicate actual marketing and other cost incurred per crop in Rand

Crops (Code A)	Transport of produce to market (include fares and transport hire)	Cost of materials (e.g. bags)	Other costs (specify)
	35	36	37

38. Did you sell some of your produce collectively or as a group? 1= Yes 0= No

39. How many days do you spend negotiating with traders for selling of your crops?

1= anything up to a day 2= 1-3 days 3= 4-7 days 4= 8-11 days 5= 12-14 times 6= above two weeks

40. Did you spend time looking for price information prior to selling? 1= Yes 0= No

41. How are your predictions of crop prices compared to the final selling price?

1= always lower 2= often lower 3= equal 4= often higher 5= always higher

42a. What is the distance from your homestead to the nearest road? _____ Minutes

42b. Is accessing transport to markets a problem?

1= no problem 2= minor problem 3= problem 4= significant problem 5= major problem

43. Is a fee payable to sell in local or urban markets? 1= Yes 0= No

44. If Yes, how much do you pay each time you visit the market? _____

45. How many times do you visit the market per year?

1= 1-2 times 2= 3-4 times 3= 5-6 times 4= 7-8 times 5= 9-10 times 6= above 10 times

46. Is the risk that the product/ produce will not be bought a problem?

1= no problem 2= minor problem 3= problem 4= significant problem 5= major problem

47. Do you sell some of your crop produce on credit? 1= Yes 0= No

48. If Yes, on average how many days does it take to get paid?

1=less than 30 days 2=30-59 days 3= 60-89 days 4= 90 and above

Do you do any value addition to the crops before selling and if yes what are the costs of value addition in Rands?

Crops (Code A)	Value addition 1-Yes 0-No	Washing (Cost)	Packaging (Cost)	Shredding (Cost)	Drying (Cost)	Grading (Cost)	Other (specify) (Cost)
	49	50	51	52	53	54	55

Complete the following table for production inputs used for each crop in 2014/2015 or 2015/2016

Crop	Inputs	Unit	56. Quantity/Number	57. Cost per unit (R)	58. Total Cost (R)
	a. Seeds				
	b. Basal fertilizer				
	c. Top fertilizer				
	d. Manure (umquba)				
	e. Herbicides (ukhula)				
	f. Pesticides				
	g. Tractor/ ox				
	h. Transport cost				
	a. Seeds/ seedlings				
	b. Basal fertilizer				
	c. Top fertilizer				
	d. Manure				
	e. Herbicides				
	f. Pesticides				
	g. Tractor/ox				
	h. Transport cost				
	a. Seeds/ seedlings				
	a. Basal fertilizer				
	b. Top fertilizer				
	c. Manure				
	d. Herbicides				
	e. Pesticides				
	f. Tractor/ox				
	g. Transport cost				

Complete table below for FAMILY LABOUR use for all crops produced in the above mentioned season

Crop grown (Code A)	Land preparation		Planting		Weeding		Fertilizer application		Pest control		Mechanical control		In field fallow maintenance		Harvesting		Packaging		Marketing	
	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days
	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78

Complete table for HIRED LABOUR for all crops produced in 2015

Complete table for HYPER-EXCEL for all crops produced in 2025																														
Crop grown (Code A)	Land preparation			Planting			Weeding			Fertilizer application			Pest control			Mechanical control			In field fallow maintenance			Harvesting			Packaging			Marketing		
	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day
	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	102	103	104	105	106	107	108	109	110

111. What are your average working time in hours for family labour in the field per day (this week)?__ hour per day

112. Are there periods in the production season when hired labour is not available? 1=Yes 2=No

113. If Yes, which months in the season is hired labour not available or difficult to find?

1= Dec-Mar 2= Apr-July 3= Aug-Nov

114. How much total cost is incurred by farmer for canal maintenance?_____

115. How much total cost is incurred by farmer for pump maintenance?_____

F. STORAGE FACILITIES

1. Do you have access to farm storage facilities for fresh produce within the scheme? 1=Yes 0 = No

2. Do you have access to storage facilities for long storage of produce like maize grain? 1 = Yes 0 = No

3. What type of storage do you have for grain produce?

1= house 2=granary 3= store in the open 3= spread on the floor 4=crib 5= Other (specify)

4. What type of storage do you have for vegetable produce?

1= shed 2= cold room 3= cool place 4= Other (specify)

5. What is the adequacy of fresh produce or long-term storage facilities that the farmer has?

1=not adequate 2=neutral 3= moderately adequate 4=adequate 5 =very adequate

6. What do you use to preserve your produce before selling?

a. Grain produce?_____

b. Vegetables/Tomatoes?_____

G. SOCIAL CAPITAL

1. Are you a member of any agricultural cooperative / group? 1=Yes 0 = No

2. If Yes, please specify the name of co-op _____

3. In what form do you practice farming? 1= As an individual OR household 2 = As member of informal group

3= As member of cooperative 4= other (please specify) _____

4. Can you rank the following sources of information relevant for your farming activities, based on how you have used them in the past year (e.g. where to sell, market prices, etc.)

1. Have never used the source 2. Don't know /Neutral 3. Not important 4. Important 5. Very important

Information Source	Rank of source of information
a. Extension officers	
b. Media (newspapers, radio, TV)	
c. Internet (emails, websites, etc.)	
d. Fellow farmers	
e. Community meetings	
f. Irrigation / Scheme committees	
g. Cooperative leaders	
h. Traditional leaders	
i. Non-governmental organisations (NGOs)	
j. Private organisations	
k. Phone (sms, text)	
l. Other (Please specify)	

5. How difficult is it to access agricultural information?

1= Very easy 2= Easy 3= Neutral 4= Difficult 5= Very difficult

Complete table below indicating whether the activity is done as a group

	6. Which activities do you do in groups? 0= Not at all 1= at times 2= regularly
a. Land preparation	
b. Planting	
c. Weeding	
d. Irrigation	
e. Harvesting	
f. Securing output market for commodities	
g. Hiring of transport for marketing	
h. Hiring of tractors/machinery for agricultural activities	
i. Marketing of agricultural produce	
j. Input procurement	
k. Negotiating market prices for the produce	
l. Canal maintenance	
m. Pump maintenance	
n. Any other (please specify)	

7. How often do disputes occur among farmers or between blocks on water issues?

1= Very Often 2= Often 3= Neutral 4= Occasionally 5= Never

8. Where do you report problems with the canal?

1=Department of Agriculture 2= Block Committee 3= Other (please specify).....

H. PSYCHOLOGICAL CAPITAL AND ENTREPRENEURIAL CHARACTERISTICS

1. What is your main reason for farming?

1=Income 2=Extra food 3= Leisure time 4=Employment 5=Other_____

2. You consider farming as a business and can be managed as such?

1= Strongly agree 2= Agree 3= Neutral 4=Disagree 5= Strongly disagree

3. Do you distinguish (separate) your farming operations from family operations?

1. Always 2. Often 3. Sometimes 4. Rarely 5. Not at all

4a. You are interested in expanding your farming operations (including increasing plots)

1= Strongly agree 2= Agree 3= Neutral 4=Disagree 5= Strongly disagree

4b. If disagree or strongly disagree, what are the factors holding you up?_____

5. Do you see yourself as a potential commercial farmer one day? 1=Yes 0=No

6. You feel confident to contribute to discussions about the irrigation scheme strategy

1= Strongly agree 2= Agree 3= Neutral 4=Disagree 5= Strongly disagree

7. How satisfied are you with the performance of the scheme?

1=Very satisfied 2=Satisfied 3= Neutral 4= Dissatisfied 5= Very Dissatisfied

8. How interested are you in being a scheme committee member?

1= Very interested 2= Interested 3=Neutral 4= Slightly disinterested 5= Not interested at all

9. How interested are you in taking part in training in collective management of irrigation scheme?

1= Very interested 2= Interested 3=Neutral 4= Slightly disinterested 5= Not interested at all

10. How high is your confidence in farming as a means to a sustainable livelihood?

1 =Very high 2= High 3= Neutral 4= Low 5= Very low

11. How high is your confidence in yourself as a farmer?

1 =Very high 2= High 3= Neutral 4= Low 5= Very low

Please rate the extent to which you agree with the following statements:

Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

Farmer attitudes	12. Response
a. The social grant is sufficient money to maintain the household	
b. The government is responsible for the wellbeing of rural households	
c. The government must create more job opportunities	
d. People are poor because they were not given equal opportunities as others	
e. I do not blame anyone for the poverty of my family	
f. I have power to affect the outcome of my farming	
g. I trust other farmers	
h. I have interest in running a farm as a business	
i. I have sufficient capital to farm	
j. I often fail to sell farm produce due to lack of market access and poor market prices	
k. Input costs of farming are far too high	
l. Labour costs are too high	
m. My right or claim to water is secure	
n. Water is sufficient for my cropping requirements	
o. In general, availability and security of water constrains my performance	
p. In general, the water distribution network is not in a good condition	
q. Poor quality of the agricultural extension service is a major bottleneck	
r. I have the ability to pay for water and water-related services Yes=1 No=0	
s. Am interested in farming perennial crops	

13. In your opinion, who should pay for water services?

1= No one, government only 2= Everyone participating in irrigation schemes 3= Only those irrigating a lot

4= Only those that are making more money

Please indicate the extent to which you agree with following statements pertaining to your constraints to farming operations? Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

Constraints	14. Response
a. lack of access to inputs	
b. large unaffordable increase in input prices	
c. production below normal	
d. declining market prices for outputs	
e. increasing food prices	
f. land tenure not secure	
g. no enough land	
h. local and political conflict	
i. lack of support services	
j. high pump and maintenance cost	
k. Water availability	
l. Other (specify)	

15. If farmer is not in an irrigation scheme, is the farmer willing to join an irrigation scheme if the opportunity arises? Yes=1 No= 0

16. If No to **15**, please give reasons? _____

17. If Yes to **15**, would you like to irrigate individually =1 or collectively =2

18. What are the reasons for your answer? _____

19. If farmer is not irrigating, please rate the extent to which you agree for the reasons why you are not irrigating: Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

m. Irrigation system is under construction	
n. There is no water source	
o. Irrigation scheme is far away from my plots	
p. I produce only for the household	
q. I can't pay (financial constraint)	
r. Other (specify)	

20. If farmer is an independent irrigator, please rate the extent to which you agree with the following reason(s) for irrigating independently: *Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5*

a. There are no available plots in irrigation schemes	
b. There is a lot of red tape involved in land allocation in irrigation schemes (e.g. waiting list)	
c. Being a member of an irrigation scheme deprives one of individual decision-making powers	
d. Being a member in a group of farmers limits members' flexibility in terms of irrigation.	
e. Irrigation schemes are too far from homestead	
f. There is a lot of free riding in collective irrigation schemes	
g. Water theft is a major concern for irrigation schemes managed collectively	
h. Lack of enforceable rules in collectively managed irrigation schemes is a challenge	
i. Other (specify)	

21. If farmer is a home gardener, please rate the extent to which they agree with the following reasons for sticking to homestead food gardening: *Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5*

a. Lack of farming experience	
b. Shortage of finance	
c. Shortages of resources (land and other nonfinancial resources)	
d. Land tenure issues	
e. Other (specify)	

Please indicate the extent to which you agree with the following statements:

Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

Entrepreneurial Characteristics	22. Response
f. I like being my own boss	
g. I produce mainly for the market	
h. I produce mainly for household consumption	
i. I view my farm as a means of earning profits	
j. I view my farm as a profit-making business	
k. I know what and when resources and materials are needed and where to get them	
l. I know where the most profitable market for each enterprise is	
m. I am passionate about my farm business	
n. I can adapt quickly to market changes and market opportunities	
o. I always look for better and profitable ways to run farm operations	
p. I am able to recognise market gaps and exploit market opportunities	
q. I deal with problems as they arise rather than spend time to anticipate them	
r. I manage my farming business as a long-term venture with a view to making it sustainable	
s. I try things that are very new and different from what I have done before	

Entrepreneurial Characteristics	22. Response
t. I stick with my decisions even if others disagree strongly with me	
u. My production decisions are based on what is possible, not just what I need	
v. I work long and irregular hours to meet demands	
w. I am highly motivated and ambitious	
x. I understand how to motivate people	
y. I have the ability to inspire and energize others	
z. I always welcome change and view it as an opportunity	
aa. I am very flexible and always willing to adapt	
bb. I always take responsibility for solving problems that I face	
cc. I always cooperate with others	
dd. I possess persuasive communication and negotiation skills	
ee. I have the ability to set goals and set new ones once attained	
ff. Despite many difficult circumstances, I often tend to not give up	
gg. I am very competitive in nature	
hh. I am always willing to learn new things	
ii. I am strong willed	
jj. I am very hands-on	
kk. I tend to take control in unstructured situations	
ll. I welcome failures from which I am able to learn	
mm. I seek information that will help with tasks I am working on	
nn. I find ways to complete tasks faster	
oo. I weigh my chances of succeeding or failing before I decide to do something	
pp. I seek the advice of people who know more about the tasks I need to accomplish	
qq. When faced with a difficult problem, I spend a lot of time trying to find a solution	
rr. I prefer situations in which I can control the outcome as much as possible	
ss. I am willing to co-operate with other farmers to buy inputs	
tt. I prefer activities that I am familiar with and with which I am comfortable	
uu. I take action without wasting any time to gather additional information	
vv. If one problem is persistent, I try alternative approaches to address it	
ww. I think of solutions that benefit everyone when solving a problem	
xx. I am happy to do someone else's work in order to get the job done	
yy. I am able to meet deadlines and do my work on time	

The data collected for this project is stored and can be accessed at the Discipline of Agricultural Economics, School of Agricultural, Earth and Environmental Sciences, Pietermaritzburg Campus, KZN

Appendix 2. Focus Group Discussion points and key informant interview checklist

a) Focus Group Discussion points and key informant interviews checklist – 1



University of KwaZulu-Natal and WRC



The information to be captured from this discussion is strictly confidential and will be used for research purposes by staff and students at the University of KwaZulu-Natal to examine **appropriate entrepreneurial development paths for homestead food gardening and smallholder irrigation crop farming in and around selected irrigation schemes in KwaZulu-Natal province.**

Checklist

1. What do you do farming? How important is farming compared to other sources of income?
2. Which farming enterprises or crops have significant contribution to the livelihoods of farmers?
3. What are the most important challenges that farmers face in farming? Natural hazards? How do you cope with challenges?
4. Where do farmers access the different inputs required for producing the above crops? Mention the agro-dealers?
5. Do you use hired labour and if yes, how accessible is hired labour for your operations?
6. How do farmers sell their produce? Individually? Cooperatives or Associations? Contracts? What are the common marketing channels? Any challenges in marketing?
7. Are you interested to be part of a small-scale irrigation scheme? If Yes, Why? If No, Why not? If you are interested why have you not moved into irrigations plot?
8. Are you interested in collective management of water in the irrigations schemes?
9. Would you be prepared to pay for water use in the irrigations scheme? If Yes, Why? If No, Why not?

10. Have you ever experienced any conflicts related to water use? What were the points of conflict?
11. What would you recommend should be done to ensure that homestead/ independent irrigators also participate in small-scale irrigation in the schemes?

For scheme irrigators only

1. How much are farmers paying for water? Are the fees paid monthly? Yearly? Or at what interval?
2. Are farmers charged based on the amount of water they use or a flat rate? If flat rate, how are farmers over-irrigating monitored?
3. What are the farmers' opinions on the water charging system?
4. Are most farmers willingly paying water fees? Please explain? What could make farmers not pay their water fees?
5. Who is responsible for maintenance of irrigation infrastructure in the scheme?
6. What is the farmers' contribution in the maintenance of irrigation infrastructure?
7. What is the water use/ sharing arrangement?
8. Are there any conflicts that arise between farmers regarding water use/ sharing? If Yes, what are those conflicts and what are the causes?
9. What is the source for water used for irrigation? What are the other major competing uses of water from the same source?
10. Do farmers recognise that water is a scarce resource? What do you think needs to be done so that farmers can realise that water is a scarce resource?

b) Development Pathways Focus Group Discussion points – 2



University of KwaZulu-Natal and WRC



We have grouped you into one based on your similarities? Your group is does that characterise you well?

We have made some recommendations (for your group) based on our findings. The purpose of our meeting now is to get your version of what needs to happen in terms of government policy? What is expected of you and what is expected of other stakeholders?

Interview/research fatigue

We have learnt that in some research areas there is too much research and too little action. As a result, there is some resistance from some farmers to get response on interview questions.

Interview fatigue – this problem is surfacing again?

- Explain to farmers that research and development are complementary but not the same and acted upon by the same actor(s)
- Farmers are tired of lots of interviews and information – no action but false promise
- Explain to farmers that the relevant stakeholders will be consulted to do testing of development pathways

CHECKLIST OF QUESTIONS

What are the major **challenges** that you face in relation to your farming activities? Issues for discussions/ what needs to happen regarding the following:

- Access to irrigation water? Irrigation equipment;
- Access to land? Relationships with the traditional leadership – why land cannot be privatized?
- Access to finance?

- Access to markets? Transport? Currently everyone produces the same set of crops and harvest at the same time flooding the market at the same time. Why are farmers not able to produce more than once a year and schedule their production and market supply among themselves to deal with market access problem?
- Access to inputs? Chemicals? Seeds?
- Cooperatives and challenges in in taking advantage of collective action organisations? Cooperatives transformation?
- Collective management of irrigation schemes?
- Any issues related to livestock; Crop and livestock integration
- Gender related challenges – access to resources?? time burden??
- Tractors
- Fencing? Land/property encroachment?
- Weeds and pests,
- Theft – water, livestock, crop harvests
- Skills training,
- Issues related to agricultural extension

Request farmers to suggest possible **solutions** for the above-mentioned challenges; compare and contrast our recommendations from farmers' recommendations per typology

Appendix 3. Statistical results

Table A1. Heckman two step selection model results for Makhathini and Ndumo-B

ASPIRE	Probit regression		OLS regression		
	Coef.	Marginal effect	Coef. (normal std. errors)	Coef. (robust std. errors)	Marginal effect
LOCATION	-0.286 (1.583)	-0.006	-0.291 (0.712)	-0.291 (0.740)	-0.196
GENDER_FR	1.395 (1.110)	0.027	1.035 (0.684)	1.035 (0.653)	0.697
AGE_FR	-0.042 (0.045)	-0.001	0.046 (0.032)	0.046 (0.031)	0.031
EDU_LEVEL	0.088 (0.106)	0.002	0.060 (0.082)	0.060 (0.070)	0.040
ACC_CREDIT	2.247 ^c (1.353)	0.044	-0.541 (0.636)	-0.581 (1.209)	-0.364
LOC_SOC	-0.785 (0.490)	-0.015	0.926 ^a (0.239)	0.926 ^a (0.278)	0.624
MEM_COOP	-0.152 (1.057)	-0.003	-0.175 (0.685)	-0.175 (0.826)	-0.118
MEM_SOC_GRP	2.469 ^c (1.514)	0.048	0.364 (0.650)	0.364 (0.666)	0.245
MKT_TOWN	-0.065 ^c (0.034)	-0.001	-0.029 ^c (0.017)	-0.029 ^c (0.015)	-0.020
POS_PSYCAP	4.653 ^b (2.006)	0.090	0.146 (0.540)	0.146 (0.542)	0.098
LAND_SEC	-1.898 ^c (1.080)	-0.037			
OBJ_FARM	0.718 (1.247)	0.014			
DEP_RATIO			0.091 (0.296)	0.091 (0.322)	0.061
FM_EXP_RATIO			-0.581 (1.358)	-0.541 (0.668)	-0.392
LOG_HHASSETS			0.947 ^b (0.417)	0.947 ^b (0.461)	0.638
SCHEME_DM			0.279 (0.702)	0.279 (0.887)	0.188
LAND_DRY_FR			1.910 ^c (1.076)	1.910 (1.191)	1.287
Mills_lambda			-1.621 (2.480)	-1.621 (1.540)	
_cons			-2.809 (2.655)	-2.809 (2.831)	
Rho			-0.314		
Sigma			5.161		
Observations			324		
Wald chi2 (15)			39.8 ^a		

Note: Parenthesis (.) standard errors; ^{a, b, c} significant at the 1%, 5% and 10%, respectively

Source: Survey data, April 2016

Table A2. Ordered probit results for Bululwane and Tugela Ferry

Variables	Coeff.	Marginal Effects (dy/dx)		
		0	1	2
Age	-0.186 ^b	0.0069	0.0004	-0.0073
Sex	-0.405 ^c	0.1511	0.0078	-0.1590
Household Size	-0.085 ^c	0.0316	0.0016	-0.0333
Total land	-0.008	0.0028	0.0001	-0.003
Total Farm Income	3.88E-06	-1.45E-06	-7.51E-08	1.52E-06
Input	-0.308	0.1103	0.0118	-0.1222
Assets	-8.91E-05	0.00003	1.73E-06	-0.00004
Access to irrigation equipment	-0.149	0.0557	0.0029	-0.0586
/cut1	-2.6607			
/cut2	-2.1237			
Number of observations	167	Pseudo R ²	0.067	
Wald Chi-square (8)	23.04	Log likelihood	-163.05	
Prob > Chi-square	0.006	Mean VIF	1.19	

Notes: ^{a, b, c} significant at the 1%, 5% and 10%, respectively

Source: Survey data (March/April 2017)

Appendix 4. List of postgraduate students

Name	Degree	Progress
Unity Chipfupa	PhD	Graduated
Sandile Phakathi	MSc	Graduated
Nolwazi Hadebe	MSc	Graduated
Lungelo Cele	MSc	Graduated
Fortunate Zaca	MSc	2 nd Year

Appendix 5. Abstracts of the PhD thesis and MSc dissertations

a) Unity Chipfupa – PhD

Title: Entrepreneurial development pathways for smallholders irrigation farming in KwaZulu-Natal: typologies, aspirations and preferences

Abstract

Smallholder irrigation in South Africa is strategically recognized as an important sector in addressing rural poverty, food insecurity and rising youth unemployment. However, despite the government's efforts and huge investment, the sector has failed to make a meaningful contribution to overcoming these challenges. The poor performance has been attributed to the failure of the existing programmes to develop the human and social capital to manage the schemes and effectively engage in market-oriented agricultural production. This has resulted in the inability of smallholders to utilize the opportunities availed through irrigation farming.

South Africa's national policies identify entrepreneurship as an appropriate intervention strategy for improving the performance of smallholder irrigation. However, to unlock entrepreneurship, a better understanding is required regarding smallholder farmer behaviour *vis a vis* the relevance/application of the concept to smallholders, and their aspirations, heterogeneity and preferences for irrigation water management. Thus, the objectives of the study were: to assess the validity and applicability of the mainstream concept of entrepreneurship to smallholder irrigation farming in South Africa and identify avenues of adaptation to make it relevant; to identify sources of smallholder heterogeneity and determine the farmer typologies in smallholder irrigation, accounting for psychological capital; to examine aspirations of smallholder farmers to expand irrigation crop production; and assess farmer preferences for managing irrigation water resources and their willingness to pay for irrigation water.

The data for the study came from a stratified random sample of 328 smallholders in and around Makhathini and Ndumo-B irrigation schemes in Jozini, KwaZulu-Natal, South Africa. The data were collected through a household questionnaire survey and focus group discussions. The study employed literature review, descriptive analysis and several empirical approaches (Principal Component Analysis, Cluster Analysis, Heckman two-step selection model and choice experiment modelling). The research uniquely introduced and integrated the concept of psychological capital

to the Sustainable Livelihoods Framework literature to enhance understanding of entrepreneurship among smallholder farmers.

The findings showed that smallholders do not conform to the mainstream definition of entrepreneurship which is mainly the result of the neoclassical economics paradigm. This does not, however, mean that such farmers cannot be entrepreneurial, but it highlights the need for redefining the concept to suit their context. A paradigm shift is required to improve the performance of smallholder irrigation and unlock entrepreneurial spirit, putting smallholder behaviour at the centre for which the concepts of psychological capital and behavioural economics are expected to play a bigger part. There is also a need to embrace indigenous knowledge, the multipurpose nature of smallholder farming, heterogeneity and creating an enabling environment. In the end, the study proposed a contextualized definition of entrepreneurship for smallholders which places more significance on the willingness and ability of entrepreneurial smallholders, through their own initiatives, to address their challenges, even in the midst of constraints.

The study revealed five farmer typologies in smallholder irrigation in South Africa: elderly and uneducated, cautious and short-sighted, financial capital and psychological capital endowed, social grant reliant, and land endowed rainfed farmers. Heterogeneity in these typologies is observed regarding psychological capital endowment, market access, collective action and access to credit. The results affirm the fact that the ‘one size fits all’ approach to agricultural policy and support is not appropriate. Heterogeneity among smallholders should be accounted for in future agricultural and rural development programmes. However, accounting for this heterogeneity is a double-edged sword. On one side it complicates tailor-made policy formulation and on the other side, if there is capacity, it makes the portfolio of policies and strategies impactful and relevant. The study identifies psychological capital as important and recommends its recognition and nurturing as a key livelihood asset.

The findings suggest that farmers’ willingness to expand irrigation farming activities is affected by positive psychological capital, access to markets, access to credit, land tenure security and membership to social groups. Their ability to achieve their aspirations is determined by asset ownership, access to markets and local resource use conflicts. This evidence further demonstrates the importance of developing positive psychological capital among smallholders. The priority areas for improving access to agricultural credit and markets include, among others, value chain financing, reforming the existing agricultural credit schemes and investment in road and transport

infrastructure. Smallholders' ability to achieve their aspirations and make better use of irrigation schemes should be enabled through improving access to physical capital assets, addressing land security concerns, and supporting institutions that promote social interaction and learning.

The findings from the choice experiment demonstrate that valuing and recognizing the scarcity of irrigation water is essential for its sustainable use. The results suggest the need for irrigation water pricing to reflect irrigation intensity. They also show that improving agricultural production and productivity, with market access can enhance farmers' willingness and ability to pay for irrigation water. The study reveals the need to consider multiple uses of irrigation water, while a focus on women smallholders has positive implications for sustainable management and use of irrigation water. It also recommends a shift towards volumetric water pricing at the farm or plot level in the irrigation schemes.

In sum, the study has shown why it is of critical importance to take the mindset and human behaviour as the locus of interventions to improve the performance of smallholder irrigation schemes. It recommends a psychological and behavioural economics approach to understanding farmers' decisions and behaviour and to provide the road map to realize the returns on investment in the smallholder irrigation sector. Agricultural extension approaches need to target for developing the psychological capital and entrepreneurial spirit of smallholders and supporting cooperatives deliver their mandate effectively. Furthermore, policies should assist in creating an environment that nurtures farmer entrepreneurial spirit, and that is supportive of smallholder entrepreneurs. This includes, but not limited to, encouraging and incentivizing own effort rather than embracing a culture of dependency.

b) Sandile Phakathi – MSc

Title: Small-scale irrigation water use productivity and its role in diversifying rural livelihood options: case studies from Ndumo-B and Makhathini irrigation schemes, KwaZulu-Natal, South Africa

Abstract

Small-scale farming is recognised as an important vehicle in reducing poverty and increasing economic growth in developing countries. As a result, the South African government has prioritized small-scale irrigation schemes and made huge investment in their establishment, rehabilitation and revitalization. Regardless of government's huge investment in small-scale irrigation infrastructure, a growing body of literature reveals that they are still underperforming as they have not brought about expected social and economic development. Despite using large volumes of water, the average value product produced by the small-scale irrigation sector has been low. This is a cause for concern for policy makers, especially in the light of rising water scarcity. Whereas attention has been paid on lack of physical, natural, financial, social and human capital assets as factors contributing to weak performance of small-scale irrigation schemes, limited attention has been paid on the role of psychological capital.

In this study, it is argued that psychological capital should be considered among the key factors hindering farmers' performance. Positive psychological capital denotes individual mindset and attitude, affecting motivation to take initiatives or otherwise which directly has an impact on farmer's productivity. Thus, the integration of this form of capital to the sustainable livelihoods framework makes this study unique compared to previous studies. Furthermore, the study provides estimates of water values for four typologies of small-scale farmers. Reliable estimates of water value are crucial for investment decisions in water resources development, policy decisions on sustainable water use and water allocation. To the best of the author's knowledge, no study has investigated irrigation water value in Makhathini and Ndumo-B irrigation schemes.

Given this background, this study aims to investigate (1) water use productivity and water value per crop, among the different farmer typologies and (2) factors (including psychological capital) affecting irrigation water value. A stratified random sampling was used to obtain a sample of 82 scheme irrigators, 38 independent irrigators, 24 homestead food gardeners and 15 community food gardeners in Makhathini and Ndumo areas. Water measurements were done using a standard rain

gauge for crops grown by scheme irrigators using sprinkler system over a single production cycle. Furthermore, the CROPWAT 8.0 model was used to generate secondary data on irrigation water requirements for the major crops grown (cabbage, maize, beans and tomatoes) and used to generate water values. The data were analysed using gross margin analysis, residual valuation method, principal component analysis and general linear model.

The results indicated that the water values of scheme irrigators were higher than the other irrigating types, implying that the economic performance of scheme irrigators is better. The higher water values attained by scheme irrigators can be attributed to two main factors. Firstly, reduced transaction cost due to economies of scale obtained from transacting through cooperatives and reliable water supply compared to other farmer typologies. Secondly and more importantly, the results from focus group discussions indicate that scheme irrigators receive more support in terms of training, funds, input procurements and market access which has a direct positive effect on water values. The results from CROPWAT estimates indicated that tomatoes and cabbage yielded the highest aggregate water value of ZAR8.60/m³ and ZAR8.47/m³, respectively. Maize and beans had the lowest aggregate water value of ZAR2.88/m³ and ZAR2.22/m³, respectively. Comparing water values based on crops grown, scheme irrigators had the highest cabbage water value of ZAR11.42/m³ while community food gardeners, independent irrigators and homestead food gardeners had the highest water values for tomato enterprise at ZAR12.95, ZAR11.03 and ZAR0.85, respectively. The results from actual water used by scheme irrigators revealed that cabbage presented a lucrative enterprise with an aggregate value of ZAR13.43/m³, compared to ZAR3.55/m³ and ZAR2.36/m³ for maize and dry beans, respectively. The results further indicate that, on average, the value of water varies according to the type of farmer, irrigation technology, farming experience, main occupation of a farmer, marital status and psychological capital.

The study results show the importance of psychological capital in the success or failure of smallholder farming. The farmers with positive psychological capital (confident, hopeful, optimistic and resilient) were found to be more persistent and productive despite prevailing constraints and challenges (such as markets access). However, the results indicated that the majority of smallholder farmers had less confidence in themselves (endowments and capabilities) because over time they have developed dependency syndrome that government has do everything

for them. This obviously reduces their self-confidence and hinders their potential to grow and become large commercial farmers.

These results also showed the importance of institutional arrangements in the efficient utilisation of water among small-scale farmers. Farmers that were more organised and structured in such a way that they can benefit from economies of scale and institutional support were more inclined to have higher water use productivity. The SLF stresses the importance of institutional arrangements and collective bargaining in improving the livelihoods of rural farmers. Organised farmers have a stronger voice in price negotiations in the input and output markets resulting in reduced cost and increased profits. Farmers' occupation and type of irrigation technology greatly influence water values compared to other factors. This was attributed to the fact that full time farmers devote more time in farming, attend most of the training even in short notices and are more willing to learn and adopt new methods in farming. Therefore, the study recommends that government and other stakeholders continue to support farmers through tailor-made training activities.

c) Nolwazi Hadebe – MSc

Title: The impact of capital endowment on smallholder farmers' entrepreneurial drive in taking advantage of small-scale irrigation schemes: case studies from Makhathini and Ndumo-B irrigation scheme in KwaZulu-Natal, South Africa

Abstract

Smallholder irrigation has been taken across the developing countries as a means of poverty reduction. However, irrigation schemes have failed to meet these goals for various technical and institutional reasons. The South African government has invested significant amount of funds into projects that are meant to link smallholder farmers into commercial agricultural market value chains. Despite this huge investment on smallholder irrigation infrastructure, the performance of South African smallholder farmers remains unsatisfactory. Smallholder farming has shown very little change in the number of farmers actively participating in commercial agricultural markets. This study was started with the identification of several barriers to the development of agricultural businesses at small production scale. One of the key challenges is the misconception related to visualising smallholder farmers as homogeneous. Many studies in the development economics literature have shown that they are diverse in terms of preferences, resource endowments, capabilities, entitlements, constraints and opportunities. Given this reality, considering them as a homogenous unit is inaccurate and it hinders the process of action, research and development for policy and management interventions. For farmers to survive the increasingly competitive environment they operate in, it is imperative that they possess entrepreneurial skills. The purpose of this study, therefore, was to evaluate the impact of capital endowment on on-farm entrepreneurial skills to take advantage of small-scale irrigation schemes and enhance rural livelihoods. The first objective of this study was to evaluate the impact of human, physical, financial, social, natural and psychological capital assets on unlocking on-farm entrepreneurship in Makhathini and Ndumo-B irrigation schemes. This was done using descriptive analysis, Analysis of Variance (ANOVA), Principal Component Analysis (PCA) and 2-limit Tobit Regression. The second objective of the study was to examine the impact of on-farm entrepreneurship and capital endowment on enabling smallholder farmers to productively use the scheme infrastructure. This was done using ANOVA and a One-limit Tobit Regression estimation of cabbage production function. Production functions were estimated for the dominant crops to find out the impact (at the margin) of on-farm entrepreneurship on the productivity of individual

farmers in each category of the respondents. Cobb-Douglas production functional form was chosen for this analysis. A stratified random sampling technique was used to obtain a sample comprising of 114 scheme irrigators, 46 independent irrigators, 24 homestead food gardeners, 15 community food gardeners and 22 non-irrigators in Makhathini and Ndumo-B irrigation scheme areas.

The results suggest that the number of days in a week, availability of farmer for labour, level of education, distance of household to the irrigation scheme, total size of land operated, crop income, number of years the household had been receiving child grant and recipient of foster child grant were all statistically significantly different across farming groups. The on-farm entrepreneurship index generated using PCA was dominated by motivated farmers who perceived their farms as a means of making profit and ambitious farmers who also understand how to motivate people. Household size, farming experience, education level, distance from the irrigation infrastructure and psychological capital are the key variables that have been found to explain on-farm entrepreneurship. There was statistically significant association between on-farm entrepreneurship and gross margin for maize, beans, tomatoes and spinach. The econometric models indicated that household size, gender of the household head, education level and farming experience statistically and significantly explain the variation of on-farm entrepreneurship. It is, therefore, concluded that socioeconomic variables together with human capital help explain on-farm entrepreneurship. Thus, government's exclusive focus on infrastructural investment, with no due consideration of the human and social dimensions of collective management of the schemes, has to be revisited. Training related to agricultural commodity marketing, credit access, land size, household size, education level, farming experience, cabbage yield, price for cabbage and on-farm entrepreneurship over time were all statistically significant in explaining the variations in cabbage gross margins. Moving forward, the key to unlock the potentials of small-scale irrigation schemes is a holistic approach, not just focusing on infrastructure but placing the human aspect right at the centre. With males being more entrepreneurial, entrepreneurial skills training needs to target women. To improve the economic performance of small farm enterprises, an assessment of the goals and aspirations of current and potential female farmers should be made. The more educated the farmer, the less on-farm entrepreneurial he/she would be. This could be because the younger generation, often better educated, had very little interest in farming as a career. Government initiatives in promoting agriculture and campaigns together with universities can shape public perceptions and make agriculture more appealing to the youth. Therefore, government investment

in smallholder irrigation for rural poverty reduction should continue but the sector has to be made more appealing for the youth. Improving the ICT infrastructure in the rural areas and enhancing the role of this technology in agriculture could be one of the focus areas of the intervention package, as the youth are attracted to ICTs. The study recommends the continuation of investments in smallholder irrigation provided that a more holistic approach is taken that accounts for smallholder farmer heterogeneity and the complexity of their farming systems. The institutional and human dimensions of sustainable and collective management of small-scale irrigations schemes has to be the key area of focus to improve their governance. It is important to note that capital endowment of any kind is not effective in isolation. What is needed is a policy environment enabling and inducing on-farm entrepreneurship in rural areas. The effectiveness of such policies, in turn, depends on the availability of capital assets (especially psychological capital) and capabilities.

d) Lungelo Cele – MSc

Title: Land and water use rights in smallholder farming: impacts on productive use of irrigation water and entrepreneurial spirit in KwaZulu-Natal

Abstract

The increasing pressure on land and water resources in developing countries due to population growth has led to the need for improvement of the regulations that control the use of these scarce resources. However, the impact of those regulations and institutional issues therein are little understood, especially in the communal rural areas of South Africa. Recently, entrepreneurship has come to be recognised as a major engine for job creation and economic development in countries around the world. The South African National Development Plan Vision 2030 suggests that agricultural development needs to be based on successful land reform, employment generation through establishment and expansion of agri-businesses and ensuring strong environmental safeguards. Yet, policy makers have very little information on how the policies they develop and adopt affect smallholder farmers' entrepreneurial spirit. Moreover, very little is understood about whether smallholder farmers are interested in expanding their farming operations or not and if so, what factors influence their willingness and ability to expand. Not much research has empirically analysed the impact of land use rights and water use rights on the productive use of irrigation water and entrepreneurial spirit of smallholder farmers. Previous studies have mainly focused on the impact of land tenure systems on agriculture investment. This study differs as it classifies customary land tenure system to identify which of the bundle rights have a significant impact on the productive use of irrigation water and entrepreneurial spirit, while taking into account water use rights which have not been accounted for in those studies. Moreover, no research has empirically analysed the factors that influence the willingness and ability of smallholder farmers to expand their farming operations. Yet, government has been making efforts in trying to move smallholder farmers into commercial farming by expanding existing irrigation schemes and creating new ones.

The study was conducted in three areas, namely, Msinga, Nongoma and Jozini. The data was collected from 242 smallholder farmers using a combination of purposive and stratified random sampling methods. The study purposively selected farmers who are engaged in food crop farming to allow for comparison across different smallholder farmers. A stratified random sampling technique was then employed to select the respondents. Households were categorized into four

strata: scheme irrigators (166), non-irrigators (23), community food gardeners (27) and homestead food gardeners (26). The study made use of key informant interviews, focus group discussions and household surveys to gather the data. To analyse the data, descriptive statistics, gross margin analysis, Principal Component Analysis (PCA), Univariate General Linear Model (UGLM), Multivariate General Linear Model (MGLM), ordered probit regression model and Heckman selection model were used. The descriptive analysis was performed to compare socio-economic characteristics of smallholder farmers' typologies. The study made use of the PCA method to develop land use right indices (right to use and exclude others, land transferability and land use decision making), water use right indices (secure access to water, effective scheme management and access to irrigation equipment), psychological capital indices (mainly capturing risk taking, open mindedness, self-confidence and ambition) and entrepreneurial spirit indices (business mindset, self-confidence, innovation and risk taking). The Keiser-Meyer-Olkin and Bartlett's sphericity tests were employed to test the assumptions underlying the use of PCA. The gross margin analysis was used to compare variations among crops and smallholder farmer typologies. The UGLM was used to analyse the factors that influence the gross margin per hectare (proxy for productive use of irrigation water). The MGLM was used to analyse the factors that influence smallholder farmers' entrepreneurial spirit. The ordered probit and Heckman model were used to explain the factors affecting smallholder farmers' willingness and ability to expand.

Based on the findings of this study, smallholder farmers face many challenges like drought, pests and crop diseases, scarce arable land with water, market availability, old age, low level of education, availability of quality infrastructure like good roads within the schemes and good cellphone network connections and access to quality inputs. Due to these challenges, agriculture contribution to total household income is low and social grants are the major contributor. This study found that the existing land tenure system is in line with the communal land tenure policy in the irrigation schemes with land related matters being handled by scheme committees who report to traditional leaders and they, in turn, report to government. The findings indicated that education level hinder productive use of irrigation water, while access to input markets, land transferability and scheme management enhance productive use of irrigation water. To encourage smallholder farmers' entrepreneurial spirit, there is a need to take into account their mode of water supply, output market information, right to use and exclude others from land, land transferability, access to irrigation equipment and on-farm income. To change smallholder farmers' subsistence mindset,

investments need to be made in output markets and irrigation equipment. The findings suggest that there are three statistically significant variables that deter the smallholder farmers' willingness and ability to expand, namely, age, gender and household size.

From this study, it's not clear what benefits privatization of individual land title would bring to improve productivity or investments in land when commons are governed collectively and effectively. This is especially the case as smallholders were not willing to use their land as collateral and also did not have credit records or proof of income which is required by banks to get credit. Therefore, customary tenure system was found to be favorable in this study as it was inclusive, ensured sustainability of land and accountability of leadership. The communal land tenure policy was found to be consistent with what was happening at local level. Therefore, the study recommends that the roles and responsibilities of scheme committees be reflected in both the communal land tenure policy and the national water resource strategy as a body that is responsible for land and water in the irrigation schemes for smallholder farmers. Agency control tenure systems need to be more inclusive in decision making as it affects smallholders' production level. A provincial body of scheme committees is needed whereby smallholders will capacitate each other to collectively address the challenges they face related to water, land and markets. This body would also need to be represented in the policy formulation and can aid in policy implementation. When agriculture and other livelihoods fail, smallholder farmers depend mainly on social grants to survive. Therefore, the study recommends that when developing irrigation projects, departments like social development and economic development should also be part of the consultation to improve smallholder farmers' livelihoods. Moreover, the study recommends that in new irrigation schemes young people must be given priority and there must be proper incentive schemes targeted specifically for them. Furthermore, it must be ensured that they receive necessary training and exposure to be able to participate meaningfully in the whole value chain.

Appendix 6. Knowledge dissemination: list of journal papers, conferences presentations and popular articles

1. Journal articles:

- Chipfupa U and E. Wale. Farmer typology formulation accounting for psychological capital: implications for on-farm entrepreneurial development (Reviewed, revised and resubmitted: *Development in Practice*)
- Chipfupa U and E. Wale. Explaining smallholder farmer's aspirations to expand irrigation crop production in Makhathini and Ndumo-B, KwaZulu-Natal, South Africa. (Under revision to be resubmitted: *Agrekon*)
- Chipfupa U and E. Wale. Smallholder farmer willingness to pay and preferences in managing irrigation water in KwaZulu-Natal, South Africa: a choice experiment approach. (Under review: *Water SA*)
- Chipfupa U and E. Wale. Towards defining and making relevant entrepreneurship to smallholders: evidence from Makhathini and Ndumo-B, KwaZulu-Natal, South Africa (To be submitted: *Journal of Developmental Entrepreneurship*)
- Phakathi S and E. Wale. Explaining variance in the economic value of irrigation water using psychological capital: a case study from Ndumo-B and Makhathini, KwaZulu-Natal, South Africa (Reviewed and resubmitted: *Water SA*)
- Cele L and E. Wale. The role of land and water use rights on smallholder' productive use of irrigation water in KwaZulu-Natal, South Africa (Submitted: African Journal of Agricultural and Resource Economics)
- Cele L and E. Wale. Determinants of smallholder' entrepreneurial spirit, willingness and ability to expand farming operations in KwaZulu-Natal, South Africa (Submitted: Development in Practice)

2. Dissertations and Thesis:

A. Dissertations Completed:

- Entrepreneurial development pathways for smallholder irrigation farming in KwaZulu-Natal: typologies, aspirations and preferences – PhD thesis – by Unity Chipfupa – March 2018

- Small-scale irrigation water use productivity and its role in diversifying rural livelihood options: case studies from Ndumo-B and Makhathini irrigation schemes, KwaZulu-Natal, South Africa. By Sandile Phakathi – March 2016
- The impact of capital endowment on smallholder farmers' entrepreneurial drive in taking advantage of small-scale irrigation schemes: case studies from Makhathini and Ndumo-B irrigation schemes in KwaZulu-Natal, South Africa. By Nolwazi Hadebe – April 2016
- Land and water use rights in smallholder farming: impacts on productive use of irrigation water and entrepreneurial spirit in selected schemes in KwaZulu-Natal – Masters – submitted for external examination March 2018 – by Lungelo Cele

B. Ongoing:

- Social grant dependency, irrigation water use and on-farm entrepreneurial spirit: a behavioural explanation for smallholders in KwaZulu-Natal – Masters – Ongoing – by Fortunate Zaca

3. Popular Articles – Newsletters

- Wale, E. Smallholder rural development challenges for collective action: unlocking on-farm entrepreneurship and enhancing productive use of irrigation schemes in South Africa. Agri Kultuur/Culture, July 2017.
- Wale, E. and project team. Smallholder irrigation: recipe for success – exploring the tools farmers need to succeed. The Water Wheel. January/February 2017 Volume 16(1): 16-18.

4. Conference Presentations:

- E. Wale. On entrepreneurship and smallholders: some evidence from selected irrigation schemes in KwaZulu-Natal. Paper presented at the 'WRC Research Symposium – Agricultural Water Issues and Entrepreneurship in South Africa', 55th Annual Conference of the Agricultural Economists Association of South Africa (AEASA), 19-21 September 2017, Durban, South Africa
- U. Chipfupa and E. Wale. 2017. Explaining smallholder farmer's aspirations to expand irrigation crop production in Makhathini and Ndumo-B, KwaZulu-Natal province, South Africa. Contributed papers to be presented at the 55th Annual Conference of the

Agricultural Economists Association of South Africa (AEASA), 19-21 September 2017, Durban, South Africa.

- Chipfupa, U. and E. Wale. Accounting for heterogeneity in small-scale irrigation farming: Implications for entrepreneurial development, KwaZulu-Natal, South Africa. Contributed paper presented at the 54th Annual Conference of the Agricultural Economists Association of South Africa (AEASA), 14-16 September 2016, Muldersdrift, Johannesburg, South Africa.
- Phakathi, S. and E. Wale. Explaining irrigation water use productivity using psychological capital: case studies from small producers in Ndumo-B and Makhathini irrigation schemes, KwaZulu-Natal, South Africa. Contributed paper presented at the Economic Society of South Africa 2017 Biennial Conference, 30 August-1 September 2017, Rhodes University, Grahamstown ESSA.

This paper was also presented as:

- Contributed paper presented at the 54th Annual Conference of the Agricultural Economists Association of South Africa (AEASA), 14-16 September 2016, Muldersdrift, Johannesburg, South Africa.
- Contributed paper presented at the 1st Conference of the Water Footprint Research Alliance, 4-7 April 2016, Cape Town, South Africa.
- S. Phakathi and E. Wale. Why and to what extent do smallholder farmers over-irrigate? Empirical evidence on the institutional factors from Ndumo-B and Makhathini irrigation Schemes, KwaZulu-Natal, South Africa. Contributed papers presented at the Economic Society of South Africa 2017 Biennial Conference, 30 August-1 September 2017, Rhodes University, Grahamstown.
- Chipfupa, U. and E. Wale. Back to basics: priority rural development challenges for collective action to productively utilise irrigation schemes in rural South Africa. A paper presented at the World Water day, 22-24 March 2017, Inkosi Albert Luthuli International Conference Centre, Durban, South Africa.