

EXECUTIVE SUMMARY

BACKGROUND TO THE PROJECT

In this report on WRC Project K5/1464/4, entitled *Best management practices for small-scale subsistence farming on selected irrigation schemes and surrounding areas through participatory adaptive research in Limpopo Province*, the findings of the research and development activities that occurred over a four-year period from April 2003 until March 2007, are presented.

The project was conducted in the form of a case study using Dzindi Irrigation Scheme (23°01'S; 30°26'E) as the case. Additional fieldwork was conducted at Khumbe Irrigation Scheme (23°03'S; 30°21'E) and Rabali Irrigation Scheme (22°53'S; 30°07'E) to find out to what extent the findings at Dzindi had wider application. All three schemes were similar in size and used canal irrigation. They also shared a similar general production pattern that featured maize in summer and vegetables in winter.

Research activities aimed at identifying best management practices occurred in three domains, namely the domain of the individual plot holder household and farm enterprise, the domain of the irrigation scheme and the domain of the world outside the scheme. Two types of research and development activities were done, namely activities aimed at understanding existing management practices and activities aimed at improving management practices. Nearly all of these activities were done at Dzindi. Methods used in data collection at Dzindi included the use of Rapid Rural Appraisal (RRA) techniques, surveys involving probability sampling and structured interview schedules, experiments in the green house, on-station and on-farm field experiments and qualitative methods. Methods of data collection at Khumbe and Rabali were largely limited to the use of RRA techniques.

To encourage active participation of plot holders in the project at Dzindi, the 'merging of communities of practice' approach was adopted. The application of this approach yielded a priority list of goals for the project, which were translated into research and development activities, taking into account the limitations imposed by the availability of financial and human resources.

RESULTS OF THE ANALYSIS OF EXISTING MANAGEMENT PRACTICES ON SELECTED SMALLHOLDER CANAL IRRIGATION SCHEMES IN LIMPOPO PROVINCE

The domain of the individual plot holder

It is well known that management practices at the level of the individual farm enterprise are guided by the objectives of the farmer. Generally, farmers on the three irrigation schemes that featured in this study matched the description of 'the smallholder farmer – lower risk, diversified farming' development trajectory proposed by Denison and Monona (2007). The key question was whether plot holders on

these schemes can be regarded as a homogeneous group who share the same farming objectives. To answer this question, livelihood and farming of plot holder households were analysed on these schemes. The most detailed investigation was done at Dzindi and the results presented here only refer to that scheme. The studies conducted at the other two schemes produced results that did not contradict the findings at Dzindi.

Using principal source of income (cash and kind), which was defined as the source of income that contributed at least 50% to total household income, to categorise livelihood among plot holder households at Dzindi, **nine livelihood types** were identified. These were:

- (i) One-generation pensioner households;
- (ii) Two-generation pensioner households;
- (iii) Three-generation pensioner households;
- (iv) Wage-earner households reliant on skilled formal employed;
- (v) Wage-earner households reliant on unskilled formal employment;
- (vi) Market oriented farming households;
- (vii) Subsistence farming households;
- (viii) Households active in the informal sector; and
- (ix) Diversified-income households.

Among households in the different livelihood types, total household income was subject to considerable variability. Skilled wage-earner households had the highest mean total household income, followed by unskilled wage-earner households. Subsistence farmer households were the poorest. Households with a large number of economically active adults did not necessarily obtain high levels of income. This was particularly evident among subsistence farmer households and three-generation pensioner households. Market-oriented farmers had the highest mean gross farm income and the mean gross margin of their plot enterprises was also the highest, suggesting that households in this livelihood type had a different approach to farming than households in the other livelihood types.

The analysis of diversity of farming at Dzindi resulted in the identification of **four farming styles**. Farming style is an integrating concept that portrays a particular way of practising agriculture. The four farming styles identified at Dzindi were:

- (i) Profit makers;
- (ii) Employers;
- (iii) Food farmers (type 1); and
- (iv) Food farmers (type 2)

Profit makers farmed mainly for market purposes (>50% of the total annual value of their production was sold). Important commodities were white cabbages and green maize. Compared to other farming styles, profit makers were least adverse to risk. Typically they made use of inputs and services of high quality in their production systems and were prepared to pay a premium for these. Profit makers sourced most of their labour from within their homesteads, hiring temporary labour only at times of peak demand. Finding markets for their produce was their most important concern.

Characteristic of employers was that they hired one or more full-time workers to provide the labour on their farms. This contributed considerably to the total variable costs of production usually resulting in negative gross margins.

Food farmers farmed mainly for home consumption (>50% of the total annual value of their production was consumed at home). The food farmers (type 1) style corresponded most closely with the concept of the subsistence farmer, which has the general characteristics of:

- i. operating a farm that is limited in scale and output;
- ii. having household food security through own production as the primary objective and not the generation of income through cash sales of produce;
- iii. making limited use of purchased inputs;
- iv. being risk adverse; and
- v. having cash sales of farm produce as a minor source of total homestead income.

During summer, food farmers (type 1) produced maize for grain, which was stored at home or delivered to the commercial mill in return for credit notes. Producing and storing sufficient maize grain to supply the homestead for a full year or even longer was a key objective of these farmers. Winter production was mainly limited to traditional vegetables on small parts of the plot, partly for sale and partly for consumption at home. The main concerns of these farmers were to limit expenditure and to avoid risk.

The food farmers (type 2) had characteristics that were similar to those of food farmers (type 1). They also farmed mostly for home consumption and produced the same type of crops but on a small scale they were also prepared to take risk by producing green maize or white cabbage. The identifying characteristic of this farming style was that they achieved high returns from expenditure on variable costs of production (>R2 for every R1 invested).

Livelihood types and farming styles were shown to be related, providing evidence that irrigated farming by plot holder households needs to be understood in the context of their overall livelihood strategy. The longitudinal study of livelihood and farming of a selection of households at Dzindi showed that both were dynamic and subject to interaction.

The domain of the irrigation scheme

The social and institutional dimensions of irrigated farming were found to be of great importance in the domain of the irrigation scheme. The social arenas that were investigated included (i) the sharing of water among smallholders; (ii) the maintenance of infrastructure; (iii) accessing markets; (iv) land tenure and exchange; and (v) land preparation.

Management of irrigation water: At Dzindi, the rules governing the sharing of water among farmers were imposed when the scheme was commissioned and they have largely survived for more than 50 years. Reduced influence of the state brought about relaxation of the rules by creating room for farmers to negotiate among each other. Whereas this increased the flexibility of the rule system, it also opened the door for abuse and conflict.

Maintenance of irrigation infrastructure: At the establishment of Dzindi, an institutional system of collective action was imposed, monitored and enforced by the state to ensure that routine maintenance was taken care of. Over time, the routine maintenance institution was internalised by the group and when external monitoring and enforcement was removed, the institution persisted.

Natural change in the composition of the group and change in the structure of the livelihoods of plot holders provided the context for the institution to be challenged, initially by norm entrepreneurs and later on by the majority of plot holders. This forced the group to fundamentally modify the routine maintenance institution from a system that relied on plot holders to voluntarily supply their labour to a system that demanded plot holders to make financial contributions to pay for labour.

The new institution showed its weaknesses almost immediately and for the practical purpose of ensuring that the conveyance system is maintained, it has already collapsed, threatening the sustainability of irrigation at the Scheme. The 2007 initiative of plot holders in Block 2 to revert to the old system of collective action to get their section of the canal cleaned up suggested that the Dzindi community will find a solution to the crisis.

The current group of plot holders at Dzindi lacked understanding of the relationship between routine maintenance, flow rate in the canals, and stream size at plot edge. Educating plot holders about this relationship is considered a critical element to the internal debate that is necessary to craft a new and effective routine maintenance institution.

Access to input and output markets: At Dzindi, voluntary co-operation among farmers for improved access to markets has been limited to input markets. No evidence of voluntary cooperation was found in relation to output markets and this also applied to Khumbe and Rabali. The farmers' association was the original form in which farmers at Dzindi sought to improve access to input markets. The concept was introduced by the state but farmers were given the opportunity to reflect on what the role of the farmers' association should be, how it should be structured and managed and what its functions should be. The institutional arrangements plot holders arrived at were based on the value of mutual aid in line with traditional forms of collectivism. Structurally, power and authority in the organisation was held by the collective of plot holders and its elected leadership. The management practices of the organisation were based on volunteerism and mutual trust. Despite the absence of any bookkeeping procedures there were no complaints of misappropriation of funds during the long history of the Dzindi Farmers' Association.

The state, probably influenced by the expert system that informed it, felt it necessary to intervene and insisted that the small holder farmers' associations be converted into registered co-operatives. It imposed the co-operative model that applied to the white commercial farming sector seemingly with complete disregard for the differences between that sector and the African smallholder sector. The outcome was not successful because the imposed model did not suit smallholder communities.

Access to land: Trust tenure applied to all three irrigation schemes that were included in this study. The issue of new permission to occupy (PTO) certificates by the

authorities to register transfer of ownership of plots continues, even though from a legal perspective these issues are no longer valid.

Historically plot holders have experienced Trust tenure as highly insecure, especially at Dzindi but enforcement of PTO conditions by the state is largely a thing of the past, even though some conditions remain in force. In terms of holding rights, plots remain indivisible, but subdivision of the user rights is being allowed. The authorities maintain control over the transfer of the rights over a plot following the death of a plot holder or when a plot is vacated, but the composition of what constituted the authorities differed among the schemes.

The contemporary irrigator communities at the three schemes each interpreted the Trust tenure system differently and enforced selected elements of the historical PTO conditions that applied, whilst ignoring others. This phenomenon had important implications for land exchange at the three schemes. At Dzindi, exchanges of land have been discouraged completely by the community and its leadership until very recently, seemingly because of the history of evictions for non-compliance with PTO conditions at that scheme. At Khumbe, land exchanges were allowed by means of sharecropping arrangements involving members of the Khumbe community only. Strictly forbidden at Khumbe were the renting out of land against payment and exchanges of land involving 'outsiders', with severe fines being imposed on transgressors. At Rabali, both sharecropping and renting out of land were common practice and both members of the irrigation community and 'outsiders' were allowed to engage in these types of land exchanges. Poverty was the main motivation among plot holders at Rabali to engage in exchanges of land.

Land preparation: The withdrawal of the subsidized public land preparation service from smallholder irrigation schemes in Limpopo Province resulted in a substantial increase in the cost of cultivation to farmers. Five different strategies developed by farmers to cope with the high cost of land preparation were identified. They included establishing a collective cultivation service that offered discounts, leaving part of the plot fallow, share cropping, converting to animal draught and resorting to manual labour. The different strategies enabled farmers to continue producing crops, which was particularly important for the attainment of food security at the level of their households. For the poor the withdrawal of the subsidized public land preparation service has made life more difficult than before.

The domain of the world outside the scheme

The external world influences farming in many ways. Markets are one of the important ways in which the external world affects farming. Access to markets tends to be a spatial factor, particularly in smallholder agriculture. Smallholder access to markets improves with proximity to urban areas.

Commodity prices, policy, security, the cost of doing business and input costs are other important external-world factors that affect the functioning of irrigation schemes. For example, policy measures in the form of subsidised assets (land, equipment, water), or services (advisory, marketing, finance) can improve the financial viability of farming. Low commodity prices, high input costs and security concerns are examples of factors that reduce the financial viability of farming.

The availability of livelihood options other than farming is an important indirect effect of the external world on farming as it affects the availability of labour on the farm.

Research into the domain of the world outside the scheme conducted under the auspices of this project was limited to an investigation of the relationship between Dzindi Irrigation Scheme and the settlements that surround it with special reference to the issues of land and water.

Dzindi is located in a zone of rapid urbanization and in the settlements surrounding the Scheme access to land for farming was extremely limited. Functionally, the livelihood of households residing in these settlements was urban, but the rural heritage of people still had a strong influence on their lifestyles and outlooks. Dzindi was essentially the only potential source of arable land in the area. Residents of settlements surrounding Dzindi identified purchase or renting of unused land as suitable options to obtain access to land for crop production at Dzindi but were not interested in share cropping. No evidence was found that people in the settlements surrounding Dzindi entertained the idea of challenging ownership of land at Dzindi. Instead, a general acceptance that plot holders were the legitimate owners of their plots prevailed among those that participated in the study even though the demand for land, especially arable land, in the surrounds was high. This was evident from the widespread use of residential sites for agricultural purposes and the cultivation of roadsides and land alongside the irrigation canal.

Access to water in the settlements surrounding Dzindi was generally adequate. Households obtained water from different sources for various uses, including domestic and agricultural. Extraction of water from the canal by residents in these settlements was limited and probably did not materially affect water availability at the Scheme. A degree of tension between plot holders and members of surrounding communities who planted crops along the canal and used water from the canal to irrigate these crops was identified, even though the amounts of water extracted for this purpose were negligible on the whole.

Above the weir that supplies Dzindi, extraction of water from the river occurred at several sites, by means of pumps and river diversions. These extractions undoubtedly had a reducing effect on the amount of water reaching the weir during periods of base flow but the overall impact was limited.

About one in every four households residing in the settlements surrounding Dzindi declared that they benefited from the presence of Dzindi Irrigation Scheme. The main benefit was in the form of access to cheap and fresh food, sometimes obtained in the form of gifts. Employment on the scheme was another benefit that was identified but its impact was more modest.

ANALYSIS OF IMPORTANT COMMODITY SYSTEMS ON SELECTED IRRIGATION SCHEMES IN LIMPOPO PROVINCE

Maize

The results of the study of the maize commodity chain at Dzindi showed that maize simultaneously served as a high-value cash crop and as a food crop. The close proximity of Thohoyandou ensured the availability of a sizeable market for green maize cobs. Growing maize for the purpose of green maize sales enabled smallholders to obtain much higher gross margins from maize than growing the crop for grain but hawkers, to whom most green maize was sold, applied quality control measures that limited the proportion of cobs being sold by farmers. Plants with cobs that did not make their quality standards were left in the field for farmers to harvest as grain at maturity.

The importance Dzindi farmers attached to the role of maize grain in the food security of their households was re-enforced by the availability of two storage and transformation systems, which enabled farmers to process their grain into maize meal for consumption. The proximity to Dzindi of an industrial mill where grain could be exchanged for meal using a system of credits, which permitted long-term storage of grain for emergencies, was coincidental. The supply of maize by Dzindi farmers to the industrial mill, which sources its grain mainly from producers in the maize triangle, was of no consequence to the turn-over of the mill. The presence of two small-scale, privately-owned grain mills at Itsani, of which Dzindi is part, was not coincidental because these small mills appeared to generate sufficient business from irrigated maize production at the Scheme and dryland production in the surrounds.

Technically, maize production practices at Dzindi appeared to address the key growth requirements of the crop, using both modern and traditional technology, but the relatively low yields, equivalent to about 2.5 tons grain ha⁻¹ on average, suggested room for improvement.

The study showed that many farmers at Dzindi associated household food security with the availability of maize grain in their stores. This association was strengthened further by the availability of the necessary infrastructure to transform the grain into the desired products for consumption. For this reason, attempts to replace maize with other crops on smallholder irrigation schemes where circumstances are similar to Dzindi are likely to meet with resistance from farmers.

Vegetables

At all three smallholder irrigation schemes that featured in this study, production during the winter season mainly involved vegetables. The types of vegetables that were grown differed among the three schemes. At Rabali, tomatoes were the principal winter crop, whilst cabbages, Chinese cabbage and nightshade featured most prominently at Dzindi. Among the three schemes, Khumbe displayed the widest diversity in vegetable production, Vegetable species grown at Khumbe included fruity types, such as tomatoes, tuberous and bulbous vegetable species, such as sweet potatoes and onions and also a wide range of leafy vegetables.

A detailed study of the smallholder vegetable commodity chain was conducted at Dzindi and focused on two African leafy vegetables, namely, Chinese cabbage (*Brassica rapa* subsp. *chinensis*) and nightshade (*Solanum retroflexum* Dun.) and two exogenous vegetables, namely, Swiss chard (*Beta vulgaris* L.) and white cabbage (*Brassica oleracea* L. var. *capitata*).

For each of the four vegetables, farmers had developed, adapted or adopted comprehensive production systems. Farmers were most confident in the production of the two African leafy vegetables but the Chinese cabbage enterprise provided farmers with the lowest gross margin followed by the nightshade enterprise. The production of cabbage was the most lucrative but managerially farmers considered it to be the most demanding of the four vegetables that were investigated.

From a technical perspective the high and on occasion excessive use of fertilisers, which accounted for about 40% of the total variable costs of production of the two African leafy vegetables, was identified as an opportunity for improving the gross margins of production. Development of fertiliser guidelines for these two vegetables was selected as a suitable topic for research and development aimed at improved management of these two crops.

Integrating crop and livestock production systems on smallholder irrigation schemes in Limpopo Province

All three smallholder irrigation schemes had the virtual absence of animal production in common. Integrating crop and animal production holds potential advantages in smallholder irrigation. These include the creation of additional produce markets in the form of crops to be used as animal feed and animal products and the local supply of animal manures for use in the management of nutrient availability in cropped land. Following a feasibility study of different types of poultry production, the research team developed the idea to introduce broiler production as a first step in the direction of developing integrated farming systems on smallholder irrigation schemes.

BEST MANAGEMENT PRACTICES FOR SMALLHOLDER IRRIGATION SCHEMES IN LIMPOPO PROVINCE: GENERAL RECOMMENDATIONS

The domain of the individual plot holder

The implication of the observed diversity at the level of the individual farm enterprises found on smallholder irrigation schemes was that best management practices should be tailored to suit the specific objectives of farming households. Consequently, a 'one size fits all' approach is unlikely to be successful when developing and disseminating best management guidelines for use at the farm enterprise level. Categorising households in livelihood types and farming styles was shown to be a suitable approach to make sense of the diversity among them. The results of this study showed that households contained in the same farming style category tended to share the same farming objectives. Categorising plot holders according to their farming styles is, therefore, a suitable way to identify extension domains for the development and dissemination of technical management information.

The domain of the irrigation scheme

The domain of the irrigation scheme, more specifically the group of people who make use of this asset, is probably the most important and also the most ignored domain in the management of smallholder irrigation schemes in Limpopo and possibly also elsewhere in South Africa. It is this domain of management that determines access to irrigation water and land by individual farmers. Management in this domain can also improve access to markets and services, such as land preparation.

The **management of water and irrigation infrastructure** is of particular importance in smallholder canal irrigation. The findings of this study indicate that a system of simple rules that govern the sharing of water among farmers and the routine maintenance of the canal system can form the appropriate basis for sustainable water management by plot holders. However, the study also identified the need for an external agency to form part of the overall management system. The principal roles of this agency should be to participate in regular monitoring and evaluation of the management activities and to intermediate, and if necessary intervene, in conflict situations. Considering that the Limpopo Department of Agriculture is the legal owner of many if not all of the smallholder canal irrigation schemes in the Province, it is appropriate that this Department serves as the proposed external agency. Critical outcomes of a sustainable water and irrigation infrastructure management system for canal irrigation schemes are that water is being shared equitably among farmers and that canals are clean and in good condition.

An important weakness identified at all three schemes was the absence of adequate expertise to manage water flow in the canal system. As a result, gates and valves were not used to best effect, causing water losses and inequitable distribution of the water to the different parts of the scheme. Invariably, the extension staff assigned to the three schemes that featured in this study had never been trained in the regulation of water in canal irrigation systems. Considering the abundance of smallholder canal irrigation schemes in South Africa, particularly in Limpopo Province, the need to develop an appropriate training programme for extension staff working on this type of schemes was identified.

The results of this study showed that voluntary co-operation among farmers can improve **access to markets**. The results also suggested that institutional arrangements that are based on the value of mutual aid, in line with traditional forms of collectivism, are probably best suited when developing collective action among plot holders for improved market access. Intervention by the state should aim to support the initiatives of farmers and not to regulate voluntary collective action. When regulation does become prudent, it should be introduced in ways that allow smallholders sufficient time to internalise the new concepts and to adapt them to suit their own circumstances.

The results of this study show that *de facto* Trust tenure continues to apply on many canal irrigation schemes in Limpopo Province. Whereas most plot holders on these schemes do not cultivate their entire allotment at all times, there are others, primarily those that run farm enterprises with a strong market focus, who are in desperate need of additional land. **Land exchanges** among plot holders are the most obvious way for

those in need to access more land. Opening the market for land exchanges on these schemes is expected to be assisted by the development of a simple rule system to govern exchanges, the development of a register of plot holders (usually in place), the demarcation of the individual plots in the field, and the appointment of an external agency to intervene when conflicts arise. As in the case of water management, the Limpopo Department of Agriculture is the most appropriate body to serve as the external agent. Lastly, there is also a need for mobilisation to encourage plot holders to consider land exchange as a way of deriving benefit from their plots.

Affordability and access to mechanised **land preparation** limit overall production on smallholder irrigation schemes. Poor households who are involved in subsistence farming are most affected by this constraint. The option of re-introducing animal draught on smallholder irrigation schemes as a way to reduce variable costs and possibly limiting the problem of soil compaction associated with the use of tractors warrants investigation. It is probably not practical for each plot holder to own the wherewithal to cultivate land using animal draught but there are no obvious reasons why selected households could not provide land preparation services to others on a commercial basis using animal draught equipment.

The domain of the world outside the scheme

Limiting recommendations for best management practices to aspects that were investigated empirically, the study identified two opportunities to distribute more widely the benefits associated with smallholder irrigation schemes.

One opportunity was to broaden access to irrigation land. Land is available at these schemes, particularly during winter, suggesting room for others to join production. However, at this stage plot holders tend to be reluctant to enter land exchanges involving outsiders.

Another opportunity to enable more people to benefit from the presence of a canal irrigation scheme was to allow outsiders to extract water from the canal, particularly during the night and storing this water in tanks. This opportunity would benefit people living within close vicinity of the canal by enabling them to access irrigation water for home gardening purposes. However, at Dzindi, existing extraction by outsiders, which mostly involved small quantities of water, already stirred up emotions among plot holders, suggesting that considerable negotiations would be needed before plot holders would allow for this to happen.

SELECTED BEST MANAGEMENT PRACTICES FOR IMPORTANT COMMODITY SYSTEMS FOUND ON SMALLHOLDER IRRIGATION SCHEMES IN LIMPOPO PROVINCE

Improving green maize production

Several opportunities exist to improve green maize production on smallholder irrigation schemes in Vhembe. To maximise the number of marketable cobs per unit area, cultivar selection is important and ETZ 200 and SC 701 were identified as superior cultivars in terms of cob length and other important attributes. For September plantings at Dzindi, the optimum planting density for green maize production using the cultivar SC 701 was about 4.0 plants m⁻², but planting density has to be reduced to about 3.0 plants m⁻² when using the PAN 93 cultivar.

Improving the production of selected African leafy vegetables

Optimising soil nitrogen availability was the most critical nutrient management concern in the production of Chinese cabbage and nightshade. Sufficient nitrogen needs to be available in the soil for the two crops to achieve optimum growth, but adding too much nitrogen adversely affects biomass production. Considering that smallholders produce these two vegetables under irrigation, which increases the likelihood of nitrogen losses due to leaching, maintaining optimum availability of N in field soils throughout the growing season is expected to be difficult to achieve. The use of split application of N, which is common practice among smallholders at present, is likely to be the appropriate strategy to achieve optimum availability of N but this needs to be investigated.

Production of Chinese cabbage and nightshade is also dependent on the adequate availability of phosphorus and potassium, but the adverse effects caused by applying these two nutrients in excess of the rate at which biomass production peaked were less distinct than for nitrogen.

Growers stand to benefit financially from optimizing fertiliser application rates in the production of Chinese cabbage and nightshade, but field experiments are needed to identify these rates.

The yield of Chinese cabbage peaks when the crop is planted during the period 25 May until 2 July. Postponing the planting date beyond the 2nd of July rapidly reduces yield and bringing planting forward to dates earlier than 25 May also reduces yield, but in a less extreme way. Consequently, the option of spreading the planting date of Chinese cabbage more widely, to avoid the period of excess supply on the local market, is seriously compromised by the important effect of planting date on the yield of this crop.

Full irrigation produces the highest yield in Chinese cabbage but this requires farmers to irrigate the crop at least twice per week. Considering that plot holders on canal schemes are only allocated water once per week, farmers can only implement full irrigation by practising night-irrigation or by negotiating access to additional water with other plot holders using the same supply furrow. Use of a deficit irrigation approach

when producing this vegetable has limitations because compared to full irrigation, deficit irrigation reduces yield substantially.

Integrating crop and animal production systems

Assessment of the performance of a single-phase broiler diet obtained by on-farm processing of yellow maize grain and soya beans using a commercially available three-phase diet as the benchmark for comparison showed that birds fed of the commercial diet (C) grew faster and were ready for marketing one week earlier than birds fed on the on-farm diet (OF). From an economic perspective, the performance of the enterprises based on the use of the two diets was not very different. The experimental enterprise that used the three-phase commercial diet (C) provided a higher gross margin (R6.79 bird⁻¹) than the enterprise that used the on-farm single-phase diet (OF) (R5.38 bird⁻¹), a difference of R1.32 bird⁻¹. The main advantage of using the on-farm diet was that it provided the opportunity to integrate crop and animal production and to locate a larger part of the value chain within the local agrarian economy. The results obtained so far warrant further research.

References

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