THE CURRENT RAIN-FED AND IRRIGATED PRODUCTION OF FOOD CROPS AND ITS POTENTIAL TO MEET THE YEAR-ROUND NUTRITIONAL REQUIREMENTS OF RURAL POOR PEOPLE IN NORTH WEST, LIMPOPO, KWAZULU-NATAL AND THE EASTERN CAPE

Report to the
WATER RESEARCH COMMISSION

and

DEPARTMENT OF AGRICULTURE, FORESTRY & FISHERIES

by

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EXECUTIVE SUMMARY

While there is not much evidence of widespread starvation and extreme undernutrition in South Africa, national surveys provide evidence of multiple forms of deprivation related to the experience of hunger, widespread manifestation of hidden hunger or micronutrient deficiencies and increasing rates of overweight and obesity. Moreover, the co-existence of adult (especially female) overweight and obesity with hidden hunger and child malnutrition raises serious concerns over household food security. Despite a multitude of state, private sector and non-governmental agency (NGO)-funded food security programmes, South Africa is one of only 12 countries in the world where stunting has increased over the Millennium Development Goal (MDG) period. It is also the only country in the Southern African Development Community (SADC) region where child stunting has not decreased. The increasing incidence of overweight among women and children raises alarm. This indicates severe inadequacies related to the diets of South Africans and highlights the importance of understanding the constraints faced by households in achieving food security to ensure health, productivity and development.

A baseline and scoping study commissioned by the Water Research Commission (WRC Report No. TT 537/12) has revealed numerous knowledge gaps with regard to smallholder production and food security in South Africa. The study highlighted that there is limited current and generalisable food security and nutrition research in South Africa. Very few studies have investigated the year-round source(s) of food for the rural poor. In particular, agricultural interventions to improve human nutrition and the (indirect) eventual outcomes of health, education and economics are practically non-existent. The study identified two specific knowledge gaps. Firstly, it identified that the contribution of home- or smallholder-grown foods to total dietary intake and nutritional requirements (in the context of an in-depth description of the food environment and its links to water) is not known. Secondly, the effect of seasonality on home or smallholder production is not documented.

This project set out to address this significant and longstanding gap in knowledge and to propose a set of options for strengthening rain-fed and irrigated crop production in the rural areas investigated to identify the research focus areas related to efficient water use that could directly overcome dietary inadequacies and lead to better nutrition of rural household members. This unique study drew on a transdisciplinary research approach to investigate the consumption and production patterns of rural households in communities in four selected sites in the poorest local municipalities in South Africa. This report presents the findings of this study.

A desk study identified the poorest districts in the four provinces identified by the WRC for this study: Eastern Cape, KwaZulu-Natal, Limpopo and North West. The most deprived local municipalities in each district were identified from existing data on poverty and child undernutrition. Two enumeration area units from each local municipality were randomly

selected from areas classified as ‘traditional rural’ for the Ingquza Hill, Maruleng and Ratlou municipalities.

In this way, one area was selected for Jozini. The population of available and accessible farm households from a list of Mjindi irrigation scheme members residing in Jozini comprised the second sample in this area. Between 2013 and 2015, data was collected qualitatively and quantitatively through focus group discussions (FGDs), key informant interviews and a two-round panel survey to cover both the summer and winter seasons at each site. The food security situation of the households was assessed using the anthropometry of children between 24 and 59 months and their female caregivers, food consumption frequencies and the diversity of their diets.

Qualitative and quantitative data related to production and consumption was used to identify what crops could improve the dietary diversity and nutrition of these households and to compare the nutritional status, dietary diversity and food consumption patterns of households engaged in rain-fed and irrigated crop production with households not engaged in crop production. The agronomic conditions in the four sites were examined and crops that could grow in these areas were identified. The food consumption gaps and potential crops were prioritised in terms of which crops could be grown to improve the diets in each site. The prioritised list of crops was presented to the communities for validation.

It is clear from the findings of this study that most households are food insecure, with inadequate food available to meet the requirements for a diversified diet. Roughly one in four households reported experiencing hunger for most months of the year, but the majority of households (more than one in three) reported experiencing hunger in January. In terms of food availability, it seemed that most households were able to purchase enough of the staple maize meal, which is consumed by all the households every day. Relatively few young children and their female caregivers were underweight, but there was substantial evidence of extensive hidden hunger. The largely starch-based diet is likely to be the underlying reason for both growth faltering in children and overweight in women. A high proportion of female caregivers were overweight and obese, suggesting that for most households, sufficient dietary energy in the form of the staple food – refined, purchased white maize – is available. The high levels of stunting indicate that the children included in the survey experienced growth faltering early in life. What is of concern, however, is how many of these stunted children were also overweight.

Hidden hunger is characterised by inadequate dietary diversity and micronutrient deficiencies. Although no clinical tests were conducted to confirm this, the lack of dietary diversity and the daily consumption of foods from multiple food groups are indicative of an inadequate diet. The daily consumption of a variety of fruit and vegetables is essential for good nutrition, human productivity and child development. However, the availability of fruit and vegetables that are essential for good nutrition is of concern. Very few households consumed an adequate diversity of fruit and vegetables on a daily basis. Seasonality affected

the availability of fresh fruit and vegetables, which reduced the availability of these foods in winter. A lack of water constrained the production of many nutritious crops. Participants in FGDs reported that drought and climate change have reduced opportunities for diversifying production and the availability of wild foods.

Access to a diversified diet was problematic for households in these communities. Households reported that a diverse diet was unaffordable. Jozini was an exception, as dietary diversity was higher and households consumed foods from an average of four food groups each day. The typical diet of most households consisted of maize meal with sugar. Where income permitted and production provided ingredients, a relish of onion and tomato or cabbage was added to one meal a day.

The dietary assessment indicated that there is a dire need to strengthen the existing good consumption patterns that relate to the consumption of diverse diets in these communities and to promote and encourage the consumption of more diverse diets daily. It is particularly important that these communities should regularly consume foods in the following food groups:

- Dark green leafy vegetables such as Swiss chard, broccoli, the leaves of beetroot, cowpeas, beans, pumpkin and sweet potatoes, as well as African leafy vegetables such as blackjack, cat's whiskers, amaranth, lambquarters, nettle, nightshade and sow thistle;
- Other vegetables such as cabbage, cauliflower, cucumber, eggplant (brinjal), gem squash, 'calabash' or other squash, green beans, green peppers, lettuce, peas, onions and zucchini (baby marrow);
- Orange- and red-fleshed vegetables such as beetroot, carrots, dark orange pumpkin, butternut or squash, orange-fleshed sweet potatoes and tomatoes;
- Legumes such as Bambara groundnut, cowpeas, dhal, dry beans and peanuts;
- Roots and tubers such as *amadumbe* (taro), potatoes and sweet potatoes;
- Orange- and red-coloured fruit such as citrus fruit, *makataan*, mango, papaya, pineapple, cantaloupe and watermelon;
- Other fruit, including avocados, bananas, figs, loquats and marulas.

An encouraging number of households are engaged in agriculture in Ingquza Hill, Jozini and Maruleng. It was also encouraging to note how many households were keen to engage in agriculture and produce a wider range of crops. A very small number of households were engaged in agriculture in Ratlou due to the aridity of the area.

The study found an encouraging link between engagement in agriculture and improved dietary quality. Engagement in agriculture increased the availability of vegetables and, in some cases, fruit when in season. This improved household dietary diversity and children's anthropometry scores. Income from farmland production and irrigated agriculture led to the

increased intake of fruit and vegetables in general, but also meat, eggs, fish, milk, roots and tubers.

A number of fruit and vegetable crops can be produced in these communities. However, the number of crops that will produce edible food in winter is severely constrained. In the areas with higher rainfall (Ingquza Hill, Jozini and Maruleng), a number of these crops can be produced under rain-fed conditions when normal climatic conditions prevail. However, communities reported that this is not possible under the current conditions of drought. Access to irrigation is necessary to overcome these constraints, reduce the risk of crop failure, improve yields, as well as extend the range of possible crops and the growing season.

The nutrient water productivity of the prioritised crops shows that a number of nutrient-dense crops can be grown in the four communities, but it also demonstrates the need to combine a variety of fruit and vegetables regularly in the diet to ensure that household members consume the essential nutrients. Again, the number of crops with high nutrient water productivity that produce edible portions of food in winter is very low. Most crops that produce nutritious fresh vegetables in winter require irrigation. Irrigating crops had a clear benefit in terms of providing a more diverse diet – not only in terms of available fresh produce, but possibly also through the sale of produce. Irrigation offers the potential of increasing the amount and variety of crops, as well as extending the period of availability of fresh produce.

The findings of the study can be generalised to poor rural communities in South Africa. Its findings show that the diets of poor rural households in South Africa lack diversity and do not include the frequent consumption of a diversity of fruit and vegetables necessary for ensuring good nutrition, human productivity and child development. The crops listed above should be prioritised to strengthen existing positive consumption patterns and promote greater dietary diversity. In theory, many of these crops can be grown in Ingquza Hill, Jozini and Maruleng under rain-fed conditions. Yet, community consultations reveal that many of these crops will not grow under prevailing conditions of drought, weather uncertainty and climate change. Very few of these crops produce edible portions of food in winter. Many require supplemental irrigation.

Therefore, research is needed to investigate the impact of climate change on growing patterns to advise on adaptations to production techniques, irrigation practices, production timing and the potential for the development of early- and late-maturing crops to extend the growing season and make food available for longer periods. The biofortification of crops could increase the nutrient density of multiple micronutrients. Usually, biofortification focuses on increasing the availability of a single nutrient per crop. Research should investigate the amplification of multiple nutrients in foods that could be considered dual crops, such as beetroot, or where the nutrient water productivity of more than one nutrient could be enhanced (such as vitamin A, iron and zinc in carrots). Dual crops are crops where more than one part of the plant is nutrient dense, such as the leaves, roots, fruit or seeds.

It is clear from the research that many households engage in home production. Therefore, technologies and practices appropriate to these conditions (including pest and disease management) should be prioritised in research and extension. Water harvesting practices and systems for the delivery of water to gardens to reduce drudgery for women are essential to enable food production in more homes. The provision of boreholes and piped water is essential in drier areas such as Ratlou, although production in such areas always requires extensive amounts of supplemental irrigation.

This study highlights a number of priority research areas that the WRC could pursue. The first of these includes research related to the production of nutrient-dense crops that can strengthen and support households' diet year-round under rain-fed and irrigated conditions, as set out above. The anthropometric and dietary diversity data, particularly the seasonal aspects of the latter, strongly suggests that the addition of more nutritious foods to regular household consumption, year-round, could enhance the accessibility, availability and stability of household food security. The inclusion of more 'traditional' crops – African leafy vegetables and indigenous melons, for example – might restore some of the social-embeddedness of food, that is, the knowledge of production and preparation that is in danger of being lost, and which the communities all associate with better health and nutrition.

The second priority area for research relates to water harvesting and irrigation technologies to enable and encourage the production of crops with high nutrient water productivity and that can reduce labour drudgery for women in particular. In all the communities, there is the potential to enhance household and smallholder irrigation. In some cases, this poses technical obstacles, for example, at the arid Ratlou site. At other sites, it could be purely financial, for example, in Maruleng, where a partly functioning irrigation system is in need of repair and maintenance in order to serve a wider community. More problematic is the scenario of Jozini, where the vast potential of the beleaguered Mgindi irrigation scheme seems embroiled in conflicting commercial interests, managerial incompetence and stakeholder inequality. Ingquza Hill poses other challenges. Farming has undergone a drastic transformation from what was once the highly productive, rain-fed, terrace farming of staples and livestock to small, fenced, home gardens that rely on rainfall or arduous manual irrigation. Significant investments in infrastructure might be necessary to make use of the relatively abundant river water in such hilly and rugged topography.

The third priority relates to the biofortification of crops to improve the nutrient water productivity of more than one nutrient per crop. There was widespread sentiment among small producers and home gardeners that agricultural inputs and extension services are inaccessible or simply inappropriate. In several communities, farmers spoke about the inappropriateness of trying to adapt the commercial crop inputs available through commercial channels to local conditions. Reports of indebtedness and crop failure were common. Smallholder producers in the study sites demonstrated the will and energy to adapt their methods to changing conditions, for example, through the conservation of local and more drought-resistant crops. There is significant interest among farmers in knowledge sharing and

farmer-to-farmer exchanges to this effect, and it would be sensible to take an inventory of these practices and explore the potential for their dissemination. Documentation of this knowledge and systems for sharing it are urgently needed to support production in these areas.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY III
ACKNOWLEDGEMENTS IX
TABLE OF CONTENTS XI
LIST OF TABLES XIV
LIST OF FIGURES XVI
LIST OF ABBREVIATIONS AND ACRONYMS XVII
CHAPTER 1: INTRODUCTION 1
CHAPTER 2: REVIEW OF FOOD INSECURITY AND NUTRITION IN SOUTH AFRICA 3

2.1 Understanding Household Food Security 3
2.2 Food Security in South Africa 5
2.3 Synopsis 10

CHAPTER 3: METHODOLOGY 11

3.1 Identification of the Study Districts 11
3.2 Site Selection 11
3.3 Sample selection 15
3.4 Questionnaire Design 16
3.5 Constraints Faced During Data Collection 19
3.6 Data Treatment and Analysis 19
3.7 Training of Enumerators 21
3.8 Focus Group Discussions 22
3.9 Validation of Findings 26

CHAPTER 4: DESCRIPTION OF STUDY SITES 28

4.1 Demography 28
4.2 Brief Overview and Observations from the Sites 31

4.2.1 Ingquza Hill 32
4.2.2 Jozini 33
4.2.3 Maruleng 34
4.2.4 Ratlou 35

CHAPTER 5: CURRENT RAIN-FED AND IRRIGATED PRODUCTION 37
CHAPTER 6: CURRENT CONSUMPTION PATTERNS 51

6.1 Food Procurement 51
6.2 Frequency of Consumption 51
6.3 Experience of Hunger 53
6.4 Food Consumption Patterns and Dietary Diversity 55
6.5 Food Consumption Patterns in Ingquza Hill 63

6.5.1 Meal patterns and composition 63

6.5.2 Food for children in the household 64
6.5.3 Food supply 65
6.5.4 Changes in food eaten and the preservation of traditions 66
6.5.5 Special occasions 67
6.5.6 Food shortages 67
6.6 Food Consumption Patterns in Jozini 68
6.6.1 Meal patterns and composition 68
6.6.2 Food for children in the household 69
6.6.3 Food supply 70
6.6.4 Changes in food eaten and the preservation of traditions 71
6.6.5 Special occasions 72
6.6.6 Food shortages 72
6.7 Food Consumption Patterns in Maruleng 72
6.7.1 Meal patterns and composition 72
6.7.2 Food for children in the household 73
6.7.3 Food supply 74
6.7.4 Changes in food eaten and the preservation of traditions 75
6.7.5 Special occasions 75
6.7.6 Food shortages 75
6.8 Food Consumption Patterns in Ratlou 76
6.8.1 Meal patterns and composition 76
6.8.2 Food for children in the household 77
6.8.3 Food supply 77
6.8.4 Changes in food eaten and the preservation of traditions 78
6.8.5 Special occasions 78
6.8.6 Food shortages 79
6.9 Discussion Regarding Consumption Patterns 79
6.10 Precautionary Behaviour Related do Consumption During Food Shortages 80
6.11 Nutrition and Social Change 83
CHAPTER 7: NUTRITIONAL STATUS OF CAREGIVERS AND CHILDREN 86
CHAPTER 8: NUTRITIONAL CONSIDERATIONS FOR CROP-BASED RECOMMENDATIONS 93
8.1 Food Group-based Considerations 93
8.2 Dietary Recommendations 93
CHAPTER 9: THE CONTRIBUTION OF PRODUCTION TO HOUSEHOLD CONSUMPTION 96
9.1 The Influence of Cropping and Scale of Cropping on Food Consumption 96
9.2 What Can be Grown? 100
9.3 Nutrient Composition of the Recommended Crops 105
9.4 Water-Efficient Options to Improve Diet Quality 109

CHAPTER 10: PRIORITISED CROPS TO IMPROVE THE DIETS OF POOR RURAL COMMUNITIES 116
10.1 Priority Crops Identified 116
10.2 Validation of the Findings 121
CHAPTER 11: CONCLUSIONS AND RECOMMENDATIONS 123
11.1 Study Conclusions 123
11.2 Recommendations for Priority Crops to Improve the Diet of Poor Rural Communities throughout the Year 125
11.3 Recommendations for Research 126
11.4 Dissemination of the Findings 127
REFERENCES 129
APPENDIX A: GLOSSARY OF FOOD ITEMS IN LOCAL LANGUAGES 138
APPENDIX B: GENERAL NOTES ON THE PRODUCTION OF THE DIFFERENT CROPS 142
APPENDIX C: PUBLICATIONS AND PRODUCT OUTPUTS 149
Published journal articles 149
Papers submitted to journals for consideration 149
Papers in preparation 149
Research briefs 149
Invited presentations in which the results have been presented 150
Papers presented at conferences 150
Popular media 151
Software 151
APPENDIX D: CAPACITY BUILDING 153

LIST OF TABLES

Table 1: Summary of Food Security and Nutrition Statistics for South Africa 7
Table 2: Hunger and Malnutrition Situation in South Africa 9
Table 3: Recent Food Insecurity Indicators in South Africa 9
Table 4: Justification for Site Selection 13
Table 5: Dates of Surveys 18
Table 6: List of Food Groups 20
Table 7: Focus Group Discussions Held 23
Table 8: Comparative Demographics of the Study Sites 29
Table 9: Number of Surveyed Households at Each Site 31
Table 10: Number of Households Surveyed per Community 32
Table 11: Households Involved in Crop Production and Irrigation 38
Table 12: Crops Produced in Ingquza Hill 40
Table 13: Crops Produced in Jozini 41
Table 14: Crops Grown in Maruleng 41
Table 15: The Seasonaliy of Production in Ingquza Hill (from FGDs) 43
Table 16: The Seasonality of Production in Jozini (Mangwenya FGD) 44
Table 17: The Seasonality of Production in Jozini (Hlakaniphani FGDs) 45
Table 18: The Seasonality of Production in Maruleng (Madeira FGDs) 46
Table 19: The Seasonality of Production in Maruleng (Bochabelo FGDs) 47
Table 20: The Seasonality of Production in Ratlou (Phitshane FGDs) 48
Table 21: The Seasonality of Production in Ratlou (Madibogo FGDs) 48
Table 22: What Households Would Like to Produce and Are Not Currently Producing 50
Table 23: Food Procurement Source 52
Table 24: Number of Meals Eaten by Adults Per Day 53
Table 25: Number of Meals Eaten by Children Per Day 53
Table 26: Months of Adequate Food Access 54
Table 27: Number of Food Groups Consumed in the Previous 24 Hours 55
Table 28: Frequency of Consumption of Food Groups in the Previous Seven Days 56
Table 29: Food Group Consumption Comparison Among Sites From the 24-Hour Recall 57
Table 30: The Household Dietary Diversity Scores From the 24-Hour Recall 58
Table 31: Correlations for Food Group Consumption 59
Table 32: Households Gathering Wild Food 66
Table 33: Practices of Households When Faced With Food Shortages 81
Table 34: Reductions of Food Quality and Variety 83
Table 35: BMI of Female, Non-Pregnant Caregivers 86
Table 36: Child Anthropometry 88
Table 37: Variables Significantly Influencing Anthropometry Classification 91
Table 38: Recommendations to Improve Dietary Intake 94
Table 39: Food Group Consumption for Cropping and Non-Cropping Households From the 24-Hour Recall 99
Table 40: Correlations (Spearman's) of Food Group Consumption and Scale of Farming 101

Table 41: Recommended Vegetable Crops Based on the Potential for Production and the Current Production Patterns in the Four Sites.....103
Table 42: Table of Recommended Fruit Crops Based on Their Potential for Production.....104
Table 43: Selected Nutrient Values for the Recommended Vegetable Crops.....106
Table 44: Selected Nutrient Values for the Recommended Fruit Crops 108
Table 45: The Water Nutrient Productivity of the Recommended Crops 110
Table 46: Water Nutrient Productivity of the Recommended Fruit 113
Table 47: Dietary Reference Intakes for Children.....114

LIST OF FIGURES

figure 1: The Food Security Continuum 4
Figure 2: Experience of Hunger in South Africa 8
Figure 3: Map of the Study Sites 14
Figure 4: Proportion of Households Experiencing Hunger 54
Figure 5a: Children's Weight for Height 89
Figure 5b: Children's Weight for Age 89
Figure 5c: Children's Length or Height for Age 89
Figure 5d: Children's BMI for Age 89
Figure 5e: Children's MUAC for Age 90
Figure 5f: Children's Weight for Age by Sex 90
Figure 5g: Children's Length for Age by Sex 90
Figure 6: Dietary Diversity Score – Summer 97
Figure 7: Dietary Diversity – Winter 98
Figure 8: Illustration of the Nutritional Water Quality Per 100 G of Edible Produce 115
Figure 9: Priority Crops for Ingquza Hill 117
Figure 10: Priority Crops for Jozini 118
Figure 11: Priority Crops for Maruleng 119
Figure 12: Priority Crops for Ratlou 120

LIST OF ABBREVIATIONS AND ACRONYMS

ANC	African National Congress
BAZ	BMI for age Z-score
B-BBEE	Broad-based Black Equity Empowerment
BMI	Body Mass Index
CCHIP	Community Childhood Hunger Identification Project
CRDP	Community Rural Development Programme
DAFF	Department for Agriculture, Forestry and Fisheries
DI	Deprivation Index
DoH	Department of Health
DPME	Department of Planning, Monitoring and Evaluation
DSD	Department of Social Development
EAU	Enumeration area unit
ECD	Early Childhood Development
FANTA	Food and Nutrition Technical Agency
FGD	Focus group discussion
FIVIMS	Food Insecurity Vulnerability Information Monitoring System
FIVIMS-ZA	Food Insecurity Vulnerability Information Monitoring System in South Africa
GHS	General Household Survey
HAZ	Height-for-age Z-score
HDDS	Household Dietary Diversity Score
HFIAS	Household Food Insecurity Acess Scale
HSRC	Human Sciences Research Council
IDP	Integrated Development Plan
ISRDP	Integrated Sustainable Rural Development Programme
KZNDAE	KwaZulu-Natal Department of Agriculture and Environmental Affairs
LRAD	Land Redistribution for Agricultural Development (LRAD) programme
MAHFP	Months of adequate household food provisioning
MDG	Millennium Development Goal
MNCWH	Maternal, Newborn, Child, and Women's Health
MUAC	Mid-upper arm circumference
MUACZ	Mid-upper arm circumference Z-score
NCD	Non-communicable diseases
NDP	National Development Plan
NFCS	National Food Consumption Survey
NGO	Non-governmental Organisation
NPFNS	National Policy on Food and Nutrition Security
PCA	Principal Component Analysis
SANHANES	South African National Health and Nutrition Evaluation Survey
SASAS	South African Social Assessment Survey
SADC	Southern African Development Community
SD	Standard deviations

SGS	Société Générale de Surveillance South Africa (Pty) Ltd
SPSS	Statistics Package for Social Sciences
Stats SA	Statistics South Africa
UNICEF	United Nations International Children's Emergency Fund
UP	University of Pretoria
USAID	United States of America International Aid
WAZ	Weight-for-age Z-score
WFP	World Food Programme
WHO	World Health Organisation
WHZ	Weight-for-height Z-score
WRC	Water Research Commission

CHAPTER 1: INTRODUCTION

A baseline and scoping study commissioned by the Water Research Commission (WRC Report No. TT 537/12) has revealed numerous knowledge gaps with regard to smallholder production and food security in South Africa. The study highlighted that there is limited current and generalisable food security and nutrition research in South Africa. Very few studies have investigated the year-round source(s) of food for the rural poor. In particular, agricultural interventions to improve human nutrition and the (indirect) eventual outcomes of health, education and economics, are practically non-existent. The study identified two specific knowledge gaps. Firstly, it identified that the contribution of home- or smallholder-grown foods to total dietary intake and nutritional requirements (in the context of an in-depth description of the food environment and its links to water) is not known. Secondly, the effect of seasonality on home or smallholder production is not documented (Wenhold et al. 2012).

This project set out to address these significant and longstanding gaps in knowledge and to propose a set of options for strengthening rain-fed and irrigated crop production in the rural areas investigated to identify research focus areas related to efficient water use that could directly overcome dietary inadequacies and lead to better nutrition of rural household members. This unique study drew on a transdisciplinary research approach to investigate the consumption and production patterns of rural households in communities in four selected sites in the poorest local municipalities in South Africa. Transdisciplinarity is an emerging science that offers innovative methodologies for high-impact science through understanding and taking action on complex societal problems that can no longer be approached and solved by monodisciplinary approaches only (Regeer and Bunders 2008; Lang et al. 2012). It adopts the integration of theoretical and methodological perspectives of multiple disciplines to generate novel conceptual and empirical analysis that transcends discipline perspectives, and moves between, across and beyond traditional disciplines (Holistic Education Network of Tasmania 2011). Transdisciplinarity produces new knowledge with, rather than for society.

The general objective of the study was to assess the current rain-fed and irrigated production of food crops and its potential in relation to the food and nutrition requirements of poor rural people to determine crop water use in a future project. The specific objectives of the study were as follows:

- Specific Objective 1: To describe the total population (rural poor) in the provinces with reference, among other things, to demographics, education and training, sources of income and livelihood, socioeconomic and cultural dynamics (including food culture), natural resources, institutional arrangements related to land, farming or gardening systems (including the apportionment of produce) and the use of this information to identify, select and justify the sample sites
- Specific Objective 2: To determine poor rural people's food intake (type of food consumed), frequency of consumption and contribution towards nutritional

requirements) and the sources of these foods all year round (natural and social seasons)

- Specific Objective 3: To determine the total current food production patterns of poor rural people
- Specific Objective 4: To determine the direct and indirect food crop production opportunities for poor rural people to comply with their nutritional requirements
- Specific Objective 5: To prioritise relevant food crops in the diets of poor rural people for future research on water use, yield and good management practices.

This report presents the findings of this study in sections that report on the following sequential steps of the research process:

- Investigate the crop production patterns, food consumption patterns and anthropometry of children between 24 and 59 months.
- Compare the nutritional status, dietary diversity and food consumption patterns of households engaged in rain-fed and irrigated crop production with households not engaged in crop production.
- Identify the food consumption gaps.
- Examine the agronomic conditions in the four sites and identify what crops could grow in these areas.
- Identify and prioritise the potential crop that could be grown to improve diets in each site.
- Validate the prioritised list of crops with the communities.
- Develop information resources and tools to disseminate the information.

The final chapter of the report presents the conclusions, prioritised list of crops to improve the diets of poor rural communities, and recommendations for the WRC's future research activities.

CHAPTER 2: REVIEW OF FOOD INSECURITY AND NUTRITION IN SOUTH AFRICA

A high proportion of South Africa's rural households face the risk of experiencing food shortages that negatively affect their long-term food security and undermine their human potential (Hendriks 2014). Food security exists "when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences" (FAO 1996). While food insecurity is experienced at national, community and household level, malnutrition is experienced at individual level. Overall, the definition of food security implies that families and individuals do not need to worry about where their next meal will come from. Being food secure relies on having access to stable sources of food supply or income to purchase food for consumption.

2.1 Understanding Household Food Security

Food security is achieved when all members of a household consume adequate food to meet their individual dietary needs on a continual basis (FAO 1996). Sound nutrition is essential for human productivity, health, and child development. Food security rests on four elements: food availability, access, adequate nutrition and the stability of the supply of income and food (resilience). While food security is one foundational requirement for nutrition, two other elements are essential for sound nutrition. These are adequate care and healthy environments with adequate housing, sanitation, waste management, and good quality air and water (Hendriks 2015).

Food insecurity and malnutrition are forms of deprivation. Each manifests in a variety of symptoms of varying severity (Hendriks 2015). Hunger and wasting (extreme underweight-for-age) are extreme experiences of food insecurity, but food insecurity can also manifest as hidden hunger or less obviously observable forms of malnutrition. Malnutrition includes undernutrition, micronutrient deficiencies or overweight and obesity. The latter is a result of unbalanced intakes and, in particular, the consumption of too many calories without adequate intake of protein and micronutrients (Hendriks 2015). Hidden hunger includes various forms of less severe malnutrition, including micronutrient deficiencies. The levels of severity of food insecurity can be visualised as a continuum, as depicted in the figure below.

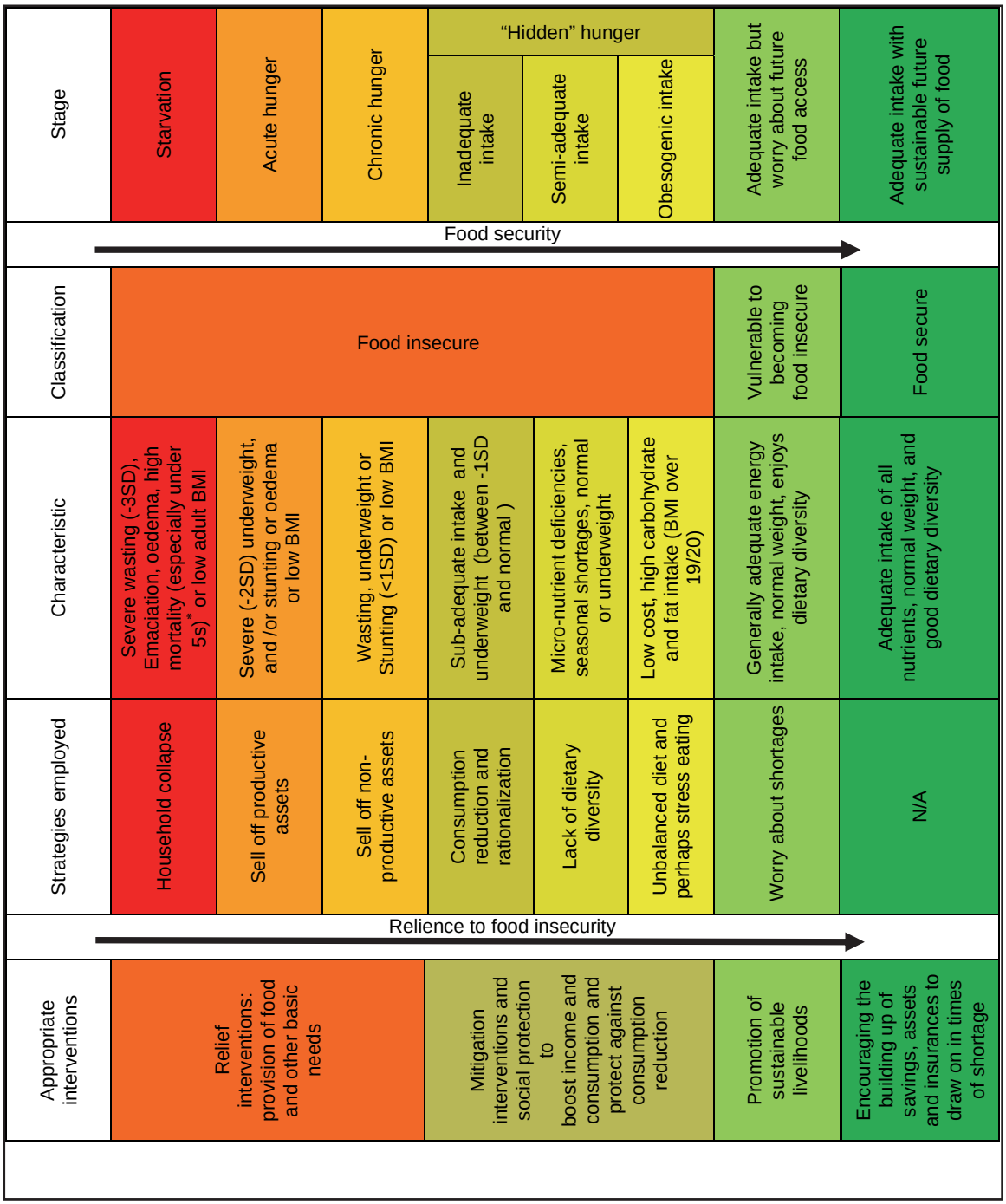

Figure 1: The food security continuum
Source: Hendriks (2015)

The causes of food insecurity and malnutrition are rooted in interconnected economic, social, environmental and political system failures. They are both causes and consequences of poverty, inequality and unemployment. Eliminating food insecurity and malnutrition demands ensuring that everyone has sufficient income to pay basic living costs and afford an adequate diet (Hendriks 2015).

2.2 Food Security in South Africa

The right to food is entrenched in Section 27 of the Constitution of South Africa (RSA 1996). The Constitution obliges the state to take the necessary steps to meet citizens' basic food needs, including passing legislation to ensure the right to food security. Section 28(1) of the Constitution further ensures children's unconditional right to basic nutrition. South Africa has set an ambitious target of eliminating poverty and inequality by 2030 (NPC 2012). The National Development Plan (NDP) refers to a number of interventions to be implemented to improve food security. These include expanded irrigation and security of land tenure – especially for women – and social protection, including nutrition education (NPC 2012). The NDP provides a framework to inform the actions required to address pervasive hunger (NPC 2012). The NDP calls for collaboration between government, the private sector and citizens to establish self-reliant local food systems that would ensure universal access and utilisation over time (DPME 2014).

Food insecurity is a constraint to development in South Africa and is the focus of many state development programmes and initiatives (Battersby 2011). Food security in South Africa demands serious and urgent attention amidst excessively high unemployment, high levels of inequality and depressed economic growth (Hendriks 2013). Building on existing food security initiatives, the African National Congress (ANC) identified food security as a key focus area in the 2009 General Elections (ANC 2014) and it was included in the national priority outcomes (Medium-term Strategic Framework) (DPME 2014).

South Africa faces serious food security challenges compared to countries with similar income levels such as Angola, Algeria, Brazil and Malaysia (DPME 2014). The South African government recognises that food security is a prerequisite for sustained economic growth and poverty reduction (RSA 2014). The National Policy on Food and Nutrition Security (NPFNS) was approved in August 2013, (RSA 2014). The policy's goal is to ensure the availability, accessibility and affordability of safe and nutritious food at national and household levels through improved nutritional safety nets, nutrition education, the alignment of investment in agriculture, the market participation of emerging farmers and risk management.

Numerous national programmes for addressing food insecurity have been implemented and include, among others (Hendriks 2014; Abdu-Raheem and Worth 2011):

- Agricultural programmes – such as household food production and food preservation
- Social services – such as social grants
- Public works programmes
- Nutrition – such as school feeding schemes and nutrition education and counselling
- Free health services (particularly for children under five years of age)

Food security in South Africa has to be addressed within the context of various development issues, including but not limited to poverty, increasing fuel and food prices, sources of

income, social protection, rural and urban development, changing household structures, land, health, education, and water and sanitation (RSA 2014). Despite progressive constitutional rights for citizens and some progress towards clear development targets, the level of food insecurity in South Africa is considerably high (Hendriks 2013). Currently, there are no legislative measures in place to realise the right to food as enshrined in the Constitution and there is no comprehensive information system to monitor and report on levels of food insecurity in South Africa (Hendriks 2014).

Table 1 presents a summary of nationally available representative food security and nutrition-related indicators for South Africa.

Table 1: Summary of food security and nutrition statistics for South Africa
Source: Hendriks et al. (2016)

Indicator	Unit	Latest available status[a]	Data source
Households living in extreme poverty	%	21.7	Stats SA (2015a)
Households without enough income to purchase adequate food and non-food items	%	37[a]	Stats SA (2015b)
Gini coefficient	%	0.69	Stats SA (2015a)
Unemployment	%	25	Stats SA (2015a)
Childhood stunting < 60 months	%	26.4	Shisana et al. (2013)
Anaemia in women (16 to 35 years old)	%	23.1	Shisana et al. (2013)
Low birth weight babies < 2.5 kg	%	13	DoH (2012)
Children < 9 years old overweight or obese	%	14	Shisana et al. (2013)
Exclusive breastfeeding in the first six months	%	37	Labadarios et al. (2011)
Childhood wasting 1 to 3 years	%	2.2	Shisana et al. (2013)
Households living on less than the lower bound of poverty (R779 per month)	%	53.8[a]	Stats SA (2015a)
Households experiencing hunger	%	13.1	Stats SA (2015b)
Households experiencing severe inadequate access to food	%	5.9[a]	Stats SA (2015b)
Households experiencing inadequate access to food	%	16.6[a]	Stats SA (2015b)
Life expectancy	Years	62.2	Dorrington et al. (2014)
Maternal mortality ratio	Per 100 000 live births	174	DoH (2012)
Neonatal mortality rate	Per 1 000 live births	15	DoH (2012)
Infant mortality rate	Per 1 000 live births	27	DoH (2012)
Mortality rate of children under 5 years	Per 1 000 live births	41	DoH (2012)
Vitamin A supplementation of children < 60 months	% coverage rate	54	DoH (2012)
Obese women > 15 years old	%	24.8	Shisana et al. (2013)
Overweight women > 15 years old	%	39.2	Shisana et al. (2013)
Non-communicable diseases (NCD) mortality rate females	Per 100 000	98.1	WHO (2011a)
NCD mortality rate males	Per 100 000	92.4	WHO (2011a)
Population receiving social grants	%	32[a]	DSD (2014)
Household with access to piped or tap water	%	86	Stats SA (2015a)
Household with access to sanitation	%	79.5	Stats SA (2015a)

[a] No targets and benchmarks exist for these indicators.

Legend:

Good progress based on available data from previous assessment
Slow progress based on available data from previous assessment
No progress or deteriorated based on available data from previous assessment

Figure 2 shows the prevalence of self-reported hunger in South Africa in 2012, as assessed using a Community Childhood Hunger Identification Project (CCHIP). More than 30% of households in the country's rural and urban informal areas reported experiencing hunger in 2012 (Shisana et al. 2013). The General Household Survey (GHD) reported that 11% and 13% of households and individuals, respectively, in South Africa reported experiencing hunger in the four weeks prior to the GHS of 2013 (Table 2) (Stats SA 2014b).

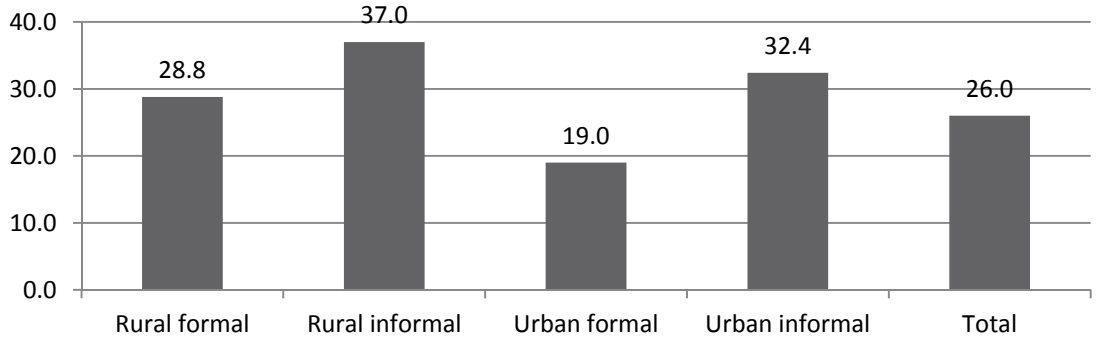

Figure 2: Experience of hunger in South Africa
Source: Shisana et al. (2013)

With regard to food access, results from the GHS of 2013 – using questions from the Household Food Insecurity Access Scale (HFIAS) with a 30-day recall period – indicated that the percentage of households reporting limited access to food increased from 22% in 2012 to 23% in 2013 (Stats SA 2014b). However, the percentage of individuals with limited access to food remained virtually constant at around 26% (see Table 3). The increase in the number of households with limited access to food clearly indicates that the implementation of the existing food security interventions should be improved (Stats SA 2014b). Table 2 shows the provincial situation with regard to food access and hunger.

Table 2: Hunger and malnutrition situation in South Africa

Variable	**National Food Consumption Survey 1999** (Labadarios 2000)	**National Food Consumption Survey 2005** (Labadarios et al. 2008)	**South African Social Assessment Survey 2008** (HSRC 2008)	**South African National Health and Nutrition Evaluation Survey, 2012** (Shisana et al. 2013)
	n = 2 735	n = 2 413	n = 1 150	n = 6 306
	%	%	%	%
Food secure	25	19.8	48	45.6
At risk of hunger	23	27.9	25	28.3
Experiencing hunger	52.3	52	25.9	26.0

Although self-reported experiences of hunger have dropped since 1999, much needs to be done to improve food security in the country (Table 3). The findings from four national surveys (using the CCHIP Index as proxy for food security) indicated that the proportion of food insecure households halved from 1999 to 2008, reducing from 52.3% to 25.9%, while the proportion of households at risk of food insecurity ranged from 23.0% to 27.9% between 1999 and 2005 (Labadarios et al. 2011; Labadarios et al. 2008). However, the data from the first South African National Health and Nutrition Evaluation Survey (SANHANES-1) in 2012 and the GHS in 2013 suggest no improvement since 2008.

Nationally, 26% of boys and 25% of girls aged one to three years old were stunted in 2012, an increase in the 2005 National Food Consumption Survey (NFCS) data (Shisana et al. 2013). There is also a growing obesity problem in children aged two to five years, with 18.9% of girls being overweight and 4.9% being obese, and 17.5% of boys being overweight and 4.4% being obese (Shisana et al. 2013). This is indicative of poor diet quality.

Table 3: Recent food insecurity indicators in South Africa

Data source	**Province of South Africa[a]**									**RSA**
GHS 2013 data (Stats SA 2014b)	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**	**RSA**
Food access severely inadequate	7.0	5.4	4.7	4.0	1.7	8.8	9.6	14.7	8.3	6.1
Food access inadequate	22.4	21.1	13.0	20.9	7.0	20.7	21.0	22.6	15.0	17.0
Food access adequate	70.6	73.5	82.3	75.2	91.3	70.6	69.3	62.7	76.8	76.9
SANHANES-1 2012 data (Shisana et al. 2013)	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**	**RSA**
Prevalence of the experience of hunger	36.2	28.8	19.2	28.3	30.8	29.5	20.7	29.5	16.4	26.0
Household experience of hunger	32.4	31.9	24.8	34.4	27.3	15.5	22.8	30.0	25.6	28.3
Food secure	31.4	39.3	56.0	37.3	41.9	55.0	56.5	40.4	57.9	45.6

[a] EC = Eastern Cape, FS = Free State, GP = Gauteng, KZN = KwaZulu-Natal, LP = Limpopo, MP = Mpumalanga, NC = Northern Cape, NW = North West, WC = Western Cape, RSA = Republic of South Africa

2.3 Synopsis

It is clear from the abovementioned data that food security in South Africa is complex. While there is not much evidence of widespread starvation and extreme undernutrition in the country, there is clear evidence of multiple forms of deprivation related to the experience of hunger, widespread manifestation of hidden hunger or micronutrient deficiencies and the co-existence of overweight and obesity with hidden hunger and child malnutrition. Despite a multitude of state, private sector and NGO-funded food security programmes, stunting levels in South Africa increased over the Millennium Development Goal (MDG) period. South Africa is the only country in the South African Development Community (SADC) region where child stunting has not decreased during the MDG period (Hendriks et al. 2016). The increasing incidence of overweight among women and children raises alarm. This indicates severe inadequacies related to the diets of South Africans. Yet, very little research has been carried out in South Africa regarding food consumption patterns at the household level and linking this to what can be grown to improve the diets of poor rural people.

CHAPTER 3: METHODOLOGY

3.1 Identification of the Study Districts

This study began with a desk review of available literature, reports and other official and non-governmental organisation (NGO)-authored documents to profile the four provinces selected by the WRC for this study. Comparative data was collected on the following aspects:

- Demographics
- Education and training
- Sources of income and livelihoods
- Sociocultural dynamics (including food culture)
- Natural resources, institutional arrangements related to land
- Farming/gardening systems (including apportionment of produce)

The desk review identified the Integrated Sustainable Rural Development Programme (ISRDP) priority districts as the primary point for the selection of the study districts in the Eastern Cape, KwaZulu-Natal and Limpopo for this study. These districts represent the 18 rural nodes across South Africa in which South Africa's poorest citizens live (Harmse 2010; Stats SA 2016). No priority rural nodes exist in North West (Stats SA 2016).

3.2 Site Selection

Using these priority districts in the Eastern Cape, KwaZulu-Natal, Limpopo and the North West, data from the Heath Systems Trust (Day et al. 2012) Deprivation Index (DI) was used to identify the most deprived district in North West and then the most deprived municipalities in the district from each province. The DI provides a useful tool for identifying the poorest regions in the country. The DI is a measure of relative deprivation. The 2011 index was derived from a set of demographic and socio-economic variables from the 2007 Community Survey and the 2005 and 2006 General Household Surveys. Day et al. (2012) estimated the DI using Principal Component Analysis (PCA) from a set of key binomial variables for the following:

- Children who are below the age of five years
- Black Africans
- Female household heads
- Household heads with no formal education
- Working-age people who are unemployed (not working, whether looking for work or not – the official definition of unemployment in South Africa)
- People who live in a traditional dwelling, informal shack or tent
- People who have no piped water in their house or on site
- People who have a pit or bucket toilet or no form of toilet
- People who do not have access to electricity, gas or solar power for lighting, heating or cooking

    - (Day et al. 2012).

Although not direct food security indicators, many of these variables are also indicators of food insecurity and poverty. From this data, one district municipality per province was selected as the location for the study. The reports for the identified districts of the Community Rural Development Programme (CRDP) of the Department for Rural Development and Land Reform were also consulted to verify the selection of the most deprived areas. For KwaZulu-Natal, the district identified as having the highest level of child undernutrition (uMkhanyakude) did not have CRDP reports available at the time. The only available equivalent data for this district at the time were drawn from the Food Insecurity Vulnerability Information Monitoring System (FIVIMS) (NDA 2007) information sheets, using 2005 data. These information sheets confirmed that the level of deprivation in uMkhanyakude was the highest in the province.

The NFCS (Labadarios and Nel 2000; Labadarios 2000) reported that Hlabisa had the highest proportion of the population experiencing hunger in the 1999 and 2005 survey data for KwaZulu-Natal. However, the proportion of households receiving migrant income in Hlabisa was high relative to Jozini. Working in Hlabisa had budgetary implications for the study. Lima had a long-term working relationship with the Jozini community (as well as the sites in the Eastern Cape and Limpopo where the site selection coincidently identified communities where Lima has long-term relationships). This facilitated community access and allowed the research team the opportunity to build on a long-term development programme in the area rather than an interventionist, extractive research approach. For these reasons, Jozini was selected as the preferred study area in KwaZulu-Natal.

Jozini, Ingquza Hill, Maruleng and Ratlou had the highest rates of child stunting per province. The four sites were distinctive with different land capabilities (see Table 4 and Figure 3).

Except for Mopani, they also represented the most deprived districts according to the Health Systems Trust Barometer (Day et al. 2012). The Greater Sekhukhune District had a lower level of deprivation than Mopani and fell in the bottom percentile in the province. However, Mopani had a higher level of stunting – which is an important indicator of poverty and food insecurity. Therefore, Mopani was recommended as the study site for Limpopo over Greater Sekhukhune.

Initially, Port St Johns Local Municipality in the OR Tambo District was selected as the area for the Eastern Cape sample, but the undulating topography and the lack of farming settlements in this district required reconsideration of this site. In consultation with the WRC managers, Ingquza Hill was selected as having the next highest poverty rate and a suitable agricultural context.

Table 4: Justification for site selection

Province	**KwaZulu-Natal**	**Eastern Cape**	**Limpopo**	**North West**
District	uMkhanyakude	OR Tambo	Mopani District	Ngaka Modiri Molema (Ratlou Local Municipality 2010)
Local municipality	Jozini	Ingquza Hill	Maruleng Local Municipality	Ratlou
Agronomy	Tropical Ideal weather conditions for agricultural production. In some areas crops can grow year-round – two to three crop cycles a year are possible (Jozini Local Municipality 2012)	Coastal (mixed biome) Ingquza Hill is home to dune forests, swamp forests and coastal forests. Forests are used by local communities and receive little protection due to a lack of formal control. Subsistence agriculture is predominant (Ingquza Hill Local Municipality 2016)	Lowveld High agricultural potential with production of tropical and citrus fruit (Maruleng Local Municipality, 2012).	Grassland/semi-arid This is a semi-arid area with water scarcity.
Hydrology	Jozini Dam is a major source of drinking water for people, animals, and irrigation (Jozini Local Municipality 2012).	The area has one large river, the Umzimvubu River, two medium-sized rivers and a number of smaller coastal rivers with limited catchment areas that stretch 60 km inland. The area receives above 800 mm of rainfall a year (OR Tambo District Municipality undated).	Located on the banks of the Blyde River (Maruleng Local Municipality 2012) A large population of communal farmers is settled in an area between Hoedspruit and Tzaneen. Seven medium-sized irrigation schemes have been developed in the area, but only two remain functional.	The community is highly dependent on scarce ground water. With the existence of two river systems, one to the north and one in the centre of the area, water tables are relatively low. Borehole water is available, especially in close proximity to the river systems. Agricultural activities should also be located close to water sources (Ratlou Local Municipality 2010). There used to be a dam at Mabule, but, due to floods, it has burst its wall, resulting in the lack of a secure water supply for the villagers.

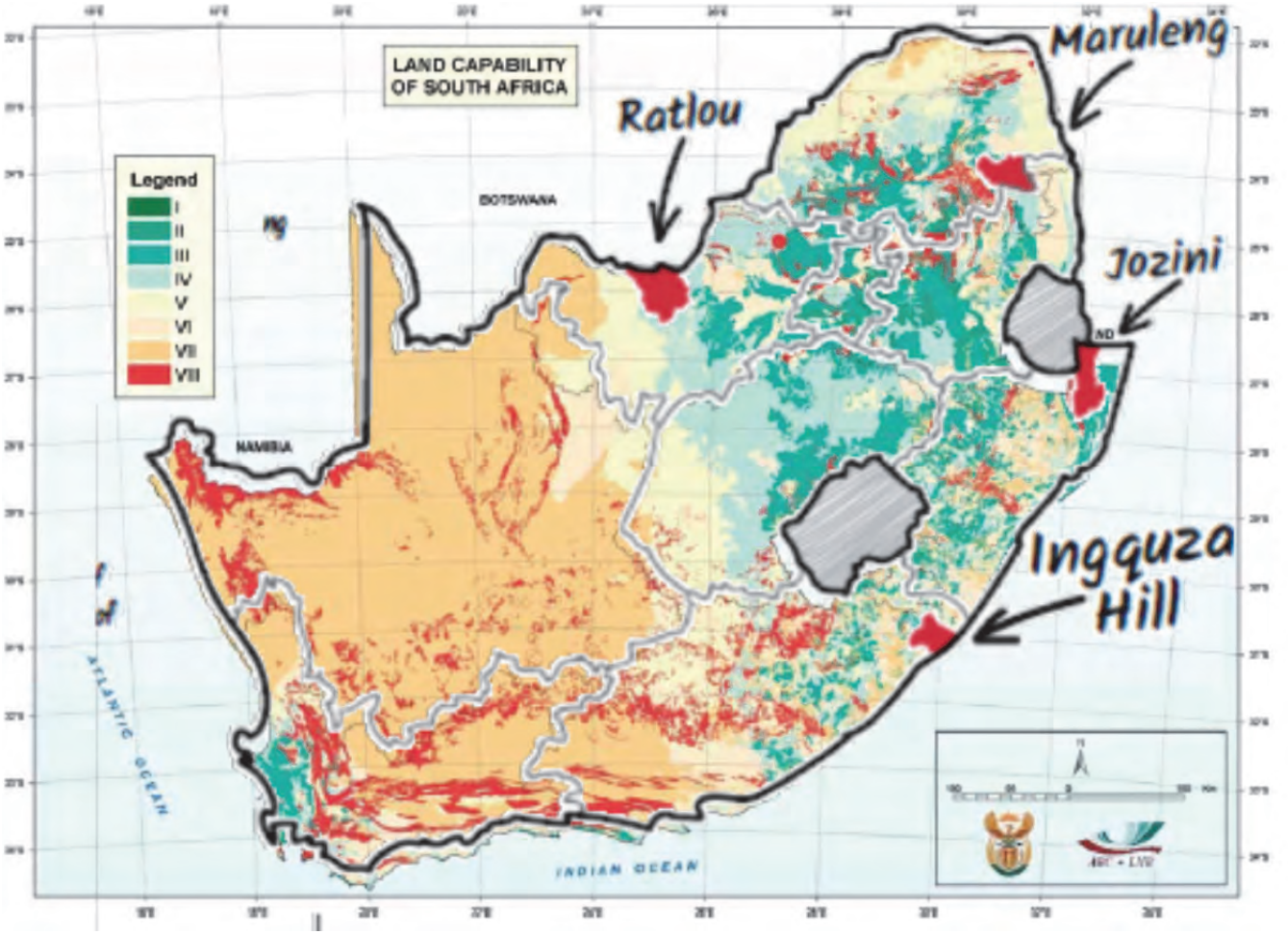

Figure 3: Map of the study sites
Source: Adapted from Collett and Lindermann (2008)

3.3 Sample selection

Once the local municipalities were selected, a multistage stratified random sampling technique was applied to identify the communities and sample households for the quantitative survey and qualitative assessments. Enumeration area unit (EAU) orthophoto maps from the national statistics framework (Stats SA 2003) were obtained from Statistics South Africa (Stats SA). For the selected local municipalities, all EAUs classified as 'traditional residential' were listed. Random computer-generated numbers were used to select two EAUs per local municipality. The number of households per EAU was counted from the orthophoto maps provided by Stats SA. The sampled households were drawn using random computer-generated numbers from the total number of homesteads in each EAU (obtained from Stats SA). Initially, the research team had planned to sample 25 crop-producing and irrigating households per site. However, this was not possible. Where the EAUs were the sampling frame base (for the sites in Ingquza Hill, Maruleng and Ratlou and one site in Jozini), a list of at least 100 random household numbers were generated and the households were identified and approached in the order of the random sampling list. Where a household was unavailable or did not meet the criteria for inclusion (see below), the next household on the list was approached until at least 50 households per site were interviewed for the first round of data collection. Contacting the households for the second round of data collection proved tricky, so there was natural attrition in the sample size.

In the case of KwaZulu-Natal, two different approaches were adopted to identify farmers from an irrigation scheme (called Makhatini Block 6B or Mjindi) and a second sample representing households not associated with an irrigation scheme. In the case of the irrigation scheme, a list of all farmers belonging to the scheme was obtained (407 members) and the households residing in Jozini (89 members) were identified. Random computer-generated numbers were used to identify a sample of 50 households. A replacement number list was drawn in the same manner and was used to substitute where farmers could not be located, were unavailable for interviews or unwilling to participate in the survey. Due to the process of substitution of additional randomly selected members, all 69 available qualifying households were interviewed from the members of the irrigation scheme. For the second group of farmers in KwaZulu-Natal who did not belong to the irrigation scheme, the same procedure was followed as for the other three provinces.

The Ingquza Hill area in the Eastern Cape is quite undulating with multiple tributaries and rivulets. From an examination of the orthophoto map of the area, most households seemed to live within at least 2 km of a water source. For this reason, in this site, irrigating and non-irrigating areas were not identifiable. Similarly, at the Limpopo sites, households lived in formal housing settlements and farmed in areas beyond the township. In North West, no farming was visible at all from the orthophoto maps. This was confirmed by a site visit. It was therefore impossible to identify irrigating and non-irrigating households ahead of time, so a random sample was drawn from the total population of EAUs at two sites per municipality for these three provinces and one EAU in Jozini.

To be included in the survey, a household had to have at least one child aged between 24 and 59 months with a caregiver present in the homestead and willing to participate in the study. Finding qualifying households in Ratlou was difficult, due to the absence of children.

3.4 Questionnaire Design

Surveys were studied to select appropriate questions for the quantitative survey. These surveys included the following:

- Stats SA General Household Survey
- South African Quality of Life Surveys
- Household Profiling Tool of the Department of Social Development (DSD)
- South African Community Surveys
- Living Standards Measurement
- Food Insecurity Vulnerability Information Monitoring System in South Africa (FIVIMS ZA)
- SA Census 2012 and 2013 questionnaires
- Stats SA Census of Commercial Agriculture questionnaire, 2012
- Surveys from other countries (demographic household surveys) including Malawi, Zambia and Uganda

Current food security tools were also reviewed. This included the Household Hunger Scale (Ballard et al. 2011) and the Food Sovereignty Assessment Tool (Bell-Sheeter 2004).

The survey tool was drafted in consultation with Stats SA, where staff members were kind enough to allow the use of the 2013 GHS as a basis for the current survey prior to the commencement of the 2013 GHS. The 2012 Stats SA census of commercial agriculture was drawn on for the agricultural production questions. The survey tool was drafted and digitised by a team member, loaded onto Samsung tablets and the data captured directly on the tablet. This allowed for instant data capturing into an Excel spread sheet for analysis. The University of Pretoria (UP) Ethics Committee granted ethical approval for the study (approval number EC130628-066).

Two panel surveys were conducted at each site – one in the drier and less agriculturally productive winter months and one in the summer months (see Table 5). The survey captured information about household crop production, food consumption, a range of food security indicators, and anthropometric measurements of children aged between 24 and 59 months and their female caregivers.

Quantitative data was collected through household surveys. Table 5 sets out the dates on which the surveys were conducted. Caregivers signed a standard informed consent agreement. Enumerators from the communities with at least 12 years of completed education were identified, recruited and trained for the fieldwork. The questions and terminology

required for the survey were translated into the local language of the area. Glossaries of terms (see Appendix A) were prepared as a guide for the enumerators and field support staff, and were used in training.

The project's principal investigator checked each survey submission as it was submitted. Each submission was checked for errors and the survey coordinator was alerted of any errors, missing data or anomalies so that these could be corrected while the survey team was on site. The survey design's information technology expert was on call to manage technical glitches.

Table 5: Dates of surveys

Province	District	Local municipality	Round	Season	Date	Location
Eastern Cape	OR Tambo	Ingquza Hill	Round 1	Summer	October 2013	KwaThahle Dubana
			Round 2	Winter	July 2014	25 Dubana 34 KwaThahle
KwaZulu-Natal	uMkhanyakude	Jozini	Round 1 Makatini Block 6B (irrigation scheme members)	Winter	July 2013	Makatini Block 6B Irrigation Scheme
			Round 2 for irrigation and Round 1 for non-irrigating	Summer	October/November 2014	Makatini Block 6B Irrigation Scheme KwaJobe
			Round 2 (non-members)	Winter	May 2015	KwaJobe
Limpopo	Maruleng	Mopani	Round 1	Summer	November 2014	Bochabelo Sedawa
			Round 2	Winter	May 2015	Bochabelo Sedawa
North West	Ngaka Modiri Molema	Ratlou	Round 1	Summer	November 2014	Madibogo Phitshane
			Round 2	Winter	June 2015	Madibogo Phitshane

3.5 Constraints Faced During Data Collection

Tracing the households in the second round of data collection proved to be extremely difficult. Due to electioneering and disruptions of the national elections in April 2014, fieldwork had to be suspended between December 2013 and April 2014. This meant that the team was unable to survey consecutive summer and winter seasons at some of the sites. The delay also meant that some of the children who were under 59 months in the first round of data collection were older than 59 months on the second visit and could not be used in the survey for Round 2. Where possible, children who had become older than 24 months were included in Round 2. Some households were not traceable in the second round as they had relocated or the participants were not found for Round 2 of the survey.

Obtaining the child anthropometry data was no simple task. The researchers did not expect the number of children attending the Early Childhood Development (ECD) centres of the DSD (especially in Jozini) to be so high. The field staff struggled to gain access to these small children in order to take their anthropometric measurements, as they were not at home during the day.

3.6 Data Treatment and Analysis

The data from the survey was cleaned, checked and analysed for frequencies. Comparisons of the various elements under investigation were conducted using Microsoft Excel and SPSS Version 23 (IBM Corporation 2014).

Crop-producing households were considered to be those engaged in some form of crop production, such as vegetables, fruit or industrial crops. The scale of production was not taken into consideration, except where the data was disaggregated into large-scale farming, community gardens (smaller plots on a shared commonage), school gardens where groups farm smaller plots on a larger commonage, and home gardens. Livestock production was not considered.

Non-cropping households did not engage in cropping of any kind, but may have been involved in livestock production. Irrigating households were those engaged in cropping who used some form of irrigation (from buckets to irrigation scheme canals).
Numerous food security access indicators were evaluated and compared across the two seasons and compared to anthropometric measurements for children aged between 24 and 59 months and their female caregivers. Each indicator was estimated according to the following standard procedures set out in the literature.

The Household Dietary Diversity Score (HDDS) (Kennedy et al. 2011) is a measure of dietary quality. It uses a 24-hour recall period of 16 food groups, without asking about frequency of consumption. The HDDS is the sum of the first 14 scores classified as ‘1’ for yes and ‘0’ for no. As this is a continuous variable without international cut-offs, it was not

classified into categories for this study. The description of the food groups is presented in Table 6. In this study, a non-quantitative 24-hour recall was used.

Table 6: List of food groups

Cereals: maize, millet, sorghum, wheat and any other foods made from cereals such as porridges and bread
White roots and tubers: potatoes, sweet potatoes (excluding orange-fleshed sweet potatoes)
Orange-fleshed vegetables: butternut, carrots, orange-fleshed sweet potatoes and pumpkin
Dark green leafy vegetables: including *imifino* (green leafy vegetables), *morogo* (wild/indigenous green leafy vegetables)
Other vegetables: eggplant, gem squash, green beans, onions and tomatoes
Orange-coloured fruit: apricot, dried peach, ripe mango, papaya and 100% fruit juice made from these fruit
Other fruit: banana, apple, orange and pear
Organ meat: heart, kidney, liver and other organ meats
Meat: beef, goat, poultry, pork and sheep
Eggs
Fish and seafood: fresh, tinned or dried fish and shellfish
Dried beans and pulses: lentils, nuts, peas, seeds or foods made from these (e.g. peanut butter)
Milk and milk products: cheese, milk, *amasi* and yoghurt
Oils and fats: butter, lard, margarine and sunflower oil
Sweets: honey, sugar, sweetened squashes and juices, carbonated sweetened drinks and sugary foods such as chocolates, cookies and cakes
Beverages and spices: condiments (e.g. tomato sauce), pepper and salt, non-alcoholic beverages (coffee and tea) and alcoholic beverages

Self-reported experience of hunger questions was used to estimate the incidence of experiences of hunger among adults and children in households during the preceding 12 months. The experience of hunger was based on questions typically included in the South African GHS (Stats SA 2014b). These questions ask whether any adult or child went hungry in the past 12 months because there was not enough food in the household during that time.

Months of inadequate household food provision is a simple sum of the number of months a household reports experiencing hunger in the previous 12 months (Bilinsky and Swindale 2010).

Anthropometry was used to assess children between 24 and 59 months and their female caregivers. Z-scores for child anthropometry were determined using Anthro for Personal Computers (version 3.2.2) (WHO 2011b) and international reference guidelines. Adult body mass index (BMI) was calculated as the weight of a caregiver divided by her height in centimetres squared.

3.7 Training of Enumerators

Lima recruited enumerators from the communities in which the surveys were conducted. Eight enumerators from each community were selected and trained in survey data collection. The enumerator training was carried out in stages. Initial training on the use of the mobile device was carried out. The enumerators were taken through the paper-based survey questions. They were then trained on entering the data into the tablet. Experts from UP trained the enumerators in taking the anthropometric measurements. Role play was used to allow enumerators to practice engaging with households, introduce the survey, complete the informed consent form, ask questions, take anthropometric measurements and accurately record these, as well as entering and checking the data.

Anthropometry training sought to accomplish the following:

- Familiarise the enumerators with the anthropometric equipment
- Demonstrate techniques
- Give enumerators the opportunity to practice techniques under supervision
- Standardise height measurement

The training focused on three anthropometric measures:

- Weight (adult caregivers and two- to five-year-old children)
- Standing height (adult caregivers and two- to five-year-old children)
- Mid-upper arm circumference (MUAC) (two- to five-year-old children)

The training procedure included the following:

- Familiarisation with the equipment in terms of proper assembly, disassembly, operation, maintenance and storage; the equipment included the following:
  - Leicester portable stadiometers (INVICTA PLASTICS Ltd, England) for height
  - CAMRY digital scales (ISO 9001 (2008 certified by SGS) models EB9323 and EF906 and 118) for weight
  - United Nations International Children's Emergency Fund (UNICEF) colour-coded insertion tapes for MUAC
- Step-by-step demonstration of the proper technique by the trainer
- Practice of the technique by the enumerators in a relaxed atmosphere, yet under supervision, to ensure that they were at ease, to explain how to deal with unusual/practical problems (e.g. the positioning of obese participants or correction for a non-compressible hairdo) and to address measurement errors

- Standardisation, whereby each enumerator performed duplicate measurements on eight other people in a blinded, private fashion. This was documented on pre-prepared forms to provide evidence of quality control and a degree of inter-rater reliability

For ethical reasons, the field staff and enumerators were told that should a child's MUAC be below 11 cm (i.e. in the red zone of the insertion tape), they should encourage caregivers to visit their primary health care clinic with their growth monitoring (Road to Health) booklet for a full assessment. Enumerators were reminded about the principles of the research, professional conduct and their role as data collectors (i.e. they should not counsel or interpret and judge the data during collection). The care and safety of equipment was emphasised.

Training in dietary assessment sought to achieve the following:

- Supplement previous training on the tablet
- Clarify food groupings though the provision and use of graphic images
- Practise the collection of non-quantitative 24-hour diet recalls

Eight A5-sized, laminated show cards with simple drawings of examples of foods in the eight food groups in the HDDS (as contained on the digital tablet) were discussed and explained to enumerators to highlight the distinguishing features of each group. An A3-sized composite of all eight groups was available for the learning facilitator. It was suggested that these be used during the interviews.

The principles of a non-quantitative 24-hour recall according to the HDDS (Kennedy et al. 2011) were explained. Appendix A presents the glossary of terms in the local languages used for standardisation of terminology and food types.

3.8 Focus Group Discussions

Focus group discussions (FGDs) were held in each community to discuss food consumption and production practices and to explore precautionary behaviour adopted when faced with food shortages. The Lima officers at each site recruited participants for the FGDs. The FGDs were arranged by the Lima office staff in each community. Participation in the FGDs was determined by community member availability. The majority of participants were women.

Table 7 presents the FGDs and the number of participants in each focus group. The aim of the FGDs on food consumption and production was to explore food consumption patterns at each site and to get a broad overview of the food production and consumption patterns of the households in each study area. The current food consumption practices and food insecurity of the households were investigated by determining the availability and accessibility (including affordability) of food. Changes in food production were also explored, together with how these changes influenced food practices. The FGDs also included simple questions around access to farming resources, including land and water, to gain a general understanding of their experiences as subsistence farmers.

Table 7: Focus group discussions held

Local municipality	Survey site	FGDs for discussing consumption and production patterns			FGDs for discussing seasonality and food security		
		Group	Composition	Number of participants	Group	Composition	Number of participants
Ingquza Hill	KwaThahle (Flagstaff)	Hlabathi	Nine women	9	KwaThahle	Nine women and two men	11
	Mtontsana	-	-	-	Sophumelele	Eight women	8
	Mzenge	-	-	-	Mzenge Community Project	Six women	6
	Dubana	Lambase (first round)	13 women	13	Lambase	13 women	13
	Mpoza and Ludidi	Mazikhule Community Project	13 women and three men	16	Masikhule Community Project	12 women and two men	14
		Follow-up	10 women and two men	12	-	-	-
	Mdakani	-	-	-	Mdakani Chicken Project	Eight women and three men	11
Jozini	Sibongile (Makhathini area)	First round	10 women and four men	14	Makhathini Block B Irrigation Scheme	13 women and two men	15
		(Second round) Follow-	12 women	12	Maphaya Community	Eight women and two men	10

Local municipality	Survey site	FGDs for discussing consumption and production patterns			FGDs for discussing seasonality and food security		
		Group	**Composition**	**Number of participants**	**Group**	**Composition**	**Number of participants**
		up			Garden		
	KwaJobe	Community garden	13 women and three men	16	GG Focus Group	Nine women and one man	10
		Community garden	13 women	13	Cezwana (Zamini Garden)	Nine women	9
		Community garden Follow-up	Five women	5	Bonelani	Eight women	8
					Mangwenya	Seven women	7
	Mzinyeni	-	-	-	Siyaphambili Community Garden	12 women and five men	17
	Ohlalwini	-	-	-	Ohlalwini Garden	11 women	11
Maruleng	Madeira	Lefata Project Group	15 women	15	Lefata Project Group	16 women	16
	Sedawa	Community Hall	16 women and six men	22 (increased to 33 during meeting)	Enable Piggery Group	13 women and one man	14
		Community	14 women and	16			

Local municipa-lity	Survey site	FGDs for discussing consumption and production patterns			FGDs for discussing seasonality and food security		
		Group	**Composition**	**Number of partici-pants**	**Group**	**Composition**	**Number of participants**
		Hall Follow-up	two men				
	Bochabelo	Bochabelo drop-in centre	10 women and three men	13	Bochabelo drop-in centre	10 women and two men	12
Ratlou	Madibogo	Tribal Authority offices	Eight women and 15 men	23	Madibogo	Eight women and 15 men	23
		Follow-up	Nine women	9			
	Phitshane	Gamosea ECD Makgobistad	12 women and three men	15	Gamosea ECD	12 women and three men	15
		Follow-up	11 women and one man	12			

A list of topics to explore the food practices was prepared with specific questions and probes to explore each of them. These included aspects relating to the following:

- Food consumption patterns
- Food supply (food sources – cultivated, collected, hunted, bought)
- Food for small children
- Food preparation facilities
- Changes in food consumption patterns
- Special occasions
- Food shortages

The questions about access to resources probed participants' understanding of decision-making and resource allocation by local authorities. The researchers also asked the women to describe changes over time in the way food was produced and consumed, using the surrounding features, for example the dam or terraced land, as reference points. The participants were asked questions about how and why farming had changed over the years and how this had influenced the availability of and preferences for different foods. Key informant interviews were also conducted.

3.9 Validation of Findings

Four validation workshops were held between 8 and 18 February 2016. Each workshop was attended by 30 to 40 participants. The participants included the community members and farmers who participated in the earlier surveys and FGDs, community garden organisers (schools and clinics), district agricultural extension workers and rural development workers.

The aim of the workshops was to present the research results to the communities for validation and feedback. Varying levels of literacy among the participants necessitated the presentation of numerical, quantitative data in an accessible way. A graphic designer was engaged to prepare a series of posters and brochures, the latter which could remain with the participants.

The four-page brochures contained a simple introduction to the research project and a map indicating the four districts included in the study. A brochure was prepared for each site. The brochures also contained tables presenting data on household dietary diversity, including the frequency of food consumption over the previous seven days and the seasonal consumption of different food groups, the anthropometry of adult female caregivers and children, key nutrition messages and recommended irrigated and non-irrigated crops for optimal dietary diversity in summer and winter.

The data was presented orally in the local languages through interpreters. Each participant was given a brochure. After the presentation, the participants were divided into thematic groups to discuss the findings among themselves. The groups were divided into farmers or

growers, garden project workers and extension or rural development workers, or by communities, to capture different perspectives on the research findings. The discussion groups then presented their conclusions to the larger group. The following discussion questions were given to the groups:

- Is the information supplied in this brochure an accurate depiction of the situation or context in the community?
- Are there foods in the recommended list for growing and eating that the community would not grow for reasons of preference, taste and/or culture?
- Are there foods in the recommended list for growing and eating that the community would not grow for reasons related to agronomic factors? What are these factors?
- If they could tell the WRC what to prioritise for research, what would it be? (varieties, crops, practices, water-related applications)
- Have we missed anything?

The next chapters present the findings of the quantitative and qualitative research.

CHAPTER 4: DESCRIPTION OF STUDY SITES

4.1 Demography

The OR Tambo District is located in the east of the Eastern Cape on the Indian Ocean coast. Some 80% of the territory was formerly part of the Transkei homeland. The district's population is 1 358 917 and consisted of 298 229 households in 2011 (Stats SA undated[a]). Only 9% of these have piped water inside, while 70% use electricity for lighting and 11% have weekly refuse removal. Ingquza Hill Local Municipality has 278 481 people who live in rural areas under the jurisdiction of traditional authorities and in traditional dwellings (Stats SA undated a).

The uMkhanyakude District is in the north of KwaZulu-Natal and borders Swaziland and Mozambique. The population of uMkhanyakude is 638 011 people living in 128 195 households, of which only 13% have piped water inside dwellings, 38% use electricity for lighting and only 9% have a weekly refuse removal service. Among people over 20 years of age, 25% have matric and 4.9% have a higher education. Almost 90% of the population lives in rural areas under the jurisdiction of traditional authorities. Between 2001 and 2011, the population of Jozini grew from 184 206 to 186 502 and comprised 38 849 households (Stats SA undated b).

The Mopani District in the northeast of Limpopo covers a land area of 20 011 km^2 with 1 109 822 people living in 125 270 households. Between 2001 and 2011, the population of Maruleng grew from 94 384 to 94 857 and comprised 24 470 households with an average household size of 3.7, of which 96% live in formal dwellings. These are most often located in traditional or tribal settlements, which comprises 89% settlement types (Stats SA undated c).

Ngaka Modiri Molema District has a population of 852 614 with a population density of 30 persons per km^2 and 227 001 households. Only 25% of the households have piped water inside dwellings, 80% use electricity for lighting and 35% have a weekly refuse removal service. In Ratlou Local Municipality, 95% of the population lives under the jurisdiction of traditional authorities (Stats SA undated d).

Unemployment in the OR Tambo District is 44%, and in uMkhanyakude it is 43%. Ingquza Hill and Jozini fall into the socio-economic Quintile 1 and are some of the poorest districts in South Africa. Mopani and the Ngaka Modiri Molema districts fall into the socio-economic Quintile 2. Table 8 presents a summary of comparative demographics for the four sites (Stats SA undated a, b, c and d).

Table 8: Comparative demographics of the study sites

Indicator	Jozini	Ingquza Hill	Maruleng	Ratlou
Total population	186 502	278 481	94 857	10 733
Young (0 to14)	41.3%	42.4%	34.4%	38.7%
Working age (15 to 64)	54.8%	52.2%	60.3%	53.9%
Elderly (65+)	3.9%	5.4%	5.3%	7.4%
Dependency ratio	82.4%	91.6%	65.8%	85.6%
Growth rate (2001 to 2011)	0.12%	0.9%	0.05%	0.11%
Unemployment rate	44.1%	51.6%	39.9%	43.9%
Youth (under 35 years of age) unemployment rate	52.7%	60.9%	51.2%	52.4%
No schooling aged 20+	27.4%	20.8%	20.9%	28.9%
Higher education 20+	5.1%	5.3%	7%	3.1%
Matric 20+	25.2%	12.6%	18.5%	11.2%
Number of households	38 849	56 213	24 470	26 889
Number of agricultural households	21 273	35 330	9 427	11 346
Average household size	4.7	4.7	3.7	3.9
Female-headed households	53.7%	59.1%	53.7%	49.5%
Formal dwellings	76.5%	40.5%	96%	89.9%
Housing owned/paid off	38.9%	62.3%	24.7%	54.1%
Flush toilet connected to sewerage	9.6%	2.4%	8.2%	1.8%
Weekly refuse removal	11%	3.2%	5.9%	0.8%
Piped water inside dwelling	10.9%	3.7%	10.9%	5.2%
Electricity for lighting	29.1%	62.8%	90.6%	83.7%

Sources: Stats SA undated a, b, c and d.

More than 75% of households in Ingquza Hill and Jozini, 87% in Maruleng and 78% in Ratlou have cell phones. Slightly less than half of the households in Ingquza Hill, Jozini and Maruleng own radios, while 61% of households in Ratlou own these items. Less than half the population in Ingquza Hill, Jozini and Maruleng own other household goods such as television sets, refrigerators and electric stoves. More than half the households in Ratlou own these items (Stats SA undated a, b, c and d).

Just over 42% of people in Ingquza Hill, 41% in Jozini, 35% in Maruleng and 39% in Ratlou are aged 14 and under. Some 21% of the people in Ingquza Hill have no schooling, while only 13% of people over 20 have completed matric and 5% have a higher education. Similarly, 27% of the people in Jozini have no schooling, while 25% have completed matric and 3% have a higher education. In Maruleng, 21% of the population has no schooling, while only 19% have completed matric and 7% have a higher education. In Ratlou, 29% of people

over 20 have no schooling, while only 11% have completed matric and 3% have a higher education. It is suggested that those who acquire tertiary education are likely to seek work opportunities elsewhere (Stats SA 2015). There is a notable outmigration trend among young men in Ingquza Hill, which skews the population towards more women than men, and women head 59% of the households. Overall unemployment in Ingquza Hill in 2011 was 52%, while it was 44% in Jozini, 40% in Maruleng and 44% in Ratlou. Youth (younger than 35 years) unemployment in all four sites is just above 50% in Jozini, Maruleng and Ratlou and over 60% in Ingquza Hill (Stats SA undated a, b, c and d).

Slightly less than half (44%) of the households in Ingquza Hill, 59% of the households in Jozini, 65% of the households in Maruleng and 87% of the households in Ratlou are classified as agricultural, but keep animals only. In Ingquza Hill, Jozini and Maruleng, this is mainly poultry, but in Ratlou, these households may keep poultry and livestock. Mixed farming is practiced by 39% of agricultural households in Ingquza Hill, 27% in Jozini, 17% in Maruleng and 3% in Ratlou. Only 17% of households in Ingquza Hill, 12% in Jozini, 15% in Maruleng and 1% in Ratlou grow crops only. A high proportion of agricultural households (43% in Ingquza Hill, 44% in Jozini, 42% in Maruleng and 38% in Ratlou) fall in the category of having no income, while 45% of households in Ingquza Hill, 38% of households in Jozini, 46% of households in Maruleng and 53% of households in Ratlou have an income of between R4 801 and R38 400 per month (Stats SA undated a, b, c and d).

The Ingquza Hill Local Municipality (2014 considers its key challenges to be infrastructure backlogs, land ownership and land rights, high poverty and unemployment, high grant dependency and poor access to social development services.

The Jozini Local Municipality (2013) considers fish farming, cropping and agro-processing to be among its key opportunities for economic growth, with rehabilitation of the Makhathini (Mjindi – a site for one of the samples) irrigation scheme as a focal point for cropping. Some 314 individual farmers (of which 84 are women) on the scheme currently produce cotton, sugar cane and vegetables. In addition, there are eight cooperatives on the scheme, totalling 603 members (of which 572 or 95% are women). The R1.8 billion broad-based black economic empowerment (B-BBEE) Makhathini sugar cane (biofuels) project was initiated in 2012 on land held by the traditional authority. It includes the Industrial Development Corporation, Tongaat Hewlett, the Development Bank of South Africa, the Central Energy Fund and Makhathini Agricultural Development Cooperative as partners.

The Maruleng Integrated Development Plan (IDP) (Maruleng Local Municipality undated) identifies its dominant economic activity as commercial agriculture, with 41% of formal employment provided by the commercial agriculture sector. The IDP considers claims and access to markets to be the most significant challenges to agricultural development. Regarding emerging, small-scale or subsistence farming, the IDP mentions very little, other than acknowledging that commercial mango and citrus production (currently the largest of

the sector) is not accessible to these people and that organising smaller farmers into cooperatives and promoting new commercial crops such as sugar cane should be considered.

The Ratlou Local Municipality considers agriculture to be a main priority for economic development and a catalyst for fighting poverty (Ratlou Local Municipality 2010). The agricultural support plan aims to promote the production of high-value cash crops through small-scale farming and to make better use of land reform and communal land to promote commercial farming. In 2011, however, only 1 371 people were formally employed in agriculture, a number that dropped from 1 565 in 2001. Although the local economic development plan cites the national CRDP, it does not clearly translate the objectives to the municipal level and no explicit connections are made between agriculture and food security.

4.2 Brief Overview and Observations from the Sites

The fieldwork included both qualitative and quantitative assessment and provided rich insight into the daily lives of the communities included in the study. Tables 9 and 10 present the number of households surveyed through the quantitative questionnaire per site and per community.

Table 9: Number of surveyed households at each site

	Summer		Winter	
Site	**Number**	**Proportion of sample (%)**	**Number**	**Proportion of sample (%)**
Ingquza Hill	55	19.8	70	25.0
Jozini	118	42.4	84	30.0
Maruleng	36	12.9	60	21.4
Ratlou	69	24.8	66	23.6
Total	278	100.0	280	100.0

Table 10: number of households surveyed per community

Site	Location	Summer		Winter	
		Number	Proportion of sample (%)	Number	Proportion of sample (%)
Ingquza Hill	Dubana	21	7.6	29	10.4
	KwaThahle	34	12.2	41	14.6
Jozini	Irrigation Scheme	72	25.9	40	14.3
	KwaJobe	46	16.5	44	15.7
Maruleng	Bochabelo	11	4.0	30	10.7
	Sadawa	25	9.0	30	10.7
Ratlou	Madibogo	47	16.9	49	17.5
	Phitshane	22	7.9	17	6.1
Total		278	100.0	280	100.0

The sections below provide an overview of observations from each site from the qualitative component of the study.

4.2.1 Ingquza Hill

One of the striking features of the landscape of the Ingquza Hill sites were the vast tracts of rain-fed, terraced farmland that were formerly planted with maize and other staples, but are now in disuse. Currently, subsistence farmers work on small, fenced home gardens, producing vegetables and keeping a few items of small livestock. A few households still use traditional ox-drawn ploughs and sledges, but these are rare and are only used by a few enthusiastic and dedicated older people who work without much support. For the most part, the terraced land lies fallow and has been this way for several decades.

The researchers asked participants in the focus groups and key informant interviews to explain why the terraces were no longer being used. They replied that terrace farming was initially practised because of the steep slopes in the area, but began to disappear 30 years ago, along with the implements and particular type of oxen used to plough. These are some of the explanations offered:

- The soil is not very fertile and the land needs to lie fallow too often.
- There is no longer enough rain.
- There are no longer fences (these apparently used to be provided by the traditional leaders) and the livestock eats the crops.
- Children have to attend school so there is no one to tend the cattle.
- When more men worked in the mines, there was money to buy fencing, oxen and other inputs.
- People are leaving to work in the cities and do not want to farm anymore.

- People are lazy and do not want to farm; they would rather stay at home and collect social grants (especially the young people).

The system of communal land tenure has not changed in this period and land shortages were not mentioned as a constraint to farming. What seems to have changed, however, is the availability of food. The focus group participants claimed that food was much more abundant a generation ago, including a wide variety of traditional foods (described in detail in the food consumption findings). One participant explained: "There was so much milk, we used to feed *amasi* (sour milk) to the dogs."

4.2.2 Jozini

Most of the surveyed households that were engaged in larger-scale crop production were in Jozini. No households from Ingquza Hill and Ratlou were engaged in larger-scale farming (more than half a hectare). The focus group participants indicated that large-scale and extensive grazing was prevalent in the past (before 1990). Grazing had declined, as had the general wealth of the community. Although the focus group participants took care to explain that this wealth was not necessarily in terms of money, rather people had their own cattle and fields to farm and produced things that now need to be purchased, such as milk.

FGDs revealed that the context of food production and food security in the district of uMkhanyakude has changed over time. There is hunger in the community, "...the conditions are not like in the old days when there was a good harvest. These days, there is no rain and [*people*] don't produce much." The period between 1984 and 1990 was referred to as a productive agricultural time. There used to be sufficient rain, but not anymore. The drought, according to the women, brought other changes besides diminished grazing to the landscape. There used to be more forested areas and a wider variety of trees in the past.

When there was enough rain, the women reported using hand hoes to plant, but now they rely on tractors, because the land is 'hard'. Previously, rainfall fell earlier in the year and they used to plant in July and it would rain in August, but now, by the time the rain comes, the seeds have died.

While the drought seems to have put an end to rain-fed home gardening, irrigation now enables year-round production in cooperative gardens for those who can participate. Those who do not have access to irrigation, according to the FGDs, are the ones in the community who go hungry. Besides, the establishment of gardening cooperatives and irrigation has brought other changes to the community. One group referred to a particular irrigated farming project, which was a source of employment at one point, but had apparently failed and many people lost their jobs.

Across three FGDs, there was ambiguity relating to knowledge about access to water for farming and how irrigation scheme decisions were made. The participants reported that

anyone with irrigation equipment could draw water from the river. Mjindi Farming makes the decisions about water scheme management, as it manages the scheme in Makatini.

Water is available to the community members, “but you have to get it from the river to your land.” Water decision-making is clearly a critical issue in the community. The Water Users Association is a participatory platform and includes a wide range of stakeholders that, in principle, should include subsistence, small-scale and commercial farmers, household users, tourism and recreational users, industry, the municipality and tribal authorities. According to one key informant in Jozini, the power dynamics are problematic.

Access to land, according to the focus groups, is not perceived as a pressing issue in the community, although land with access to water is. Being close to the river has obvious advantages. Sugar cane and maize farmers tend to occupy the prime land along the river. FGD participants and informants repeatedly emphasised access to water as the real obstacle to production. This is what enables the cooperatives to produce food for their own consumption and for the local market to earn an income from farming.

Although land was not raised as a point of conflict or tension among the focus groups, there was ambiguity about the processes by which land changes hands within communal ownership, and what the criteria are for land that is considered ‘in use’. One must be a member of the community to be granted permission by the *induna* (tribal councillor) to use it for a specific purpose.

4.2.3 Maruleng

Maruleng is a district where agriculture appears to play a very central role in livelihoods, perhaps more so than in the other study sites, and there seems to be more diverse and vibrant involvement in household, subsistence and smallholder production, as well as a greater variety of crops and more involved local management and innovation.

Overall, Maruleng producers seem to farm on larger plots and produce more staples than the Eastern Cape and KwaZulu-Natal groups. Some households were farming maize on plots of up to six hectares. They reportedly produced enough maize to feed their families for the entire year without the need to purchase maize. Their main constraints seem to be fertilizer and mechanised tillage (the use of tractors), which are both considered too expensive. Water is also considered an important issue, with inadequate local infrastructure as the main constraint.

The Mopani District has a number of small, community-managed irrigation schemes fed by mountain springs. One of these is in Maruleng near the Madeira community. Built in the late 1960s, it is maintained entirely with community labour and resources with reportedly no government support. Its further reaches are in disrepair, but the main network of canals, sluices and dams seems to be functioning. Small plots of less than one hectare of fruit and vegetables are grown on this scheme. The scheme manager is tasked with opening and

closing the sluices in accordance with decisions taken by a local committee. The water source in the mountains is a sacred site that is occasionally used by church groups and during initiations. It was said to be inhabited by water spirits – a belief that is commonly held in traditional rural communities in this area.

There are other organised groups of farmers interested in and practicing agro-ecology and sustainable farming methods, for example, the Mopani Farmers' Union, members of which have been involved with sustainable farming activists, including the global peasant organisation La Via Campesina. One example was a female farmer who used agro-ecological methods to produce food (traditional maize, pumpkins, sweet potatoes and other vegetables, along with medicinal crops such as moringa and wild ginger). She raises small livestock (free-range local chickens) and keeps a few head of cattle. Using composting, manure from chickens and cattle, and mulching, this farmer produces sufficient food for herself and her neighbours, with additional produce to sell, as well as medicinal crops that can be sold to buyers from outside the province, meeting a growing demand for moringa powder as a natural nutritional supplement. She saves and trades seeds with other farmers and networks with local and international small farmers and food activists. She experiments with seeds, composting and mulching, and is a rich source of knowledge of traditional farming methods and indigenous plants. She works without irrigation and credits her productivity to good soil management, which she contrasts with the input-reliant practices of her seed- and fertilizer-purchasing neighbours. She points out that they are all in debt because inputs just get more expensive each year.

One small-scale farmer complained about the high water demand and low yields over time from a conventional maize crop grown on a one-hectare plot from seed purchased at the co-op, using chemical fertilizers, pesticides and herbicides. He complained of being in debt to the co-ops for much of the year. This suggests perhaps unsuccessful attempts at 'scaled-down' commercial farming on plots too small and with inadequate irrigation to grow maize as it is grown commercially.

4.2.4 Ratlou

The Phitshane and Madibogo communities in the Ratlou District Municipality, although 80 km apart, share the same typical arid bushveld-savannah type landscape. With the exception of a few large farms, limited crop production was observed. In the FGDs, participants confirmed that, nowadays, only a few people engage in limited crop production activities. This is also shown in Table 11, with only 6% of the households doing home gardening. Previously, many households followed the Tswana tradition of cultivating crops for household use at the *masimo* (traditional cultivation fields usually outside a Tswana village). Some of the older focus group participants in Madibogo remembered that maize was grown on large maize farms in the area during the time when Madibogo was part of the Bophuthatswana homeland. In recent years, the scale of maize production in this area has decreased on many of these farms to such an extent that the grain silos near the railway

station in Madibogo are no longer in use. The low maize and other crop production activities were attributed to the low rainfall in recent years and the scarcity of water as nearby rivers had dried up and only a few households had access to boreholes. They also emphasised that because of limited access to other resources for crop production such as pesticides, fertilizers and equipment, they were not in a position to produce enough food, if any, for household consumption.

Many households in Phitshane did not have access to piped water in their homes and the communal taps in large sections of the village were often without water. Water for household consumption is then transported in 25-litre containers by donkey carts, wheelbarrows or tractors, or is carried by hand from other communal taps or tanks to the households in the sections without water. Although many households in Madibogo have access to piped water, the water supply was usually insufficient to supply home gardens. In both communities, indigenous plants are collected from the wild in summer after the first rains. Although the participants in the focus groups revealed that many indigenous plant species are becoming scarce or even unavailable, this was attributed to climate change, low rainfall and the use of fertilizers.

The majority of households in Ratlou have thus become very dependent on the retail sector for the food supplies they purchase from big supermarkets in Mafikeng, Delareyville or Vryburg on a monthly basis. This is supplemented by perishable foods purchased from the local stores and spaza shops when required and if they have money available.

CHAPTER 5: CURRENT RAIN-FED AND IRRIGATED PRODUCTION

The number of households engaged in crop production is presented in Table 11. Close to nine in ten surveyed households in Ingquza Hill and Jozini were engaged in crop production (90%). More than eight out of ten (82%) of the surveyed households in Maruleng were engaged in cropping. Very few households (four) surveyed in Ratlou were engaged in home gardening. All community gardens were irrigated, while 78% of farmland and 75% of school gardens were irrigated. Just less than half (47%) of home gardens were irrigated. Irrigation was taken to mean any application of supplemental irrigation – from overhead sprinklers using pumps, flood irrigation on irrigation schemes, and municipal water from taps or rain tanks (seen at many Ingquza Hill homesteads), to using a hose pipe or watering can with water drawn from rivers, tributaries, springs, wells, boreholes and tanks (Table 11).

The highest proportion of household gardens was found at Ingquza Hill (92% of the sample in this area). In Maruleng, 78% of gardens were home gardens. Very few households were engaged in the production of school gardens – only two in Ingquza Hill and two in Jozini (see Table 11). One household in Ingquza Hill was involved in a community garden. Half of the home gardens in Ingquza Hill were irrigated. Some 19 households in Jozini were involved in community gardens, which drew water for irrigation from the Mjindi Irrigation Scheme at Makhathini. Larger plots (typically over a hectare) were farmed in Jozini (on the irrigation scheme) and mostly under rain-fed conditions in Maruleng.

Participants in the focus groups indicated that large-scale and extensive grazing were prevalent in the past (before 1990). Grazing had declined, as had the general wealth of the community. The focus group participants took care to explain that this wealth was not necessarily in terms of money, but people had their own cattle and fields to farm. Participants explained that, in the past, livestock provided milk to make *amasi* that was fed to children, in particular, but now they buy their *amasi*.

Table 11: Households involved in crop production and irrigation

Scale of production		Whole sample		Ingquza Hill		Jozini		Maruleng		Ratlou	
		Involved in cropping	If cropping, irrigating crops	Involved in cropping	If cropping, irrigating crops	Involved in cropping	If cropping, irrigating crops	Involved in cropping	If cropping, irrigating crops	Involved in cropping	If cropping, irrigating crops
Engaged in crop production	Sample size	349	228	68	53	141	122	67	49	65	4
	Yes	242	150	61	26	126	113	51	9	4	2
	Proportion (%)	71.2	65.8	89.7	49.1	89.4	92.6	82.1	18.4	6.2	50.0
Farmland	Sample size	242	73	-	-	126	62	50	11	-	-
	Yes	75	57	-	-	64	54	10	3	-	-
	Proportion (%)	31.1	78.1	-	-	50.8	87.1	20.0	27.3	-	-
Home gardens	Sample size	242	112	61	50	126	19	51	39	4	4
	Yes	120	53	56	25	20	18	40	8	4	2
	Proportion (%)	49.6	47.3	91.8	50.0	15.9	94.7	78.4	20.5	100	50.0
School gardens	Sample size	242	4	61	2	126	2	-	-	-	-
	Yes	4	3	2	1	2	2	-	-	-	-
	Proportion (%)	1.7	75	3.3	50.0	1.6	100	-	-	-	-
Communal gardens	Sample size	242	18	61	-	126	18	-	-	-	-
	Yes	20	18	1	-	19	-	-	-	-	-
	Proportion (%)	8.3	100	1.6	-	15.1	100	-	-	-	-

Maize was reportedly produced at two school gardens in Ingquza Hill. Beans, carrots, maize, onions, potatoes, pumpkin, Swiss chard[1] and sugar beans were produced in home gardens in Ingquza Hill. Far more varieties of crops were produced in Jozini and Maruleng than at the other two sites.

A very high proportion of households in Jozini irrigated their crops. This was primarily due to the availability of abundant water from the dam and a relatively high rainfall compared to the other sites. Yet still, households in Jozini complained of a lack of accessible water. The burden of accessing water in Ingquza Hill and Jozini was a major constraint to crop production. Focus group respondents in Jozini indicated that the irrigation scheme allowed for extended planting times for those participating in the scheme, with reduced water available for non-members.

Production in Maruleng was predominantly rain fed. Some 10% of home gardens in Ingquza Hill were watered with buckets from water tanks (rain harvested). While in Jozini, community and home gardens were typically irrigated with buckets of water drawn from the dam, its tributaries and rivers. Water for the community and school gardens in Jozini was sourced from the irrigation scheme. Very few households mentioned using treadle pumps, sprinklers and municipal water. Canal and flood irrigation was used in the irrigation scheme, although respondents in the FGDs indicated that there were problems with the management and allocation of water – particularly conflicting interests between commercial producers of cotton and maize who tended to dominate the management of the irrigation scheme.

Behind the Madeira community in Maruleng, partway up the mountain, was a small, community-managed irrigation scheme fed by mountain springs. Built in the late 1960s, it was maintained entirely through community labour and resources with no government support. Its further reaches are in disrepair, but the main network of canals, sluices and dams seems to be functioning quite well. Small plots of less than one hectare of fruit and vegetables are grown on this scheme. The scheme has a manager who is in charge of opening and closing the sluices in accordance with decisions by a committee.
The focus group participants from the Madeira scheme represented a large and well-organised collective, which also operates a crèche, a broiler house and a bakery, in addition to growing vegetables for their own consumption and sale. According to this group, their main production constraint was the lack of pumps that could expand the reach of the irrigation scheme. Now water is carefully rationed (switched on and off by an appointed committee) and does not reach households and plots on the farther reaches of the community.

Water decision-making is clearly a critical issue in the Jozini community. With a participatory management structure in place in the form of the Water Users' Association and a wide range of stakeholders that should, in principle, include subsistence, small-scale and commercial farmers, household users, tourism and recreational users, industry, as well as the

[1] Please note that Swiss chard is commonly called spinach in South Africa, although this is technically incorrect. Where communities report consuming and wanting to grow spinach, they are referring to Swiss chard.

municipality and tribal authorities, the dynamics are likely to be complex. Current decision-making around water does not prioritise nutrition and food security over commercial needs.

There also seem to be differences between communities in the Mopani District with regard to the extent to which they collaborate, for example, working collectively in growing food and sharing and exchanging food. The 'informally' irrigated group (further away than the others from the 'urban' centre) exhibited a greater knowledge of wild indigenous plants and other wild food sources, extensive knowledge of traditional foods not bought in shops, and a tendency towards more collective work, such as community gardening and a grocery 'stokvel.' In this community, it was also suggested that more young people are in fact interested in farming, depending on what their families exposed them to.

The four households with home gardens in Ratlou grew beans, cabbage, green maize and tomatoes. The crops produced in the community, school and home gardens, and on larger plots of farmland, are presented by site in tables 12, 13 and 14.

It should be noted that the maize typically grown by the households surveyed was either consumed as a green vegetable (referred to here as green mealies) or left to dry on the cob for use in traditional dishes for feasts, festivals and traditional ceremonies. The latter is usually ground on a millstone or at communal granaries. Where the term maize is used in this report, it is used to refer to either green mealies or dried maize. The survey did not record production of these two crops separately, but the FGDs indicated that most maize produced in school, home and community gardens is consumed as green mealies. Dried beans refer to red speckled beans that are left in the field to dry on the plant and then harvested.

Table 12: Crops produced in Ingquza Hill

School gardens	Home gardens
Maize	Beans Carrots Maize Onions Potatoes Pumpkin Swiss chard Sugar beans

Focus group participants in all communities reported climate change, which is explained as rainfall arriving earlier or later in the season and general difficulty with predicting weather conditions. They reported that the rain had come so late in some years that the seeds did not germinate. The lack of predictable weather patterns and the late onset of rain is a deterrent to home gardening, but irrigation enables year-round production in cooperative gardens for those who can participate. According to the FGDs, those who do not have access to irrigation are the ones in the community who go hungry.

Table 13: Crops produced in Jozini

Community gardens	School gardens	Home gardens	Farmland	
Beetroot	Beans	Bananas	*Amadumbe*	Mango
Amadumbe	Cabbage	Beans	Bananas	Mealies
Bananas		Beetroot	Beans	Naartjies
Cabbage		Cabbage	Beetroot	Onions
Carrots		Calabash	Butternut	Oranges
Green peppers		Dried beans	Cabbage	Potatoes
Maize		Garlic	Calabash	Swiss chard
Onions		Green peppers	Carrots	Sugar beans
Potatoes		*Imifino*	Cassava	Sugarcane
Swiss chard		Lettuce	Green peppers	Sweet chillies
Sugarcane		Maize	*Imifino*	Sweet potatoes
Tomatoes		Onions	Lemons	Tomatoes
		Potatoes	Lettuce	
		Swiss chard	Maize	
		Sweet potatoes		
		Tomatoes		

Table 14: Crops grown in Maruleng

Home gardens		Farmland
Bambara/njugo bean (*ditloo marapo*)	Mealies (green maize)	Beans
Bananas	*Morogo*	Dry beans
Beans	Morula tree	*Leotša*
Cabbage	Papaya/pawpaw	Maize
Cowpeas (*dinawa*) and leaves	Pumpkin	*Monula*
(*mokopu*)	Sorghum	*Morogo*
Dry beans	Swiss chard	Swiss chard
Green beans	Sugar beans	
Maize	Tomatoes	
Mango	Watermelon	
Morôtsê (*makataan or citrullus lanatus*)		
Millet		

Tables 15 to 21 illustrate the seasonality of production at each of the seven EAUs and the irrigation scheme in Jozini, as agreed in the FGDs through an exercise using seasonal mapping. Quite distinct patterns of production and availability of production are evident from these tables. The diversity (or lack of it) of produce is also evident. The stark contrast between the scarcity of available produce from production in a drier area in Jozini (Hlakaniphani) and Ratlou demonstrates the necessity of water availability to improve the year-round production of vegetables. Reliance on rain-fed production constrains which crops can be planted (those that do not require lots of water and regular watering) and is a serious constraint to production in the drier months. An important consideration that surfaced in the

FGDs was the physical drudgery of collecting water from water sources (if available). Households interviewed in the Jozini and Ingquza Hill sites raised this as an important constraint to production. In Ingquza Hill, some households paid community entrepreneurs to fetch water for their household and production uses with pick-up trucks.

Table 15: The seasonality of production in Ingquza Hill (from FGDs)

	Months of the year											
Crops	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Amadumbe												
Beetroot												
Cabbage												
Carrots												
Green peppers												
Lettuce												
Maize												
Potatoes												
Sweet potatoes												
Swiss chard												
Tomatoes												

	Planting
	Harvesting

Table 16: The seasonality of production in Jozini (Mangwenya FGDs)

	Months of the year											
Crops	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Beetroot												
Butternut												
Cabbage												
Carrots												
Dry beans												
Green peppers												
Lettuce												
Maize												
Onions												
Potatoes												
Swiss chard												
Tomatoes												

	Planting
	Harvesting

Table 17: The seasonality of production in Jozini (Hlakaniphani FGDs)

	Months of the year											
Crops	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Amadumbe												
Beetroot												
Dry beans												
Green peppers												
Lettuce												
Maize												
Onions												
Swiss chard												

	Planting
	Harvesting

Table 18: The seasonality of production in Maruleng (Madeira FGDs)

Crops	Months of the year											
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Beetroot												
Brinjal												
Butternut												
Cabbage												
Calabash												
Carrots												
Cucumbers												
Dry beans												
Green peppers												
Ground nuts												
Maize												
Onions												
Peanuts												
Potatoes												
Pumpkin												
Sweet corn												
Sweet potatoes												
Swiss chard												
Tomatoes												

	Planting
	Harvesting

Table 19: The seasonality of production in Maruleng (Bochabelo FGDs)

	Months of the year											
Crops	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Beetroot												
Brinjal												
Cabbage												
Carrots												
Dry beans												
Green peppers												
Maize												
Onions												
Peanuts												
Pumpkin												
Sweet potatoes												
Swiss chard												
Tomatoes												
Water melon												

	Planting
	Harvesting

Table 20: The seasonality of production in Ratlou (Phitshane FGDs)

	Months of the year											
Crops	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Dry beans												
Maize												
Peanuts												
Pumpkin												
Sorghum												
Water melon												

Table 21: The seasonality of production in Ratlou (Madibogo FGDs)

	Months of the year											
Crops	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
Swiss chard												
Maize												
Pumpkin												
Dry beans												
Onions												

	Planting
	Harvesting

Some 60% of households that engaged in farmland crop production in Ingquza Hill and Jozini had sold produce in the year prior to the survey. Just over half (54%) of the households that engaged in larger-scale crop production in Maruleng had sold produce in the same period. Almost half of the households that engaged in community garden production in Jozini had sold produce. Four to five times as many households engaged in home crop production in Jozini (45%) had sold produce in the previous year.

Households were asked what they would like to produce and what they do not currently produce. Table 22 presents a list of the responses. The list shows considerable interest in producing a wider variety of crops.

Respondents were asked whether they had experienced crop failure and why. The reasons given varied, but could mostly be divided into three general categories:

- Inadequate water, rainfall or availability of water for irrigation
- Pests, diseases and crop damage
- Soil conditions or a lack of fertilizer

Where water access was the main constraint to production, the respondents cited drought, low rainfall and scarcity of water for irrigation, irrigation in disrepair or simply no water as reasons.

Domestic livestock, such as goats, pigs, cattle, donkeys and chickens, caused crop damage by eating the seeds and plants because gardens and fields were not fenced. More often, respondents mentioned ants and other insects, plant diseases or rats and monkeys eating the crops as reasons for failure.

Where the soil condition was the reason for failure, the respondents explained that there was a shortage of manure or fertilizer, or the soil “had no nutrients”. Three respondents claimed that ‘certified seeds’ were the reason for crop failure. Others claimed that there was too much water and poor drainage, while several others could not explain why their crops had failed.

Table 22: What households would like to produce and are not currently producing

	Jozini				Ingquza Hill				Mopani				Ratlou			
Garden type	**Home**	**Community**	**School**	**Farmland**	**Home**	**Community**	**School**	**Farmland**	**Home**	**Community**	**School**	**Farmland**	**Home**	**Community**	**School**	**Farmland**
Amadumbe	X															
Apples	X		x													
Avocados	X	x							x			x				
Bananas		x							x			x				
Beans	X	x	x						x				x			
Beetroot	X	x	x			x			x				x			
Brinjal	X															
Butternut		x	x			x			x							
Cabbage	X	x	x						x			x				
Calabash	X															
Carrots	X	x	x						x			x	x			
Dried beans		x														
Green peppers	X	x	x													
Guava												x				
Imifino/ Morogo	X															
Lettuce	X		x						x							
Maize	X	x							x				x			
Mangoes	X	x														
Naartjie			x													
Onions	X	x	x						x							
Oranges	X	x	x													
Papaya												x				
Peaches			x													
Peas			x													
Potatoes	X	x				x							x			
Pumpkin												x				
Rice																
Spinach	X	x	x						x				x			
Sugarcane	X	x							x							
Sunflower			x													
Tomatoes	X	x	x						x				x			

CHAPTER 6: CURRENT CONSUMPTION PATTERNS

6.1 Food Procurement

Most food was purchased. However, white roots and tubers, orange-fleshed vegetables, dark green leafy vegetables, orange-coloured and other fruit were sourced from gardens by 20%, 29%, 45%, 25.6%, 34% and 24% of respondents respectively in summer. A lower proportion of food was sourced from gardens in winter (see Table 23). Except for green leafy vegetables, almost half of the households sourced white roots and tubers, orange-fleshed vegetables, dark green leafy vegetables and orange-coloured fruit from their gardens in winter as opposed to summer. Dark green leafy vegetables were the exception, with 33% of households sourcing these foods from their gardens in winter (a 26% reduction).

Receiving food from in-kind payments, donations, food banks, school feeding programmes, social events such as funerals and as gifts from others (such as neighbours) was common, but not dominant at the investigated sites. Households reported that they called upon their neighbours in times of stress. They reported that school feeding programmes and ECD centres were important sources of meals for children.

6.2 Frequency of Consumption

The number of meals consumed per day by adults and children is presented in tables 24 and 25 respectively. The survey data showed that adults generally ate three meals a day (see Table 24). On average, children ate four meals a day. The average number of meals per day seemed higher for children in crop-producing households than for children in non-crop-producing households (see Table 25). Detailed information was obtained on the meal patterns and composition during the FGDs at each site. The details of these discussions are presented in the next chapter, complementing the quantitative analysis.

Table 23: Food procurement source

Source of food	Season	Cereals		White roots and tubers		Orange-fleshed vegetables		Dark green leafy vegetables		Other vegetables		Orange-coloured fruit		Other fruit	
		Number	Proportion (%)	Number	Proportion (%)	Number	Proportion (%)	Number	Proportion (%)	Number	Proportion (%)	Number	Proportion (%)	Number	Proportion (%)
Sample size	Summer	119		112		110		115		116		121		113	
	Winter	220		221		206		222		223		206		213	
Bought	Summer	112	94.1	89	79.5	75	68.2	56	28.7	82	70.7	81	72.7	82	72.6
	Winter	218	99.1	192	86.9	163	79.1	130	58.6	189	84.8	161	78.2	189	88.7
In kind/ donated*	Summer	-	-	1	0.8	4	1.8	5	4.1	3	2.5	3	2.7	4	3.5
	Winter	1	0.4	4	1.8	7	3.4	18	8.1	5	2.2	3	1.5	6	2.5
Produced (e.g. from own garden)	Summer	7	5.9	22	19.6	32	29.1	54	44.6	31	25.6	25	22.7	27	23.9
	Winter	1	0.4	19	8.6	32	15.5	73	32.9	29	13.0	21	10.2	19	8.9
Not applicable (food not eaten)	Summer	-	-	-	-	1	0.8	-	-	-	-	1	0.8	-	-
	Winter	-	-	6	2.7	4	1.9	1	0.4	-	-	21	10.2	-	-

* Food received from in-kind payments, donations, food banks, school feeding programmes, social events such as funerals and as gifts from others (such as neighbours)

Table 24: Number of meals eaten by adults per day

Sample	Sample size	Minimum	Maximum	Mean	Standard deviation
Total sample	342	1	6	2.65	0.662
Ingquza Hill	68	1	4	2.68	0.531
Jozini	143	1	5	2.54	0.690
Maruleng	67	2	4	2.72	0.517
Ratlou	64	1	6	2.81	0.814
Crop-producing households	241	1	5	2.65	0.608
Non-crop-producing households	95	1	6	2.66	0.794
Irrigating households	150	1	5	2.63	0.628

Table 25: Number of meals eaten by children per day

Sample	Sample size	Minimum	Maximum	Mean	Standard deviation
Total sample	340	1	7	3.78	1.047
Ingquza Hill	68	2	6	3.97	0.992
Jozini	141	1	6	3.60	1.014
Maruleng	67	2	5	3.54	0.098
Ratlou	64	1	7	4.27	1.212
Crop-producing households	240	1	6	3.74	0.982
Non-crop-producing households	94	1	7	3.91	1.197
Irrigating households	148	1	6	3.72	1.022

6.3 Experience of Hunger

Although self-reported experiences of hunger have their limitations, the responses to questions of whether household members had experienced hunger during the year prior to the survey revealed that close to half of all the households had experienced hunger in the last year, having to compromise food consumption and diet quality to make ends meet (see Table 26). The highest proportion of reported hunger (65%) was for January when children returned to school, when school fees had to be paid and uniforms had to be bought (see Figure 4). This period also follows the ‘festive season’.

Table 26: Months of adequate food access

Months	Number (n = 328)	Proportion of households (%)
January	114	34.8
February	162	49.4
March	177	54.0
April	184	56.1
May	187	57.0
June	177	54.0
July	182	55.5
August	190	57.9
September	185	56.4
October	174	53.0
November	186	56.7
December	187	57.0

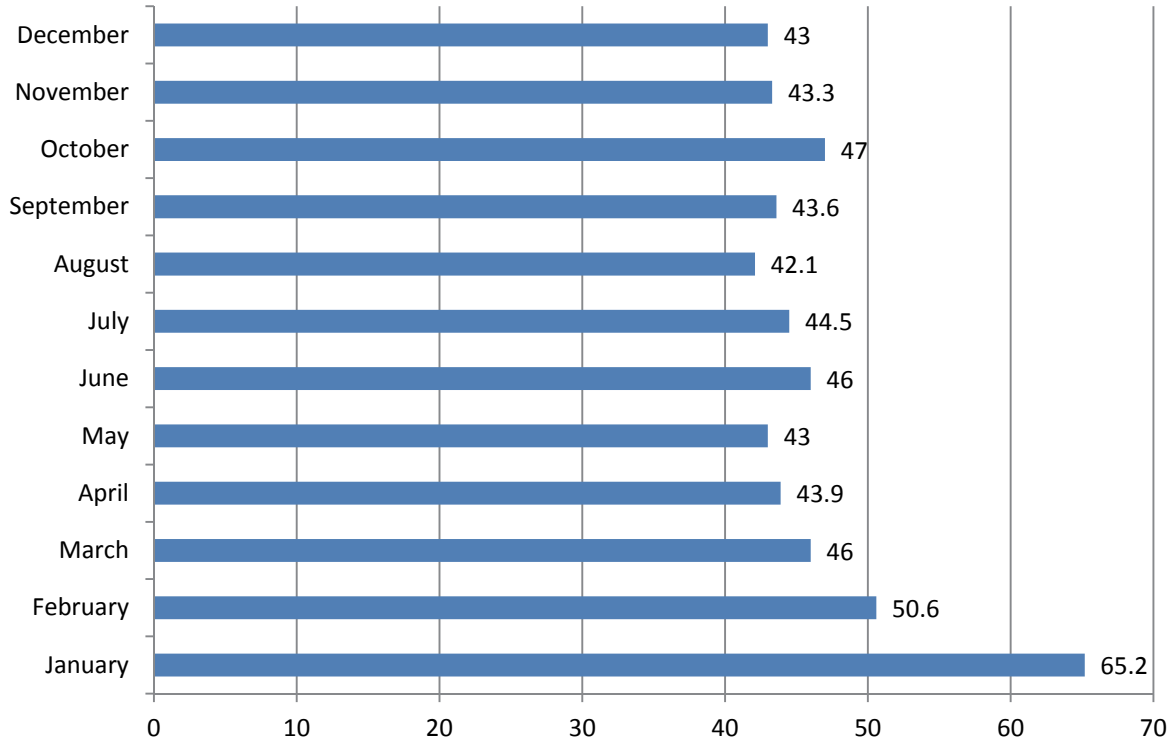

Figure 4: Proportion of households experiencing hunger

6.4 Food Consumption Patterns and Dietary Diversity

Tables 27 to 29 present the findings of the analyses of questions regarding the frequency of consumption of foods from the food groups over the week prior to the survey and the non-quantitative 24-hour recall survey data for summer and winter. The findings are discussed in the following section, which is complemented by insight gained from the FGDs and discussions with community members at the survey sites.

To explore the impact of crop production on the overall quality of diet, Spearman's correlations were carried out. Differences in consumption are evident over summer and winter in terms of the foods consumed, frequency of consumption and the HDDS (see Table 30). This score is the sum of the number of food groups consumed as 14 food groups (excluding sweets, sugar and spices, and condiments).

Table 27: Number of food groups consumed in the previous 24 hours

Sample	Season	Sample size	One to four food groups	Five to seven food groups	Eight or more food groups
Total sample	Summer	262	40.1	27.8	32.1
	Winter	271	40.2	39.9	19.9
Non-cropping	Summer	101	49.5	30.7	19.8
	Winter	81	51.9	40.7	7.4
Cropping	Summer	159	34.6	25.8	39.6
	Winter	187	34.8	39.5	25.7
Irrigating	Summer	95	20.2	25.1	54.7
	Winter	105	23.8	34.3	41.9
Ingquza Hill	Summer	55	58.2	30.9	10.9
	Winter	69	40.6	52.2	7.2
Jozini	Summer	116	13.8	19	67.2
	Winter	82	28.0	29.3	42.7
Maruleng	Summer	36	75.0	25.0	0.0
	Winter	56	44.6	50.0	5.4
Ratlou	Summer	55	54.5	45.5	0.0
	Winter	64	51.6	40.6	7.8

Table 28: Frequency of consumption of food groups in the previous seven days

Food group	Season	Sample size	Minimum	Maximum	Mean	Standard error	Standard deviation
Cereals	Summer	257	0	7	5.37	0.13	2.027
	Winter	266	1	7	6.32	0.08	1.294
White roots and tubers	Summer	204	0	7	2.14	0.13	1.833
	Winter	261	0	7	2.32	0.11	1.757
Orange-fleshed vegetables	Summer	151	0	7	1.34	0.15	1.785
	Winter	249	0	7	1.62	0.10	1.615
Dark green leafy vegetables	Summer	184	0	7	2.39	0.14	1.864
	Winter	266	0	7	2.05	0.09	1.542
Other vegetables	Summer	218	0	7	4.61	0.15	2.183
	Winter	272	0	7	4.67	0.13	2.167
Orange-coloured vegetables	Summer	151	0	6	1.03	0.13	1.579
	Winter	234	0	7	1.01	0.10	1.479
Other fruit	Summer	172	0	7	1.96	0.16	2.056
	Winter	250	0	7	2.08	0.13	1.977
Organ meat	Summer	148	0	7	1.12	0.12	1.493
	Winter	242	0	7	1.26	0.10	1.486
Meat	Summer	190	0	7	2.27	0.14	1.905
	Winter	271	0	7	2.44	0.11	1.828
Eggs	Summer	159	0	7	1.59	0.16	2.032
	Winter	248	0	7	1.76	0.12	1.901
Fish and sea food	Summer	163	0	7	1.63	0.12	1.540
	Winter	256	0	7	1.60	0.08	1.319
Dried foods	Summer	161	0	7	1.92	0.16	2.009
	Winter	260	0	7	1.62	0.09	1.405
Milk	Summer	190	0	7	2.79	0.18	2.444
	Winter	257	0	7	3.73	0.16	2.536
Sweets and sugars	Summer	184	0	7	4.22	0.19	2.563
	Winter	256	0	7	5.68	0.12	1.895
Oils and fats	Summer	255	0	7	5.53	0.12	1.869
	Winter	275	0	7	5.95	0.09	1.504

Table 29: Food group consumption comparison among sites from the 24-hour recall

Food group	Season	Total sample		Ingquza Hill		Jozini		Maruleng		Ratlou	
		Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion
Sample size	Summer	264		55		116		36		69	
	Winter	279		69		84		60		66	
Cereals	Summer	255	96.2	55	100	110	94.8	36	100	54 (of 58)	93.1
	Winter	273	97.5	69	98.6	78	92.9	60	100	66	100
White roots and tubers	Summer	125 (of 265)	47.2	24	43.6	79	68.1	2	5.6	20 (of 58)	34.5
	Winter	113	40.4	30	42.9	45	53.6	8	13.3	30	45.5
Orange-fleshed vegetables	Summer	83	31.6	12	21.8	67	56.8	1	2.8	3 (of 56)	5.4
	Winter	57	20.4	17	24.3	23	27.4	2	3.3	15	22.7
Dark green leafy vegetables	Summer	132	50.2	16	29.1	92	79.3	11	30.6	13 (of 56)	23.2
	Winter	93	33.2	10	14.5	50	59.5	18	30.0	15	22.7
Other vegetables	Summer	196	74.2	31	56.4	110	94.8	32	88.9	23 (of 57)	40.4
	Winter	180 of 274)	65.7	42	60.9	73 (of 83)	88.0	43 (of 56)	76.8	22	33.3
Orange-coloured fruit	Summer	72	27.3	3	5.5	63	54.3	1	2.8	5 (of 57)	8.8
	Winter	35 (of 277)	12.6	4	5.7	20 (of 83)	24.1	8 (of 59)	13.6	3	4.5
Other fruit	Summer	100	37.9	11	20.0	85	73.3	1	2.8	3 (of 57)	5.3
	Winter	69	24.7	17	24.3	32	38.1	13	21.7	7	10.6
Organ meat	Summer	79 (of 263)	30.0	0	0.0	70	60.3	3	8.3	6 (of 56)	10.7
	Winter	32 (of 278)	11.5	17	24.3	12	14.3	5	8.3	11	16.9
Meat	Summer	140	53.0	16	29.1	90	77.6	11	30.6	23 (of 57)	40.4
	Winter	144	51.6	4	5.7	48	57.1	31	51.7	40	60.6
Eggs	Summer	76	28.8	4	7.3	66	56.9	3	8.3	3 (of 57)	5.3
	Winter	39	13.9	6	8.6	25	29.8	5	8.3	3	4.5
Fish and seafood	Summer	98 (of 263)	37.3	4	7.3	73	62.9	14	38.9	7 (of 56)	12.5
	Winter	65	23.4	10	14.3	44	52.4	5	8.3	6	9.2
Dried beans and legumes	Summer	96	36.4	9	16.4	83	71.6	2	5.6	2 (of 57)	3.5
	Winter	79	28.2	22	31.9	47	56.0	9	15.0	1	1.5
Milk and milk products	Summer	136	51.1	16	29.1	81	69.8	5	13.9	34	59.6
	Winter	124	44.4	32	46.4	33	39.3	29	48.3	30	45.5
Oils and fats	Summer	238 (of 265)	89.9	54	98.2	109	94.0	24	66.7	51	87.9
	Winter	243	87.1	61	98.6	76	90.5	46	76.7	60	90.9

Table 30: The Household Dietary Diversity Scores from the 24-hour recall

Site	Season	Sample size	Minimum	Maximum	Mean	Standard error	Standard deviation
Total sample	Summer	159	2	14	7.4	0.327	4.122
	Winter	187	1	14	6.0	0.221	3.021
Ingquza Hill	Summer	55	2	12	4.6	0.289	2.146
	Winter	69	2	10	5.0	0.245	2.036
Jozini	Summer	116	2	14	10.2	0.378	4.070
	Winter	82	2	14	7.3	0.401	3.629
Maruleng	Summer	36	3	7	4.1	0.164	0.984
	Winter	56	2	8	4.8	0.208	1.558
Ratlou	Summer	55	1	7	4.2	0.174	1.290
	Winter	64	1	9	4.7	0.215	1.719
Non-cropping	Summer	101	1	14	6.0	0.399	4.014
	Winter	81	2	9	4.7	0.178	1.603
Cropping	Summer	159	2	14	7.4	0.327	4.122
	Winter	187	1	14	6.0	0.221	3.021
Irrigating	Summer	95	2	14	8.9	0.421	4.099
	Winter	105	2	14	7.2	0.325	3.331

The results show that the majority of households consumed foods from only four to eight food groups. Of concern is that only 32% of the households surveyed had consumed food from eight or more food groups in the previous day in summer, while 20% of the households had consumed food from these food groups in the previous day in winter (Table 27).

Table 31: Correlations for food group consumption

Food group		White roots and tubers		Orange-fleshed vegetables		Dark green leafy vegetables		Other vegetables		Orange-coloured fruit		Other fruit	
		Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Cereals	Correlation coefficient	0.147**	-.101	.092	.024	.001	-.178**	.019	-.068	.077	.061	.032	-.121*
	Significance (two-tailed)	0.016	.090	.136	.684	.990	.003	.756	.260	.213	.310	.602	.044
	Sample size	265	280	263	279	263	279	264	274	264	277	264	279
White roots and tubers	Correlation coefficient	1.000	1.000	.522**	.329**	.271**	.196**	.190**	.132*	.429**	.129*	.407**	.259**
	Significance (two-tailed)	.	.	.000	.000	.000	.001	.002	.029	.000	.031	.000	.000
	Sample size	265	280	263	279	263	279	264	274	264	277	264	279
Orange-fleshed vegetables	Correlation coefficient	0.522**	.329**	1.000	1.000	.464**	.113	.266**	.086	.721**	.317**	.648**	.328**
	Significance (two-tailed)	0.000	.000	.	.	.000	.059	.000	.154	.000	.000	.000	.000
	Sample size	263	279	263	279	263	279	263	274	263	277	263	279
Dark green leafy vegetables	Correlation coefficient	0.271**	.196**	.464**	.113	1.000	1.000	.220**	.080	.475**	.239**	.514**	.194**
	Significance (two-tailed)	0.000	.001	.000	.059	.	.	.000	.188	.000	.000	.000	.001
	Sample size	263	279	263	279	263	279	263	274	263	277	263	279
Other vegetables	Correlation coefficient	0.190**	.132*	.266**	.086	.220**	.080	1.000	1.000	.205**	.110	.317**	.278**

Food group		White roots and tubers		Orange-fleshed vegetables		Dark green leafy vegetables		Other vegetables		Orange-coloured fruit		Other fruit	
		Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
	Significance (two-tailed)	0.002	.029	.000	.154	.000	.188	.	.	.001	.070	.000	.000
	Sample size	264	274	263	274	263	274	264	274	264	273	264	274
Orange-coloured fruit	Correlation coefficient	0.429**	.129*	.721**	.317**	.475**	.239**	.205**	.110	1.000	1.000	.661**	.359**
	Significance (two-tailed)	0.000	.031	0.000	0.000	0.000	0.000	0.001	0.070	.	.	0.000	0.000
	Sample size	264	277	263	277	263	277	264	273	264	277	264	277
Other fruit	Correlation coefficient	0.407**	0.259**	0.648**	0.328**	0.514**	0.194**	0.317**	0.278**	0.661**	0.359**	1.000	1.000
	Significance (two-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	.	.
	Sample size	264	279	263	279	263	279	264	274	264	277	264	279
Organ meats	Correlation coefficient	0.411**	0.117	0.661**	0.068	0.524**	0.079	0.311**	-0.011	0.714**	0.032	0.580**	0.054
	Significance (two-tailed)	0.000	0.051	0.000	0.258	0.000	0.191	0.000	0.860	0.000	0.596	0.000	0.373
	Sample size	263	278	262	278	262	278	263	273	263	276	263	278
Meat	Correlation coefficient	0.323**	0.222**	0.510**	0.277**	0.308**	0.107	0.192**	0.176**	0.474**	0.278**	0.500**	0.372**
	Significance (two-tailed)	0.000	.000	.000	.000	.000	0.076	0.002	0.004	0.000	0.000	0.000	0.000
	Sample size	264	279	263	279	263	279	264	274	264	277	264	279

Food group		White roots and tubers		Orange-fleshed vegetables		Dark green leafy vegetables		Other vegetables		Orange-coloured fruit		Other fruit	
		Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Eggs	Correlation coefficient	0.407**	0.345**	0.668**	0.385**	0.467**	0.263**	0.279**	0.206**	0.681**	0.440**	0.607**	0.512**
	Significance (two-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sample size	264	279	263	279	263	279	264	274	264	277	264	279
Fish and seafood	Correlation coefficient	0.312**	0.222**	0.508**	0.225**	0.347**	0.293**	0.347**	0.288**	0.532**	0.290**	0.514**	0.259**
	Significance (Two-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sample size	263	278	262	278	262	278	263	273	263	276	263	278
Dry foods	Correlation coefficient	0.409**	0.118*	0.624**	0.175**	0.566**	0.231**	0.283**	0.132*	0.633**	0.269**	0.611**	0.211**
	Significance (Two-tailed)	0.000	0.048	0.000	.003	0.000	0.000	0.000	0.029	0.000	0.000	0.000	0.000
	Sample size	264	279	263	279	263	279	264	274	264	277	264	279
Milk and milk products	Correlation coefficient	0.260**	0.136*	0.481**	0.244**	0.217**	0.102	0.105	0.121*	0.475**	0.226**	0.367**	0.290**
	Significance (Two-tailed)	0.000	0.023	0.000	0.000	0.000	0.089	0.090	0.045	0.000	0.000	0.000	0.000
	Sample size	264	279	263	279	263	279	264	274	264	277	264	279
Oils and fats	Correlation coefficient	0.243**	0.228**	0.230**	0.036	0.089	0.000	0.087	0.322**	0.207**	-0.015	0.212**	0.047

Food group		White roots and tubers		Orange-fleshed vegetables		Dark green leafy vegetables		Other vegetables		Orange-coloured fruit		Other fruit	
		Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
	Significance (Two-tailed)	0.000	0.000	0.000	0.550	0.150	1.000	0.158	0.000	0.001	0.809	0.001	0.433
	Sample size	265	279	263	279	263	279	264	274	264	277	264	279
HDDS	Correlation coefficient	0.577**	0.537**	0.761**	0.465**	0.567**	0.403**	0.478**	0.530**	0.716**	0.403**	0.755**	0.592**
	Significance (Two-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Sample size	262	271	262	271	262	271	262	271	262	271	262	271

* Correlation is significant at the 0.05 level (two-tailed).

** Correlation is significant at the 0.01 level (two-tailed).

6.5 Food Consumption Patterns in Ingquza Hill

6.5.1 Meal patterns and composition

From the FGDs during the first round of data collection in October 2013, it was understood that adults generally consumed two meals on weekdays. Adults reported that they had their first meal of the day at home before they went out to attend to their fields or work at the community garden. For the majority of households, this meal consisted of black tea and bread (either homemade steamed bread or commercial brown bread). Some indicated that they ate either soft cooked porridge *(isidudu)* or leftover stiff maize meal porridge *(phaleshi*) and relish from the previous day's evening meal. During the day, when working in the fields, they drank *amahewu* (fermented maize meal beverage), although juice or tea was also taken by some. The participants from the Masikhule community focus group prepared steamed bread at a community garden site, which they ate when they were hungry during the day.

The evening meal was regarded as the main meal of the day. This consisted of either stiff *papa* or *phaleshi* (maize meal porridge), rice or samp served with either a cabbage or 'spinach' (actually Swiss chard) relish. This meal usually consists of only two dishes. Meat is scarce and, according to the participants in the focus groups, is only eaten once a month when money from social grants becomes available. This also applies to fruit (apples, oranges or bananas), which is only purchased when the household has money.

The participants from the Mdakani Project, with whom a FGD was held during the second round of data collection in August 2014, revealed that they ate three meals a day. Similarly, breakfast consisted of bread and tea. The second meal of the day (lunch) consisted of rice, *phutu* (a grainy type of maize porridge) or *papa,* eaten with soup and potatoes. Supper consisted of *papa* and meat. When available, fruit was eaten in the mid-morning. The survey results also indicated that most adults consumed either two or three meals a day in summer. In winter, the majority of adults had three meals a day. On Saturday and Sunday, the pattern seemed to be three meals a day, when a midday meal with a similar composition as the evening meal was included. On weekdays, schoolchildren were served a meal prepared at both primary and high schools during the mid-morning break. In the FGDs at Lambase, it was reported that schoolchildren take lunchboxes to school (mostly leftover food from the previous day's evening meal), but in the Masikhule area, children receive 50 cents or R1a day to spend on snacks sold by vendors at the school gate. Schoolchildren in this area ate three meals at home during the day and one meal at school.

Food preparation in the household is the responsibility of the women during weekdays. Over weekends, this task also involves the children. It was reported in the FGDs that, in most households, both boys and girls learn to cook. Although electricity is available, it is seldom used for food preparation as it is too expensive, especially for dishes that take a long time to cook, for example, samp and steamed bread. Therefore, firewood is collected and a fire is made on the floor of the cooking hut, where the household's food will be cooked and eaten.

The meals were largely starch-based. Just over half of the respondents had eaten rice for at least one meal in the previous 24 hours. Traditional food items form a substantial part of the food consumption pattern in this area. The following food items and dishes were mentioned in the FGDs and listed in the non-quantitative 24-hour recall data: *phutu, isidudu, paleshi, amahewu*, samp, steamed bread, *iscamba* (also known as 'green porridge' made from green leafy vegetables cooked and mixed with maize meal to form porridge), *nghushu* (samp and beans), and *amasi.*

All households consumed food from the cereal group in summer, with 99% reporting doing so in winter (see Table 29). The majority of households consumed foods from the oils and fats group during both summer (98%) and winter (99%).

In summer, 56% of households included other vegetables (mostly tomatoes, onions, green peppers and wild/indigenous vegetables) in their meals, while 61% did so in winter (see Table 29). Households also consumed white roots and tubers (44% in summer and 43% in winter), dark green leafy vegetables (29% in summer and 15% in winter) and orange-fleshed vegetables (22% in summer and 24% in winter). However, these were not consumed every day or in large quantities. From the FGDs, it was established that these vegetables were mainly used in the preparation of the vegetable relishes that were served with the cereal-based dishes (stiff maize meal porridge, samp and rice). According to the focus group participants, meat is not consumed daily. Meat was consumed by 29% in summer and 6% in winter, and the milk food group was consumed by 29% in summer and 46% in winter. The same applies to the fruit group, with slightly more being consumed in winter than in summer. Foods from the dried bean group were included in meals by 16% of households in summer and 32% in winter.

The results show that only three foods groups (cereals, other vegetables, oils and fats) were consumed by more than half of the households in summer, followed by roughly one in three households that included foods from the white roots and tubers, dark green vegetables, and meat and milk products groups in summer. In winter, the consumption of cereals, and oils and fats remained consistent, but the consumption of dark green leafy vegetables and meat dropped considerably. The consumption of dried legumes and milk increased in winter. The average HDDS for summer was 4.6 (standard deviation 2.14) and 5.0 (standard deviation 2.03) in winter (see Table 30).

6.5.2 Food for children in the household

From the FGDs, it was established that children under five years stay at home during the day in this area. It was explained that in households with smaller children, enough food is prepared at meal times to have food available for the children to eat when they are hungry between meals. The survey results showed that 31.5% of the smaller children in households received four or more meals a day in summer and 34.8% of these children received four or more meals a day in winter. From the age of five years, children attend crèche on weekdays

until 13:00. At the crèche, they received something to eat. This could be rice, stiff maize meal porridge with vegetables, soup or *amasi*.

6.5.3 Food supply

At the two homesteads visited at Lambase, it was observed that maize used for household consumption was stored in corrugated iron tanks. However, in the FGDs in both communities, it was reported that although some people cultivated maize, production was insufficient to provide for the needs of their households. They explained that production was hampered by a lack of fencing around fields and a lack of resources such as tractors, seeds and fertilizers for the production of enough maize. Young boys had to go to school and were therefore no longer available to tend to cattle and prevent them from destroying the crops in unfenced fields.

Vegetables such as cabbage, potatoes, sweet potatoes (white and orange-fleshed), spinach, onions, green peppers, butternut, pumpkin (*itanga*), beetroot, beans (sugar beans) and *amadumbe* were cultivated in both communities. Indigenous green leafy vegetables were allowed to grow in gardens, while some wild vegetables were cultivated. Participants at Lambase indicated that only some households cultivated vegetables in their homestead gardens. Although some crops were cultivated, most food was purchased. Households were forced to cultivate some crops, as their grant money was inadequate to buy fresh produce. However, they were not in a position to produce enough food due to the scarcity of water, and so they experienced food shortages specifically during the winter months. However, the participants indicated that they produced enough vegetables to supply their households with vegetables year-round. They were in a position to purchase vegetables from an irrigation project at a discounted price for their own households. They participated in the irrigation project to earn an income through selling their produce to others in the community and to retail outlets such as Spar and Boxer in Lusikisiki and Flagstaff.

Indigenous green leafy vegetables were observed in homestead gardens and at the irrigation project. It was explained in the FGDs that some were planted and allowed to grow there in order to have these vegetables available as a food source. It was much more convenient for them to collect these leafy vegetables from their own gardens than to go out into the wild or fields to do so. Very few households in the study (in all sites) collected wild foods (see Table 32).

Livestock such as cattle, sheep, goats, donkeys, chicken and geese were kept. The group in Mdakani also mentioned keeping horses and pigs. Only chickens and geese were occasionally used as a source of food in most households, although cattle, sheep and goats would be slaughtered when there was a special celebration by those who have livestock available. The majority of the participants in the FGDs indicated that they purchased chicken on credit from those who sell chickens.

Table 32: Households gathering wild food

Frequency	Summer		Winter	
	Number (n = 264)	Proportion (%)	Number (n = 264)	Proportion (%)
Every day (seven days per week)	2	0.76	0	0.00
Pretty often (two to six days per week)	9	3.41	8	3.03
Once in a while (one to two days per week)	21	7.95	22	8.33
Hardly at all (one day per week)	4	1.52	7	2.65
Never	228	86.36	227	85.98

The following foods were purchased on a monthly basis from stores in Lusikisiki and Flagstaff:

- Maize meal
- Samp
- Rice
- Cake flour (unfortified at the time of the survey)
- Cooking oil
- Tea
- Sugar
- Salt
- Sugar beans
- Soup
- *Amasi*
- Spices
- *Imana*
- Knorrox

6.5.4 Changes in food eaten and the preservation of traditions

Participants in the FGDs explained that the older people in this area continue to eat what their parents ate, but the younger generation do not, as they (the young people) observe what others are eating and "… they copy what others are eating". Another reason was attributed to changing food preferences. The example of *imifino* was given to explain the change in sensory preference. The elderly people still eat *imifino*, but the younger people do not like the bitter taste of *imifino*. They prefer spinach and soup (vegetable relishes prepared with processed soup mixes, flavourings and spices).

The participants in the irrigated area were also of the opinion that indigenous foods had been more readily available in the past. They now have to rely more on purchased food items that are processed. According to them, these changes were attributed to drought and lack of money. The example of the decline in their cattle herds was given. As herds were larger in the past, they were able to produce milk for their own households. Currently, this is not possible and they have to buy *amasi*. Another concern that was raised was that the younger generation was not interested in agriculture and producing crops for their own consumption. This change in attitude was attributed to young people who wanted to socialise more, due to influences from watching television and other influences from urban areas.

6.5.5 Special occasions

Weddings, initiation celebrations, funerals, tombstone unveilings, ancestral venerations, Christmas and birthdays were named as special occasions. Livestock was slaughtered to provide meat for these occasions. Households who did not have livestock such as cattle or sheep would purchase an animal to slaughter. Goats were mainly slaughtered for ancestral venerations. Large quantities of food such as rice, samp, vegetable salads (potatoes, carrots, beetroot and cabbage) and baked beans are prepared. Traditional beer is brewed from purchased sorghum. Some participants also mentioned the use of alcoholic beverages such as beer, brandy and vodka.

It was explained in the FGDs that households would plan and budget for celebrations such as weddings, initiations, birthdays and unveilings. Food and money would be set aside months in advance of the planned celebration. Some participants belonged to a 'stokvel' or similar saving scheme, and money or food could be obtained from these for special occasions. In the case of funerals, community members assist and support one another to provide food. This is especially true for households that do not have a funeral plan or in cases when a funeral plan does not cover all expenses.

Birthdays are celebrated in some families and schoolchildren take cake to school to celebrate their birthdays with their classmates. This, however, depends on the money available to purchase cakes. It was explained that 21st birthdays are usually celebrated with a big event. The food prepared for this was similar to other special occasions.

6.5.6 Food shortages

The FGDs revealed that many households experience food shortages during the last 10 days of a month. Many households rely on the money from state pensions and social grants to purchase food items. Grant money is received at the beginning of the month, usually on the first day of the month. From the 20th day of a month, food shortages are experienced. When a household runs out of food, they usually turn to their neighbours for help, as shop owners are reluctant to sell food on credit. During January, some households experience more intense food shortages, as they have additional expenses such as school uniforms and other items for children attending school.

Participants were asked to explain why food shortages occur. They attributed this to poor planning and the purchase of more expensive food items instead of the staple food maize meal.

6.6 Food Consumption Patterns in Jozini

6.6.1 Meal patterns and composition

FGDs indicated that people generally consumed three meals on weekdays, and that a similar pattern was followed over weekends. The survey results showed the same pattern of three meals a day for summer and winter, although 30.4% and 34.2% of the adults eat two meals a day in summer and winter respectively. The following food items could typically be consumed at these meals:

- Early morning before 09:00 (breakfast): Common breakfast foods include tea with sugar, brown bread, as well as phutu and soft porridge (eaten with sugar). Leftover food from the previous day's meals is also included. Some participants revealed that this meal was not regarded as a proper meal.
- In all the focus groups, it was indicated that similar types of food were consumed for the other two meals of the day, which are eaten at 12:00 or 13:00 (lunch) and 19:00 (supper). These included *isijingi* (a pumpkin and mealie-meal dish), *papa*, cabbage, beans, *phutu*, tomatoes, spinach, potatoes, *imifino*, rice and mealie rice.
- Between meals, some people would drink either mageu (a drink made from fermented mealie *papa*), juice (when available), or water and tea. In the evening some would have amasi. Some mentioned that fruit was eaten between meals when money is available to buy this.

Some participants mentioned that meat could be included in supper dishes. The inclusion of meat, however, depends on the time of the month. Meat is eaten more often during the first few days (three to four days) of the month. Some participants indicated that when they have limited money, they try to include meat (either beef or chicken) in the Sunday midday meal. Some revealed that rice was eaten often. Some participants claimed that this was eaten every day because it was easy to prepare. For the majority of households, the lunch and supper meals simply comprised *phutu (*crumbly maize-meal porridge) and a vegetable and/or bean relish (stew). Eggs were reportedly expensive and not eaten regularly.

Food is prepared by the women and children. Collected wood is used to make a fire inside the house and food is cooked on the open fire. Traditional methods of food preparation are followed, which includes mostly boiling, although frying is used in some vegetable dishes that are served as relishes or stews. Vegetables are fried in oil after boiling, and other ingredients and spices are added. Traditional food items still form a substantial part of the food consumption pattern. The following food items and dishes were mentioned: *inkhobe* (boiled dry mealies, *phutu* (crumbly maize-meal porridge), *isijingi* (combined dish prepared from pumpkin and maize-meal porridge), *mageu* (fermented maize-meal

beverage), *amasi* (sour milk), *sinkwa* (steamed mealie bread), samp, *amatabhane*, *sijabane* (*imbuya* (pigweed) and mealie-meal), beans (sugar beans – purchased), *indlubu (njugo* beans) (depending on rainfall) and *amadumbe* (taro potato). Sorghum is only used for the preparation of traditional beer on special occasions. Salads prepared with mayonnaise are also served on special occasions.

Results from the non-quantitative 24-hour recall reported in Table 27 showed that 67% of households consumed foods from eight or more food groups in summer and 43% of these households consumed foods from eight or more food groups in winter. The mean HDDS for summer was 10 (standard deviation 4.07) for the summer months and 7 (standard deviation 3.63) for winter (Table 30).

Almost all (95%) households included foods from the cereal group in summer, with 93% reporting this tendency in winter (see Table 29). The majority consumed foods from the oils and fat group during both summer (94.0%) and winter (91%).

In summer, 95% included other vegetables (mostly tomatoes, onions, green peppers and wild/indigenous vegetables) in their diets. Only 88% did so in winter. White roots and tubers (68% in summer and 54% in winter), dark green leafy vegetables (79% in summer and 60% in winter) and orange-fleshed vegetables (57% in summer and 27% in winter) were also consumed, but not in large quantities. From the FGDs, it was gathered that these vegetables were mainly used in the preparation of the vegetable relishes that were served with cereal-based dishes (*phutu*, stiff maize meal porridge, samp and rice). The inclusion of items from the meat (78% in summer and 57% in winter) and milk (70% in summer and 39% in winter) food groups was confirmed by the findings of the FGDs. These items are not generally regarded as part of the daily food intake. The same applies to the fruit group. In summer, 72% of households included foods from the dried bean group in meals and 56% did so in winter.

6.6.2 Food for children in the household

Participants in the focus groups were probed about the number of meals given to children between two and five years of age. It was explained that enough food was prepared at meal times to have it available to give to smaller children on demand. It was indicated that small children attended crèche in the mornings. The number of meals provided by crèches varied. Some provided one and others two meals, while some did not provide any meals. Those who have meals get soft porridge, rice, meat, *sinkwa*, samp, bread, banana, tea, peanut butter, oranges and apples. Soft porridge is eaten for breakfast, and fruit such as apples, bananas and oranges is eaten as snacks between meals.

At some of the crèches where meals are not provided, lunchboxes are packed for the children. The content consists of similar food as eaten by the rest of the household. When children return home in the afternoons, they are given something to drink. They eat supper with the rest of the household.

The survey data found that only 23% of children younger than five years of age ate four or more meals a day in summer and 20% of these children ate four or more meals a day in winter.

6.6.3 Food supply

According to the FGDs, cultivated foods in this area included cabbage, spinach, beans, maize, sweet potatoes, pumpkin, *amadumbe*, beetroot, carrots, onions, green peppers, tomatoes, bananas, mangoes and avocados. All the focus groups confirmed that households do not produce enough maize for their households throughout the year. Some participants indicated that a few households ground their own maize meal. The majority purchased maize meal for household consumption. The cultivated maize is used as fresh maize and only a small quantity is dried. The dried maize is used to prepare authentic traditional dishes such as samp, *inkhobe* and *sinkwa*. Some participants who were engaged in gardening indicated that they sell some of their produce to earn an income to enable them to buy other food items. When asked whether they can produce enough food for their households, they confirmed that they were able to produce vegetables for their households throughout the year.

The following items were purchased: beans, cake flour, curry powder, Knorrox, maize meal, oil, peanut butter, rice, salt, samp, sugar, spices, teabags, and 'tinned stuff' (which participants explained to be fish and beans). Fruit and meat were purchased when households had money. Fruit was mostly consumed between meals (mainly in the mornings). Households travelled by taxi to Jozini and had to pay extra money to transport their packages with purchased food. Such a trip could cost up to R100.

Chicken, goats and cattle were kept and used as food. Some households would occasionally slaughter a cow for household consumption. This meat would last for up to a month. It was explained that drying or keeping it refrigerated preserved the surplus meat. Many participants owned either electric or gas refrigerators. Gas refrigerators seemed to be common in areas without electricity.

It was reported that food from the wild was not as abundant as it had been in the past. Indigenous green leafy vegetables are no longer collected from the wild, except where households allowed *imifino* to grow in their gardens. This was attributed to climate change, as participants stated that there is "… no rainfall". However, indigenous green leafy vegetables were obtainable and collected when rainfall was sufficient. The participants indicated that they were familiar with a number of indigenous green leafy vegetables, namely, *igusha* (wild vegetable jute), *chuchuza* (black jack), *imbuya* (pigweed, amaranthus), *amahlala* (aloe saponaria), *amabunga*, *amakhiwane*, *umsobo* (black night shade) (*inkatha* in siSwati) and *indlubu* (jugo beans, bambara groundnut).

It was explained that households could grow these vegetables between the crops and pick them when required. Collecting *imifino* was the women's responsibility. Men (only those

who owned dogs) hunted. Insects such as flying ants and *amacimbi* (caterpillars) were collected by children, usually after it rained.

6.6.4 Changes in food eaten and the preservation of traditions

In earlier days, households used to produce more maize for their own consumption, and ground maize themselves. The FGD participants explained how traditional maize dishes used to be prepared from maize they produced themselves. *Amasi* was consumed more frequently in the past, as they had herds that produced enough milk for their own consumption and to prepare *amasi* from the milk obtained from their own herds. They now have to purchase it and it is reportedly expensive. Therefore, it is now used mainly for children. Beans (legume dishes) also used to be consumed more often. Some traditional maize and mixed vegetable dishes such as *isijingi* were still prepared when pumpkins were available. *Umqumboti* (traditional beer) continued to be prepared on special occasions. However, the sorghum was now purchased, rather than grown at home.

All the groups emphasised that they continue to prepare traditional dishes, although certain quick and easy modern dishes, such as rice, are frequently included in their meals. This was confirmed by statements such as "we will not stop preparing the traditional foods." FGD participants also confirmed that they "like their traditional foods a lot." *Dombolo*, another type of steamed bread, was still prepared often, although a modern version of the recipe was used. *Dombolo* seemed to be prepared over weekends.

One group specifically mentioned the increased use of oil and fat in food preparation as an example of how diets and food preparation have changed. Participants in the focus groups made statements such as "…. back then we did not use a lot of oil/fat when preparing food". They were of the opinion that today's food is not as healthy compared to the food prepared in the past, and people are inclined to get sick, as they stated that "people are not healthy anymore". According to some, the changes noted in their food consumption patterns could be attributed to the fact that they could no longer cultivate enough food. They blamed this change on the low rainfall and lack of access to water.

Some FGD participants were of the opinion that the younger generation does not like the preparation methods of the past and does not want to learn about traditional ways. Participants explained that the younger generation wants to eat ready-prepared foods (meaning take-aways and fast foods). These participants also claimed that the younger generation "… liked a lot of spices and foods with a lot of fat". Some indicated that they still taught their children the traditional ways and that children had even been taught to collect and identify indigenous green leafy vegetables (with the exception of those children who attend boarding school).

6.6.5 Special occasions

The participants indicated that a large quantity of food was prepared for special occasions. Special occasions included, birthdays, 21st birthday celebrations, funerals, weddings, family traditions and initiations. Food served at these occasions included traditional beer, meat, *inkhobe,* samp, rice, *mageu, sinkwa,* cabbage and salads with mayonnaise.

Women formed groups (organisations) that typically functioned on *stokvel* principles. Being part of such a group enabled them to 'save' money to host special occasions. The members of the group (depending on its constitution or rules) support and assist one another when they have special occasions. Assistance could be in the form of ingredients or help with the food preparation for these occasions.

6.6.6 Food shortages

Food shortages were often experienced from the middle to the end of the month. When households have money (they receive grants on the first day of each month), they use all of it to purchase food. Other times when they specifically experienced food shortages were during January when the children return to school and after they have planted.

6.7 Food Consumption Patterns in Maruleng

6.7.1 Meal patterns and composition

In all the FGDs, the majority of participants indicated that they ate two meals a day, although there were some who ate three meals a day. The survey results indicated that only 46.0% of the adults ate two or less meals a day in summer, with 20.0% following this pattern in winter. Some 53.1% and 75.0% of the adults consumed three meals a day in winter and in summer respectively. It is, however, not clear if households regarded the bread and tea that some eat in the early morning as a meal. Some regarded it as breakfast and others did not, which could explain the differences that were reported in the meal pattern. The general pattern seemed to be eating bread with tea in the early morning. This was followed at 10:00 by *pap* or *bogobe* (stiff maize meal porridge) and *morogo* (relish prepared from green leaves). In the late afternoon between 18:00 and 20:00, pap and *morogo* is eaten. Meat is eaten with pap when available. It seems as if this pattern depends on the available money. Some indicated that they would generally eat meat once or twice a week. Chicken would typically be included once a week, and legumes twice or three times a week. Some participants included fish that was caught from the river when available.

For many households, the weekend meal pattern and composition are similar to that followed during the week, although some indicated that they eat 'high class' over weekends (referring to the Sunday meal at midday when rice is served with other vegetables and salads). It was reported that rice is "easy to prepare." However, *pap* was the staple and was still cooked

specifically for the men, who prefer it over rice. Cool drinks and juice are also consumed. Nothing was reportedly eaten between meals.

The women prepared the food. Sometimes a young daughter in the household would be responsible for cooking. Most of the food preparation takes place on an open fire in an outside cooking area. Electricity is available, but it is not generally used for food preparation due to the cost. Electricity is mainly used for lighting and running the refrigerator. Electric stoves are only used to prepare food during the rainy season and for those foods with a relatively short cooking period, such as rice, eggs, fish and cabbage. Items such as tripe and legumes that require a longer cooking period are prepared over a fire. Firewood was often purchased, as wood was no longer readily available in their immediate environment. Participants claimed that it was cheaper to purchase firewood than to use electricity for food preparation. A very traditional way of food preparation was still followed.

Results from the food group consumption of the non-quantitative 24-hour recall showed that 75% and 45% of the households consumed foods from four or fewer food groups in summer and winter respectively. All households (100%) consumed foods from the cereal group in summer, as well as in winter. The oils and fat group was consumed by the majority during summer (67%) and winter (77%).

Although 89% of households included other vegetables (mostly tomatoes, onions, green peppers and wild/indigenous vegetables) in summer, 77% did so in winter. Dark green leafy vegetables were consumed by 31% of the surveyed households in summer and by 30% in winter. It can be assumed that these are not consumed in large quantities. Like in the other sites, FGDs indicated that these vegetables were mainly used in the preparation of the vegetable relishes that are served with cereal-based dishes (stiff maize meal porridge, samp and rice). The inclusion of white roots and tubers (6% in summer and 13% in winter) and orange-fleshed vegetables (3% in summer and winter) was exceptionally lower than for Ingquza Hill and Jozini. FGDs confirmed the inclusion of items from the meat (31% in summer and 52% in winter) and milk (14% in summer and 48% in winter) food groups. These foods are not generally regarded as part of the daily food intake. Meat was only consumed at the beginning of the month. The same applies to fruit. The inclusion of items from the dried bean food group was also low, as only 6% of households included it in summer and 15% included it in winter.

The results showed that only three food groups (cereals, other vegetables, and oils and fats) were consumed by more than 60% of the households. The mean HDDS for summer was 4.1 (standard deviation 0.984) and 4.8 (standard deviation 1.558) in winter (see Table 30).

6.7.2 Food for children in the household

Smaller children between the ages of two and five years old ate the same food as the rest of the household, but they consumed meals more frequently. The participants indicated, “we

cook and then set food aside for the kids" to be eaten when the children are hungry. One group explained that they made sure that meat was available for the children to eat, as they like meat and do not want to eat *morogo*. Smaller children attended ECD centres where they received something to eat. Instant porridge was mentioned.

6.7.3 Food supply

Food was cultivated, collected, hunted and purchased for household consumption. The following was mentioned:

- Vegetables: beans, cabbage, spinach, sweet potatoes (both white- and orange-fleshed), pumpkin, beetroot, carrots, onions, green peppers, tomatoes, butternut, maraca , green beans and lerotse (tsamma melon, wild watermelon)
- Fruit: bananas, mangoes, oranges, paw paw, watermelon, avocado and sugarcane
- Legumes: dinawa (cow peas), ditloo (jugo beans, bambara groundnuts), marapo and sugar beans
- Grains: maize and sorghum (mabele).

Most participants said that they do not produce sufficient maize for the whole year, and during certain periods (some mentioned November and December), they have to purchase maize meal. All groups indicated that the cultivated maize was taken to the cooperative where it was ground for them. It seemed as if the majority of the households purchased maize meal for household consumption. Only two participants mentioned sorghum cultivation.

Food is still commonly collected from the wild at this site. This includes fruit and vegetables, as well as insects that are collected by women (plant foods) and children (insects). Participants mentioned green leafy vegetables such as *lebipo* (could not find English name), *thepe* (pigweed, amaranthus*), lerotho* (pepperworth), *tshetlho (*devil's thorn*), monyaku (*wild cucumber*)* and *kalaulau*, as well as the small young leaves of the indigenous melon. The wild fruit *ditshidi* (sour plum) not *ditsadi*, as well as locusts, flying ants and *masonja* (mopanie worms) were collected. Small animals were hunted by the men and included impala, duiker, warthog, baboons, porcupine and rabbits. Birds such as guinea fowl, pheasant and doves were also hunted.

Purchasing was always mentioned first when asked where households get their food. The following items were purchased: bread (mostly brown), *bupi (*maize meal), tinned fish, rice, sugar, tea, eggs, margarine, cooking oil, macaroni, salt, peanut butter, jam, chicken feet, mayonnaise, fresh milk, long-life milk and powdered milk. Purchased vegetables included potatoes, carrots and beetroot, as well as fruit such as apples, bananas and oranges.

Most participants travel to Tzaneen once a month (when they receive their grant money) to purchase the bulk of their groceries. Many indicated that 80 kg of maize meal was usually purchased per month per household.

Some households kept cattle, pigs (indigenous), goats, chicken and donkeys. With the exception of donkeys, the livestock was occasionally used as food.

6.7.4 Changes in food eaten and the preservation of traditions

Some traditional dishes were no longer prepared and eaten. The reason given for this was related to the scarcity or unavailability of certain indigenous fruit and vegetables in the natural environment. It was also explained that previously people cultivated more maize for household consumption and ground the maize themselves. Millet and sorghum were also cultivated. The participants believed that these grains contributed to previous generations' health and strength. Reasons for these crops not being cultivated anymore or not on the same scale as previously were poor rainfall, drought and lack of water. Previously, people also had knowledge of the *muti* (remedy) that was used to keep birds from destroying crops. The results of this are that people now have to buy food and that the younger generation has come to prefer the 'new' (purchased) food.

6.7.5 Special occasions

The only celebrations mentioned were weddings, where everyone in the community contributes according to their budgets for the food for such occasions. Some indicated that food such as *pap*, rice, meat and salads are served. This is mostly purchased. At funerals, some still follow the tradition of not adding salt to the food.

6.7.6 Food shortages

Food shortages were experienced in many households towards the end of the month and coping strategies included the reduction of meals. In January, many people have to pay school fees and buy new school uniforms for the children, and shortages are often more severe during this month. Crop production is usually sufficient from January to June, where after some do not have any cultivated produce to use in their households.

6.8 Food Consumption Patterns in Ratlou

6.8.1 Meal patterns and composition

In all the Ratlou FGDs, the majority of the participants indicated that they ate three meals a day. This was confirmed by the survey results, as 76% reported that they ate three meals a day in summer. In winter, 57% had three or more meals a day, and in summer 25% had three or more meals a day. The general pattern for breakfast seemed to be eating *motogo* (soft sorghum meal porridge). Other soft porridges prepared from maize meal and oats were mentioned. Some take bread with tea in the early mornings. The Madibogo group indicated that peanut butter, margarine, jam or avocados were served on the bread (typically brown). Tea could be served with or without milk and sugar, depending on its availability. Lunch consisted of *papa*, rice or samp eaten with cabbage, spinach or beans, fish, milk or *amasi*, achaar or meat. The evening meal was described as "almost the same food as lunch".

Meat was eaten with *pap* when available (only two to three times a month). A few participants indicated that they consumed meat daily, whereas most indicated that meat was only bought once a month. Some households include chicken twice a week. Chicken pieces are bought regularly from the local shops. The Phitshane group mentioned that fish (tinned, dried and fresh) is often eaten.

Some participants indicated that nothing was eaten between meals, while others indicated that they drank water and/or tea. Some mentioned that fruit (apples, bananas and oranges), juice, *masoku* buns and *gemere* (ginger beer) were taken between meals. The meal pattern and composition on Saturdays was similar to that followed during the week. Dishes that require a longer cooking time such as samp, dumplings, *dinawa* or *dombolo* were prepared on Saturdays. Milk was consumed with the *pap*. Others mentioned that, on Sundays, rice and meat were served with other vegetables and salads (cabbage, pumpkin and beetroot). Cool drink (squash) could be enjoyed with the Sunday meal. The Phitshane group indicated that they had a good meal on Sundays, which meant "the seven-colour plate". This included rice, meat and a number of vegetables and salads.

Results from the food group consumption of the 24-hour recall showed that no households consumed foods from eight or more food groups in summer and only 8% did so in winter (see Table 27). Dietary diversity (see Table 30) seemed much lower in Ratlou than in Jozini. The mean HDDS for summer was 4.2 (standard deviation 1.290) and 4.7 (standard deviation 1.719) in winter. The majority (93%) of the households included foods from the cereal group in summer and all (100%) reported doing so in winter (see Table 29). The oils and fat group was consumed by 88% of the sample households in summer and by 91% of them in winter.

Other vegetables (mostly tomatoes, onions, green peppers and wild/indigenous vegetables) were included in meals by 40% of the households in summer and 33% of the households in winter. White roots and tubers were consumed by 35% of the households in summer and by

46% of the households in winter; dark green leafy vegetables were consumed by 23% in both summer and winter, and orange-fleshed vegetables were consumed by 5% in summer and 23% in winter. It can be assumed that these are not consumed in large quantities, but are mainly used in the preparation of the vegetable relishes that are served with the cereal-based dishes (stiff maize meal porridge, samp and rice). The inclusion of items from the meat (40% in summer and 61% in winter) and milk (60% in summer and 46% in winter) food groups was confirmed by the FGDs findings. However, as for the other sites, these foods are not regarded as part of the daily food intake, despite being recorded as being consumed in the 24 hours prior to the survey. The same applied to fruit. The inclusion of items from the dried bean group was very low compared to the other sites, with 4% of households consuming these foods in summer and 2% consuming them in winter. The mean HDDS was 4.236 (standard deviation 1.290) in summer and 4.672 (standard deviation 1.719) in winter (see Table 30).

6.8.2 Food for children in the household

Smaller children between the ages of two and 5 years ate the same food as the rest of the household. However, children ate meals more frequently. Food prepared for the household is set aside to be available when the children are hungry. Food available for children included *pap*, meat, soft porridge, Weet-Bix, oats, Morvite (instant sorghum porridge), pumpkin, mashed potatoes and soup. Smaller children attended ECD centres where they received food.

6.8.3 Food supply

Food is cultivated, collected, hunted and purchased for household consumption. Cultivation is limited in Phitshane, mainly due to lack of rainfall and water in general. Watermelon, peanuts, cabbage, carrots, *mabele* (sorghum), sunflower and *lerotse* are grown, although households reported that pumpkins do not grow well in the area. Maize and sorghum (*mabele*) are grown. Sorghum is mainly used for brewing beer. The participants of the FGDs reported that they do not have home gardens because of water shortages. Those who cultivate crops do so at the *masimo* (a traditional cultivation field that is usually located outside a Tswana village).

Similar information was offered by the Madibogo group, which stated that they used to grow beans, *dinawa*, maize, *makatane* (mellon), peanuts, sorghum, sunflower, sweet reeds (sugarcane), watermelon and white sweet potatoes in the past. Some community members have small home gardens where they grow crops such as beetroot, butternuts, cabbage, carrots, chillies, green beans, green peppers, onions, potatoes, pumpkin, spinach and tomatoes.

Limited food is collected from the wild – usually after the rain in summer. In Phitshane, this includes *thepe* (pigweed, amaranthus*), morogo wa dinawa* (cow pea leaves), *morokolane, dithatanyana, morogo wan aga, motlhankanyane, motoloko, morekwa, ditlhekwa, setwane, motsutsujwane, mmura, sekgalo, rekolwane, leropa, mola* and *motunasane.* In Madibogo,

women collect the following wild vegetables: *thepe* (pigweed, amaranthus), *mochane, lelopolane, moretwa, morotoko, sethwane, mokgalo and morogo wa dinoga.* In Madibogo, the following wild fruit are gathered: *moretwa, setwane, mochane* and *tsutsubele.*

Tsie (locusts) and *lephoyi* (doves) are eaten. It was reported that mopane worms were eaten, but these were purchased, as mopane trees are now scarce because they have been cleared for cropping. Men, women and children collect insects. *Mmutu* (hare), duiker, *tshipe* (springbok), *phuduhudu, ngulube yanaka, thakadu, tholo* and *noko* (porcupine), as well as guinea fowl and warthog, were hunted by men.

Purchasing was spontaneously mentioned first when participants were asked where they get food for their households. Groceries that are generally bought include beans, beef, bread, cooking oil, cabbage, coffee, cornflakes, juices (Oros), eggs, fish (tinned), carbonated drinks (Sprite), flour, frozen mixed vegetables, milk, maize meal, mealie rice, *mabele* (sorghum), macaroni, oats, potatoes, rice, samp, *amasi* (sour milk), spaghetti, sugar and tea.

Most participants travel to Mahikeng once a month (when they receive grant money) to purchase groceries. In Madibogo, some participants also reported purchasing from stores in Vryburg or Delareyville.

Some households keep ducks, cattle, chicken, geese, goats, pigs, sheep and turkeys. Horses, mules and donkeys were also mentioned. It was reported that goats and sheep were slaughtered for home consumption once or twice a year, as were donkeys and pigs (mainly in winter). Some respondents ate pigs. Chickens were mainly slaughtered for home consumption over weekends. Cattle were mainly slaughtered once a year for weddings and funerals.

6.8.4 Changes in food eaten and the preservation of traditions

Some traditional crops were no longer available due to the scarcity or unavailability of certain indigenous fruit and vegetables in the natural environment. Some participants mentioned and even blamed climate change and the use of fertilizers for this change. Previously people were "eating sorghum meals only." When they had *pap,* it was from their own cultivated maize, that they ground themselves to "make lekker *pap*". Now, all maize meal is purchased. The meat of slaughtered animals is cooked and the remaining meat is dried and kept for a long time. Meat is not kept in fridges. One group emphasised that there was a greater variety of foods when they were younger, but *pap* has replaced traditional foods.

6.8.5 Special occasions

A number of special occasions, both modern and traditional, were mentioned, including weddings, birthday parties, graduation parties, the unveiling of tombstones, *Badimo* (ancestral veneration or thanksgiving) funerals and church gatherings. At traditional celebrations, traditional food would include beer, meat (*chotho* or *seswaa*), porridge and

samp. However, participants stated that seven-colour dishes are more common during the celebration of modern traditions. They explained that they have copied other cultures.

6.8.6 Food shortages

Food shortages were experienced in many households towards the end of the month, usually a week before the end of the month. Eating more soft porridge than other food types of food is a common coping strategy. FGD participants also reported buying on credit and borrowing money from the village bank. In January, people pay school fees and buy school uniforms for the children. Therefore, January is very difficult and shortages are often more severe, as households spend too much in December.

6.9 Discussion Regarding Consumption Patterns

Overall, the qualitative and quantitative data suggests several common consumption patterns. Firstly, the bulk of diets consist of purchased cereals. Food purchasing occurs around the time government grants are disbursed. In the ensuing weeks, food consumption and dietary diversity decline.

Secondly, the preparation and consumption of traditional foods is still appreciated, but qualitative information indicated that these practices and preferences are not being passed onto the next generation, despite the involvement of children in food preparation. It was apparent that some foods and preparation practices have vanished entirely from the menu. This can, to some degree, be explained by environmental, social and economic changes that affect entitlements. The same can probably be said for household food production.

Thirdly, seasonality and special occasions influence consumption. January is a month of shortages, when dietary diversity and food quantities are reduced. Celebrations and social events depend on familial and communal contributions and are events where food can be sourced, even in times of scarcity.

In addition, the quantitative statistical analysis of consumption patterns shows that the consumption of roots and tubers, fruit and vegetables was positively and significantly related to each other and the consumption of other food groups (see Table 31). The consumption of fruit and dark green leafy vegetables was significantly and negatively related to the consumption of cereals in winter and positively related to the consumption of white roots and tubers in summer. This infers that households that consume primarily cereal-based diets were less likely to consume fruit and dark green leafy vegetables in winter, which confirms a largely maize-based diet, especially in winter. This is of concern, as fruit and dark green leafy vegetables are important sources of micronutrients that are essential for health, productivity and well-being. The consumption of white roots and tubers was significantly and positively related to all the other crop-based food groups, which indicates that there is a tendency to include foods from more than one group when foods from these food groups are included in the diet. Similar trends were seen across the non-crop food groups, as well as for overall

dietary diversity, which meant that an increase in the consumption of crop-based food group items was accompanied by overall improvements in dietary diversity.

6.10 Precautionary Behaviour Related do Consumption During Food Shortages

The study findings confirmed that food shortages led to reductions in the quality of diets, with households reporting both child and adult hunger (see Table 33).

Table 33: Practices of households when faced with food shortages

Consumption reduction strategy	How frequently did this happen?	Number	Proportion of households (%)
In the past 12 months, did an adult go hungry because of a lack of resources?	Never	160	53.2
	Often (more than 10 times a month)	5	1.7
	Sometimes (three to 10 times a month)	45	15
	Rarely (once or twice a month)	91	30.2
	Total	301	100.0
In the past 12 months, did a child go hungry because of a lack of resources?	Never	184	59.4
	Often (more than 10 times a month)	3	1.0
	Sometimes (three to 10 times a month)	41	13.2
	Rarely (once or twice a month)	82	26.5
	Total	310	100.0
In the past 12 months, did an adult eat less often than he or she should have because of a lack of resources?	Never	141	45.5
	Often (more than 10 times a month)	7	2.3
	Sometimes (three to 10 times a month)	53	17.1
	Rarely (once or twice a month)	109	35.2
	Total	310	100.0
In the past 12 months, did a child eat smaller meals than he or she should have because of a lack of resources?	Never	151	48.7
	Often (more than 10 times a month)	8	2.6
	Sometimes (three to 10 times a month)	48	15.5
	Rarely (once or twice a month)	103	33.2
	Total	310	100.0
In the past 12 months, did an adult go to bed at night without food because of a lack of resources?	Never	220	71.0
	Often (more than 10 times a month)	3	1.0
	Sometimes (three to 10 times a month)	33	10.6
	Rarely (once or twice a month)	54	17.4
	Total	310	100.0
In the past 12 months, did a child go to bed at night without food because of a lack of resources?	Never	248	80.0
	Often (more than 10 times a month)	1	0.3
	Sometimes (three to 10 times a month)	21	6.8
	Rarely (once or twice a month)	40	12.9
	Total	310	100.0

Consumption reduction strategy	How frequently did this happen?	Number	Proportion of households (%)
In the past 12 months, did an adult go a whole day and night without food because of a lack of resources?	Never	100	75.8
	Often (more than 10 times a month)	1	0.8
	Sometimes (three to 10 times a month)	4	3
	Rarely (once or twice times a month)	27	20.5
	Total	132	100.0
In the past 12 months, did a child go a whole day and night without food because of a lack of resources?	Never	242	77.8
	Often (more than 10 times a month)	3	1.0
	Sometimes (three to 10 times a month)	22	7.1
	Rarely (once or twice times a month)	44	14.1
	Total	311	100.0

However, the findings show that hunger was not chronic or enduring, but was only experienced ‘rarely’ (once or twice a month) and ‘sometimes’ (three to 10 times a month) (see Table 33). Very few households reported that hunger was experienced ‘often’ (more than 10 times a month). All households reported having to eat a less diverse diet than they would have liked due to a lack of resources (see Table 34). More than half of the households skipped meals, but only 31% reported doing this more than five days in the previous month. Just over half the households surveyed reported eating less variety more than five days in the last 30 days. Skipping meals and eating less diverse diets for more than five days in a month are indicators used by Stats SA as an indicator of inadequate access to food.

Table 34: Reduction of food quality and variety

Coping strategies	Sample size	Number	Proportion (%)
Has a household member skipped any meals during the past 12 months because there was not enough food in the house?	311	163	52.4
Has a household member skipped meals five or more days in the past 30 days?	310	95	30.6
Has a household member had to eat a smaller variety of foods during the past 12 months than he or she would have liked because there was not enough food in the house?	314	314	100
Has any household member eaten a smaller variety for five or more days in the past 30 days?	312	160	51.3

6.11 Nutrition and Social Change

Neves and Du Toit (2013:95) state that rural livelihoods in the study areas are diverse, show considerable complexity and diversity and incorporate both agrarian and non-agrarian informal sector activities, state grants and networks of social reciprocity. They characterise the persistence of rural poverty as "... less one of the exclusion or estrangement of the economically marginalised from the economic mainstream, than their 'adverse incorporation' into the broader political economy of South Africa. South Africa's subalterns have long been incorporated into commodity relations as consumers, social grant recipients, low-waged workers, informal-sector survivalists or the dependents of these groups".

For poor rural households that spend a high proportion of their income on food, food insecurity is a significant part of this adversity, to which households respond with ever-shifting strategies, depending on the severity and temporal dimensions (Hendriks 2014). These span the formal and informal sectors that involve wage labour, migration, household production, changing consumption patterns and sometimes severe and irreversible measures to stave off hunger (Hendriks 2014).

Increasingly, rural household food security is influenced by the availability, quality and costs of food purchased from large retail chains, whose expansion into poor communities is supported by the infusion of social grant money into rural economies (Bähre 2011; Igumbor et al. 2012). In this way, social protection may be having a profound influence on household food consumption patterns and nutrition outcomes, as well as the role of household production in livelihood strategies. An increased reliance on purchased food implies changes in both the social fabric and communities' use of natural resources .

The collective changes in diet, physical activity, health and nutrition that take place in many developing countries are collectively known as the 'nutrition transition' (FAO undated). The growing consumption of more affordable packaged, processed and fast foods and soft drinks is undoubtedly driving the nutrition transition in South Africa (Armstrong et al. 2006; Igumbor et al. 2012). Temple et al. (2011) conclude that a healthy diet is unaffordable for most South Africans, and people with low incomes rely increasingly on cheap, energy-dense foods, which may begin to explain the co-existence of stunting and obesity within the same socio-economic strata and within the same households (Armstrong et al. 2006; Popkin et al. 2012).

It is not known whether this tendency is exaggerated in poor rural areas, and even less is understood about how infusions of cash in the form of grants and the introduction of other social protection measures interact with subsistence farming to influence household food security strategies and nutrition outcomes.

It is worthwhile, however, to consider the rural and historical context in order to better understand the livelihood adaptations that determine food security. The legacies of land dispossession and migrant labour, alongside more recent rural development challenges, are arguably historical contributors to chronic food insecurity in the former homelands (O'Laughlin 2013). However, the picture is a complex one of dynamic adaptations of livelihoods rather than straightforward agrarian decline. Rural people continue to use subsistence farming as an important component of household food security and it remains part of a diverse and fluid livelihood and coping strategies, which span the formal and informal sectors (Aliber and Hart 2009; Neves and Du Toit 2013).

Qualitative data from the study sites suggests a number of possibilities with regard to the interplay of labour remittances, social grants, seasonality, household production and nutrition outcomes:

- With declining urban employment, remittances that were used to invest in household and small-scale production have shrunk and input costs are rising. Participants report that they can no longer afford many of the inputs, such as oxen for animal traction and fencing for terraced crop farming (Ingquza Hill).
- There are changes in settlement patterns, mainly as people move closer to urban centres for access to social grants and shops, as the opportunity costs of subsistence farming are outweighed by the benefits of grants and other social protection measures (Jozini and Maruleng).
- Because of social grants, households that comprise pensioners and grandchildren may be better off than others, because there is cash to capitalise household production. Pensioners, moreover, have experience and knowledge of subsistence production. Therefore, livelihood strategies are more diverse (all four sites).

- Subsistence farming is not being passed along to the current generation of working-age adults. This phenomenon is accompanied by changing food consumption patterns, new preferences and new designations of what are ‘traditional’ (home-grown) and ‘modern’ (store-bought) foods (all four sites).
- The emphasis on large-scale, commercial agricultural projects has meant that smallholders and subsistence producers have been overlooked, which has numerous consequences. This includes the shortfall in extension services and the failure to adapt to these ecologically such as the unsustainable ‘scaling down’ of commercial farming methods using inappropriate pesticides, herbicides, fertilizers and water consumption (Maruleng) and the loss of productive land and ecosystem services to commercial and cash cropping (Jozini).

CHAPTER 7: NUTRITIONAL STATUS OF CAREGIVERS AND CHILDREN

Anthropometry is regarded as one of the few measures relating to food security with scientifically validated international standards. Nutrition, which reflects the quality and quantity of food consumed, is only one outcome of food security. This study collected the anthropometric data of children between 24 and 59 months of age and their female caregivers.

Table 35 presents the BMI[2] of female carers of small children in the households surveyed. Just over one in five of the female caregivers (22%) was overweight and 37% were classified as obese (BMI over 30). Combined, the proportion of overweight and obese female carers was 59%. Proportionately fewer cases of underweight women were found. However, 19% of the carers in Maruleng were underweight.

Table 35: BMI of female, non-pregnant caregivers

Sample size	**Total sample**	**Ingquza Hill**	**Jozini**	**Maruleng**	**Ratlou**
	175	37	54	21	63
BMI	Percentage				
Underweight (BMI ≤ 18.5)	8.6	0.0	9.3	19.0	9.5
Normal (BMI 18.5 to 24.9)	32.6	40.5	27.8	23.8	34.9
Overweight (BMI 25 to 29.9)	22.3	24.3	25.9	23.8	17.5
Obese (BMI ≥ 30)	36.6	35.1	37.0	33.3	38.1
Total	100	100	100	100	100
Overweight and obese (BMI ≥ 25)	58.9	59.4	62.9	57.1	55.6

The rates of stunting (24%) among children of 24 to 59 months generally confirmed the national statistics for this indicator of deprivation. Stunting was considerably lower in Maruleng than at the other sites (see Table 36). Reasons for this were not obvious, except that many more rain-fed crops grew in this district. The graphs in Figure 5 show that the children's height-for-age is skewed downwards, but their weight-for-age and BMI scores for age are skewed upwards. Overall, 15% of the children were overweight. The boys were generally more undernourished than the girls. This raises concern over the food consumption patterns of children who are unable to consume large quantities of the largely maize-based diet.

The classified (underweight, normal and overweight) BMI scores of the caregivers were negatively correlated to the classified BMI for age Z-score (BAZ) (Spearman's rho = -0.215; p = 0.044; n = 88) and weight-for-age Z-score (WAZ) (Spearman's rho = -0.231; p = 0.018; n = 105) of children. The classified weight-for-height Z-score (WHZ) was negatively

[2] The BMI is calculated as: $\frac{Weight\ in\ kg}{Height\ in\ meters^2}$

correlated to the HAZ (rho = -0.150; p = 0,011; n = 284) and the BAZ (rho = 0.296; p = 0.000; n = 227). The WAZ was positively correlated with the BAZ (rho = 0.403; p = 0.000; n = 284). Due to missing data, not all the anthropometric measures were available for all the children.

Irrigation was the only variable that had a statistically significant (negative) influence on the classified child anthropometry scores (see Table 37). Applying irrigation was negatively correlated to the classified BMI scores of female caregivers in Ingquza Hill. Dietary diversity had a positive correlation with the classified BMI scores of the females in Ingquza Hill, but it did not have a statistically significant relationship with dietary diversity in the other sites. This may infer that increasing dietary diversity is associated with higher incomes and greater reliance on purchased foods that lead to higher BMI scores, as indicated in the FGDs. This was supported by the negative significant correlation of the BMI scores of caregivers with irrigation.

Participation in crop production had a significant negative correlation with the children's mid-upper arm circumference Z-score (MUACZ. Participation in a school garden had a significant negative correlation with the children's WHZ in Ingquza Hill. It is not clear how to interpret this finding, as reductions in a high MUACZ and WHZ could mean that children are underweight, but it could be positive if mitigating higher-end scores associated with overweight and obesity. There were generally more overweight children than underweight children. Participation in a school garden could be an indication of landlessness and marginalisation – especially of female community members who are forced to use the available communal land for crop production.

In Maruleng, the only statistically significant (positive) influence of crop production on anthropometry was found between dietary diversity and child stunting (HAZ). In Ratlou, crop production and home gardening were negatively correlated with the WHZ, but practising irrigation was positively correlated with the same anthropometric measure. It is unclear how to interpret these findings, but one should be mindful that only four households in this sample practised irrigation, so there are not enough cases to see a trend.

Table 36: Child anthropometry

Sample	Categories	Z-scores				
		BAZ (%)	HAZ (%)	MUACZ (%)	WAZ (%)	WHZ (%)
Total	Sample size	285	314	357	326	286
	Below the norm ≤ -2SD	5.3	23.9	2.8	8.6	4.5
	Normal (-1.99 SD ≤ z ≤ +1.99 SD)	80.0	73.9	94.1	87.7	82.2
	Above the norm ≥ +2SD)	14.7	2.2	3.1	3.7	13.3
Ingquza Hill	Sample size	60	70	79	67	61
	Below the norm ≤ -2SD	10.0	24.3	2.5	10.4	8.2
	Normal (-1.99 SD ≤ z ≤ +1.99 SD)	75.0	74.3	96.2	86.6	77.0
	Above the norm ≥ +2SD)	15.0	1.4	1.3	3.0	14.8
Jozini	Sample size	96	104	116	110	96
	Below the norm ≤ -2SD	5.2	26.0	2.6	11.8	5.2
	Normal (-1.99 SD ≤ z ≤ +1.99 SD)	83.3	71.2	92.2	84.5	83.3
	Above the norm ≥ +2SD)	11.5	2.9	5.2	3.6	11.5
Maruleng	Sample size	51	54	63	58	51
	Below the norm ≤ -2SD	3.9	16.7	1.6	3.4	3.9
	Normal (-1.99 SD ≤ z ≤ +1.99 SD)	76.5	79.6	96.8	91.4	76.5
	Above the norm ≥ +2SD)	19.6	3.7	1.6	5.2	19.6
Ratlou	Sample size	74	82	95	87	75
	Below the norm ≤ -2SD	1.4	25.6	4.2	6.9	1.3
	Normal (-1.99 SD ≤ z ≤ +1.99 SD)	83.8	73.2	92.6	89.7	89.3
	Above the norm ≥ +2SD)	14.9	1.2	3.2	3.4	9.3

Note: SD = Standard deviations above or below the norm; BAZ = BMI for age Z-score; HAZ = Height-for-age Z-score; MUACZ = Mid-upper arm circumference Z-score; WAZ = Weight-for-age Z-score; WHZ = Weight-for-height Z-score.

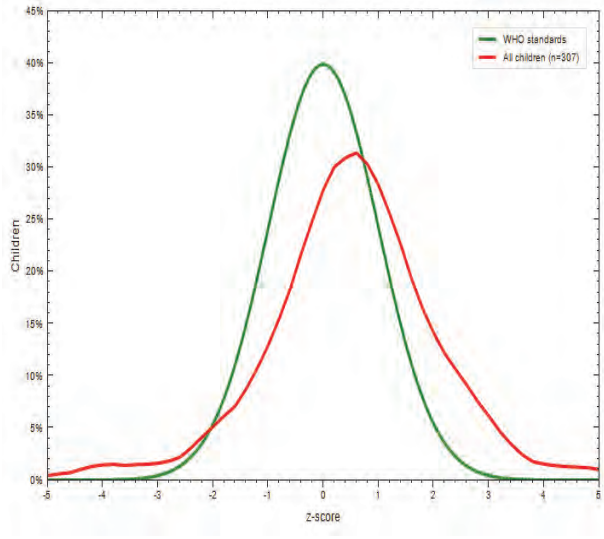

Figure 5A: Children's weight for height
Source: WHO (2011b) using authors' data

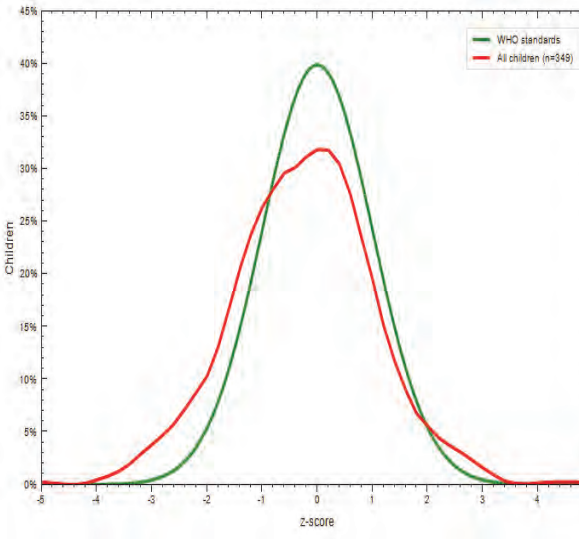

Figure 5B: Children's weight for age
Source: WHO (2011b) using authors' data

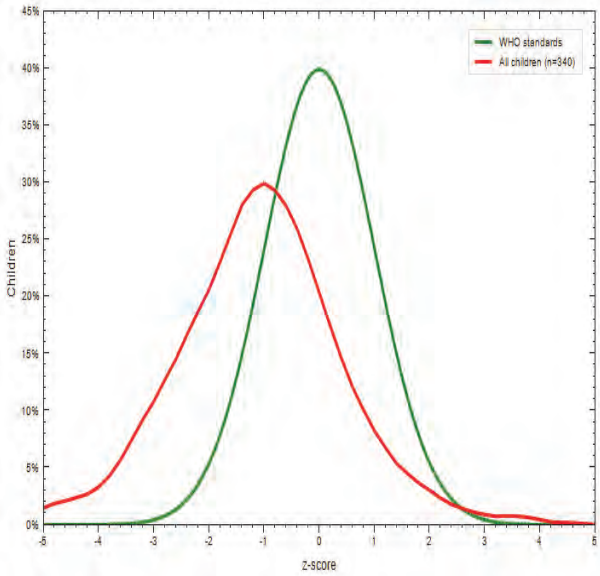

Figure 5C: Children's length or height for age
Source: WHO (2011b) using authors' data

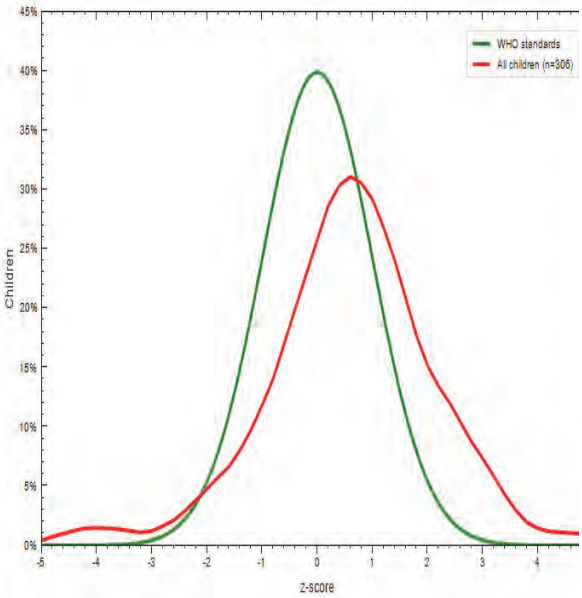

Figure 5D: Children's BMI for age
Source: WHO (2011b) using authors' data

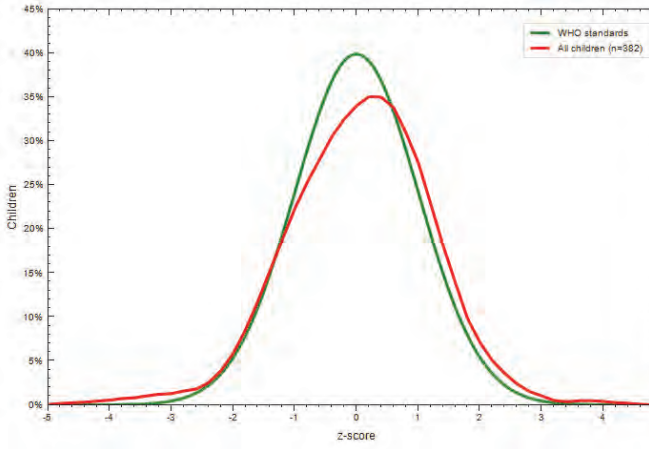

Figure 5E: Children's MUAC for age
Source: WHO (2011b) using authors' data

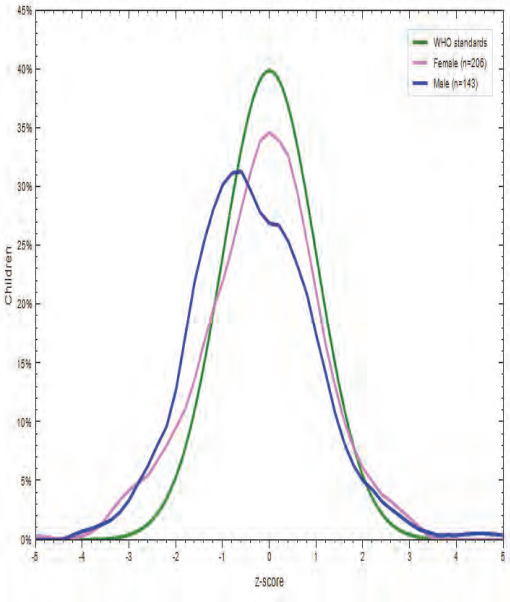

Figure 5F: Children's weight for age by sex
Source: WHO (2011b) using authors' data

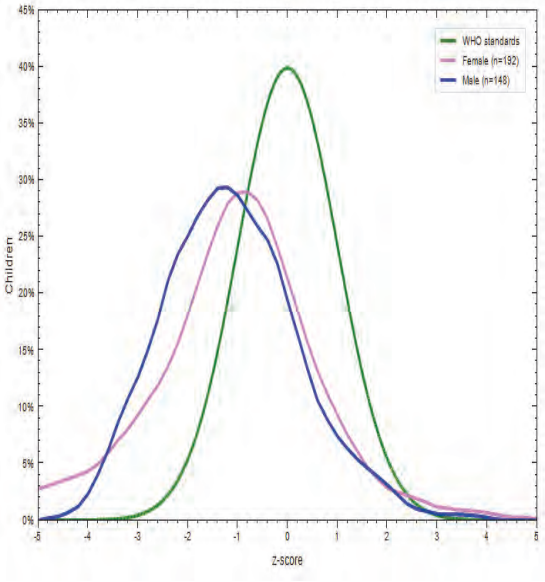

Figure 5G: Children's length for age by sex
Source: WHO (2011b) using authors' data

Table 37: Variables significantly influencing anthropometry classification

Whole sample		WHZ classification	HAZ classification	WAZ classification	MUACZ classification	Adult BMI classification
Whole sample						
Irrigating households	Correlation coefficient	0.078	-0.125*	0.055	-0.039	-0.127
	Significance (two-tailed)	0.208	0.035	0.342	0.483	0.108
	Sample size	259	283	296	323	161
Ingquza Hill						
HDDS	Correlation coefficient	-0.015	-0.121	0.214	-0.052	0.391*
	Significance (two-tailed)	0.908	0.327	0.084	0.655	0.017
	Sample size	59	68	66	77	37
Agricultural engagement	Correlation coefficient	0.157	0.157	-0.088	-0.240*	0.290
	Significance (two-tailed)	0.235	0.200	0.485	0.036	0.082
	Sample size	59	68	66	77	37
Irrigating households	Correlation coefficient	-0.049	-0.162	0.354*	0.116	-0.437*
	Significance (two-tailed)	0.746	0.253	0.011	0.378	0.020
	Sample size	46	52	51	60	28
School garden	Correlation coefficient	-0.288*	0.087	0.038	0.000	0.155
	Significance (two-tailed)	0.026	0.477	0.758	1.000	0.358
	Sample size	60	69	67	78	37
Jozini						
Irrigating households	Correlation coefficient	0.167	-0.156	-0.163	-0.075	-0.281*
	Significance (two-tailed)	0.116	0.124	0.099	.442	0.048
	Sample size	90	98	103	108	50

Whole sample		WHZ classification	HAZ classification	WAZ classification	MUACZ classification	Adult BMI classification
Maruleng						
HDDS	Correlation coefficient	-0.053	0.313*	0.183	0.232	0.274
	Significance (two-tailed)	0.713	0.023	0.172	0.069	0.242
	Sample size	51	53	57	62	20
Ratlou						
Agricultural engagement	Correlation coefficient	-0.236*	-0.128	-0.149	0.200	-0.117
	Significance (two-tailed)	0.042	0.254	0.169	0.051	0.362
	Sample size	75	82	87	95	63
Irrigating households	Correlation coefficient	0.290*	-0.083	-0.012	-0.016	0.117
	Significance (two-tailed)	0.013	0.464	0.910	0.880	0.362
	Sample size	73	80	85	94	63
Home garden	Correlation coefficient	-0.286*	0.087	0.017	0.007	-0.117
	Significance (two-tailed)	0.013	0.438	0.873	0.944	0.362
	Sample size	75	82	87	95	63

* Correlation is significant at the 0.05 level (two-tailed).

** Correlation is significant at the 0.01 level (two-tailed).

CHAPTER 8: NUTRITIONAL CONSIDERATIONS FOR CROP-BASED RECOMMENDATIONS

8.1 Food Group-based Considerations

The seven plant-based food groups used to calculate the HDDS provide the base for recommendations for improving the diets of the households in this study. These food groups are cereals, white roots and tubers, orange-fleshed vegetables, dark green leafy vegetables, other vegetables, orange fruit, and other fruit. Almost all households consumed cereals every day, therefore, the recommendations focus on food that can increase dietary diversity and overall nutrition.

8.2 Dietary Recommendations

The HDDS is based on a recall of non-quantitative consumption for the day prior to the survey and may have included weekends or non-typical days such as celebrations. No quantitative intake information (portion size) is available for these intakes, so the findings need to be carefully interpreted. The recommendations are based on what food consumption patterns can s*trengthen* existing good consumption patterns and what changes can be *promoted* to improve food consumption. Promotion is understood to mean taking active steps to increase the current, relatively low intakes.

Table 38 presents a list of potentially important crops for achieving improvements in food consumption among these community members. These recommendations are made based purely on a human nutrition perspective, and keeping dietary diversity and current eating and purchasing patterns in mind. The next section of the report will evaluate these recommendations in light of what can be produced in the communities.

Table 38: Recommendations to improve dietary intake

Food group	**Specific crops (alphabetically)** * Refers to the consumption of the leaves of the crops & Presumably small quantities are eaten; thus no nutrient intake significance (flavour and diversity considerations) # Acceptability unknown	**Recommendations**			
		Ingquza Hill	**Jozini**	**Maruleng**	**Ratlou**
Dark green leafy vegetables	Beetroot* Legumes* Pumpkins* Spinach Sweet potatoes* African leafy vegetables (‘wild’ or cultivated)	Promote and strengthen existing good patterns	Strengthen existing good patterns	Promote existing good patterns	Promote existing good patterns
Other vegetables	Beetroot Cabbage Cucumber Eggplant (brinjal)# Green beans Gem squash/’Calabash’/other squash and pumpkin Green peppers& Lettuce Onions& Tomatoes Zucchini (baby marrow)#	Promote and strengthen existing good patterns	Strengthen existing good patterns	Strengthen existing good patterns	Promote existing good patterns

Food group	Specific crops (alphabetically) * Refers to the consumption of the leaves of the crops & Presumably small quantities are eaten; thus no nutrient intake significance (flavour and diversity considerations) # Acceptability unknown	Recommendations			
		Ingquza Hill	**Jozini**	**Maruleng**	**Ratlou**
Other fruit	Apples Avocados Bananas Berries Citrus fruit Figs Guava (this tree has been classified as an invader species, and although high in nutrition, should not be recommended for cultivation) Pears Pineapples Plums# Watermelons	Promote existing good patterns	Promote and strengthen existing good patterns	Promote and strengthen existing good patterns	Promote existing good patterns
Short-term: Orange-fleshed vegetables	Carrots Dark orange pumpkin, butternut or squash Orange sweet potatoes	Promote existing good patterns	Strengthen existing good patterns	Promote existing good patterns	Promote existing good patterns
Longer term: Orange-coloured fruit	Apricots Loquats Mangos Papaya Orange peaches Spanspek (cantaloupe)#	Promote existing good patterns	Promote existing good patterns	Promote existing good patterns	Promote existing good patterns

[1] This refers to potentially important crops, purely from a human nutrition perspective and keeping dietary diversity and current eating and purchasing patterns in mind.

CHAPTER 9: THE CONTRIBUTION OF PRODUCTION TO HOUSEHOLD CONSUMPTION

This study set out to address two major knowledge gaps:

- What is the contribution of home- or smallholder-grown foods to total dietary intake and nutritional requirements (in the context of an in-depth description of the food environment and its linkages to water)?
- What is the effect of seasonality on home or smallholder production and the resultant food intake?

To answer these two questions, the researchers considered the sources of food and contribution of production to the diets of the households.

9.1 The Influence of Cropping and Scale of Cropping on Food Consumption

Engagement in cropping did not seem to reduce the number of months of inadequate hunger reported by households. However, engagement in production influenced dietary diversity (see Table 27). Far more cropping households consumed foods from eight or more food groups in both summer and winter. Even though most foods were purchased, cropping increased the availability of foods for home consumption (see Table 23). However, Table 39 presents a comparison of the proportion of households consuming various food groups. The analysis does not indicate a strong influence of crop production on the consumption of food groups in summer. However, proportionally fewer cropping households consumed orange-fleshed vegetables in summer, but consumed more than non-cropping households consume in winter. The same pattern was seen for the consumption of dark green leafy vegetables, other vegetables, orange-coloured fruit, other fruit, as well as dried beans and legumes. This shows a more positive influence of cropping on food consumption in winter than in summer. This result was not expected, as the number of crops that can produce edible portions in winter is rather limited. Yet, the data presented in Table 27 shows that 40% of households involved in cropping consumed foods from eight or more food groups in summer and 26% did so in winter. This was remarkably different to the non-cropping households, where only 20% consumed foods from eight or more food groups in summer and 7% did so in winter. Over half (55%) of irrigating households consumed foods from eight or more food groups in summer and 42% consumed these foods in winter (see Table 27). Figures 6 and 7 present the HDDSs by engagement in crop-production during summer and winter.

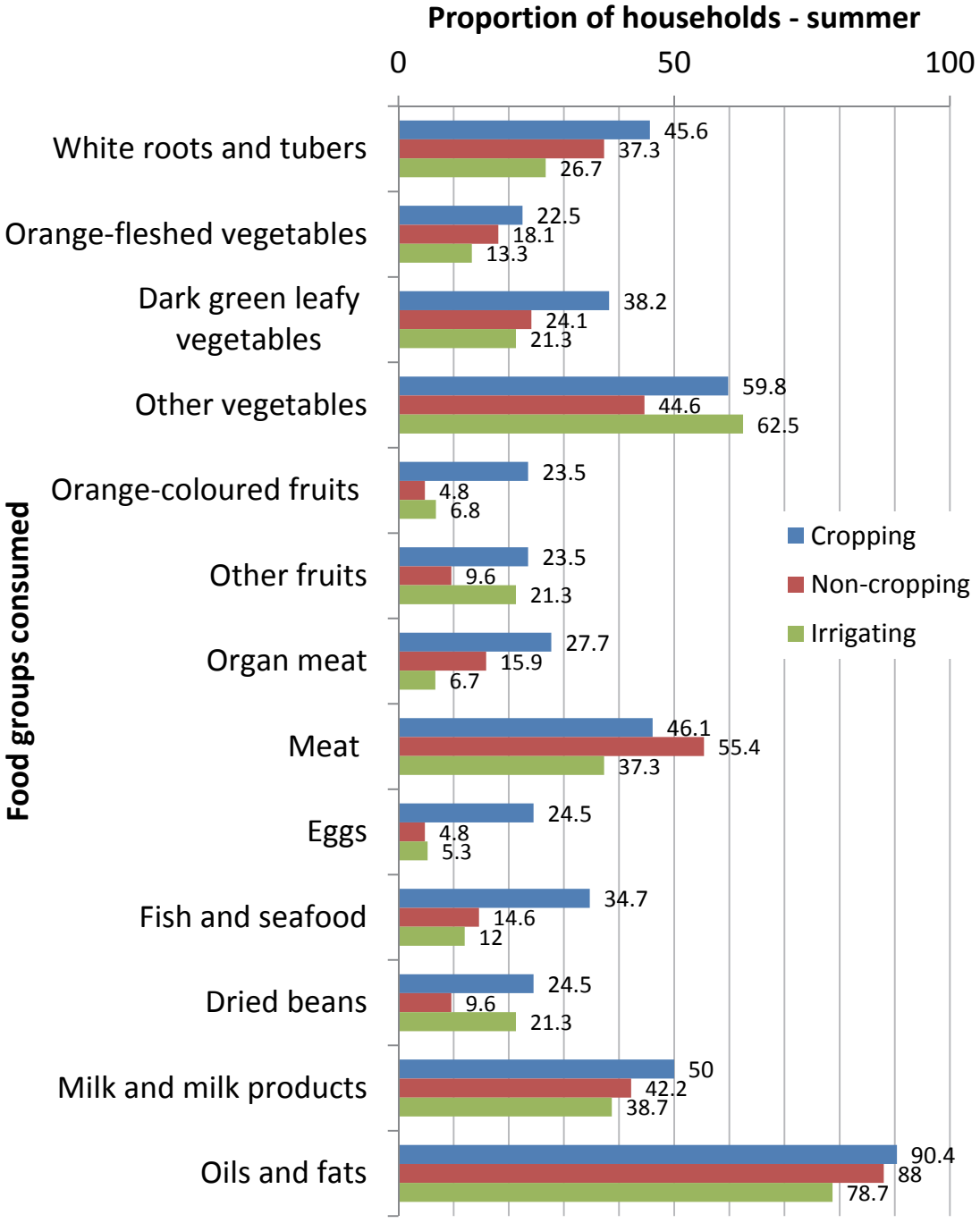

Figure 6: Dietary diversity score – summer

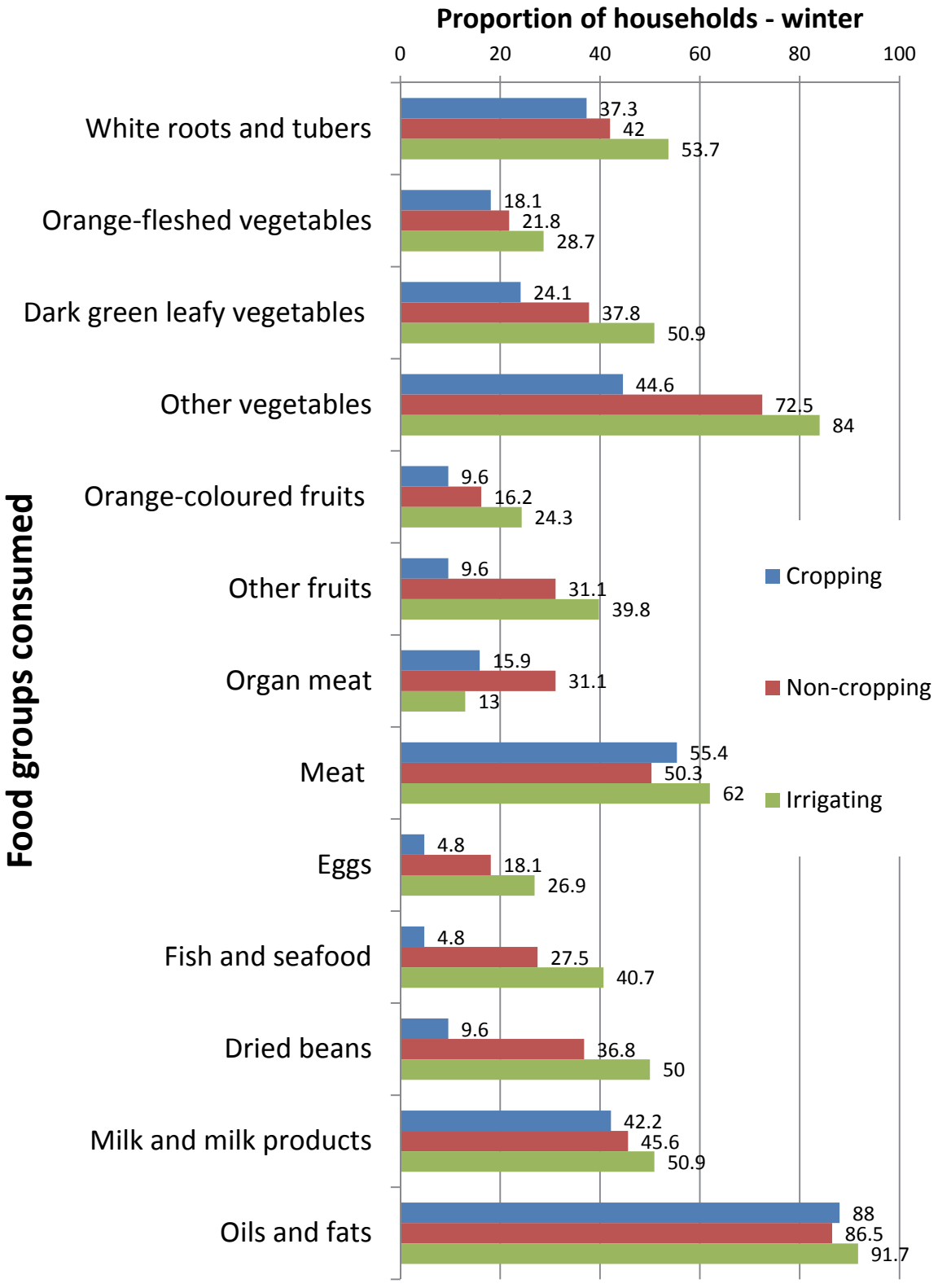

Figure 7: Dietary diversity – winter

Table 39: Food group consumption for cropping and non-cropping households from the 24-hour recall

Food group	Season	Total sample		Non-cropping		Cropping		Irrigating	
		Number	Proportion	Number	Proportion	Number	Proportion	Number	Proportion
Sample size	Summer	264		103		83		75	
	Winter	279		83		193		108	
Cereals	Summer	255	96.2	99	96.1	83	100	74	98.7
	Winter	273	97.5	83	100	186	96.4	102	94.4
White roots and tubers	Summer	125 (of 265)	47.2	47	45.6	31	37.3	20	26.7
	Winter	113	40.4	31	37.3	81	42.0	58	53.7
Orange-fleshed vegetables	Summer	83	31.6	23 (of 102)	22.5	15	18.1	10	13.3
	Winter	57	20.4	15	18.1	42	21.8	31	28.7
Dark green leafy vegetables	Summer	132	50.2	39 (of 102)	38.2	20	24.1	16	21.3
	Winter	93	33.2	20	24.1	73	37.8	55	50.9
Other vegetables	Summer	196	74.2	61 (of 102)	59.8	37	44.6	45 (of 72)	62.5
	Winter	180 of 274)	65.7	37	44.6	140	72.5	89 (of 106)	84.0
Orange-coloured fruit	Summer	72	27.3	24 (of 102)	23.5	4	4.8	5 (of 74)	6.8
	Winter	35 (of 277)	12.6	4	9.6	31 (of 191)	16.2	26 (of 107)	24.3
Other fruit	Summer	100	37.9	24 (of 102)	23.5	8	9.6	16	21.3
	Winter	69	24.7	8	9.6	60	31.1	43	39.8
Organ meat	Summer	79 (of 263)	30.0	28 (of 102)	27.7	13 (of 82)	15.9	5	6.7
	Winter	32 (of 278)	11.5	13 (of 82)	15.9	19	31.1	14	13.0
Meat	Summer	140	53.0	47 (of 102)	46.1	46	55.4	28	37.3
	Winter	144	51.6	46	55.4	97	50.3	67	62.0
Eggs	Summer	76	28.8	25 (of 102)	24.5	4	4.8	4	5.3
	Winter	39	13.9	4	4.8	35	18.1	29	26.9
Fish and seafood	Summer	98 (of 263)	37.3	35 (of 101)	34.7	12 (of 82)	14.6	9	12.0
	Winter	65	23.4	12 (of 82)	4.8	53	27.5	44	40.7
Dried beans and legumes	Summer	96	36.4	25 (of 102)	24.5	8	9.6	16	21.3
	Winter	79	28.2	8	9.6	71	36.8	54	50.0
Milk and milk products	Summer	136	51.1	51 (of 102)	50.0	35	42.2	29	38.7
	Winter	124	44.4	35	42.2	88	45.6	55	50.9
Oils and fats	Summer	238 (of 265)	89.9	91	90.4	73	88.0	59	78.7
	Winter	243	87.1	73	88.0	167	86.5	99	91.7

The dietary diversity of non-crop-producing households was lower than that of crop-producing households in both winter and summer (see Table 30), and decreased by at least one food group in winter. Households engaged in cropping had higher average HDDSs. Irrigation increased the average HDDS of crop-producing households even further. The HDDS for irrigating households increased from an average of 7.1 food groups in summer to 8.9 in winter. Cropping was significantly and positively correlated with the consumption of orange-fleshed vegetables, dark green leafy vegetables, other vegetables, other fruit and dried beans and legumes (see Table 40). Irrigating and farmland (larger-scale) production were positively correlated to the consumption of other vegetables, other fruit, and dried beans and legumes. Farmland production also led to a significant increase in the consumption of orange-fleshed vegetables.

Home gardening led to a significant positive increase in the consumption of white roots and tubers, dark green leafy vegetables, orange-coloured fruit and other fruit in the 24 hours prior to the survey (see Table 40). Participation in a community garden led to significant increases in the consumption of dark green leafy vegetables and other vegetables. School gardening did not demonstrate any statistical relationships with the consumption of foods from the crop-related food groups.

9.2 What Can be Grown?

The purpose of the study was to assess the current rain-fed and irrigated production of food crops and the potential for production in relation to the food and nutrition requirements of poor rural people to propose a prioritised list of opportunities for efficient water use that could directly overcome dietary inadequacies and lead to better nutrition of rural household members.

Having established that engagement in food production has a positive influence on consumption, dietary diversity and dietary quality, and that the availability of produce in summer has a positive overall influence on consumption patterns, the researchers turned to understanding what can be produced in the areas under study to improve food supply and diets all year round.

Table 40: Correlations (Spearman's) of food group consumption and scale of farming

Food group		Cropping	Irrigating	Farm-land	Home garden	School garden	Community garden
White roots and tubers	Correlation coefficient	0.027	0.073	0.084	-0.138**	0.031	0.063
	Significance (two-tailed)	0.531	0.103	0.051	0.001	0.470	0.140
	Sample size	539	506	543	545	545	545
Orange-fleshed vegetables	Correlation coefficient	0.088*	-0.027	0.083	-0.083	0.044	0.041
	Significance (two-tailed)	0.040	0.542	0.054	0.054	0.301	0.335
	Sample size	537	504	540	542	542	542
Dark green leafy vegetables	Correlation coefficient	0.142**	-0.059	0.153**	-0.194**	0.003	0.156**
	Significance (two-tailed)	0.001	0.187	0.000	0.000	0.942	0.000
	Sample size	537	504	540	542	542	542
Other vegetables	Correlation coefficient	0.264**	-0.234**	0.285**	-0.075	-0.068	0.142**
	Significance (two-tailed)	0.000	0.000	0.000	0.082	0.117	0.001
	Sample size	533	500	536	538	538	538
Orange-coloured fruit	Correlation coefficient	0.085	-0.034	0.138**	-0.172**	0.025	0.082
	Significance (two-tailed)	0.050	0.447	0.001	0.000	0.557	0.055
	Sample size	536	503	539	541	541	541
Other fruit	Correlation coefficient	0.212**	-0.121**	0.167**	-0.085*	0.029	0.081
	Significance (two-tailed)	0.000	0.007	0.000	0.049	0.501	0.059
	Sample size	538	505	541	543	543	543
Dry beans and legumes	Correlation coefficient	0.222**	-0.150**	0.134**	-0.075	-0.009	0.144**
	Significance (two-tailed)	0.000	0.001	0.002	0.079	0.835	0.001
	Sample size	538	505	541	543	543	543

** Correlation is significant at the 0.01 level (two-tailed).

* Correlation is significant at the 0.05 level (two-tailed).

Following an investigation of possible crops that can be grown in these communities, a list of potential crops that can be grown in each of the local municipalities under investigation was

prepared. The crops listed by the communities as ones they are not growing, but would like to grow were considered in this exercise. This list is presented below. Production considerations were considered in identifying these crops. This included the timing of planting, frost and pests, and disease problems.

People in the area currently grow most of the recommended crops for improved dietary intake, which were mentioned in Chapter 8. Community members also indicated that they would like to produce these crops in future. The households identified some crops they want to plant, but these crops would not contribute significantly to improving the key nutrients that would improve overall nutrition (vitamin A, iron and zinc), for example, maize and potatoes. The researchers recommend crops such as cucumber, brinjal and zucchini (baby marrow) as important crops to improve dietary quality, but the farmers have no interest in producing these crops. These might be unknown crops in the area and therefore not easily introduced into the diets of the households in these areas.

Some farmers in the surveyed communities produced sweet potatoes, but it is not known if these were the orange-fleshed varieties. Orange-fleshed sweet potato is relatively drought tolerant. The Dry Bean Producers' Organization is working on dry bean cultivars that are more drought tolerant, which can be used by small-scale or rural households where supplementary irrigation is not possible. It should be remembered that the production potential of crops is determined by the site-specific environmental, soil and water availability conditions.

Most fruits are short-season crops. While they can improve dietary intake for periods, these periods often coincide with summer crop availability. Citrus fruit can provide fruit in winter months. However, for all fruit, unless processing and packaging technologies are available to extend the period of availability, these will only supplement diets for short periods of the year. More investigation is required regarding the palatability and acceptance of many fruits and their agronomic potential for the selected sites. Temperate fruits, such as apples and apricots, need a certain number of cold units to induce flowering. In the subtropical areas, such as Maruleng, the winters may not be cold enough to accumulate the required cold units, which leads to poor fruit, if any. The tropical or subtropic crops, such as bananas and avocados, should all be able to be produced in this area. For tree crops, supplementary irrigation may be necessary for sustainable yields. Crops such as strawberries need plenty of water for good production and may not do as well as watermelon and cantaloupe in rain-fed conditions.

Tables 41 and 42 present the list of recommended crops (fruit and vegetables respectively) for consumption at each site, their production considerations, whether they are produced or not, and if the community indicated whether they would like to grow them. For Jozini, the KwaZulu-Natal Department for Agriculture and Environmental Affairs (2013) was approached for bioresource information. The list of potential crops and the growing conditions in this area were taken into consideration. Appendix B contains a list of general

recommendations for producing the crops identified as having the potential to improve nutrition in the investigated sites.

Table 41: Recommended vegetable crops based on the potential for production and the current production patterns in the four sites

Recommended crop based on the potential to improve nutrition	Can it grow in Ingquza Hill?	Is it currently produced in Ingquza Hill?	Can it grow in Jozini?	Is it currently produced in Jozini?	Can it grow in Maruleng?	Is it currently produced in Maruleng?	Can it grow in Ratlou?	Is it currently produced in Ratlou?	Can it be produced under rain-fed conditions?	Can it be produced under irrigation conditions?
African leafy vegetables* ('wild' or cultivated)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4210 Leaves, black jack#	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4197 Leaves, cat's whiskers#	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4198 Leaves, cowpea#	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3785 Leaves, amaranth#	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4200 Leaves, lambquarters#	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4202 Leaves, nettle#	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4203 Leaves, nightshade#	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4204 Leaves, pumpkin#	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4206 Leaves, sow thistle#	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4208 Leaves, sweet potatoes#	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Amadumbe	Yes	Yes	Yes	Yes	No	No	No	No	No	Yes
Bambara groundnut	Yes	Not sure	Yes	No	Yes	Yes	Yes	Not sure	Yes	Yes
Beetroot* roots	Yes	Yes***	Yes	Yes	Yes**	Not sure	Yes**	Not sure	Yes**	Yes
Beetroot leaves	Yes	Yes***	Yes	Yes	Yes**	Not sure	Yes**	Not sure	Yes**	Yes
Broccoli	Yes	No***	Yes**	No	Yes**	No	Yes**	No	No	Yes
Cauliflower	Yes	No***	Yes**	No	Yes**	No	Yes**	No	No	Yes
Cabbage*	Yes	Yes***	Yes	Yes	Yes**	Yes	Yes**	Yes	Yes	Yes
Carrots	Yes	Yes	Yes	Yes	Yes**	Yes	Yes**	Not sure	Yes	Yes
Cowpeas leaves and beans	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not sure	Yes	Yes
Cucumber* (field cucumber)	Yes	Not sure	Yes	No	Yes	Not sure	Yes	No	Yes	Yes
Dark orange pumpkin, butternut or squash*	Yes	Yes***	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eggplant* (brinjal)	Yes	Not sure	Yes	No	Yes	Not sure	Yes	Not sure	Yes	Yes
Gem squash/ 'calabash'/other squash and pumpkin*	Yes	Yes***	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Green beans* leaves and beans	Yes	Yes***	Yes	Yes	Yes**	Yes	Yes**	Yes	Yes	Yes
Green peppers*	Yes	Yes***	Yes	Yes	Yes	Not sure	Yes	Not sure	Yes	Yes
Legumes* (dhal, dry beans, etc.)	Yes	Yes***	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ground nuts (peanuts)	Yes	Not sure	Yes	Not sure	Yes	Not sure	Yes	Not sure	Yes	Yes
Lettuce*	Yes	Yes	Yes**	Yes	Yes	Not sure	Yes**	Not sure	Yes**	Yes

Recommended crop based on the potential to improve nutrition	Can it grow in Ingquza Hill?	Is it currently produced in Ingquza Hill?	Can it grow in Jozini?	Is it currently produced in Jozini?	Can it grow in Maruleng?	Is it currently produced in Maruleng?	Can it grow in Ratlou?	Is it currently produced in Ratlou?	Can it be produced under rain-fed conditions?	Can it be produced under irrigation conditions?
Onions*	Yes	Yes***	Yes	Yes	Yes	Not sure	Yes	Yes	Yes	Yes
Orange-fleshed sweet potatoes*	Yes	Yes	Yes	Yes	Yes	Not sure	Yes	Not sure	Yes	Yes
Peas	Yes	Yes	Yes	Not sure	Yes**	Not sure	Yes**	Not sure	Yes**	Yes
Potatoes	Yes	Yes***	Yes**	Not sure	Yes**	Not sure	Yes**	Not sure	Yes**	Yes
Pumpkins*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Swiss chard* (wrongly indicated as spinach)	Yes	Yes***	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sweet potatoes* see orange sweet potatoes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not sure	Yes	Yes
Tomatoes*	Yes	Yes***	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zucchini*	Yes	Not sure	Yes	Not sure	Yes	Not sure	Yes	Not sure	Yes	Yes

* The crop is prioritised for its nutritional content.

** The crop would do better with supplementary irrigation.

*** Farmers are interested in cultivating the crop.

Table 42: Table of recommended fruit crops based on their potential for production

Recommended crop based on the potential to improve nutrition	Can it grow in Ingquza Hill?	Is it currently produced in Ingquza Hill?	Can it grow in Jozini?	Is it currently produced in Jozini?	Can it grow in Mopani?	Is it currently produced in Maruleng?	Can it grow in Ratlou?	Is it currently produced in Ratlou?	Can it be produced under rain-fed conditions?	Can it be produced under irrigation conditions?
Apples	No	No	No	No	No	No	No	No	N/A	N/A
Apricots	No	No	No	No	No	No	No	No	N/A	N/A
Avocados	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Not sure	Yes	Yes
Bananas	Yes	Not sure	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Berries	No	No	No	No	No	No	No	No	N/A	N/A
Citrus fruit	No	No	Yes	Not sure	Yes	Yes	Yes	Not sure	Yes	Yes
Figs	Yes	Not sure	Yes	Not sure	Yes	Not sure	Yes	Not sure	Yes	Yes
Loquats	Yes	Not sure	Yes	No sure	Yes	Not sure	Yes	Not sure	Yes	Yes
Mangoes	Yes	Not sure	Yes	Not sure	Yes	Yes	Yes	Not sure	Yes	Yes
Marula	No	No	Yes	Not sure	Yes	Yes	No	No	Yes	Yes
Peaches (orange)	No	No	No	No	No	No	No	No	N/A	N/A
Papaya	Yes	Not sure	Yes	Not sure	Yes	Yes	Yes	Not sure	Yes	Yes
Pears	No	No	No	No	No	No	No	No	N/A	N/A
Pineapples	Yes	Not sure	Yes	Not sure	Yes	Not sure	No	No	Yes	Yes
Plums	No	No	No	No	No	No	No	No	N/A	N/A

Recommended crop based on the potential to improve nutrition	Can it grow in Ingquza Hill?	Is it currently produced in Ingquza Hill?	Can it grow in Jozini?	Is it currently produced in Jozini?	Can it grow in Mopani?	Is it currently produced in Maruleng?	Can it grow in Ratlou?	Is it currently produced in Ratlou?	Can it be produced under rain-fed conditions?	Can it be produced under irrigation conditions?
Spanspek (cantaloupe)	Yes	Not sure	Yes	Not sure	Yes	Not sure	Yes	Not sure	Yes	Yes
Watermelon/*makataan*	Yes	Not sure	Yes	Not sure	Yes	Not sure	Yes	Not sure	Yes	Yes

9.3 Nutrient Composition of the Recommended Crops

The recommended crops for improving the diets of the households surveyed were presented in Chapter 8. Tables 43 and 44 present the nutrient values per 100 g of raw, edible food[3] of the recommended crops for key nutrients – vitamin A (largely found in orange-fleshed vegetables and orange- and red-coloured fruit), iron (found in higher concentrations in green leafy vegetables) and zinc (based largely on Wolmarans et al. 2010; Kruger et al. 1998). This data was used to rank the crops by nutrient composition and density. The equivalent values for raw, edible food were used, converted from 'as purchased' to 'as ready to cook or serve raw' by Wolmarans et al. (2010) and Kruger et al. (1998).

The team considered other important macronutrients (such as protein), micronutrients (such as folate) and trace elements (such as zinc). Protein and zinc are not found in significant quantities in plant foods, except for the protein in legumes. Legumes are protein-rich foods, but they are already included in the list of recommended foods due to their iron content. Legumes are also good sources of zinc. Moreover, phytates, which are commonly found in plant foods, can reduce zinc absorption.

The best sources of folate are green leafy vegetables, avocados, broccoli, fruit (especially citrus, papaya and berries), cauliflower, beetroot, carrots, legumes and squash. All these foods have already been included in the list of recommended crops.

The South African food composition database (Wolmarans et al. 2010; Kruger et al. 1998) does not contain beta-carotene values. These were calculated by multiplying the retinol equivalent values by six to get the beta-carotene values (as per Wolmarans et al. 2010:5). Beta-carotene is only found in fruit and vegetables. As beta-carotene is the precursor for vitamin A, it was assumed that legumes do not contain vitamin A.

[3] Conversion from 'as purchased' to 'as ready to cook or serve raw' (Shugart et al. 1986; Lynch 2012)

Table 43: Selected nutrient values for the recommended vegetable crops

Consumption recommendation	Database code[1]	Nutrient values per 100 g of edible food[2]			
		Beta-carotene (µg)[1]	Vitamin A (µg RE)	Iron (mg)	Zinc (mg)
African leafy vegetables ('wild' or cultivated)	4210 Leaves, black jack#	5898	983	6	0.91
	4197 Leaves, cat's whiskers#	7182	1197	2.6	0.76
	4198 Leaves, cowpea#	594	99	2.7	0.4
	3785 Leaves, amaranth raw#	1956	326	4.8	1.51
	4196 Leaves, amaranth dried#	16140	2690	21	4.99
	4200 Leaves, lambquarters#	5490	915	6.1	1.36
	4202 Leaves, nettle#	6072	1012	7.2	0.69
	4203 Leaves, nightshade#	6378	1063	8.5	1.16
	4204 Leaves, pumpkin#	1164	194	2.2	0.2
	4206 Leaves, sow thistle#	5898	983	7.1	0.9
	4208 Leaves, sweet potato#	618	103	1	0.29
Amadumbe	3787 Tuber, raw, (flesh only)	-	-	0.6	0.23
Bambara groundnuts	03_001 Seeds, dried, raw	30	5	4.4	2.2
Beetroot roots	4096 Roots (flesh and skin)	18	3	0.8	0.29
Beetroot leaves	4097 Leaves	3660	610	3.3	0.38
Broccoli	3702	396	66	1.2	0.66
Cabbage	3704 Cabbage raw	42	7	0.3	0.14
	4108 Chinese cabbage	50	9	0.4	0.14
Carrots	3709 (flesh and skin)	19500	3250	0.6	0.35
Cauliflower	3828	12	2	0.5	0.32
Cowpeas	03_004 Dried, raw	41	7	7.8	8
	04_010 Leaves, raw	2900	483	4.5	0.6
	4198 Leaves, raw	594	99	2.7	0.40
Cucumber (field cucumber)	4252 Wild, raw	42	7	0.5	0.25

Consumption recommendation	Database code[1]	Nutrient values per 100 g of edible food[2]			
		Beta-carotene (µg)[1]	Vitamin A (µg RE)	Iron (mg)	Zinc (mg)
Dark orange pumpkin, butternut or squash	4174 Butternut	768	128	0.4	0.31
Eggplant (brinjal)	4098 (Flesh and skin)	72	12	0.6	0.32
Green beans	4120 Green beans raw	216	36	0.9	0.40
Ground nuts (peanuts)	4285 Peanut	-	0	4.6	3.27
Green peppers	3733 Sweet green, raw	216	36	0.9	0.24
Legumes (dhal, dry beans, etc.)	3200 Broad beans, dried	30	5	6.7	3.14
	3180 Beans haricot, dried	-	0	6.4	2.54
	3206 Beans sugar, dried	-	0	5.9	2.54
Lettuce	3723	90	15	0.5	0.28
Onions	3755	-	0	0.5	0.31
Orange-fleshed sweet potatoes	02_013 Yellow, raw	5256	876	2.0	0.3
Orange-fleshed sweet potatoes	3748 Orange-fleshed, baked	13092	2182	0.5	0.29
Peas	4144	156	26	1.7	0.87
Potatoes	4154 (Flesh only)	-	trace	0.7	0.29
	4121 (Flesh and skin)	-	0	1.2	0.29
Pumpkins	4163 Pumpkin	936	156	0.4	0.24
	4163 Hubbard Squash	2376	396	0.2	0.16
Squash (gem squash, calabash or other squash and pumpkin)	4174 Butternut	768	128	0.4	0.31
	3769 Baby marrow (zucchini)	132	22	0.8	0.55
	4211 Calabash/gourd (white) raw	-	-	0.5	0.70
	4175 Gem (flesh only), raw	-	trace	0.2	0.28
Swiss chard (often wrongly indicated as spinach)	4168	2808	468	4.4	0.73
Tomatoes	3750	234	39	0.2	0.16

[1] Wolmarans et al. 2010; Stadlmayr et al. 2010; Kruger et al. 1998 – no values available

[#] Estimated as µg retinol equivalents (µg RE) x 6 µg carotene following Wolmarans et al. (2010:5)

Table 44: Selected nutrient values for the recommended fruit crops

Consumption recommendation	Database code	Beta-carotene (µg)	Vitamin A (µg RE)	Iron (mg)	Zinc (mg)
Apples, average	3532	18	3	0.3	0.09
Apricots	3534	408	68	0.5	0.16
Avocados	3656	18	3	0.4	0.57
Bananas	3540	96	16	0.6	0.23
Berries, blueberries	3566	30	5	0.2	0.11
Citrus fruit, orange	3560	24	4	0.3	0.22
Citrus fruit, naartjie	3558	114	19	0.1	0.05
Figs	3544	150	25	0.5	4.53
Loquats	3555	594	99	0.3	0.05
Mangoes	3556	396	66	0.2	0.07
Marulas	4241	-	0	0.5	0.10
Melon, wild raw	3678	12	2	0.9	0.05
Melon (raw), also known as *tsama* or *makataan*	4246	450	75	0.3	0.09
Peaches (yellow)	3565	36	6	0.3	0.09
Papaya	3563	606	101	0.1	0.04
Pears	3582	18	3	0.4	0.14
Pineapples	3581	30	5	0.3	0.03
Plums, wild	3597	228	38	0.6	0.14
Plums	3570	48	8	0.3	0.10
Spanspek, (cantaloupe) or melon (orange flesh)	3541	696	116	0.4	0.10
Watermelon/*makataan*	3576	66	11	0.1	0.09

[1] Wolmarans et al. 2010, Stadlmayr et al. 2010, Kruger et al. 1998 – no values available

[#] Estimated as µg retinol equivalents (µg RE) x 6 µg carotene following Wolmarans et al. (2010:5)

9.4 Water-Efficient Options to Improve Diet Quality

Having established which crops can grow in the four areas with the potential for improving the diets of poor rural households in the sites, the researchers turned to investigating the water requirements of the various recommended crops.

Nutrient water productivity indicates the weight (kg) of produce that can be produced per cubic metre of water (Wenhold et al. 2012). The higher the water productivity value, the more can be produced per unit of water. Crops with higher water productivity are recommended for production in dry areas. Tables 45 and 46 present the water productivity for the crops recommended for improving nutrition in the study sites. As seen from the data, most of the recommended crops were selected for their provision of at least one specific nutrient, but also provide a range of nutrients that are required as part of the diversified diet that is necessary to improve nutrition.

It is noted that some of the crops on the recommended list are ‘dual-purpose’ crops, and provide nutritious grains (as in the case of cowpea) or starch (as in the case of beetroot and pumpkins or squashes), as well as leaves that can be used fresh or dried. Some of these, for example cowpeas, also provide feed for animals. Leguminous plants also have benefits for soil quality and nitrogen, and support improved yields for other crops.

Figure 8 provides insight into the water productivity of the recommended crops and indicates how efficiently they can produce nutritious food. The estimates make a number of assumptions that need to be considered when interpreting the graph. These assumptions relate to, among other things, water losses in the system, the conversion of harvested produce to edible portions, the bioavailability of nutrients for use by the human body, and losses in cooking and preparation. Nevertheless, the illustration offers insight into comparative nutrient yield per unit of raw produce produced per cubic metre of water applied to the plant.

From this diagram, it is clear that different crops are beneficial for improving the intake of one nutrient, but these crops are not necessarily high in another nutrient per unit of edible food and produced with a unit of water. As dietary diversity is important for nutrition, it is important to produce a variety of crops to ensure a diverse plate of food.

Table 45: The water nutrient productivity of the recommended crops

Consumption recommendation	Database code[a]	Water productivity (kg/m^{-3})	Reference
African leafy vegetables ('wild' or cultivated)	4210 Leaves, black jack#	Mustard 0.89 to 2.01 Jute mallow 0.26 to 0.56 Spider plant 0.2 to 0.73 Watermelon 0.14 to 0.43	Wenhold et al. (2012)
	4197 Leaves, cat's whiskers#		
	4198 Leaves, cowpea#		
3785 Leaves, amaranth#	3785 Leaves, amaranth#	0.54 to 1.11	
4200 Leaves, lambquarters#	4200 Leaves, lambquarters#	-	
4202 Leaves, nettle#	4202 Leaves, nettle#	-	
4203 Leaves, nightshade#	4203 Leaves, nightshade#	0.81 to 2.88	
4204 Leaves, pumpkin#	4204 Leaves, pumpkin#	0.13 to 0.92	
4206 Leaves, sow thistle#	4206 Leaves, sow thistle#	-	
4208 Leaves, sweet potatoes#	4208 Leaves, sweet potato#	0.1 to 0.9	
Amadumbe		0.22 to 0.24	Mabhaudhi et al. (2013a)
Bambara groundnut		0.38 to 0.53 – also 0.09 to 0.25 mentioned	Karunaratnea et al. (2015); Mabhaudhi et al. (2013b)
Beetroot root	Roots	-	
Beetroot leaves	4097 Leaves	-	
Broccoli		1.89 to 14.61 – also 2.08 to 3.37	Erdem et al. (2010); Lopez-Urrea et al. (2009)

Consumption recommendation	Database code[a]	Water productivity (kg/m^{-3})	Reference
Cauliflower		3.74 to 7.49 – also 3.28 to 31.91	Bozkurt et al. (2011); Sarkar (2009)
Cabbage	4108	7.4 to 11.8 – also 3.93 to 11.38	Imtiyaz et al. (2000); Kadyampakeni (2013)
	3704 Cabbage leaves, Chinese cabbage	As above	
Carrots	3709	6.4 to 12.8 – also 1.27 to 6.86	Imtiyaz et al. (2000); Sarkar (2009)
Cowpeas leaves as well as beans	Green beans	Leaves = 0.23 to 0.53	
	Cowpea		
	4198 Cowpea leaves		Wenhold et al. (2012)
Cucumber (field cucumber)		5.1 to 8.58 – also 19 to 33 1.08 to 9.12 (furrow vs. drip)	Abd El-Mageeda and Semidab (2015a); Iqbal et al. (2014); Rahil and Qanadillo (2015)
Dark orange pumpkin, butternut or squash	4174 Butternut	9.28 to 12.22 – also 13.42 to 18.58	Fandika et al. (2011)
Eggplant* (brinjal)		6.93 – also 4.36 to 11.6	Amiri et al. (2012); Manjunatha et al. (2004)
Gem squash/'calabash'/ other squash and pumpkin		2.96 to 5.46 – also 18.87 to 25.99	Abd El-Mageeda and Semidab (2015b); Fandika et al. (2011)
Green beans (leaves and beans)		1.8 to 4.4 for beans	Köksal et al. (2008)
Green peppers	3733	0.68 to 4.52 (furrow vs. drip)	Iqbal et al. (2014)
Legumes (dhal, dry beans, etc.)	3200 Beans, broad beans, dried	2.56 to 9.89 – also 0.74 to 1.9	Bhattarai et al. (2006); Efetha et al. (2011)
	3180 Beans, haricot, dried		
	3206 Beans, sugar, dried		
Ground nuts (peanuts)	4285	0.71 to 9.64	Kuotsu et al. (2014)
Lettuce		3.5 – also 6.8 to 8.8	Aggelides et al. (1999); Gonnella et al. (2003)

Consumption recommendation	Database code[a]	Water productivity (kg/m^{-3})	Reference
Onions		3.71 to 7.33	Imtiyaz et al. (2000)
Orange-fleshed sweet potatoes	3748	0.8 to 2.3	Gomes and Carr (2003)
Peas		6.44 to 11.63	Wang et al. (2012)
Potatoes		2.14 to 4.76	Ahmadi et al. (2014)
Pumpkins	4176 Hubbard squash	9.28 to 12.22 – also 13.42 to 18.58	Bhattarai et al. (2006); Fandika (2011)
	4163 Pumpkin		
Swiss chard (wrongly indicated as spinach)	4168	1.16 to 3.55	Imtiyaz et al. (2000)
Sweet potatoes – see orange sweet potatoes		0.8 to 2.3	Gomes and Carr (2003)
Tomatoes		2.72 to 6.55 – also 1.43 to 9.09 (furrow vs. drip)	Imtiyaz et al. (2000); Iqbal et al. (2014)
Zucchini		22.6 to 27.9 – also 2.73 to 4.02	Rouphael et al. (2006); Rouphael and Colla (2005)

[a] Reference in Wolmarans et al. 2010; Kruger et al. 1998

- No data available

Table 46: Water nutrient productivity of the recommended fruit

Consumption recommendation	Database code	Water productivity (kg/m$^{-3)}$	Reference
Apples		1.01 to 7.32 – also 17.44 to 49.58	Liu et al. (2012); Zegbe and Serna-Pérez (2012)
Apricots	3534	6.86 to 9.62	Nicolas et al. (2005)
Avocados		1.57 to 2.2	Carr (2013)
Bananas		4 to 8	Carr (2009)
Berries		2.1 to 3.1 (blue berries) 6.5 to 25.6 (strawberries)	Grant et al. (2010); Keen and Slavich (2012)
Citrus fruit		4.0 to 8.2 – also 0.93 to 1.24	Consolia et al. (2014); Roccuzzo et al. (2014)
Figs		-	
Loquats	3555	2.24 to 5.73	Cuevasa et al. (2012)
Mangoes	3556	5.81 to 7.94	Da Silva et al. (2009)
Marulas		-	
Peaches (orange)	4258	5.3 to 9.5 – also 1.1 to 2.48	Gunduz et al. (2011); Wang et al. (2015)
Papaya	3563	1.76 to 4.06	Mellado-Vazquez et al. (2005)
Pears		5.3 to 21.9 – also 5.91 to 10.88	Cui et al. (2009); Yin et al. (2012)
Pineapples		5 to 12	Carr (2012)
Plums		4.2 to 7.5	Intrigliolo and Castel (2010)
Spanspek (cantaloupe)		10.3 to 21.4	Song (2004)
Watermelon/*maketaan*		31.0 to 50.3	Kaya et al. (2003)

[a] Reference in Wolmarans et al. 2010; Kruger et al. 1998

- No data available

Each member in a household will have nutrient requirements specific to their life stage and it will depend on their level of activity and health status. As pointed out by the Nutrition Information Centre (undated), the results of the National Food Consumption Survey of South African children aged one to nine years old in 1999 showed that a very significant proportion of the country's population lives under adverse socio-economic conditions and that the dietary intake of micronutrients is poor. The same was found for the households included in these study sites. Therefore, "socio-economic upliftment is considered essential to the sustainable reduction of micronutrient deficiencies and under-nutrition in general. This emphasises the need to include and eat micronutrient-dense food" (Nutrition Information Centre undated).To illustrate the potential of the prioritised crops to provide an adequate portion of key nutrients (vitamin A, zinc and iron), the table below presents the dietary reference intakes for children four to six years old.

Table 47: Dietary reference intakes for children

Age	Vitamin A (µg RE)	Iron (mg)	Zinc (mg)
Four to six years old	400	10	5

Source: Nutrition Information Centre (undated)

It is clear from Figure 8 that only the orange-fleshed vegetables could provide nutrient-dense edible portions of produce. Please note that the nutrient water productivity of beetroot was not available, so no values for the nutrient water productivity for vitamin A in beetroot (roots or leaves) are available for comparison, but it would be expected to be high.

It is concerning that very few of the identified crops are able to produce edible food in winter. It is also important to note from the production guidelines in Appendix B that many of these crops will require supplemental water, especially in winter. Another important consideration with regard to children is the acceptability of fruit and vegetables. Children are notoriously fussy eaters. They also eat small portions at a time and require more small meals per day than adults do.

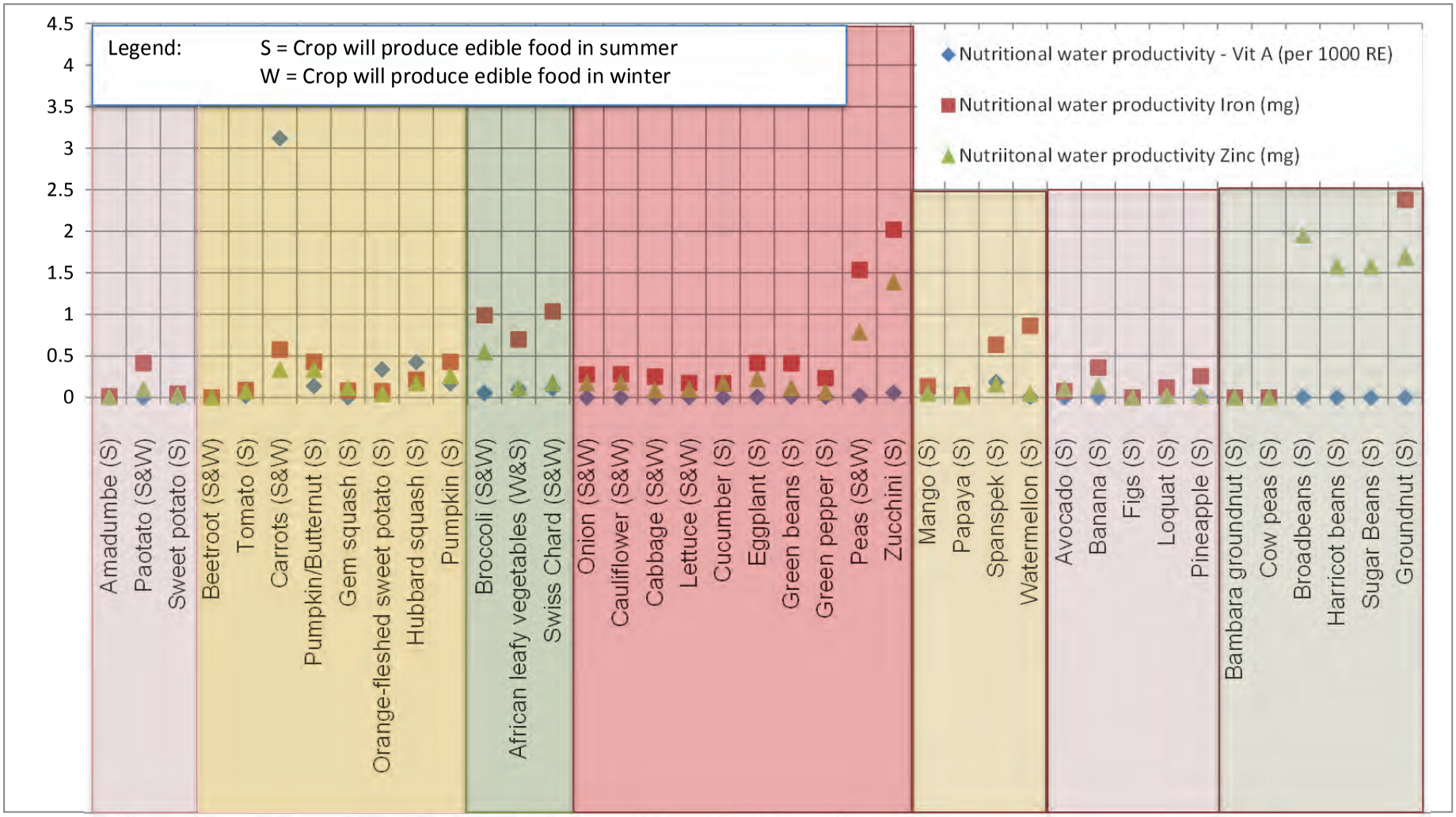

Figure 8: Illustration of the nutritional water quality per 100 g of edible produce

CHAPTER 10: PRIORITISED CROPS TO IMPROVE THE DIETS OF POOR RURAL COMMUNITIES

The purpose of this study was to assess the current rain-fed and irrigated production of food crops and their potential in relation to the food and nutrition requirements of poor rural people to determine crop water use elements for further research. After investigating the production and consumption patterns of rural communities in Ingquza Hill, Jozini, Maruleng and Ratlou, the consumption patterns of the households were analysed and gaps identified. Possible crops that can be produced under rain-fed and irrigated conditions were listed for each site. The limitations of food production in each area were considered. The potential for the production of these crops to sustain annual per capita food consumption was investigated. The water use, yield and good management practices were taken into account in the final list of priority crops. Finally, the findings and priority lists were presented to the communities for validation.

10.1 Priority Crops Identified

The list of priority crops identified for each site is presented in figures 9 to 12. These crops are recommended for production by the communities at Ingquza Hill, Jozini, Maruleng and Ratlou to improve their year-round consumption of diversified diets. Guidelines for production are presented in Appendix B. It is important to note that the categorisation of these crops does not follow the typical food groups set out by Kennedy et al. (2011) and presented in Table 6. The crops have been classified in a way that the research team felt was more relevant for presenting the dietary recommendations to the members of the communities that participated in the survey.

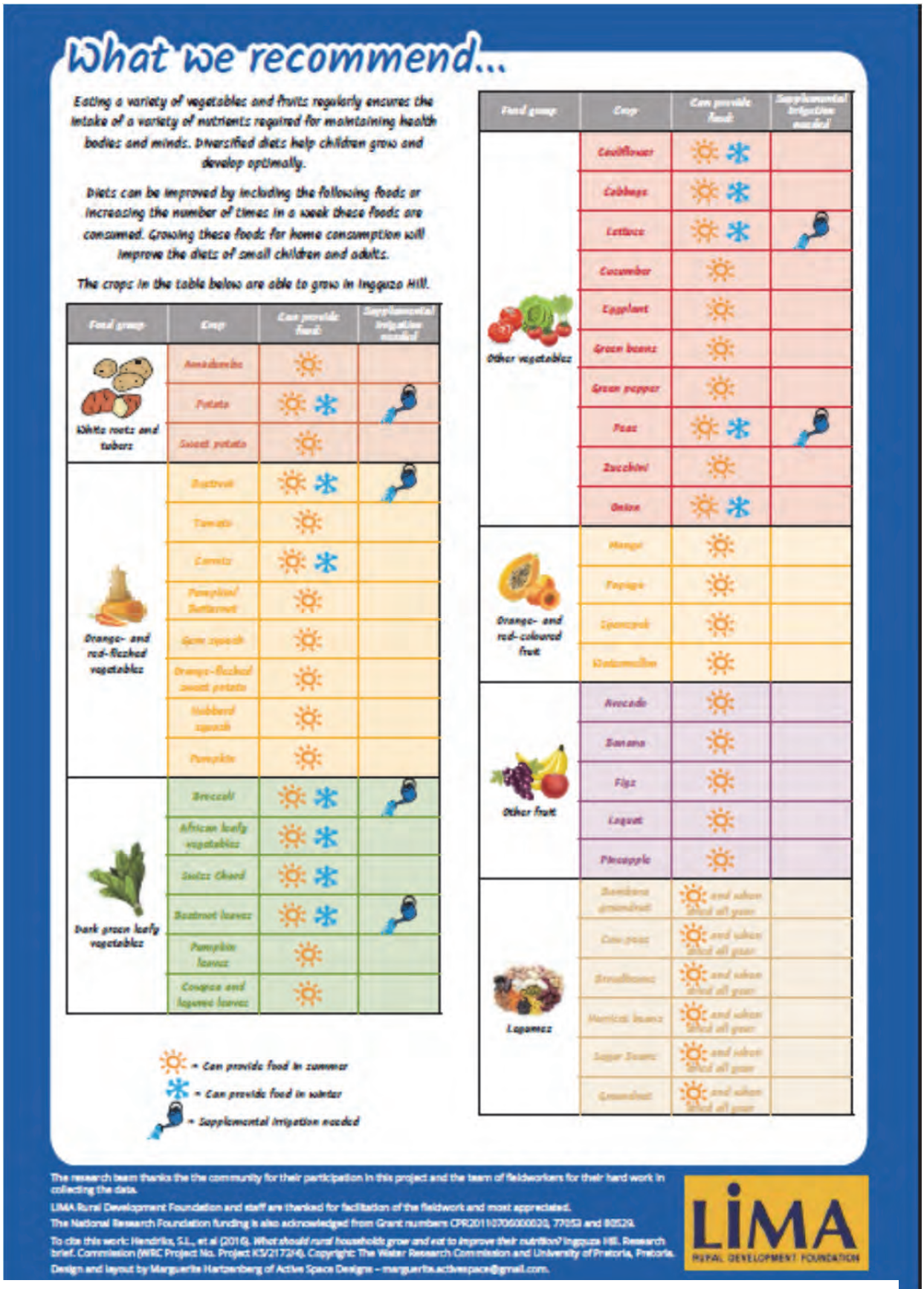

Figure 9: Priority crops for Ingquza Hill

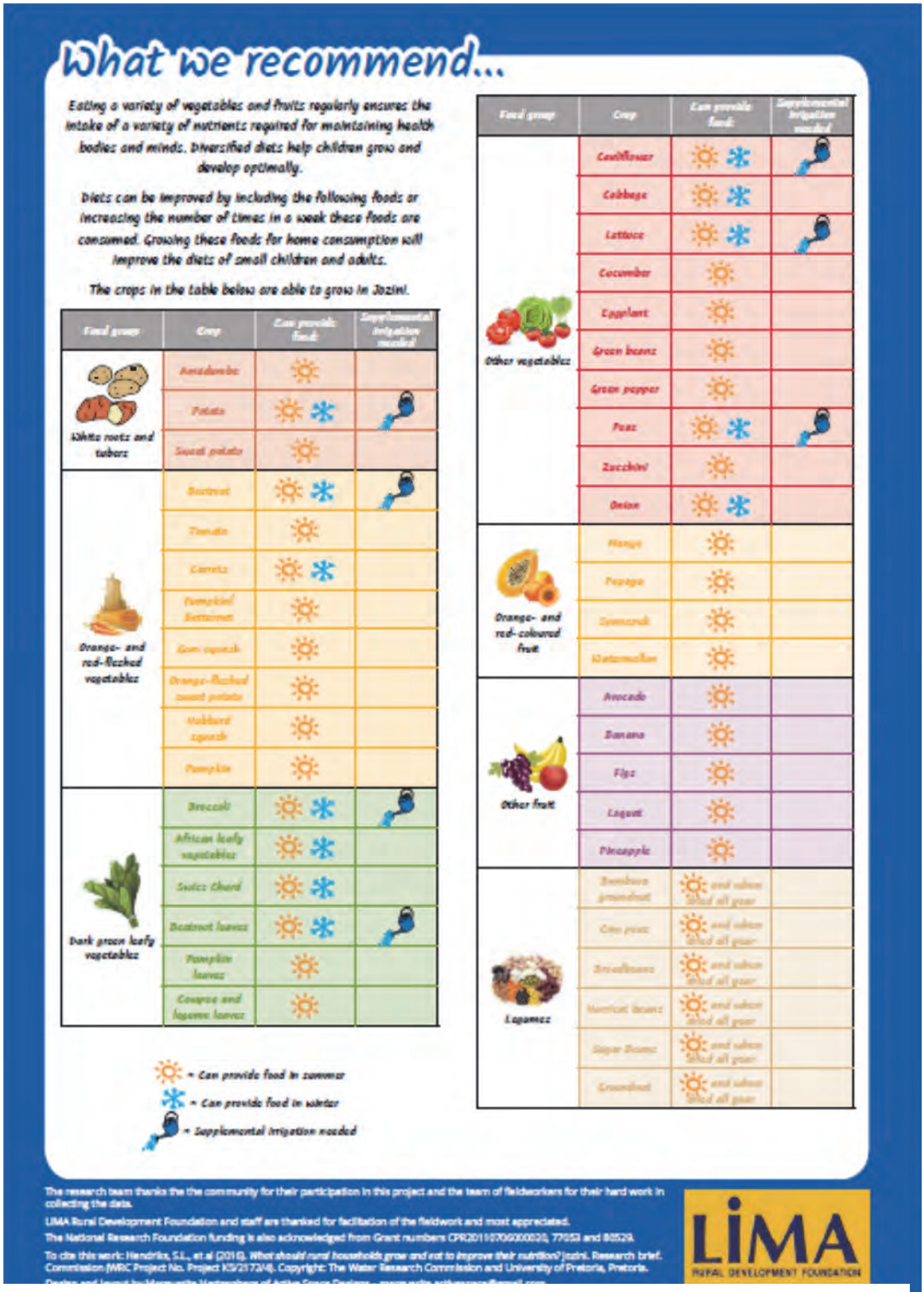

Figure 10: Priority crops for Jozini

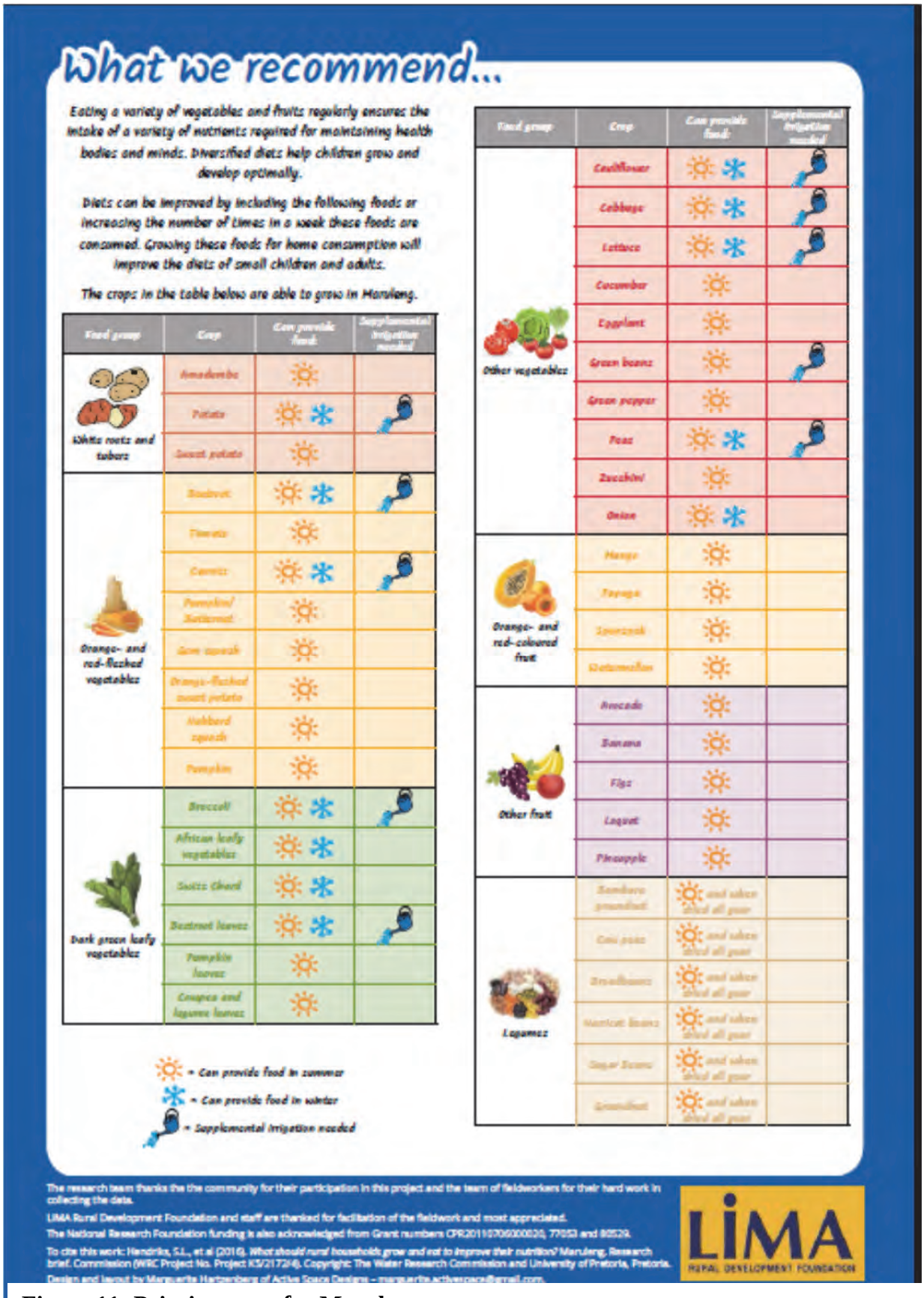

Figure 11: Priority crops for Maruleng

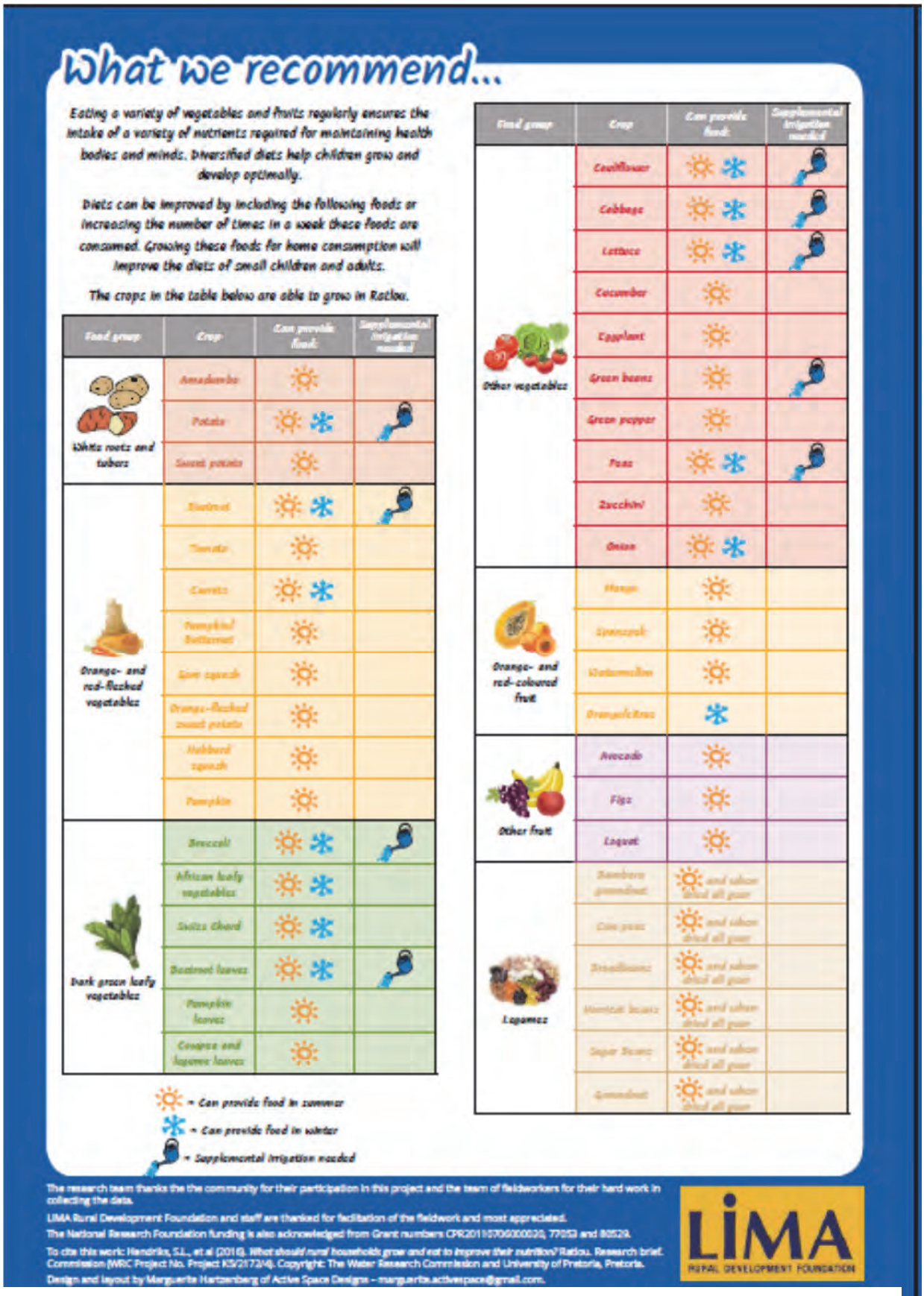

Figure 12: Priority crops for Ratlou

10.2 Validation of the Findings

Four validation workshops (one at each site) were held between 8 and18 February 2016. Some 30 to 40 participants attended the workshop. Participants included community members and farmers who participated in the field research focus groups, community garden organisers (schools and clinics), district agricultural extension workers and rural development workers.

The aim of the workshops was to present the research results to the communities for validation and feedback. Varying levels of literacy among the participants necessitated the presentation of numerical, quantitative data in accessible forms. A graphic designer was engaged to prepare a series of posters and brochures, the latter of which could remain with the participants.

The four-page brochures contained a simple introduction to the research project, tables presenting data on household dietary diversity, the frequency of food consumption, the seasonal consumption of different food groups, the anthropometry of adult female caregivers and children, the key nutrition findings and the prioritised list of recommended rain-fed and irrigated crops for summer and winter.

Brochures were handed to each participant and the findings and recommendations were orally presented to the participants through interpreters in the local language. After a brief presentation, the participants were divided into groups to discuss the findings among themselves for 15 minutes. The groups were divided into farmers/growers, garden project workers and extension/rural development workers to capture different perspectives on the research findings. Each group presented a summary of the discussion in a plenary. The discussion questions given to the groups were the following:

- Is the information supplied in this brochure an accurate depiction of the situation or context in the community?
- Are there foods on the recommended list for growing and eating that the community would not grow for reasons of preference, taste or culture?
- Are there foods on the recommended list for growing and eating that the community would not grow for reasons related to agronomic factors? What are these factors?
- If they could tell the WRC what to prioritise for research (for example, varieties, crops, practices, water-related applications), what would it be?
- Have we missed anything?

All the participants were delighted that the research team had honoured their word to return to present the findings of the study. They expressed appreciation for the brochures and found them useful.

Overall, the respondents at each site concurred with the findings of the study. They stated that diverse diets were not affordable. There were no reasons presented for why preference, culture and taste would constrain the consumption of the recommended crops. There was wide acknowledgement that purchased ‘modern’ foods make people obese and unhealthier than they were in the past.

However, the lack of water was highlighted in each discussion as the major limitation to producing the prioritised crops. Even where the agronomic literature consulted indicated that the crop could be produced under rain-fed conditions at that site, the communities did not agree that this was possible.

Most participants indicated that many of these foods had been produced in the past, but the current climatic conditions and a lack of water were not conducive conditions for production. Given that the validation sessions were conducted during one of the worst droughts on record in the country, one could expect that the lack of water would be a crucial point of discussion. However, the topic of climate change also emerged repeatedly in the initial FGDs. Respondents suggested that the WRC’s future research should focus on access to water and adapting farming methods to climate change.

CHAPTER 11: CONCLUSIONS AND RECOMMENDATIONS

This unique study drew on a transdisciplinary research approach to investigate the consumption and production patterns of rural households in communities in four selected sites in the poorest local municipalities in South Africa. The food security of the households was assessed using the anthropometry of children between 24 and 59 months and their female caregivers, food consumption frequencies and the diversity of their diets. Qualitative and quantitative data related to production and consumption was used to identify which crops could improve the dietary diversity and nutrition of these households and compare the nutritional status, dietary diversity and food consumption patterns of households that are engaged in rain-fed and irrigated crop production with that of households that are not engaged in crop production. The agronomic conditions in the four sites were examined and crops that could grow in these areas were identified. The food consumption gaps and potential crops were prioritised in terms of which crops could be grown to improve the diets in each site. These were validated by presenting the findings and recommendations to the communities in Ingquza Hill, Jozini, Maruleng and Ratlou.

11.1 Study Conclusions

It is clear from the study that most households are food insecure, with inadequate food available to meet the requirements for a diversified diet. Roughly one in four households reported experiencing hunger for most months of the year, but the majority of households (more than one in three) reported experiencing hunger in January. In terms of food availability, it seemed that most households were able to purchase enough of the staple maize meal consumed daily by all households. Relatively few young children and their female caregivers were underweight, but there is substantial evidence of extensive hidden hunger. A high proportion of female caregivers were overweight and obese, which suggested that sufficient dietary energy in the form of the staple food – refined, purchased white maize – is available to most households. The high levels of stunting indicate that the children included in the survey have experienced growth faltering early in their lives. What is of concern, however, is how many of these stunted children were also overweight. The largely maize-based diet is likely to be the underlying reason for both growth faltering in children and overweight in women.

The daily consumption of a variety of fruit and vegetables is essential for good nutrition, human productivity and child development. Hidden hunger is characterised by inadequate dietary diversity and micronutrient deficiencies. Although the researchers did not conduct a clinical test to confirm this, the lack of dietary diversity and daily consumption of foods from multiple food groups is indicative of an inadequate diet. The lack of availability of the fruit and vegetables that are essential for good nutrition is of concern. Very few households consume an adequate diversity of fruit and vegetables on a daily basis. Seasonality affects the availability of fresh fruit and vegetables, which reduces the availability of these foods in winter. A lack of water constrained the production of many nutritious crops, and participants

in FGDs reported that drought and climate change have reduced opportunities for diversifying production and the availability of wild foods.

Access to a diversified diet is problematic for households in these communities. Households reported that a diverse diet was unaffordable. Jozini (where dietary diversity was higher) was an exception, because households consumed foods from an average of four food groups each day. The typical diet consisted of maize meal with sugar. Where incomes permitted and production provided ingredients, a relish of onion and tomato or cabbage was added to one meal per day.

The dietary assessment indicated that there is a dire need to strengthen the existing good consumption patterns related to the consumption of diverse diets in these communities and to promote and encourage the consumption of more diverse diets daily. It is particularly important that these communities regularly consume foods from the following food groups:

- Dark green leafy vegetables such as beans, broccoli, the leaves of beetroot, cowpeas, pumpkin, sweet potatoes and Swiss chard, as well as African green leafy vegetables, such as blackjack, cat's whiskers, amaranth, lamb quarters, nettle, nightshade and sow thistle
- Other vegetables such as cabbage, cauliflower, cucumber, eggplant (brinjal), gem squash, 'calabash' or other squash, green beans, green peppers, lettuce, peas, onions and zucchini (baby marrow)
- Orange- and red-fleshed vegetables such as beetroot, carrots, dark orange pumpkin, butternut or squash, as well as orange-fleshed sweet potatoes and tomatoes
- Legumes such as Bambara groundnuts, cowpeas, dhal, dry beans and ground nuts (peanuts)
- Roots and tubers such as *amadumbe*, potatoes and sweet potatoes
- Orange- and red-coloured fruit such as citrus fruit, mango, papaya, pineapple, cantaloupe and watermelon or *makataan*
- Other fruit including avocadoes, banana, figs, loquats and marulas

An encouraging number of households were engaged in agriculture in Ingquza Hill, Jozini and Maruleng. It was also encouraging to note how many households were keen to engage in agriculture and produce a wider range of crops. A very small number of households engaged in agriculture in Ratlou due to the aridity of the area.

The study found an encouraging link between engaging in agriculture and diet. Engagement in crop production increased the availability of vegetables and, in some cases, fruit (when in season). This improved households' dietary diversity and children's anthropometry scores. Income from farmland production and irrigated agriculture led to increased intakes of fruit and vegetables in general, but also meat, eggs, fish, milk, roots and tubers. A number of fruit and vegetable crops can be produced in these communities. However, the number of crops

that will produce edible food in winter is severely constrained. In the areas with higher rainfall (Ingquza Hill, Jozini and Maruleng), a number of these crops can be produced under rain-fed conditions under normal climatic conditions. However, communities reported that this is not possible under the prevailing conditions of drought. Access to irrigation is necessary to overcome constraints, reduce the risk of crop failure and improve yields.

The nutrient water productivity of the prioritised crops shows that a number of nutrient-dense crops can be grown in the four communities. However, it demonstrates the need to regularly combine a variety of fruit and vegetables in the diet to ensure that household members consume the essential nutrients. Again, the number of crops with high nutrient water productivity that will produce edible portions of food in winter is very low. Most crops that will produce nutritious fresh vegetables in winter require irrigation. Irrigating crops had a clear benefit in terms of providing a more diverse diet – not only in terms of available fresh produce, but possibly also through the sale of produce. Irrigation offers the potential of extending the availability of fresh produce.

11.2 Recommendations for Priority Crops to Improve the Diet of Poor Rural Communities throughout the Year

The following investigation of the consumption and production patterns of poor rural communities in four of the poorest communities in South Africa shows that diets lack diversity and do not include the essential fruit and vegetables that are necessary for ensuring good nutrition, productivity and child development. The following crops should be prioritised to strengthen existing positive consumption patterns and promote greater dietary diversity:

- Dark green leafy vegetables such as beans, broccoli, the leaves of beetroot, cowpeas, pumpkin, sweet potatoes and Swiss chard, as well as African leafy vegetables, such as blackjack, cat's whiskers, amaranth, lambquarters, nettle, nightshade and sow thistle
- Other vegetables such as cabbage, cauliflower, cucumber, eggplant (brinjal), gem squash, 'calabash' or other squash, green beans, green peppers, lettuce, peas, onions and zucchini (baby marrow)
- Orange-fleshed vegetables such as beetroot, carrots, dark orange pumpkin, butternut or squash, orange-fleshed sweet potatoes and tomatoes
- Legumes such as Bambara groundnuts, cowpeas, dhal, dry beans and ground nuts (peanuts)
- Roots and tubers such as *amadumbe*, potatoes and sweet potatoes
- Orange-coloured fruit such as citrus fruit, mango, papaya, pineapple, cantaloupe and watermelon/*makataan*
- Other fruit, including avocados, banana, figs, loquats and marulas

In theory, many of these crops can be grown in Ingquza Hill, Jozini and Maruleng under rain-fed conditions. Yet, community consultations reveal that many of these crops will not grow under the prevailing climatic conditions of drought, weather uncertainty and climate change.

Very few of these crops will produce edible portions of food in winter. Many require supplemental irrigation.

Therefore, research is needed to investigate the impact of climate change on growing patterns to advise on adaptations to production techniques, irrigation practices, production timing and the potential for the development of early- and late-maturing crops to extend the growing season and make food from own production available for longer periods. The biofortification of crops could increase the nutrient density of micronutrients. Usually, biofortification focuses on increasing the availability of a single nutrient per crop, but research should investigate the amplification of multiple nutrients in foods that could be considered dual crops, such as beetroot, or where the nutrient water productivity of more than one nutrient could be enhanced (such as vitamin A, iron and zinc in carrots). Dual crops are crops where more than one part of the plant is nutrient-dense, such as the leaves, roots, fruit or seeds.

It is clear from the research that many households engage in home production. Therefore, technologies and practices that are appropriate to these conditions (including pest and disease management) should be prioritised. Water harvesting practices and systems for the delivery of water to gardens to reduce the drudgery for women are essential to enable food production in more homes. The provision of boreholes and piped water is essential in drier areas such as Ratlou, although production in such areas will always require extensive amounts of water.

11.3 Recommendations for Research

This study highlights a number of priority research areas that the WRC could pursue. The first of these is research related to the production of nutrient-dense crops that can strengthen and support households' diet all year round under rain-fed and irrigated conditions, as set out above. The anthropometric and dietary diversity data, particularly the seasonal aspects of the latter, strongly suggests that the addition of more nutritious foods to regular household consumption, year-round, could enhance the accessibility, availability and stability of household food security. The inclusion of more 'traditional' crops, such as the African leafy vegetables and indigenous melons, might restore some of the social embeddedness of food, that is, the knowledge of production and preparation that is in danger of being lost, and which the communities all associate with better health and nutrition.

The second priority area for research relates to water harvesting and irrigation technologies to enable and encourage the production of crops with high nutrient water productivity and that can reduce the labour drudgery for women in particular. In all the communities, there is the potential to enhance household and smallholder irrigation. In some cases, this poses technical obstacles, for example in the arid Ratlou site. In others, the obstacles could be purely financial, for example in Maruleng, where a partly functioning irrigation system is in need of repair and maintenance in order to serve a wider community. More problematic is the scenario of Jozini, where the vast potential of the beleaguered Mjindi irrigation scheme seems embroiled in conflicting commercial interests, managerial incompetence and stakeholder

inequality. Ingquza Hill poses greater challenges. Farming has undergone a drastic transformation from what was once the highly productive, rain-fed terrace farming of staples and livestock to small, fenced, home gardens that rely on rainfall or arduous manual irrigation. Significant investments in infrastructure might be necessary to make use of the relatively abundant river water in such a hilly, rugged topography.

The third priority relates to the biofortification of crops to improve the nutrient water productivity of more than one nutrient per crop. There was widespread sentiment among small producers and home gardeners that agricultural inputs and extension services are inaccessible or simply inappropriate. In several communities, farmers spoke about the inappropriateness of trying to adapt the commercial crop inputs available through commercial channels to local conditions. Reports of indebtedness and crop failure were common. Smallholder producers in the study sites demonstrated the will and energy to adapt their methods to changing conditions, for example through the conservation of local and more drought-resistant crops. There is significant interest among farmers in knowledge sharing and farmer-to-farmer exchanges to this effect, and it would be timely to take an inventory of these practices and explore the potential for the dissemination of these practices.

11.4 Dissemination of the Findings

The findings of this study have been shared with the communities that participated in the surveys and FGDs. The brochures found in Appendix D were prepared for validation workshops in each community and were very well received by the communities. The brochures show the findings specific to each community and present the prioritised list of crops to improve diets. The research team has developed a digital application of this, which can be downloaded on a seven-inch tablet from https://www.dropbox.com/sh/vivzn5r0d9jiqev/AABSXvIdpcmfkxFlhjFrX74Ca?dl=0. This digital tool provides community members with the opportunity to identify which crops can be produced in their area under rain-fed and irrigated conditions, and provides production guidelines for each crop.

The project leader used the data from the study as part of a practical for a masters degree module at the University of Pretoria in 2014. The module, LEK834, trains students to measure and monitor food security. As part of the practical component, each of the students in the class calculated one food security indicator from the Eastern Cape dataset. They discussed their findings with a meeting of the South African Vulnerability Assessment Committee Technical Task Team in November 2014, providing input into the selection of indicators for the development of the South African National Food Security Information System. This was a great learning opportunity for the task team and the students. The paper (Hendriks et al. 2016) was published in March 2016. It received very positive feedback from the reviewers of the Journal of the Ecology of Food and Nutrition. The paper provides recommendations for the South African Vulnerability Assessment Committee Technical Task Team regarding the choice of indicators for the development of the South African National Food Security Information System.

Further dissemination activities include a public presentation of the results, the preparation and dissemination of the brochures and research briefs in the local languages of the four communities included in the study, the preparation of further research papers for journals, and the development of a web page on which to load the brochures and provide a link to the mobile application.

Details of the capacity development component of this project are set out in Appendix E.

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Appendix A: Glossary of food items in local languages

English	seTswana	Sepedi[4]	IsiXhosa	IsiZulu
01 – Cereal Group				
Amahewu/ metôgô	Mahewu	Mague/metôgô	Amarhewu	Amahewu/idokwe
Bread	Borotho	Borotho	Isonka	Isinkwa
Brown bread			Isonke esimdaka	Isinkwa esinsundu/Isinkwa esim'nyama
Cake flour	Flouru jwa Dikuku	Flour/folouro	Flawa	Ufulawa
Crumbly maize meal porridge	-	Phuthu/photho	Umphokoqo	Uphuthu
Dry mealies	Mmidi	Lekôkôrô/dikgobe	Umbona	Umbila owomile
Boiled dry mealies	Digkobe/Kabu		Inkobe	Izinkobe
Fresh maize	Mmidi	Mealies/mmidi	Mbona omsha	Ifutho/umbila
Macaroni/spaghetti	Macaroni/spaghetti		Macaroni/spaghetti	Macaroni/spaghetti
Maize	Mmidi	Lefela	Mbona	Umbila
Maize meal (dry)	Bupi	Bupi	Mbona omdala	Impuphu
Mealie rice	Mmele rice	Meali rice – not familiar to people	Mili rice – not familiar to people	Umgqakazo
Millet	-	Leotša		Imfe
Morvite	Morvite			
Oats	Oats	Jungle oats	Oats	Ukolweni/Oats
Rice	Rice	Rice	Rice	Ilayisi
Samp	Setampa	Stampa	Umgyusho	Isitambu
Soft maize meal and other soft porridges	Motogo/metôgô	Isidudu/motêpa/ting/ legala	Isidudu	Iphalishi/umdoko
Sorghum	Mabele	Mabele/ leatša	Inkoduso/amazimba	Amabele
Steamed bread	Ledombolo	Dinkgwa/ dombolo	Idombolo	Ujeqe/idombolo
Dumplings				Idombolo
Stiff maize meal porridge/ *pap*	Papa	Papa/Bogôbê	Papa/phalishi	Ipapa
Vetkoek	Matshutshu/magwinya	Magwenya	Amagwinya	Amagwinya
White bread	Brotho	Brotho	Isonka esimhlobhe	Isinkwa esim'hlophe
02 – White roots and tubers				
Potatoes	Ditapole	Mazambane/diputata	Zitapile/ amazambane	Amazambane
Sweet potatoes	Dipotata	Morepa	Ubhatata	Ubhatata
03 – Dark yellow and orange-fleshed vegetables				
Pumpkin	Lephutshi maphutsi	Lerotse/mofodi	Ithanga	Ithanga
Butternut		Lekgwana	?	Ithanga
Orange-fleshed sweet potatoes			Ubhatata obuvo	Ubhatata

[4] Source: Quin (1959)

English	seTswana	Sepedi[4]	IsiXhosa	IsiZulu
Carrots	Digwete		Iminqatha	Izaqathi/ikheroti
04 – Dark green leafy vegetables				
Spinach	Morogo wa sepenashi	Spinach/spinash	Spinach/spinash	Isipinashi
Including wild/ indigenous green leaves		Morogo	Imifino	Imifino
Thêêpê/thepe	Thepe	Morôgô thepe		
Lerotho		Morôgô lerotho		
Monyaku		Morôgô monyaku		
Leaves of ditloo, dinawa, dithlodi prepared as morôgô		Morôgô ditloo, dinawa, dithlodi	Imbotyi	
Morogo from pumpkin leaves		Morôgô diputsi		Umfino weziintanga
05 – Other vegetables				
Cabbage	Cabbage	Cabbage	Khaphetdshu/khabishi	Iklabishi
Green beans	Ibontje	Ibontje	Imbotyi	Ubhontsisi
Tomatoes	Tamati	Tamati	Tumati	Utamatisi
Onions	Aiye	anyanise	Intswele	U-Anyanisi
Egg plant		Not familiar to people	Brinjal	Ubhilinjolo
Beetroot	Beetroot	Beetroot	Beetroot	Beetroot
Green peppers	Pepere e tala	Green peppers	Green peppers	Upelepele omkhulu ongababi/Green paper
Gourd	Legodu	Moraka/leraka		
Citron/melon	Lekatane	Morôtsê	-	-
Watermelon	Magapu	Mogapu/legodu	Vatala	Ikhabe
Wild cucumber		Monyaku		ikhukhamba
06 – Orange-coloured fruit				
Mango (ripe mango)	Mango	Mango	Mango	Umango
Peaches	Perekise	Periske	Pesika	Impentshisi
Paw paw	Phopho	Paw paw	Paw po	Uphopho
Apricots	-	Not familiar to people	Not familiar to people	I-Apilikosi
07– Other fruit				
Oranges	Nemune	Lamoene/ namune	Lamula	Amawolintshi
Apples	Apolo	Apple/Apolo	Apile	Ihabhula
Bananas	Panana	Banana	Banana	U-Bhanana
Pears	Piere	Piere	Not familiar to people	Ipheya
Red grapes	Diterebe tse dikhibidu			Amagilebhisi abomvu
Including wild/ indigenous fruit				
Sour plum		Dishidi		
Wild plum/ stamvrugte		Mohlatswa		

English	seTswana	Sepedi[4]	IsiXhosa	IsiZulu
Monkey apple/klapper		Morotlue		
Marulas		Morula		
Figs	Fayiye/ motroko	Feiye		Umkhiwana
08 – Organ meat				
Liver	Sebete	Sebete	Isibindi	Isibindi
Kidneys	Diphio		Intso	Izintso/ izinso
Heart	Pelo	Pelo	Inhliziyo	Inhliziyo
Chicken livers and giblets		Dibetwana le dikilana	?	Ibindi zenkukhu
Chicken intestines	Chicken mala	Chicken malana	?	Amathumbu ezinkukhu/Izinywenywe
Tripe/offal	Mogodu	Mogodu	?	Usu/ulusu
09 – Meat				
Beef	Nama ya Kgomo	Nyama kgomo	Inyama yekomo	Inyama yenkomo
Goat	Nama ya Pudi	Pudi	Inyame yebokwe	Inyama yembuzi
Sheep	Nama ya Nku	Nku	Inyame yegusha	Isiklabhu/inyama yemvu
Pig	Nama ya Kolobe	Kolobe	Inyama yehhaku	Inyama yengulube
Poultry (chicken)	Nama ya koko	Kgogo	Inyama yenkuku	Inyama yenkukhu
Game	Nama ya Mosha			Inyama yenyamazane
Chicken feet, heads, necks	Moatwana	Maotwana	Amanqina nenhloko	Amanqondo
Chicken geese				Ingingila
Dried meat/biltong		Biltong	Umqwayito	Umqwebu/umcweba
Tarentaal, patrys		kgaka		impangele
Impala	Impala	Impala	Impala	Inyama yempala
Rabbit/hare		moutla	umvundla	Unogwaja
Duiker				
Insects – mopane worms, flying ants, termites/ grasshoppers/locust		Masonja/ditšhoš wane/ ditšiê	izinambuzane	Amacimbi izintethe
10 – Eggs				
Eggs from any animal	Mae	Mae/Mahe	Amaqanda	Amaqanda
11 – Fish				
Fresh fish	Tlhapi	Hlapi	Inhlanzi	Inhlanzi edotshiwe
Tinned fish (Lucky Star)				Inhlanzi esethinini
12 – Dried beans				
Beans (sugar beans)		Sugar beans	Imbotyi	Ubhontshisi
Including other beans such as				
Peanuts	Matokomane	Tokgomani	Amantongomani/amakinati	Amantongomani/Amakinati
Cowpeas	Dinawa tse di omileng	Monawa		Imbumba
Njugo/ bambara		Ditloo marapo		
Mung bean		Dihlodi		
Porridges prepared with dry legumes	Lehata (sorghum and dry beans) Nyola (dried maize and beans)	Sekgôthô	Umqwa	

English	seTswana	Sepedi[4]	IsiXhosa	IsiZulu
	Mosotwane (coarse mabele and dried beans)			
Nuts				
Bean gravies and bean stews		Setôpja and lewa		
Seeds		Dithôtse		Imbewu
13 – Milk and products				
Milk	Maswi	Maswi	Lubisi/intusi	Ubisi
Maas	Madila	Amasi	Amasi	Amasi
Oils and fats				
Oil	Mahura/mafura	Fish oil/cooking oil/mafura	Amafutha	Uteli/amafutha/okupheka
Margarine		Rama	Rama	Ibhotela
Holsum	Wholesum			Amafutha anqumelayo
14 – Sugars and sweets				
Sugar	Sukere	Swekir/Swikiri	Swekir	Ushukela
Honey	Mamepa	Mamep	Ubus	Uju
Sweets	Dimonamene	Dimonamonane	Ilekese	Amaswidi
Cakes	Dikuku	Dicake/dikuku	Amakhekhe	Amakhekhe
Juice		Juice	Juice	Ujusi
Fizzy drinks (Fanta, Sprite. Coke)		Senwamaphodi	Iziphuzo	Unemenayithi
15 – Spices				
Spice	Metswako	Spices	Spices	Isipayisi
Salt	Letswai	Letswai	Ityuwa/ityiwa	Usawoti/Iswayi
Coffee	Kofi	Kofi	Kofi	Ikhofi
Tea	Tee	Teye	Iti	Itiye
Knorrox cubes		Knorrox	Knorrox	Amagaqa

Appendix B: General notes on the production of the different crops

Consumption recommendation	Notes regarding production considerations
African leafy vegetables (‘wild’ or cultivated)	Most of the African leafy vegetables can be found in areas where the land has been disturbed. The kinds of African leafy vegetables found depend on the climate and soil. These vegetables include the following: • Black jack leaves • Cat’s whiskers • Cowpea leaves • Amaranth leaves • Lamb quarters leaves • Nettle leaves • Nightshade leaves • Pumpkin leaves • Sow thistle leaves These vegetables are rain fed and highly nutritious. They grow quickly, as they only take four to six weeks from planting to harvest. They can be harvested several times. They are usually summer-growing crops that should not be planted in winter. When cultivated, they can give yields of 40-60 t/ha^{-1} and 10 t/ha^{-1} when uncultivated. More information is available from Dr Willem Janse van Rensburg of the Agricultural Research Council Vegetable and Ornamental Plant Institute (ARC VOPI) at wjvrensburg@arc.agric.za.

Consumption recommendation	Notes regarding production considerations
Amadumbe (starch)	Amadumbe needs a long growing season and grows well if there is a drought. It can produce between 0.5 and 1.0 kg of corms per plant. If corms are left in the soil too long, they start to dry out and lose quality. This should not be planted in winter when the maximum temperature is below 30 °C in the day.
Bambara groundnut	This is indigenous to Africa. It can grow in poor soil with little rainfall. As a summer-growing crop, it can produce ½ to 3 t-ha^{-1}.
Beetroot	Beetroot can be planted as seeds directly into the fields or from seedlings. It is a cool-season crop, which is best planted from February to August. It can be planted out of season, but the yield and quality may be poorer and it may be attacked by diseases and insects. It will grow and produce in rain-fed conditions, but will do better (higher yields) if there is no drought. The spread of the rainfall is important, as the beetroot has a shallow root system. A sandy to sandy-loam soil makes harvesting easier, but there are more problems with nematodes. Crop rotation helps to control this. Beetroot can rotate with legumes, cereals, tomatoes or cabbage. If it is grown in a clay soil, the crop will need to be washed before selling. Clay makes it more difficult to lift the crop from the soil and can also change the shape of the beets. It can be harvested within two and a half to four months after planting. There is only one harvest, but staggered planting ensures a harvestable crop throughout the year. An irrigated yield can be 18 to 25 t/ha^{-1} under irrigation. Too much compost (organic material) can lead to the development of too many lateral roots.
Broccoli	Broccoli can be planted from seeds or seedlings between March and July. As for beetroot, out-of-season planting can also cause problems. It may be attacked by insects, such as caterpillars, and disease, such was mildew and clubfoot. Special care should be taken to protect the crop against these threats. It is sensitive to high temperatures and may be attacked by insects and diseases.
Cauliflower	Cauliflower can be planted from seeds or seedlings between March and July. As for beetroot, out-of-season planting can also cause problems. It may be attacked by insects, such as caterpillars, and disease, such was mildew and clubfoot. Special care should be taken to protect the crop against these threats. It is sensitive to high temperatures and may be attacked by insects and diseases.

Consumption recommendation	Notes regarding production considerations
Cabbage	Cabbage can be planted from seeds or seedlings between March and July. As for beetroot, out-of-season planting can also cause problems. It may be attacked by insects, such as caterpillars, and disease, such was mildew and clubfoot. Special care should be taken to protect the crop against these threats. Root knot nematodes can also be a problem. Cabbage can be harvested within three to four months after planting. It yields 60 to 80 t/ha^{-1} under irrigation and each plant can only be harvested once. Staggered planting will ensure produce throughout the year.
Carrots	Carrots prefer a sandy to sandy-loam soil to make harvesting easier. In clay soil, the crop will need to be washed before selling. It is also more difficult to lift the crop from the soil. In sandy soil, there can be problems with nematodes, and crop rotation will be essential to prevent the build-up of nematodes. A soil pH of 6 to 6.5 is preferable. Too much organic material in the soil leads to the splitting of roots, and they may become more hairy. Compost and kraal manure are not recommended. Carrots can be sown during May and June. It is a cool-season crop, but is also sensitive to frost. It can be harvested within three to three and a half months after sowing. Irrigated yields range from 25 to 50 t/ha^{-1}.
Cowpeas (leaves as well as beans)	It is a summer-growing crop, but can grow in dry conditions. It has a yield potential of ½ to 3 t/ha^{-1} of dry beans. As fresh beans, it should be similar to dry beans at 15 to 20 t/ha^{-1}.
Cucumber (field cucumber)	Phosphorus fertilization for cucumbers is important to ensure good-quality fruit. A pH ranging from 5.5 to 7.5 is ideal. Field cucumbers are warm-season crops and can only be established after the last frost. Likewise, the crop should be harvested before the first frost. Cucumbers, sweet melons (cantaloupe), watermelon, pumpkins, butternut, squash, gem squash and zucchini are all classified as vine crops due to their trailing growth form. Some crops, like zucchini, can also be more bushy in growth. Vine crops are more prone to diseases in wet conditions. The crops then also prefer deep, well-drained soils of 90 cm or deeper. Vine crops are planted with seed, directly into the fields. Irrigated crops yield 25 to 35 t/ha^{-1}.

Consumption recommendation	**Notes regarding production considerations**
Dark orange pumpkin, butternut or squash Gem quash/'calabash'/other squash and pumpkin Zucchini	These warm-season crops can only be established after the last frost. The crop should be harvested before the first frost. Pumpkin and hubbard squash yields of 20 to 30 t/ha^{-1} can be harvested under irrigation. Some can be stored for long periods of time before losing quality. Butternut under irrigation yields between 20 and 25 t/ha^{-1}. Yields under irrigation range from 20 to 25 t/ha^{-1} for gem squash and other *Cucurbita pepo* pumpkins, including zucchini. These types of pumpkins/squashes should be harvested when they are still immature and therefore do not last long after harvesting. The *Cucurbita pepo* group is the only vegetable group that can be grown in dry land with success because it originated in desert areas. Dark-coloured fruit can easily get sun scald. Good disease and insect control will ensure that the fruits are covered by the leaves. Diseases and insects cause the leaves to die and expose the fruits to the sun. Bees are very important to the good production of crops that require pollination for fruit development. Drip irrigation is better than overhead irrigation if water can collect where the stem is attached to the fruit. Too much water in this area can lead to severe disease infections.
Eggplant (brinjal)	These warm-season crops can only be established after the last frost. The crop should be harvested before the first frost. Brinjals have a long growing season and should be planted in areas with long, hot summers. Deep, well-drained soil is best. Brinjals grow well with manure and compost, but without these, heavy fertilization is necessary. Similar production practices should be implemented as for tomatoes and green peppers. Under irrigation, yields can reach 25 to 35 t/ha^{-1}.
Green beans Leaves and beans	These warm-season crops can only be established after the last frost. The crop should be harvested before the first frost. Green beans are also legumes and therefore the information here is also relevant for legumes. Beans need deep, well-drained soils and a clay content that is not too high or too low. A soil pH of 6 to 6.5 is ideal. Zinc, manganese and boron deficiencies can be problematic. Beans do not do well in soils with a high salt content. Bush beans can yield 8 to 10 t/ha^{-1} and runner beans 15 to 20 t/ha^{-1}. It has a long growing season, but a short harvest period, and therefore staggered planting is important to ensure the availability of green beans over a longer period of time.

Consumption recommendation	Notes regarding production considerations
Green peppers	These warm-season crops can only be established after the last frost. The crop should be harvested before the first frost. The crops are established with seedlings. Green peppers yield 25 to 30 t/ha^{-1} under irrigation. The plant flowers continuously and therefore peppers can be available for a long period of time. Sun scald and blossom end rot (calcium deficiency) are some of the problems to look out for. Scald can be reduced by ensuring a healthy leaf canopy, while correct irrigation and the application of calcium can reduce blossom end rot. Green peppers require similar production practices as tomatoes.
Legumes (dhal, dry beans, etc.)	The Department of Agriculture is supporting and encouraging the production of this crop in all the provinces. These warm-season crops can only be established after the last frost. The crop should be harvested before the first frost. They are sown directly into the field. Deep, well-drained soils without acidity problems are preferred. Inoculation with the correct nitrogen-fixing bacteria is important to successful production. Dry beans have a very short growing season of 85 to 120 days. Two plantings per season can be done if water is available. The most popular dry beans are sugar/red speckled beans, followed by small white and big white kidney beans. Yields vary from less than 1 t under dryland to as high as 5 t/ha^{-1} under irrigation.
Lettuce	Lettuce is a cool-season crop. In summer conditions, it also gets damaged by temperature and water stress, which leads to poor head development and a short shelf life. Lettuce prefers clay soils with a low salt content and a pH of about 6.5. Fertilization, especially nitrogen, is important. No fertilizers containing chlorine should be applied, since it can affect the salt content of the soil. Yields of 20 to 25 t/ha^{-1} can be obtained under irrigation.

Consumption recommendation	Notes regarding production considerations
Onions	Onions are biannual (as are cabbage, beetroot and carrots). They produce the edible part in the first year and flower in the second year. Onions can flower at the wrong time (bolting), which leads to the cracking of the onion bulb. Flowering is mainly controlled by day length and it is important to only use cultivars recommended for the area. The correct planting date is also important. Planting too early or too late can affect the yield. Yields of 30 to 70 t/ha^{-1} can be obtained with irrigation. Onions can be sown directly, established as seedlings or by using sets. Too much nitrogen late in the season can lead to poor bulb formation, and slow-release fertilizers and organic material should not be used. A deep, well-drained sandy to sandy-loam soil makes harvesting easier. In clay soil, the crop will need to be washed before selling. It is also more difficult to lift the crop from the soil. In sandy soil, one can expect more problems with nematodes. Crop rotation will be essential to prevent the build-up of nematode populations. Onions are sensitive to soil salinity. A soil pH of 5.8 to 6.8 is ideal.
Orange-fleshed sweet potatoes/white fleshed sweet potatoes	These warm-season crops can only be established after the last frost. The crop should be harvested before the first frost. Sweet potatoes are established with vegetative material (cuttings) and should be free from diseases. These vegetables need deep, well-drained soils with not too much clay. In clay soil, the crop will need to be washed before selling and it is also more difficult to lift it from the soil. In sandy soil, there are more problems with nematodes. Crop rotation will be essential to prevent the build-up of nematode populations. Applying manure and compost can also lead to thin, poorly shaped tubers. Yields of 40 to 60 t/ha^{-1} can be obtained under irrigation conditions.
Parsley	Parsley is a very easy herb to grow. It can re-grow and can thus be harvested continuously.
Peas	This cool-season crop yields of 3 to 5 t/ha^{-1} under irrigation. Depending on the cultivar, it can be harvested once or over a period of time.
Potatoes	This crop is very sensitive to drought and it is not recommended for rain-fed conditions in South Africa. It can be produced throughout the year, but in summer the yield and quality are much lower than in the cooler months. Under irrigation conditions, yields of 40 to 80 t/ha^{-1} can be obtained.

Consumption recommendation	**Notes regarding production considerations**
Swiss chard (often incorrectly referred to as spinach)	Swiss chard is a cool-weather crop that has adapted to warmer conditions and can be produced throughout the year. It is usually sown directly in the field. It is easy to grow, but insects and diseases can be a problem in the summer months. Continuous harvesting makes it an ideal leafy crop to have in the garden. Under irrigation, yields of 15 to 20 t/ha^{-1}can be obtained.
Tomatoes	Fresh produce market cultivars need support to keep the plant upright with stakes or trellises. It will produce fruit continuously and can thus be harvested over a period of months. Tomatoes cannot be grown successfully without crop rotation due to diseases that attack this crop. There are also problems with numerous diseases. Tomatoes need any type of soil that is deep and well drained, and the fruits are susceptible to calcium deficiencies that cause blossom end rot. Too much water or water on the fruit surface can cause cracking and can affect the quality of the fruit's appearance. Poor canopy cover due to insects and disease attacks can lead to sun-scalded fruit. Yields can be as low as 10 t/ha^{-1} for poor dryland producers, but can go up to 120 t/ha^{-1} under commercial irrigated conditions.

Appendix C: Publications and product outputs

The following publications and presentations have been published and presented to date.

Published journal articles

- Hendriks SL, Van der Merwe C, Ngidi MS, Manyamba C, Mbele M, McIntyre M, Molefe QN, Mphephu MN, Mgwane L (2016). What are we measuring? A comparison of household food security indicators from a sample of households in the Eastern Cape Province, South Africa. *Ecology of Food and Nutrition*. http://www.tandfonline.com/doi/full/10.1080/03670244.2015.1094063.
- Ngidi MS and Hendriks SL (2014). Coping with food insecurity in rural South Africa: the case of Jozini, KwaZulu-Natal. *Mediterranean Journal of Social Sciences*, 5 (25), 278-289. http://mcser-org.ervinhatibi.com/journal/index.php/mjss/article/viewFile/5374/5186.

Papers submitted to journals for consideration

Ngidi MSC, Hendriks SL and Njonono M (2014). Does crop production buffer rural households from food insecurity and applying erosive coping strategies? Paper resubmitted to *Development Southern Africa*, January 2015.

Papers in preparation

- Hendriks SL, Viljoen AT, Marais D, Wenhold F, McIntyre AM, Ngidi MS, Van der Merwe C, Annandale J, Kalaba M, Stewart D. (forthcoming). What crops can rural poor communities produce to improve their food security? Paper in preparation for submission.
- Hendriks SL, Gallei M (forthcoming). What are we measuring? A comparison of household food security indicators from a sample of households in the poorest provinces of South Africa. Paper in preparation for submission to *Global Food Security*.

Research briefs

- Hendriks SL, Viljoen AT, Marais D, Wenhold F, McIntyre AM, Ngidi MS, Van der Merwe C, Annandale J, Kalaba M, Stewart D (2016). What should rural households grow and eat to improve their nutrition? Research Brief No 1. Water Research Commission (WRC Project No. Project K5/2172/4). Water Research Commission and Institute for Food, Nutrition and Well-being, Pretoria: University of Pretoria. http://www.up.ac.za/media/shared/238/1601-ifnuw-fs-article_-lowres.zp84288.pdf
- Hendriks SL, Viljoen AT, Marais D, Wenhold F, McIntyre AM, Ngidi MS, Van der Merwe C, Annandale J, Kalaba M, Stewart D (2016). What should rural households grow and eat to improve their nutrition? Ingquza Hill. Research Brief No 2. Water

Research Commission (WRC Project No. Project K5/2172/4). Water Research Commission and Institute for Food, Nutrition and Well-being. Pretoria: University of Pretoria. http://www.up.ac.za/media/shared/238/1601-ifnuw-a4-brochure-ingquza-hill-0316.zp83908.pdf

- Hendriks SL, Viljoen AT, Marais D, Wenhold F, McIntyre AM, Ngidi MS, Van der Merwe C, Annandale J, Kalaba M, Stewart D (2016). What should rural households grow and eat to improve their nutrition? Jozini. Research Brief No 3. Water Research Commission (WRC Project No. Project K5/2172/4). Water Research Commission and Institute for Food, Nutrition and Well-being. Pretoria: University of Pretoria. http://www.up.ac.za/media/shared/238/1601-ifnuw-a4-brochure-jozini-0316.zp83910.pdf
- Hendriks SL, Viljoen AT, Marais D, Wenhold F, McIntyre AM, Ngidi MS, Van der Merwe C, Annandale J, Kalaba M, Stewart D (2016). What should rural households grow and eat to improve their nutrition? Maruleng. Research Brief No 4. Water Research Commission (WRC Project No. Project K5/2172/4). Water Research Commission and Institute for Food, Nutrition and Well-being. Pretoria: University of Pretoria. http://www.up.ac.za/media/shared/238/1601-ifnuw-a4-brochure-maruleng-0316.zp83912.pdf
- Hendriks SL, Viljoen AT, Marais D, Wenhold F, McIntyre AM, Ngidi MS, Van der Merwe C, Annandale J, Kalaba M, Stewart D (2016). What should rural households grow and eat to improve their nutrition? Ratlou. Research Brief No 5. Water Research Commission (WRC Project No. Project K5/2172/4). Water Research Commission and Institute for Food, Nutrition and Well-being. Pretoria: University of Pretoria. http://www.up.ac.za/media/shared/238/1601-ifnuw-a4-brochure-ratlou-0316.zp83914.pdf

Invited presentations in which the results have been presented

Hendriks SL (2016). Contextualisation of food security. Invited presentation to the Joint Workshop on Food Security and Food Safety: Portfolio Committees on Agriculture, Forestry and Fisheries, Health, Social Development and the Select Committee on Land and Mineral Resources, Cape Town, 2 February 2016.

Papers presented at conferences

- Makamo CT, Viljoen AT, Hendriks SL and Ngidi M. (2016). Food consumption patterns and dietary diversity of rural households in Ratlou, North-West Province, South Africa. Paper presented at the 12th International SAAFECS Conference, St Georges Hotel and Conference Centre, Pretoria, 22-26 February 2016.
- McIntyre AM and Hendriks SL (2015). South Africa's changing food security landscapes: using mixed methodologies for analysis. Paper presented at the 2nd Global Food Security Conference, Cornell University, Ithaca, NY, 14 October 2015.
- Molefe QN and Hendriks SL (2016). Contributions of agricultural production to food security in rural households of South Africa. Paper accepted for presentation at the

South African Association of Family Ecology and Consumer Science, St George's Hotel, Pretoria, February 2016.

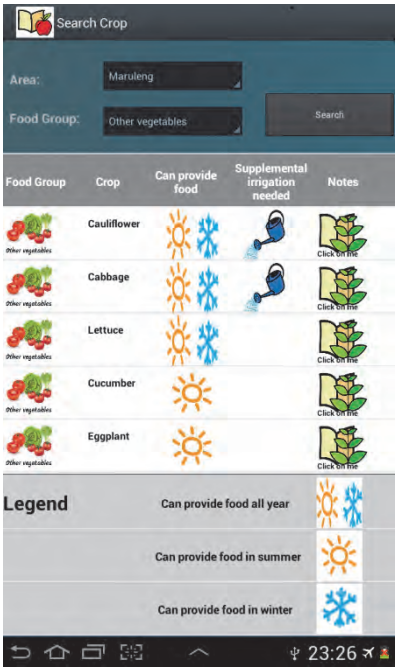
- Manyamba C. (2014). Application of the Women's Empowerment in Agriculture Index. The Cases of Eastern Cape, South Africa. Paper presented at the Gender, water and development: the untapped connection conference held at the International Convention Centre, East London, 3-7 November 2014.
- Ngidi MS and Hendriks SL (2014). Coping with food insecurity in rural South Africa: the case of Jozini, KwaZulu-Natal. Conference presentation International Academic Conference on Business and Social Sciences (ICBSS), Blue Waters Hotel, Durban, 6-8 November 2014.
- Ngidi MS and Hendriks SL (2014). Investigating the food insecurity coping strategies at Ingquza Hill Municipality, Eastern Cape. Conference presentation ASSAf Annual South African Young Scientists' Conference, Pretoria, 14-16 October.

Popular media

Hendriks SL and McIntyre AM (2016). Why a diverse diet is crucial for rural South African. *The Conversation Africa*, 19 May 2016. https://theconversation.com/why-a-diverse-diet-is-crucial-for-rural-south-africans-57304.

Software

Van der Merwe C, Hendriks SL, Viljoen AT, Marais D, Wenhold F, Annandale J, Kalaba M and Stewart D (2016). Grow smart: crop choice options to improve rural diets. Digital application software developed for the Water Research Commission Project No. Project K5/2172/4. Water Research Commission and Institute for Food, Nutrition and Well-being. Pretoria: University of Pretoria. http://www.up.ac.za/media/shared/238/presentation1.zp83916.pdf



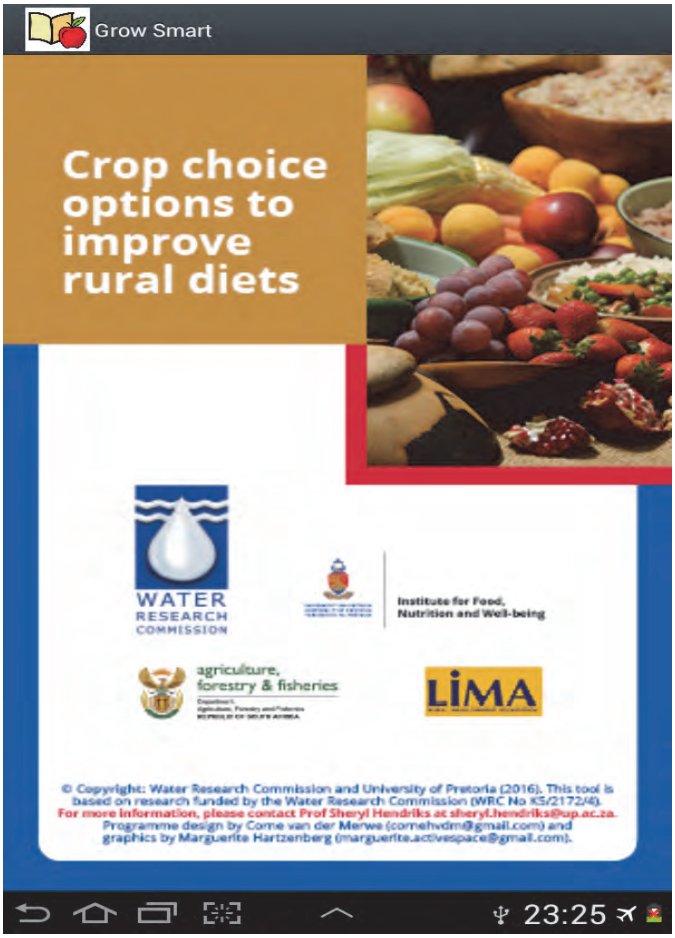


Figure 12: Screenshot of the Grow Smart application

Appendix D: Capacity building

The project initially proposed the inclusion of three masters degree students and one PhD candidate. Four masters degree students and one PhD candidate are using the data for their research projects. A postdoctoral researcher led the survey fieldwork for the team and has presented papers at conferences and published papers using the data. Another PhD candidate was involved in the survey design, fieldwork and data analysis.

The list of theses and dissertations expected from analysis of the data by the postgraduates engaged in the project includes the following:

McIntyre AM. Pathways to the right to food in South Africa. Unpublished PhD thesis in Rural Development Planning. Department of Agricultural Economics, Extension and Rural Development, University of Pretoria. Supervisor: Prof SL Hendriks.

Molokomme M. The minimum cost of the diet in Ingquza Hill, South Africa. Unpublished MCom dissertation. Department of Agricultural Economics, Extension and Rural Development, University of Pretoria. Supervisor: Prof SL Hendriks. Co-supervisors: Dr M Kalaba and Prof HC Schönfeldt.

Van der Merwe CH. How can information systems support rural South Africa's decision-making processes? Unpublished MCom dissertation. Department of Informatics, University of Pretoria. Supervisor: Dr M Turpin. Co-Supervisor: Prof SL Hendriks.

Molefe QN. The contribution of crop production to food security in three poor rural communities in South Africa. Unpublished masters dissertation. Department of Agricultural Economics, Extension and Rural Development, University of Pretoria. Supervisor: Prof SL Hendriks.

Makamo CT. Food consumption patterns and dietary diversity of rural households in Ratlou North West Province, South Africa. Unpublished masters dissertation in Consumer Science. Department of Consumer Science, University of Pretoria. Supervisor: Dr AT Viljoen.

There have been many opportunities for skills development. Dr Ngidi (a postdoctoral researcher) has been supporting a survey with DAFF as part of the establishment of the South African Food Security Information System. For many of the postgraduates working on this project, this is their first experience of survey work. Working with the data in the masters degree module helped develop the skills of six postgraduate students.

In addition, the researchers hired a team of six to eight young people in each community as enumerators to help with the household surveys. These 35 young people were trained in anthropometric measurement, survey and interview skills. In each community, the researchers worked with Lima staff members. Four Lima staff members were trained in these skills as well.

List of students involved in this project

Name	Degree	Research topic	Role	Notes
Dr Mjabuliseni Ngidi	Postdoctoral researcher	Coping strategies	Field survey team leader	Completed March 2015
Mr Christopher Manyamba	PhD candidate	Gender and food security	Survey questionnaire leader, sampling, data cleaning and analysis	Continuing
Ms Angela McIntyre	PhD candidate	Food sovereignty	Lead person for the qualitative survey component and analysis	Continuing
Ms Maria Molokomme	Masters degree student	Minimum cost of a food basket	Economic analysis and survey data collection	Continuing
Mr Corné van der Merwe	Honours degree student in 2013and now a masters degree student	Use of digital technology for food security	Digitisation of survey questionnaire	Graduated with an honours degree cum laude and is now registered for a masters degree
Ms Queeneth Molefe	Masters degree student in Rural Development	Contribution of agricultural production to food security in rural households of South Africa	Fieldwork in North West	Continuing
Ms Carlibet Makamo	Masters degree student in Consumer Science	Food consumption patterns and dietary diversification of rural poor households	Survey lead person in North West	Continuing