An exploration of perceptions, adaptive capacity and food security in the Ngqushwa Local Municipality, Eastern Cape, South Africa

By

Sonwabo Perez Mazinyo

Submitted in Partial Fulfilment of the Requirements of Doctor of Philosophy Degree in Geography in the Department of Geography and Environmental Sciences at the University of Fort Hare

Supervisors: Prof. Werner Nel and Dr. Leocadia Zhou

2015

DECLARATION

I, Sonwabo Perez Mazinyo, hereby declare that:

1) The work in this thesis is my own original work;

2) This thesis has not been previously submitted in full or partial fulfillment of the requirements for an equivalent qualification at any other recognised education institution.

NAME: SONWABO PEREZ MAZINYO

SIGNATURE: ___________________

DATE: 31 August 2015

PLACE: UNIVERSITY OF FORT HARE, ALICE

ABSTRACT

Approximately sixty percent of Africans depend on rainfed agriculture for their livelihoods. South Africa is evidenced to be susceptible to inclement climate which impacts on rural livelihoods as well as on farming systems. While South Africa is considered to be food sufficient, it is estimated that approximately 35% of the population is vulnerable to food insecurity. Therefore with the application of surveys and interviews this study investigates the factors influencing household, subsistence and small-scale farmer perceptions of vulnerability to climate variability as well as the determinants of adaptive capacity.

A sample of 308 households is surveyed and four focus group discussions are administered in Ngqushwa Local Municipality as a case study. Furthermore, the study also focuses on the biophysical changes or factors (scientific analysis of the prevailing climatic regimes–rainfall trends); the interrogation of the impact of food systems on both food prices as well as its implications on food sovereignty. The study also interrogates the relationship between crop yield and rainfall data over a 30-year period. Therefore the study adopts a mixed method approach to ensure triangulation. The study finds that rural communities are able to perceive climate variability and its related changes as well as its negative impact on crop production, food access and availability. The perceived rainfall trends also corroborate this.

Pearson product-moment correlation coefficient reveals that there is a strong correlation between crop yields and rainfall ($r = 0.69$). Meteorological analyses also show that the rainfall trend has been significantly variable over 112 years (1900 - 2011) with several dry spells threatening the subsistence and small-scale farmers' sustainable livelihoods. The food systems pose threats to food safety, food security and historical food sovereignty for the rural community of Ngqushwa Local Municipality. Adaptive capacity is greatly impaired by the lack of co-ordination of adaptation strategies, which communally benefit the majority of the farming respondents in the study area. Therefore vulnerability to climate variability impacts on the ability of the respondents to achieve food security. The study also finds that there is perceived competition between the farmers and wild life for the natural resources. The respondents' perception is that climate variability and change is responsible for such competition.

The study recommends that the national, provincial and local governments must foster a new food production model that is not based on the agro-business model and its attendant technologies but on one that is based on robust agro-ecological farming techniques which enhance adaptive capacity; which foster food safety; which promote food sovereignty; and which reduce vulnerability in a sustainable manner. Given the extent of climate variability in the study area the restoration of the NLM weather station infrastructure can also aid the farmers in taking advantage of a robust early warning system for better estimation of climate trends which enhance crop production.

Keywords: perceptions, food systems, adaptive capacity, food security, food sovereignty, rural, rainfall, climate variability and change.

DEDICATION

To two very special persons: Toishia -Lynn Jamison and Florence Thandiwe Sira

Thank you to Mvusi, Myles & Iminathi, Nocawe Mazinyo, Lukhanyo & Vuyelwa, Ernest & Katie Webb, and Student B & Regina Mazinyo for the remarkable inspiration.

Last but not the least; my everlasting gratitude and affection go to Ernesha-Kazimlah Mazinyo and Solomon Oluthando Mazinyo II for the sacrifices they have had to make over the years – I owe you a lot more than words could express.

ACKNOWLEDGEMENTS

I thank the Universal Father for giving me the wisdom and strength to finish this research work. Further gratitude goes to the Govan Mbeki Research and Development Centre (GMRDC), NRF, GreenMatter and Jimmy Khanyile, Canon Collins and MyCOE for assisting with funding. The financial assistance of the National Research Foundation (NRF) towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to the NRF.

Special thanks go to my supervisors, Associate Professor W. Nel (Department of Geography and Environmental Science) and Dr. L. Zhou (Risk and Vulnerability Science Centre) for nudging me on each step of the way; Dr. K. Nhundu and Mr. A. Katiti for the additional support; and Professor C.E.P. Seethal for the philosophy and discipline of environmental research. The contributions made by the staff and students in the Department of Geography and Environmental Sciences during seminar presentations are greatly appreciated.

This study would have been impossible without the help of the ward committees, local government officials, the councillors, the farmers who allowed the researcher to come into their home and work spaces, sometimes at short notice, and the Ngqushwa Local Municipality at large. I wish to express my most sincere gratitude to each and every person who connected me to their networks during the field work – Mr. Spelman, Mr. Dyibishe, Mrs. Nkohla, Mrs. Mgwayi, Ms. Ndabazonke, Mrs. Maphekula, and many others.

Table of Contents

DECLARATION ii
ABSTRACT iii
DEDICATION v
ACKNOWLEDGEMENTS vi
LIST OF TABLES xv
LIST OF FIGURES xvii
LIST OF ABBREVIATIONS AND ACRONYMS xviii
CHAPTER I 1
BACKGROUND TO THE STUDY 1
The United Nations and climate variability and change 1
The definitions of climate change, climate variability and global change 2
Food prices, biofuels, climate variability and change 5
Projected vulnerabilities of climate variability and change in South Africa 7
Climate variability and change in the Eastern Cape 8
Brief background to the Ngqushwa Local Municipality 9
Adaptive capacity and rural communities 10
Risk and vulnerability, adaptive capacity and Ngqushwa Local Municipality (NLM) 11
Research Problem 11
Aim of the study 14
Objectives of the study 14
The significance of the study 15
The case for investigating the perceptions of local rural communities about climate variability and change 16
Ethical and intellectual property rights considerations 20
The Structure of the Study 21
CHAPTER II 24
LITERATURE REVIEW 24
Introduction 24

Factors influencing perceptions and the determinants of adaptive capacity....... 24
The extent of the effects of climate variability and global change on farming..... 26
Impact of rainfall variability on maize and crop farming 31
Food prices, food access, global food system and climate variability................. 34
South Africa's climate change and agriculture/food security policies.................. 45
Conclusion.. 52
CHAPTER III 53
THE HISTORICAL VULNERABILITIES OF PEDDIE DISTRICT AND ITS STATE OF THE ENVIRONMENT UNDER THE NGQUSHWA LOCAL MUNICIPALITY (NLM) 53
The study area.. 53
A brief history of the Ngqushwa/Peddie Magisterial District 54
Population Dynamics, Unemployment and Migration 57
Economic status of Ngqushwa Local Municipality 59
Livelihoods and attendant vulnerability.. 60
Conclusion.. 65
CHAPTER IV 66
CONCEPTUAL FRAMEWORK AND RESEARCH DESIGN 66
Introduction... 66
The conceptual framework 66
The application of the Sustainable Livelihood Framework.................................. 71
Research design.. 72
Qualitative research methods: Questionnaires and interviews 72
Focus group discussions 73
Quantitative research methods: meteorological observations 74
Sampling technique 75
Methodology for describing the socio-economic factors influencing perception . 77
Methodology for determining the factors influencing perception......................... 78
Methodology for interrogating the determinants of adaptive capacity................. 79
The binary logistic regression model 80
The dependent variable, Y, is the binary response or dichotomous variable...... 80

Methodology for determining the impact of rainfall variability on crop production 82
Data analysis 83
Methodology for investigating the impact of food systems 85
The Household Food Insecurity Access Scale (HFIAS) 86
The Household Dietary Diversity Score Measurement (HDDS) 86
Methodology for investigating influence of policies on perceptions of vulnerability 89
Limitations of the methodology 90
Conclusion 91
CHAPTER V 92
PART I: HOUSEHOLD AND FOCUS GROUP FINDINGS 92
Introduction 92
The socio-economic characteristics of the respondents 92
The general perceptions of climate variability and vulnerability 95
Factors influencing the perception of climate variability 96
The Interpretation of the logistic regression results about the determinants of adaptive capacity 99
Mgababa focus group discussion findings 104
    Perceived rainfall variability and related weather changes 104
    Perceived Vulnerabilities 105
Competition over food with wild bird life 114
    Unomyayi - Corvus capensis (Cape crow, Black crow) – Unomyayi 114
    Idada Dendrocygna bicolor (Fulvous duck) 115
Prudoe focus group discussion 116
    Perceived rainfall variability and related weather changes over time 116
Predicting weather 117
    Ukuthwasa kwe Nyanga (Full Moon) 117
Temperature 119
Perceived vulnerability to climate parameter changes 119
Adaptation amidst drought 120
Wildlife competing over food with villagers 121

Birds ... 121
Moles and Bugs/Pests ... 121
Seeds and perceptions of vulnerability ... 122
Those perceived to be most vulnerable ... 122
What can be done to build resilience and adaptive capacity? ... 123
Mgwalana focus group discussion ... 123
Changes in climate parameters and major climate related events ... 123
Weather forecasting ... 124
Perceived vulnerabilities over the years ... 125
The Most Vulnerable people in Mgwalana ... 129
Benton focus group discussion ... 130
Changes and Vulnerability as perceived by Benton discussants ... 130
The perceived risks and vulnerabilities brought by changes in climate conditions ... 133
Increased incidences of droughts ... 134
Extreme temperature levels as cause for concern ... 135
What the community does to adapt in times of adverse climatic changes ... 135
Where did the respondents hear about climate variability and change as a challenge facing humanity? ... 135
Type of farming in the NLM ... 136
Abandonment of maize crop field farming ... 137
Extension services, maize cropping and climate resilience ... 138
Sustainable livelihoods and Maize resilience ... 139
CHAPTER V ... 140
PART II: RAINFALL RESULTS & POLICY FINDINGS ... 140
The Quantification of Rainfall Variability from 1900 – 2011 ... 140
Trends in inter-annual rainfall variability ... 141
Trends in intra- annual rainfall and seasonal variability ... 143
The southern oscillation and summer rainfall ... 145
The relationship between crop yields and rainfall data ... 147
The HFIAS Survey ... 157

The price of inputs 158
The Household Dietary Diversity Score as measure of food insecurity 159
Concerns about the local food system 160
Water scarcity and market access limitations 161
Lack of political will to revive a localised food system 162
Implementation of the National Development Plan 164
The National Development Plan 165
South Africa’s National Development Plan (2030) and Rural Food Security 165
The NDP and The Right to Food 165
DSD and its programmes in the NLM 167
The (NPFNS) National Policy on Food and Nutrition Security (2013), South Africa 168
The National Policy on Food and Nutrition Security 2013 and its impact on NLM 169
The National Policy on Food and Nutrition Security (NPFNS) and Climate Change 170
The NPFNS, climate change and Intergovernmental Intervention Pogrammes 171
Policy for the Recapitalisation and Development Programme (PRDP) 171
The PRDP and its implications for the Ngqushwa Local Municipality 172
The strengthening the relative rights of people working the land policy proposal 173
Climate Sector Plan for Agriculture, Fisheries and Forestry (2013) 176
The Climate Sector Plan and the NLM 176
The National Climate Change Response Strategy (NCCRS) White Paper 177
A brief history of the NCCRS 177
The National Climate Change Response Strategy (2011) and Food Security .. 178
The Department of Water Affairs (DWA) and Water-Scarcity Adaptation Plans179
The Eastern Cape Climate Change Response Strategy (ECCCRS) of 2011 ... 181
The Ngqushwa Local Municipality (IDP) Integrated Development Plan (2012 – 2017) 183
Conclusion 184

CHAPTER VI 185
DISCUSSION 185
Introduction 185
The perceptions of the NLM respondents about climate variability 185
Factors influencing perceptions 188
The Determinants of Adaptive Capacity 189
Sustainable rural livelihoods approach, adaptive capacity, vulnerabilities and risks 193
Natural capital 193
Financial capital 195
Physical capital and human capital 197
Social capital 199
Maize/Crops and rainfall variability 201
The El Niño Southern Oscillation (ENSO) and crop/maize yield 203
Food systems, food prices and food access 205
Food prices and climate change 208
Food Prices and Food Systems 210
The Green Revolution 218
Food Safety and GMOs 220
Food Processing, GMOs and Food Sovereignty 220
The Green Revolution in the Eastern Cape – South Africa 224
The NDP and Its Implementation 230
The Absence of Full-scale DSD Intervention in Water Resource Strengthening 230
Transparency and Risk Management 231
Monitoring, Evaluation and Vulnerability 232
Conclusion 232
CHAPTER VII 234
CONCLUSION AND POLICY IMPLICATIONS 234
Households and focus group perceptions 234
Poverty, food insecurity and ‘Big Food’ 234

Rainfall variability and adaptive capacity 236
Adaptation Strategies and rainfall variability 237
Biotechnology, land issues and food price disparities 238
Decision support systems and climate variability 240
Food Sovereignty and overhaul of food system 241
Local economic development and vulnerability 242
Agro–forestry, agro–ecological methods and inter-cropping 243
A new food production model 244
Collaborations with research institutions 245
Agricultural extension services and best practice 246
Traditional custodians of food security and easier access to markets 247
References 248
APPENDICES 296
APPENDIX A 296
QUESTIONNAIRE ON HOUSEHOLD FOOD SECURITY, LIVELIHOOD DIVERSIFICATION, AGRICULTURE AND HOUSEHOLD PERCEPTIONS ON CLIMATE VARIABILITY AND CHANGE 296
APPENDIX B 305
GENERAL PERCEPTIONS ABOUT CLIMATE VARIABILITY AND ITS CHANGES 305
APPENDIX C 307
QUESTIONNAIRE ON ADAPTIVE CAPACITY 307
APPENDIX D 311
PRELIMINARY QUESTIONNAIRE FOR FARMERS AT NGQUSHWA DEPARTMENT OF AGRICULTURE OFFICES 311
APPENDIX E 315
GUIDING QUESTIONS FOR FOCUS GROUP DISCUSSIONS 315
APPENDIX F 320
QUESTIONNAIRE FOR THE MANAGER: WARD EXTENSION OFFICERS ON PERCEPTIONS ON CLIMATE VARIABILITY & CHANGE AND FOOD SECURITY 320
APPENDIX G 331

QUESTIONNAIRE FOR PROVINCIAL OFFICE (DEPARTMENT OF AGRICULTURE AND LAND AFFAIRS: FOOD SECURITY DIRECTORATE &

DEPARTMENT OF ENVIRONMENTAL AFFAIRS, ECONOMIC DEVELOMENT AND TOURISM 331

APPENDIX H 340

HOUSEHOLD DIETARY DIVERSITY SCORE TOOL 340

APPENDIX I 342

HOUSEHOLD FOOD INSECURITY ACCESS SCALE 342

LIST OF TABLES

Table **Page**

1.1: Ngqushwa Local Municipality Water Shortages Costs due to the drought of 2009 13

3.1: Unemployment and Household (HH) income for the Amathole District 59

3.2: Value and number of households (HHs) per natural resource/land use… 63

4.1: The Dietary Diversity Score Food Groups 87

5.1: The socio–economic characteristics of the sample 94

5.2: The General Perceptions of Climate Variability 96

5.3: The multiple regression results of the factors affecting the perception of climate variability 98

5.4: The Likert scale responses to adaptation strategies..................................98

5.5: The Logistic Regression Results for the Determinants of Adaptive Capacity..99

5.6: Wild fruit and medicinal trees which are perceived to be near extinct or Extinct..128

5.7: Wild birds which are perceived to be climate variability refugees at Homesteads 128

5.8: Erstwhile and current planting seasons of major crops 131

5.9: Rainfall characteristics measured at the recording stations.......................140

5.10: Wet and Dry Phases 1906 - 2009...143

5.11: Intra-Annual Rainfall and Monthly Linear Trends....................................144

5.12: Correlation coefficient r with the relevant level of significance P between station summer rainfall and the mean SOI values for certain periods..146

5.13: The estimated smallholder crop yields over 30 years..............................148

5.14: Z-scores for 30 Year Maize Crop Yield...149

5.15: Z-Scores for 30 Year Mean Annual Rainfall 151

5.16: 30 year Mean Annual Rainfall and Mean Crop Yield 155
5.17: Types of Food Groups consumed over last 24 hours 159
5.18: Household Dietary Diversity Scores 160
5.19: Milestone Agreements on the Right to Food..166
5.20: The climate variability and change vulnerabilities of Eastern Cape
Sectors and Systems...182
6.1: Food Commodity Price Increases over 5 years 206
6.2: Price Trends in (R) Rands from 2008 – 2013 207

LIST OF FIGURES

Figure **Page**

3.1: The 118 NLM villages 55
3.2: The Four Sampled Villages (Benton, Mgababa, Mgwalana and Prudoe in the NLM 56
3.3: The different tenure areas in the Peddie District..58
3.4: Annual Income of Agricultural Households 60
3.5: The population density in the NLM 62
4.1: The Sustainable Livelihoods Conceptual Framework Model 70
5.1: The stand pipe tap at considerable distances from villagers' Homesteads 106
5.2: Tractor awaiting the granting of the application for the driver and keys.....108
5.3: The remaining male members of the MFPP 110
5.4: Waxing Crescent Moon Predicting Rain 111
5.5: Image of Unomyayi - Cape crow (by Gerhard Theron)............................114
5.6: Idada (Photo by Callie De Wet) 115
5.7: Landscape devoid of trees and extensive habitat for bird life 116
5.8: Intsikizi - Southern Ground-Hornbill...118
5.9: The scopus umbretta - uthekwane (Hamerkop)...124
5.10: Usikholimanzi - the blue crane...126
5.11: Ingqawa, the caracal 126
5.12: Annual rainfall trends with linear regression and 5 year moving average for A) Grahamstown and B) Peddie 142
5.13: Z-Scores for 30 Year Crop Yield...150
5.14: Z-Scores for 30 Year Mean Annual Rainfall 152
5.15: The 30 - year Mean Annual Rainfall and Crop Yield................................156
5.16: The 30 – year Crop Yield Trends for Ward 7 (Mgwalana), Ward 9 (Mgababa and Prudoe) and Ward 13 (Benton).......................................156
5.17: HFIAS Scores and Frequency 157
6.1: Key Food System Drivers, Activities, and Outcomes................................213

LIST OF ABBREVIATIONS AND ACRONYMS

ACB	African Centre for Biodiversity
ADM	Amathole District Municipality
ANC	African National Congress
ASGISA	Accelerated Shared Growth Initiative of South Africa
Bt	Biotechnology
CDC	Centers for Disease Control
CHSCR	Committee on Economic, Social, and Cultural Rights
COP	Conferences of the Parties
CRDP	Comprehensive Rural Development Plan
DA	Democratic Alliance
DAFF	Department of Agriculture, Fisheries and Forestry
DFID	Department for International Development
DRDAR	Department of Rural Development and Agrarian Reform
DSD	Department of Social Development
DWA	Department of Water Affairs
ECCCRS	Eastern Cape Climate Change Response Strategy
ENSO	El Niño Southern Oscillation
FAO	Food and Agriculture Organisation
FGD	Focus Group Discussion
FMCG	Fast Moving Consumer Goods Company
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GMO	Genetically Modified Organisms

GRS	Green Revolution Strategy
GURT	Genetic Use Restriction Technology
HDDS	Household Dietary Diversity Score
HFIAS	Household Food Insecurity and Access Scale
HH	Household
IA	Integrated Assessment
ICT	Information and Communications Technologies
IDP	Integrated Development Plan
IPCC	Intergovernmental Panel on Climate Change
LRS	Likert Rating Scale
LTA	Long-Term Averages
MAP	Mexican Agricultural Program
MEDPT	Masifunde Education and Development Project Trust
MFPP	Massive Food Production Programme
NAMC	National Agricultural Marketing Council
NDP	National Development Plan
NLM	Ngqushwa Local Municipality
NPFNS	National Policy on Food and Nutrition Security
PCI	Precipitation Concentration Index
PGDP	Provincial Growth and Development Plan
PRDP	Policy for the Recapitalisation and Development Programme
SADC	Southern African Development Community
SANCRGP	South African National Climate Change Response Green Paper
SEAR	Strategic Environmental Assessment Report
SLA	Sustainable Livelihoods Approach

SLF	Sustainable Livelihoods Framework
SOI	Southern Oscillation Index
SPSS	Statistical Package for Social Sciences
STATS SA	Statistics South Africa
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
VIF	Variance Inflation Factors
WEMA	Water Efficient Maize for Africa
WSA	Water Services Authorities
WTO	World Trade Organisation

CHAPTER I

BACKGROUND TO THE STUDY

This chapter gives the background to the study by introducing the concepts of Climate Change, Climate Variability, Global Change and Food Systems. The relationship of the preceding concepts to food prices and biofuels are also mentioned. The projected vulnerabilities of South Africa and the Eastern Cape are briefly introduced in relation to how they are set out in the relevant Climate Change Response Strategies. A brief background to the Ngqushwa Local Municipality is also given. The chapter proceeds to provide guidance on the theme of the study by outlining the research problem; the aim and objectives; the significance of the study; the ethical considerations; as well as the structure of the study.

The United Nations and climate variability and change

The member states of the United Nations agreed that the diverse stresses caused by climate variability must be reduced (UNFCCC, 1992). Greenhouse Gas Emissions must be reduced in order to ensure sustainable livelihoods and global food security, particularly that of the poor. In making provision for the reduction of GHG emissions as well as ensuring sustainable agricultural development/food security, the UNFCCC (1992) states that to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change; to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner'' (UNFCCC Article 2, 1992, p. 4). The United Nations Millennium Development Goals were developed with specific targets to be met by 2015. One of these targets, the first thereof, provides that relative to 1990, hunger and poverty should be halved by 2015 (Gregory et al., 2005). In their study of the “assessment of the world food system” Parry et al. (1999) used the Hadley Climate Models 2 and 3 and postulated that world food security would decline as a result of the impacts of climate variability and change; these include decreased crop yields caused by 1) the shortening of the crop growing period, 2) decreases in water availability as a consequence of elevated evapotranspiration rates, and 3) poor vernalisation of temperate cereals.

The current and projected adverse effects of climate variability and change on food security include rain-fed crops (maize, wheat, rice) are projected to experience decreased production owing to both the rising atmospheric CO_2 and temperatures (Parry, 2007) and temperature increases of 1-3 ^{O}C are expected to negatively impact on global food production yield (Easterling et al., 2007). The malnutrition of the plant may lead to the malnutrition of humans as a result of protein deficiency as indicated by experiments on wheat, rice, barley and potato tubers (Taub et al., 2008). The aforementioned evidence of the negative effects of climate variability and change on crop yields are worldwide phenomena requiring further study as well as the interrogation of socio-economic drivers of food security at both the global and local scale to enable an adaptive framework for sustainable livelihoods, agriculture and development (Lobell et al., 2011; Lobell & Gourdji, 2012). The IPCC (2012) developed widely recognised definitions of both climate change and climate variability. The following section clarifies the interrelationship between three phenomena: climate change, climate variability and global change.

The definitions of climate change, climate variability and global change

Climate change is defined as

> A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC, 2012)

Also, climate variability is defined as

> Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate at all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability) (IPCC, 2012).

This study uses the term climate change in the context of the aforementioned definition (with respect to perceived decadal variability of climate properties "that persist for an extended period, typically decades or longer") and has employed the analysis of rainfall variability (standard deviations and the occurrence of extremes) since it is a variable of climate variability which directly impacts rain-fed crop production. While temperature influences crop graffetowth several studies (Falkenmark, 1989; Kang et al., 2009; Bhandari, 2013; Waha et al., 2013) have shown that reduced rainfall is the main driver behind decreased crop yields rather than increasing temperatures.

The study also uses the term climate variability and change as an all-inclusive term, which covers the diverse manifestations of climatic changes, including variations, over decades and longer. Several climate impact studies adopt the term 'climate variability and change' (Mason & Jury, 1997; O'Neill & Ebi, 2009; Nelson et al., 2010; Herrmann et al., 2013; Kassie et al., 2013; Sarr et al., 2015). Also, of importance to comprehensive adaptive capacity to climate variability and change; to the description and analysis of the food system and to the mitigation of attendant risks and vulnerability is global change. Global change is defined as

> the broad suite of biophysical and socioeconomic changes that are altering the functioning of the Earth System at the global scale. In essence, it refers to the remarkable change in the human-environment relationship that has occurred over the last few centuries. Global change encompasses change in a wide range of global

> scale phenomena: population; the economy, including magnitude and distribution; resource use, especially for production of energy; transport and communication; land use and land cover; urbanization; globalization; coastal ecosystems; atmospheric composition; riverine flow; the nitrogen cycle; the carbon cycle; the physical climate; marine food chains; and biological diversity (Oldfield & Steffen, 2004).

This definition of global change illustrates and emphasises the link between biophysical changes and socio-economic changes which effect the scientifically observed and/or socially perceived earth system changes at local, regional and global scales. The earth system encompasses the climate system. Global change encompasses "atmospheric circulation, ocean circulation, climate, the carbon cycle, the nitrogen cycle, the water cycle and other cycles, sea-ice changes, sea-level changes, food webs, food system, biological diversity, pollution, health, fish stocks, and more" (International Geosphere Biosphere Programme, 2015). Therefore, climate variability and food systems are part of global change. A food system is broadly defined as

- the interactions between and within bio-geophysical and human environments, which determine a set of activities;
- the activities themselves (from production through to consumption);
- outcomes of the activities (contributions to food security, environmental security, and social welfare) and
- other determinants of food security, including those interactions between and within bio-geophysical and human environments (Ericksen, 2007, p. 2).

In 2009/10, the number of food insecure people reached epic proportions growing drastically to 1 billion (FAO, 2009). The four dimensional food security framework of the UNFAO defines food security as 1) Food Availability (inclusive of food production, stock levels and trade; 2) Food Access (incomes, expenditure, markets and prices); 3) Food Utility (Nutrition, feeding practices, food preparation); 4) Food Stability (Weather conditions, political instability, unemployment and food prices), (FAO, 2008). Approximately sixty percent of

Africans depend on rain-fed agriculture for their livelihoods (FAO, 2003; Tanner & Mitchell, 2008). Due to climate change, climate variability and related environmental change, land degradation and loss of biodiversity will adversely affect food and agricultural production in Sub-Saharan Africa, leading to severe food insecurity (Easterling et al., 2007). Boko et al. (2007) project reductions in crop yields as high as 20% by 2020 with small scale farmers' crop revenues – who are very likely to be the worst impacted - plummeting by as much as 90% by 2100. Climate change will adversely impact on both tropic and sub-tropic regions by desiccating these territories with severely impairing droughts and floods particularly on rural areas of the developing world (Adger et al., 2003; Trenberth et al., 2007). The impacts of higher food prices will also surface and increase risk and vulnerability to climate variability and change.

Food prices, biofuels, climate variability and change

A negative climate variable such as reduced precipitation may reduce crop yields, resulting in both high food prices and stunted food accessibility (Ziervogel & Ericksen, 2010). Land use changes are not the only threats wrought by demand for food, but the demand for food can be manifested as a threat to food security by the subtle counter demand for the use of food crops as biofuels. Such a fuel-intensive demand for food crops will inevitably lead to economic stress, particularly for the poor, due to extortionate food prices (Rosegrant et al., 2008; Tirado et al., 2010).

In its broader milieu, which includes global, regional and local settings, the food system must be elaborately studied in order to better unearth the systemic effects of global trade agreements, global energy and resultant food prices. This include research on the effects of these and other socio-economic and climate system changes on local natural resource degradation, land rights, market policy and agricultural trade. This is to ensure food system resilience to both externalised and internalised effects of the interplay between food security activities and climate change phenomena (Ingram, 2011). Such factors as food price increases and malnutrition have caused the underestimation of the impacts of climate variability and change on food systems and food security particularly when the other components of food security – access, availability, stability and utilisation are not well researched (Ziervogel and Erickson, 2010).

Central to the debate on the impacts of climate variability and change on food security is the definition of food security as developed by the UN Food and Agriculture Organisation (FAO, 1996) which determined food security to have been attained ‘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 for an active and healthy life’. The FAO (1996) definition of “food security” lacked the aspect of social control of the food system, and was later developed in the State of Food Insecurity of 2001 to be about “a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, 2002).

The global demand for food will also increase exponentially, necessitating globally efficient institutional, structural, political and policy shifts (Von Braun, 2008). In addition, the environmental costs of food production due to global food demand may increase the severity of greenhouse gas emissions accompanying food miles/transport (Pretty et al., 2005). This incremental higher temperature will adversely affect the productivity of both perennial and annual crops, particularly apples, pears, plums and apricots (chill-unit dependent fruit). It is under such conditions that "acclimation-type adaptation will be necessary" especially when South Africa is evidenced to be susceptible to inclement climate which impacts on rural livelihoods as well as on farming systems (Midgley et al., 2007; Benhin, 2008; Quinn et al., 2011).

Projected vulnerabilities of climate variability and change in South Africa

Deressa et al. (2005) point out that much research has been done on the impacts of climate variability and change on agriculture in the third world (Rosenzweig, 1989; Rosenzweig & Parry, 1994; Mendelsohn et al., 1994, Winter et al., 1996; Dinar et al., 1998., Kumar & Parikh, 1998; Mendelsohn & Tiwari, 2000; Mendelsohn et al., 2000), however, few studies had been undertaken on the impacts of climate variability and change on agriculture in South Africa (Gbetibouo & Hassan, 2005). Yet in recent times the following studies have been impactful in the study of South African climate variability and change and agriculture (Benhin and Gbetibouo, 2006; Benhin, 2008, Quinn et al., 2011; Wiid & Ziervogel, 2012; Ziervogel et al., 2014). The high-risk environment and energy intensive economic system renders South Africa vulnerable to climate variability and change (Deressa et al., 2005). Vulnerability is the "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC, 2001a).

Moreover, in South Africa a 1% decline in rainfall is predicted to lead to a 1.16% decline in maize production and 1% decline in wheat production (Blignaut et al., 2009). With a projected decrease of between 5 to 10% in rainfall in South Africa over the next 50 years (Hewitson, 1999), the estimate for the decline in crop production needs to be extensively studied. Irrigation is invariably another option whenever rainfall is highly variable and unpredictable, however, given the reduction of run-off which is estimated at 10%, irrigation's dependency on precipitation would translate into lower groundwater recharge rates and poor water quality in South Africa (Schulze et al., 1993; 2001; 2005; Schulze, 2012). Alternatively, research on the utilisation of drought resistant cultivars should mitigate the negative effects of decreased rainfall rates and encroaching desiccation (Kurukulasuriya et al., 2006).

While South Africa is considered to be food sufficient, it is estimated that approximately 35% of the population is vulnerable to food insecurity (Mgijima, 1999; Steyn et al., 2001; De Klerk et al., 2004). Rural households are more vulnerable to food insecurity than urban households (Bonti-Ankohmah, 2001). The problems related to food insecurity in South African rural households can, among other socio-political environmental factors (which will be discussed later), be attributed to the marginalising machinations of apartheid South Africa, which caused rural areas such as the Peddie District[1], also known as Ngqushwa, to suffer much land degradation, soil erosion and associated desertion of traditional agricultural activity in the area. The South African National Climate Change Response Green Paper of 2010 (SANCRGP) advocates for a people-centred approach to climate change which prioritises "climate change mitigation and adaptation actions that ensure human dignity, especially considering the special vulnerabilities of the poor and in particular of women, youth and the aged" (Republic of South Africa, 2010, p.6).

Climate variability and change in the Eastern Cape

Relatively, the Eastern Cape Climate Change Response Strategy 2011 (ECCCRS) predicts that the manifestations of climate change in South Africa are likely to include higher temperatures; altered rainfall patterns; more frequent or intense extreme weather events including heat-waves, droughts, storms and floods; and rising sea levels (which, associated with more intense storm surges and floods, may result in local inundation and coastal erosion (Province of the Eastern Cape, 2011).

The Eastern Cape Climate Change Response Strategy 2011 further predicts that the western interior of the Eastern Cape will experience higher temperatures, and resultant higher evaporation rates and caustic droughts. Furthermore, the water availability dynamics in the Eastern Cape are both defined and constricted by "unutilised domestic sources of water (which) are limited to two river catchments

[1] For purposes of clarity, the name Peddie District will be used interchangeably with the name Ngqushwa Local Municipality, which incorporates the coastal town of Hamburg and the former Zwelitsha District, particularly in matters describing the area's socio-economic history and environmental characteristics.

in the ecologically sensitive and relatively undeveloped Eastern Cape province" (Blignaut et al., 2009, p. 70). Yet 60% of non-commercialised maize production in South Africa is found in the Eastern Cape, which implies the prevalence of subsistence and small scale farming activities (Trends in the Agricultural Sector, 2010).

Brief background to the Ngqushwa Local Municipality

Peddie District was part of a homeland system of apartheid South Africa which was called the Republic of Ciskei. A rural area of the Ciskei, Peddie District was a region from which a pool of cheap black labour could be exploited by major Cape Province industrialised cities of the Republic of South Africa, such as Port Elizabeth and East London, even as far afield as Cape Town (Thornton & Nel, 2007; Lester et al., 2000). Displacement to what were called "native reserves" through the following listed apartheid laws: Native Locations and Commonage Act of 1879; Glen Gray Act of 1894; 1913 and 1936 Land Act (Thornton, 2009). The aforementioned laws stripped the black people of their right to land, controlling urbanisation as well as confining black farmers to small-scale subsistence agricultural activities (Kepe, 1999; Wotshela, 2004; King & McCusker, 2007).

Given access to little land to thrive in, overpopulation and overstocking in the Ciskei in the first quarter of the 20th century led to serious soil erosion and land degradation, which significantly brought about a reduction in subsistence benefits that were previously derived by the rural communities from the land (Switzer, 1993). In South Africa a third of rural households rely on small-holder agricultural production activities as means to both supplementing incomes from remittances and unskilled jobs, and ensuring food security (Ngqaleni & Makhura, 1995; Ortmann & Machethe, 2003; Machethe, 2004). Therefore, in order to reduce risk and vulnerability, it is critical to engender a culture of agricultural adaptive capacity to climate variability and change which would stem the tide of climate related unfavourable impacts on agricultural practice and food production in rural communities of South Africa.

Adaptive capacity and rural communities

For purposes of this study adaptive capacity is defined as “the combination of the strengths, attributes, and resources available to an individual, community, society, or organization that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities (IPCC, 2012). Adaptive capacity is fundamentally a result of political, institutional, ecological, socio-economic, geographical, and culturally synergised interactions, which have both a short and long-term impact on human-environmental interactions (Eriksen et al., 2011). The situation can be quite dire for rural communities because “Indigenous people who rely on their natural resources for the provision of traditional foods will be particularly affected” (Tirado et al., 2010, p. 1735). Critical to minimising the adverse risks and vulnerability of rural livelihoods is the employment of adaptation strategies, which consist in “adjustment(s) in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts” (Smit & Pilifosova, 2001, p. 881). Incidentally, to strengthen adaptive capacity and reduce risk and vulnerability at the local level, rural communities have been found to muster their indigenous knowledge, skills, livelihood diversity strategies, perceptive awareness, cultural, technological and institutional resources to meet the challenges posed by climate variability and change on their human dignity and survival (IPCC, 2007).

Increased adaptive capacity, through risk and vulnerability scoping, can be best realised by mapping the variables of climate variability and change which impact on food security and agriculture (Adger et al., 2007; Preston et al., 2011). Fortifying adaptive capacity is an imperative which when explored translates into greater resilience to climate stresses and other underlying socio-economic factors by taking into consideration locally contextualised understandings of climate impacts and systemic involvement of the vulnerable beneficiary (Downing et al., 2005).

Risk and vulnerability, adaptive capacity and Ngqushwa Local Municipality (NLM)

This study seeks to investigate the factors influencing household (subsistence) and small-scale farmer perceptions of risk and vulnerability as well as the determinants of adaptive capacity. There are four categories of current research in climate variability and change impacts: "biophysical productivity changes, economic impacts, industry and community planning, and research into the adaptive capacity of rural communities" (Pearson et al., 2008, p. 3). This study focuses on the biophysical changes/ factors (scientific analysis of the prevailing climatic regimes -particularly rainfall trends) and the socio-economic factors influencing indigenous knowledge and perceptions of climate variability and change. The study also interrogates the impact of the global food system on both food prices and on rural sustainable livelihoods as well as its implications on food sovereignty, which possesses the potential to strengthen adaptive capacity and to reduce risk and vulnerability. Therefore, the extent of adaptive capacity, risk and vulnerability of the rural community of the Ngqushwa Local Municipality which is unique to the rural sustainable livelihoods framework were unearthed through household experiences and perceptions, and measured against meteorological data for consistency and reliability.

Research Problem

In the Ngqushwa Local Municipality (NLM), the type of small-holder farming (whether livestock or crop) employed varies and primarily consists of a mixed cropping system which includes poultry, pigs, cattle, sheep, maize, pumpkins and melons and dry beans (Steyn, 1988; Silwana, 2000; Wenhold et al., 2007). However, all farming systems have a water footprint which puts South Africa (a water stressed country) in an untenable position given that agriculture consumes more than 50% of the country's water resources (Du Plessis, 2003). Therefore the Republic of South Africa (2004) National Climate Change Strategy for South Africa proposed the phasing out of irrigation farming; while promoting the planting of drought resistant crops; reduction of reliance on industrialised mono-culture cropping with more emphasis on multi-cropping varieties; and utilisation of seed types that support biodiversity integrity and resilience.

Yet crop production in South Africa is crucially dependent on precipitation even more so than it does on temperature (Durand, 2004). Smallholder and subsistence (household) farmers in developing countries depend largely on rain-fed agriculture. Crucial to rain-fed crop-production is rainfall intensity and duration, which influence soil moisture and humidity (Ludi, 2009). Because of the susceptibility of rainfall to climate variability and change, South Africa's food security and agricultural production needs require that subsistence/small-holder farmers employ sustainable adaptation strategies to help mitigate the impacts of climate variability and change on water resources. Historically, the Nqgushwa Local Municipality has experienced numerous drought spells in the past and notably the 1945 drought which rendered arable agricultural land untenable when scores of oxen and cattle that were used for ploughing were killed (Mager, 1999).

The Amathole District Municipality (ADM) under whose jurisdiction the Ngqushwa Local Municipality (NLM) falls, and hence the Peddie District, experienced a desiccating drought such that in September 2009 the Premier of the Eastern Cape Province declared the ADM a drought disaster area. The scale and extent of the impact of the afore-mentioned 2009 drought saw the Ngushwa Local Municipality required to expend from its coffers a total of R4 687 649.30 with 11 local food security co-operatives needing R367 649.30 (Table 1.1) for their water shortages related damages and costs to their operations.

Table 1.1: Ngqushwa Local Municipality Water Shortages Costs due to the drought of 2009

Nature of Impact	Affected Project/Operation	Cost in Rands (R)
Shortage of Water	Dam Scooping, Borehole Testing & Repairs and Windmill Repairs	4320000.00
Shortage of Water	Rural Development Food Security	27428.70
Shortage of Water	Lower Gwalana Food Security	1452.90
Shortage of Water	Woodridge Food Security	32090.00
Shortage of Water	Zamani Food Security	26327.00
Shortage of Water	Masincedisane Food Security	49500.00
Shortage of Water	Mtati Women’s Co-operative	31390.50
Shortage of Water	Qaqambile Food Security	50900.00
Shortage of Water	Masivuye Food Security	60085.00
Shortage of Water	Masiphakame Ngxakaxha Food Security	16603.30
Shortage of Water	Peddie Extension Women Co-operative	61774.00
Shortage of Water	Lower Mgwalana Food Security	10098.00
Total		4687649

Source: Eastern Cape Drought Impact Assessment Report (2009)

While the impacts of the drought on NLM’s food security community projects approximated R400 000, its impact on food security projects in both Buffalo City Municipality (BCM) and Nkonkobe Local Municipality amounted to R280 000 and R148 000 respectively (Eastern Cape Drought Impact Assessment Report, 2009). It is in the context of recurrent droughts, high food prices, dry spells and rainfall decline and variability that adaptation strategies to the impacts of climate change are essential to all the Peddie District community’s food security initiatives. Adaptation to the vulnerability of crop production to climate variability and change, and hence of food security to climate variability and change variables such as incessant droughts and dry spells can be well planned, consolidated and implemented when rainfall variability is studied and understood (Aghajani, 2007).

Therefore, it is of particular importance to investigate how the wider community of the NLM adapts to climate variability and change and associated shocks and stresses. Using a sustainable livelihoods approach the risks to climate variability and change as well as the vulnerability of the entire food system to climate variability and change is probed within the broad frameworks of food, social, and environmental justice. Critical to this study is the socio-economic factors influencing the perception of, and the determinants of adaptive capacity to climate variability and change with respect to food security, leading to the question of how the Ngqushwa Local Municipality (NLM) communities exercise their "right to food" in a changing climate, and how or what adaptation strategies are employed to mitigate climate related stresses on food production in the face of high food prices and actual and/or potential poverty.

Aim of the study

To examine the interface of climate variability, food systems and crop production while exploring how adaptive capacity, food security and the rural people's perceptions of vulnerability are influenced by that interface.

Objectives of the study

1. To describe the socio-economic characteristics of the respondents as well as to determine the factors influencing the existing perceptions of climate variability and change at the household level.

2. To interrogate the determinants of adaptive capacity of both small-scale and subsistence farmers as well as to investigate the nature of both the perceived vulnerabilities and of the adopted adaptation strategies.

3. To determine the impact of rainfall variability on crop cultivation in the study area; on maize crop farming, rural household gardening, small-scale and subsistence farming as well as to quantify rainfall variability.

4. To investigate the impact of both the food price dynamic and the global food system on rural livelihoods and food availability and access.

5. To investigate the extent of the impact of the interaction between South Africa's climate variability and change, food and agricultural policies and how these are articulated to galvanise food security programmes as well as how they influence the perceptions of risk and vulnerability in the Ngqushwa Local Municipality.

The significance of the study

The link between climate variability and food security in Africa is increasingly gaining more attention in the climate justice arena. Clearly, deferring research and action on the impacts of climate variability and change on food production, is both parochial and myopic, and will remain a "thorn on the side" of South Africa's poverty alleviation/eradication strategies as well as on those of the rest of the developing world. Citing the complexity and relevance of the relationship between climate variability and change and food security at the Conference on Global Warming and Climate Change, Gina Ziervogel argued that ''the link is not even made between failed crops and changing weather patterns'' (Mail & Guardian, 2008). The Mail & Guardian further quotes Ziervogel explaining that

> Changing weather patterns or extreme weather events, such as floods or droughts, can have negative consequences for agricultural production. As a result people have less access to food, which forces them to buy food products. This affects their financial situation ... It also influences their health as people often buy cheaper food which is frequently less nutritious (Mail and Guardian, 2008)

Speaking on climate smart agriculture, the South African Minister of International Relations and Co-operation, Ms Maite Nkoana-Mashabane stressed that

> there is a “need to link climate change, food security and poverty ... to engage on emerging issues including finance and technological support and approaches such as Climate-Smart Agriculture that are geared towards addressing food security, adaptation and mitigation” (and that) “research must help us to identify early actions and best practices to build capacity and increase resilience and carbon sequestration, while enhancing and ensuring food security” (Republic of South Africa, 2011a).

The case for investigating the perceptions of local rural communities about climate variability and change

From the Kyoto Protocol to the United Nations Framework Climate Change Convention (UNFCCC) to the various Conferences of the Parties (COP) and their associated international diplomatic machinations designed to devise mechanisms to mitigate Greenhouse Gases (GHG’s) emissions, the imperative to funnel such mandates to the lowest levels of society stands, and it remains essential to linking global contexts to local context (Burgess et al., 1995; Fairhead & Leach, 1996; 2000; Bassett & Crummey, 2003). There is a need to “engender grounded, locally relevant research to document the important and relevant cross-scalar—both temporal and spatial—and intersectoral linkages that are increasingly critical to understanding vulnerability from the perspective of the vulnerable (Eakin, 2005, p. 1936). West et al. (2008) argue that “Integrating the views of the people most affected by droughts with scientific views on rainfall trends is crucial if we are to understand the effects of regional climate change on societies and their ability to adapt (West et al., 2008, p. 302).

Climate variability and change is a ‘social ecological system’ which “cannot be understood relying on science alone” (Byg & Salick, 2009, p. 156). The funnelling of the GHG emissions targets, mitigation strategies and adaptation mandates to the lowest levels of society, particularly to rural communities is imperative since rural communities are most adversely affected by climate variability and change (IPCC, 2007; Pouliotte et al., 2009). In addition, the study of the impacts of climate variability and change at local level gives rise to the attainment of insight into the experiences of local people that are hardly reflected in scientific studies and models. The significance of local perceptions is critical to understanding the cultural and social context within which the environmental changes occur (Laidler, 2006). Local climatic changes influence the spatial scale of global climatic processes (Wilbanks & Kates, 1999; Laidler, 2006).

However, there are varying perceptions on the impacts of climate variability and change. For instance, in the US, (Leiserowitz, 2005) when asked to explain what or who is at greatest risk of climate variability and change a cumulative 90 percent of the American public were mainly concerned about the impacts of climate variability and change on non-human nature (ecological balance, temperature rises, melting polar ice cap, etc). The American public made little or no reference to the impact of climate variability and change on human health, particularly on the poor people living in the developing world who lack adequate clean water, nutrition and medical care, including their omission of the facts associated with global warming, and its effects on the increasing incidence of extreme weather events such as droughts (Leiserowitz, 2005).

In addition, on the issue of reducing GHG emissions the American public is wary of taking any steps that jeopardize the United States' economic stability. They prefer that the country adopts a wait-and-see strategy which will help buy enough time to determine whether GHG's are the cause for global warming/climate change (Sterman & Sweeney, 2007). However, the idea of adopting a wait-and-see approach before GHG emissions are significantly reduced may not take into account the rate of emissions concentrations less the rate of emissions removal. It may be rather to little too late (response delays) to make considerable progress towards mitigation and emissions reduction targets and the ramifications may include the rate at which policy changes and political ratification will be effected (Sterman & Sweeney, 2007).

In Fairhead & Leach's (2000; 2003) studies the importance of taking into consideration the perceptions and convictions of ordinary people about environmental change was affirmed and emphasised. The perceptions of the local farmers were corroborated by satellite imaging which agreed with the certitude of the local people that the forests in Guinea were expanding, while scientists had suggested the opposite effect; that the forest areas were shrinking. The stakeholders at grassroots level are essential to influencing the processes leading to sound climate change mitigation and adaptation action. With stakeholders ranging from forest and tourism managers, investors, to peasants, to ordinary citizens the chances of success are greatest particularly at the implementation stage of targeted policies.

This allows for the deliberate unearthing of controversial issues that may arise at the implementation stage of environmental policies (Sterman & Sweeney, 2007). Several studies have been conducted on the linkages made by ordinary people about climate variability and change and meteorological changes and variability (West et al., 2008; Deressa et al., 2005; Mertz et al., 2009, Frayne et al., 2012). Fewer research studies have been conducted on how climate variability and change are perceived by indigenous/rural communities with a bulk of those conducted being on climate variability and change and smallholder agriculture which is fundamentally practised by under-resourced rural communities (Ziervogel & Zermoglio, 2009; Petheram et al., 2010).

The Yolngu people (indigenous people) of Australia argued that climate variability and change adaptation issues should not be isolated from social issues like the neglect of their voices by Australian government agencies and private corporations, particularly those of non-indigenous descent. The Yolngu wanted the government to recognise and incorporate their traditional and cultural ways of adapting and co-existing with the environment into its climate variability and change strategies. Referring to the non-Yolngu peoples the Yolngu cited the incidence of climate variability and change as a consequence of “big cities”; “what we are doing to mother nature”; and that “mother nature is weeping” (Petheram et al., 2010). In the findings of the study on the Yolngu’s perception of climate variability and change Petheram et al. (2010, p. 687) argue that “planning of adaptation should not initially focus on predictions on climate but on understanding perceptions and current vulnerabilities in general”. The basis for the interpretation of the extent of climate variability and change impacts on lay people depends on psychological, social, moral, institutional and cultural processes (Dessai & Hulme, 2004). In a Burkina Faso study (West et al., 2008) the scientific data corroborated the perceptions of the local farmers who claimed that rainfall had been declining for the recent past decades. Even so, perception of climate variability and change does not always result in effective adaptation as it is dependent on technological access, institutional policies, political environment and cultural values of the local community under study (Weber, 2010).

While climate variability and change is a well-documented phenomena in the South Pacific islands, (Barnett & Adger, 2003; Mimura et al., 2007; Chambers & Chambers, 2007, Lazrus, 2011) the people of Funafuti, one of the atolls in the archipelago of the Tuvalo Pacific islands, would not conform to the expectation that their migration to New Zealand and Australia was caused by climate variability and change. The people of Funafuti did not perceive climate variability as the reason to migrate and leave behind their birthplace, arguing that God would not allow them to be drowned, citing their belief in the promise God made to Noah not to punish humans by inundation again. The people of Tuvalo do not identify climate variability and change as a risk, not as one warranting migration as an adaptation strategy of neither the forced nor voluntary orders (Mortreux & Barnett, 2009). The people of Zambia also believe that climate variability and change is caused by willful disobedience to God as well as by neglecting to follow the leadings of the ancestral spirits. In a Zambian study, Nyanga et al.

(2011) investigate the perceptions of Zambians about the link between the practice of conservation agriculture and the phenomena of climate variability and change. Conservation agriculture need not be invariably perceived as an adaptation strategy to climate variability and change but as a means to engendering effective food production for reliable food security (Nyanga et al., 2011).

In South Africa 86 percent of farmers observe that temperatures are increasing with 79 percent claiming that rainfall has decreased. However, while the perceptions about temperature increases have been corroborated by statistical data the perceptions about decrease in precipitation was not supported by data from the South African Weather Services over a 43 year period (Ziervogel et al., 2005). The farmers' perceptions of rainfall variability may have been based on short - term observation and not long – term inference (Ziervogel et al., 2005). While Ziervogel et al. (2005) may have come up with a negative correlation in far as the perceptions and scientific data are concerned (Gbetibuou, 2009) found that in the Limpopo Basin (South Africa) scientific data corroborated the perceptions of the farmers. Given the criticality of soliciting perceptions from indigenous communities as they inform policy decisions, this study also seeks to corroborate the perceptions of the NLM rural community with scientific/meteorological data.

Ethical and intellectual property rights considerations

The importance of adhering to the values of confidentiality and privacy formed the basis for enhancing the confidence the respondents had on the researcher. Also, an attitude of valuing the responses of each and every respondent irrespective of how seemingly irrelevant their responses are. This helped better understand the perceptions, feelings, plans and aspirations of all the concerned residents the Ngqushwa Local Municipality, the Government Department Officials and those of Public Officials. Furthermore, the researcher protected the interests of all without showing bias or analysing data in a biased manner. Consequently, each respondent's preferences was placed before the preferences of the researcher so that the consultation atmosphere could be more favourable to the respondent as he/she shares information from his/her own perceived worldview. This also relates to the observance of time and punctuality. It was also expected that some respondents would wish to remain anonymous. Therefore, the respondents' true names were not used and pseudonyms were adopted on the entire thesis.

It was therefore in the interest of a conflict free research study and sustainable working relations between all the related stakeholders and interest groups that such a request will be granted. The researcher also guarded against being consciously and/or sub-consciously predisposed to gender and racial discrimination as well as to prejudices stemming from the respondents‟ social, historical and financial backgrounds. In as far as originality is concerned, all content and the context of the research journal publications, conference publications, seminars and personal communication have been acknowledged, cited and referenced accordingly so as to maintain, promote and foster the intellectual integrity of both the cited works as well as the ethical integrity of the author of this study.

The Structure of the Study

CHAPTER I

The chapter introduces the concepts of climate variability and change, Climate Variability, Global Change and Food Systems. It gives a brief background to the Ngqushwa Local Municipality as well by outlining the research problem; the aim and objectives; the significance of the study; the ethical considerations; as well as the structure of the study.

CHAPTER II

This chapter comprises the literature review on the themes as set out in the objectives of the study. Literature on the extent of climate anomalies and global change rainfall variability as well as the interface of food prices, food systems and climate variability and change is reviewed. The chapter ends with a review of climate variability and change, food security policies and legislation.

CHAPTER III

The chapter gives a comprehensive yet concise account of the historical and current vulnerabilities of Peddie District and its state of the environment under the Ngqushwa Local Municipality (NLM). The chapter further elucidates the economic facts of the NLM as obtained from STATS SA and other relevant authors. Therefore, the chapter is a description of the state of the environment as it was known ahead of this study.

CHAPTER IV

The chapter begins by describing the conceptual framework as well the research methodology in order to achieve the research objectives. The study adopts a mixed method approach to ensure that triangulation is achieved. These research methodologies include questionnaires, unstructured interviews, focus group discussions and methodological data analysis.

CHAPTER V

The chapter consolidates the analyses of all the study objectives in order to address the research problem. The chapter uses descriptive statistics to describe the socio-economic characteristics of the respondents as well as inferential statistics to analyse both the factors influencing perceptions of climate variability and change and the determinants of adaptive capacity. It further outlines the divers' perceptions of vulnerabilities as well as the findings of the meteorological data. Chapter V is divided into two and comprises ‘household and focus group findings’ and ‘rainfall results, legislative & policy

CHAPTER VI

The chapter discusses the perceptions of the NLM respondents about climate variability and change as well as the factors influencing perception and the determinants of Adaptive Capacity. Crops and rainfall variability are also discussed as well as the nuances characterizing the current and historical effects of food systems on the climate, food prices and food access.

CHAPTER VII

The chapter concluded the study. It contains a synopsis of the study, it proposes, and recommends new approaches to solving some of the most pressing issues confronting climate variability and change and its effects on rural local food systems, food security, crop yields as well as land issues.

CHAPTER II

LITERATURE REVIEW

Introduction

This chapter comprises the literature review on the themes as set out in the objectives of the study. Firstly, the factors influencing perceptions and secondly the determinants of adaptive capacity are expatiated upon. Literature on the extent of climate anomalies and global change from around the globe is also reviewed. One of the main climate parameters – rainfall variability affecting crop production is assessed as well as the interface of food prices, food systems and climate variability and change. In order to link the laws underpinning the context of South African farmers experiences with scientific data and the perceptions of climate variability and change the chapter ends with a review of climate variability and change, food security policies and legislation.

Factors influencing perceptions and the determinants of adaptive capacity

It is important to understand the role of the different factors influencing farmers' perception and adaptation capacity to ensure the development of appropriate policy measures (Gebrehiwot & van der Veen, 2013). Juana et al. (2013) argue that in Sub-Saharan Africa years of farming experience, household size, years of education, access to credit facilities, access to extension services and off-farm income are among the significant determinants of adopting climate variability and change adaptation measures. Ofuoku (2011) found that in Nigeria the farmers adapted to climate variability and change by planting trees, soil conservation practices, changing planting dates, adopting crop varieties and utilising irrigation. The factors that influenced the farmers' perceptions of climate variability and change included education, gender, and farming experience. Ofuoko (2011) also identified barriers to adaptive capacity to climate variability and change which included lack of information, poverty, and inadequate land. Anyoha et al (2013) found that in addition to the factors identified by Ofuoko (2011) farm size, household size, and social organization were significant factors influencing perception and the choice of adaptation strategies and their impact on adaptive capacity.

In Ghana, Acquah (2011) found that the majority of the farmers perceived increase in temperature and decrease in rainfall pattern and that they employed soil conservation methods as one of the major adaptive capacity boosters. In the (Acquah, 2011) study farm land ownership and other off-farm income generating activities were significant factors contributing to perception of climate variability and change. In Ethiopia (Gebrehiwot & van der Veen, 2013) found that also level of education, age and income the household; access to credit and agricultural services; information on climate and temperature all influence farmers' choices of adaptation and hence adaptive capacity. In Uganda gender and farm size significantly affected adaptive capacity and vulnerability (Okonya et al., 2013). To offset the incidence and impact of perceived dry seasons, floods, storms, mudslides, extreme rainfall, and delayed/early rains the farmers' adaptive strategies included planting trees that is high-yielding, early-maturing, drought-tolerant and disease and of pest-resistant varieties as well as planting at onset of rains, increased pesticide/fungicide application and digging drainage channels (Okonya et al., 2013). In Swaziland the determinants of adaptive capacity varied from crop rotation to mulching to minimum tillage to early planting, late planting and intercropping. The factors determining adaptive capacity included incidences of crop pest and disease input prices and food prices (Shongwe et al., 2014).

In the rural community of Thaba Nchu, South Africa the lack of interest in farming among the youth, the historical imbalances in land access and government policies on free water access as well as social grants created dependency on state social security grants (Gandure et al., 2013). According to Gandure et al. (2013) while the Thaba Nchu community perceived climate variability and change, the preceding factors, particularly social grants, negatively influenced the need for adaptive capacity to climate stresses. Rainwater harvesting was the most adopted adaptation strategy used (Gandure et al., 2013). While Gandure et al. (2013) found that the rural community was not adapting due to dependency on social grants the community in the Limpopo Basin, South Africa was adapting (Gbetibouo, 2009). Gbetibouo (2009) also found that meteorological data indicated that rainfall was characterized by large inter-annual variability with previous three years being very dry and that farmers' perceptions of climate variability and change was corroborated by climatic data records. These studies (Gbetibouo, 2009; Gandure et al, 2013) and those by Musemwa et al. (2013) and Ndhleve et al. (2013) in the Eastern Cape indicate that there is no evidence of homogeneity of dependency on social grants to the extent of not adapting as a consequence of such dependency. In the Eastern Cape, there is a paucity of studies on the impact of climate variability and change and on how and under what socio-economic factors and circumstances the rural communities perceive and adapt to climate related stresses.

The extent of the effects of climate variability and global change on farming

Studying the various ways by which the small-scale farmer adapts to climatic variability and change is crucial to determining and learning about how to mitigate environmental stress and vulnerability (Yohe & Tol, 2002). It is in the interest of the food insecure and vulnerable people for institutional policies to facilitate "the ability to effectively translate hunger into an economic demand for food and to have access to nutritious, safe and culturally preferred foods" (Ziervogel & Erickson, 2010, p. 525).

The imparity caused by the exclusion of smallholder farmers in defining food market policy as well as the constriction of access to this market which have been imposed by global economic integration and market liberalisation further cause resilience and adapting to climatic stresses to be more challenging and untenable for the smallholder farmer (Leichenko & O'Brien, 2002). In the United States of America, wheat, maize and soybean yields were estimated to have declined from 20 to 2 percent, 30 to 5 percent and 40 to 5 percent respectively

(IPCC, 1996). In 1993 excessive precipitation that occurred in the Midwest US owing to climate variability and change caused flooding which damaged farmers' crops amounting to about $6-8 billion in crop, equipment and infrastructural damage (FEMA, 2005). As an adaptation strategy, the US farmers turn to crop insurance with a sizable modicum of the costs of insurance eked out of the coffers of the State and Federal governments (Hisschemöller et al., 2001).

In India, the vulnerabilities of farmers are twofold as they simultaneous face the sting of the free winds of trade liberalization sweeping into the shores of their land together with the negative of climate variability and change. For Indian farmers, trading and growing crops in a semi-arid tropical land with erratic monsoon rainfall has been exacerbated by agricultural trade liberalization policies that stultified the ability of Indian farmers to compete with cheaper subsidized bulk volumes of agricultural crop imports from the Global North (Singh, 1995). As a result, the adaptive capacity of the Indian farmer to the adverse effects of both climate stresses and economic trade liberalization policies was precariously undermined (Gulati & Kelley, 1999). In delineating the interlinkages between market liberalisation, climate/environmental change and economic globalisation O'Brien et al. (2004) call these farmers' predicament "double exposure" to both socio-economic and climate variability and change stresses. The vulnerability of these farmers consisted in weak adaptive capacity, high sensitivity and double trouble exposure, which led many farmers to migrate to neighbouring urban areas to access wage labour. The adaptive capacity of those farmers who have no option but to remain, is left to the devises of private moneylenders whose loans cost upwards of 36 percent (O'Brien et al., 2004).

With the introduction of neo-liberal agricultural trade policies in Latin America, the double exposure of rural Mexico to both environmental and economic variability could not be more evident than when the country was exposed to many risks that characterised the North American Free Trade Agreement (NAFTA) (Human Development Report – UNDP, 2007/08). NAFTA spawned a suite of neo-liberal free market policies and reduced regulation of resource distribution that saw major shifts taking place, from changing state run farming to privately - owned agricultural inputs to imposing austerity measures that reduced the national budget for agricultural services and service agencies (Eakin, 2005). The Mexican government had hoped that these economic reforms would attract much-needed foreign investment, but the American famers were heavily subsidized by the US government while the Mexican farmer had no government support, and were left to be exposed to the free trade globalised agriculture (Wise, 2007; Patel, 2007).

Under NAFTA the Mexican smallholder farmers could not compete with US and Canadian farmers whose grain prices, particularly maize prices, were the benchmark for the entire North American maize market (Marsh & Runsten, 1998; Nadal, 1999). With the weak Peso already competing against the heavy weight currency of the world, the dollar, the droughts, dry spells and general anomalous climate variability (frosts and increase in El Nino Southern Oscillation events) were clawing at the integrity of agricultural production in a country where about 82 percent of cultivation is rain-fed (INEGI, 2007). Mexican farmers have had to find means to adapt to both climate and economic shocks. The Mexican government proposed that farmers grow alternative grains known to be more climate variability resilient than maize, albeit their subsistence value was not so popularly applauded by local farmers, yet indeed those farmers who had grown maize in Eakin's (2005) study, reported that approximately 76 percent of fields planted with maize suffered complete losses compared to 13 percent of barley fields. In attempts at adapting to the vicissitudes of climate variability and economic uncertainty, those who suffered such irreparable loss migrated over to the land of the provenance of Mexico's woes – the United States (Eakin, 2005), with the hope that they would salvage what was left of their human dignity.

It is important to consider the role of economic policy, and how it and confounds and compounds the impacts of climate variability and change on agricultural producers at farm-level. Economic policy underscores the decisions and the adaptive planning of farmers (Brklacich et al., 1997). In times of great economic uncertainty and precipitous climate stress, farmers at different levels of the social strata respond differently to economic stimuli for various reasons. The short term needs of the poor farmer take precedence over long-term considerations, while motivation to adapt to climate variability and change is reduced to mere survival (subsistence food security), whereas the wealthy farmer will adapt to climate variability and change and economic stress to ensure greater profit margins over the long term (Ziervogel et al., 2006). To offset the impacts of neoliberal economic policies Virtanen et al. (2011) argues for the proliferation of the Multi-stakeholder model which includes major shifts away from shareholder imposition of policies to rather more inclusive and co-operative decision-making undertakings, and policy planning which are established on the foundation of stakeholder participation and integration. The farmers are by the nature of their work, close to the effects of climate variability and change and invariably experienced its effects, ranging from rainfall variability, failed crop yields, duration of growing season, early frost times, temperature variability and fluctuations. The local farmers' perspective and local knowledge are integrally pertinent to the climate variability and change adaptive policy planning, decision-making and formulation process (Thomas et al., 2007).

Impacting on stable staple food production, in the Sahel, the Horn of Africa, the severity of drought events has rocked the region since the early 1960's with similar yet less severe effects manifested in the Southern African Region (Boko et al., 2007; West et al., 2008). In the Sahel region of Burkina Faso, adaptation strategies for farmers vary in livelihood diversification from migrant wage labour in abutting cities of the Ivory Coast, working in gardens, working for development projects and women's empowerment projects (Reenberg, 2009). While droughts have desiccated lands, floods have brought inclement weather patterns which significantly stall Africa's development and prosperity accompanied by unabated economic and human losses (Boko et al., 2007). As a consequence of climate extremes in East Africa (Tanzania, Kenya and Uganda) and Mozambique (south of East Africa) the occurrence of Malaria has been a challenge of immense proportion with fatality rates predicted to soar during warmer seasons due to reduced larval development duration (McMichael et al., 2006; Pascual et al., 2006; Boko et al., 2007; Paaijmans, et al., 2010).

In the Lake Victoria (Kenya) basin prevalence of malaria is linked to an increase in higher rates of poverty. Those who earn less than a dollar a day find regular access to health care institutions to be a challenge due to increasing motorised transportation costs, resulting in self-medication, which is often not as potent as hospital medical care (Wandiga et al., 2006). Therefore, access to health care as an adaptation strategy against the resultant effects of climate variability and change becomes an almost impossible attainment. Vulnerability remains rife and intractable for the poor when the people cannot afford bed nets and experience endless frequency of food shortages (Wandiga, 2006; Wandiga et al., 2010). In Tanzania due to the high medical costs of curing prevalent climate change-induced malaria such impunity and morbidity is a harrowing challenge when people have to sell their crops in order to afford medical costs. Such drastic activities plunge the poor subsistence farmers into further food insecurity (Kangalawe, 2012).

Subsistence and small-holder farmers in dry-land tropical areas such as Kenya and Ethiopia are often susceptible to droughts, and any increase in geographical shifts of crop production due to drought may result in crop yield losses, debt, migration and dependence on food aid (Easterling et al., 2007; Schmidhuber & Tubileo, 2007). Ethiopian crop farmers employ a suite of adaptation strategies which include the use of different crop varieties, planting trees, soil conservation, changing planting dates and irrigation. In addition, albeit less frequently, off-farm activities, migration to urban areas, changing farming type, the utilisation of new technologies and water conservation have also been adopted (Bryan et al., 2009). Aliber & Hart (2009) studied and highlighted the magnitude, complexity and contribution of some 4 million homeland subsistence farmers to food security in South Africa. However, compounding the Eastern Cape subsistence farmers' climate variability and change complexities (Ortmann & Machethe, 2003) is the lack of access to implements and inputs which are necessary to the scaling down of agricultural activity to the level of home gardens in order to secure food access and availability (Aliber & Hart, 2009).

Impact of rainfall variability on maize and crop farming

There has been a plethora of studies conducted on the effects of climate parameters, change and variability on agriculture/food production and security in the developed world (Stooksbury & Michaels, 1994; Lobell & Asner, 2003; Isik & Devadoss, 2006; Carew et al., 2009; Kim & Pang, 2009). Agriculture is essential for sustaining and enhancing human welfare (Schmidhuber & Tubiello, 2007; Boubacar, 2010). Global agriculture is highly vulnerable to the negative impacts of climate variability and change. Approximately 97% of agricultural production in Sub-Saharan Africa is dependent on rainfall (Rockström et al., 2004). Climate parameters play a critical important role in determining crop production in the semi-arid regions of Africa which are characterized by a low and highly variable distribution of spatial rainfall incidence over time. Climate parameters are likely to reduce crop yields of maize, rice, wheat and other crops (Graef & Haigis, 2001; Tesfaye &Walker, 2004; Yengoh, 2010; Lobell et al*.,* 2011). There are several studies conducted on the significant impacts of rainfall variability on maize crop yield (Adejuwon, 2004; Adejuwon & Odekunle, 2006; IPCC, (2001; 2002; 2004; 2007; Awosika et al., 1994). While climate variability and change has a negative impact on agricultural production and food security, agriculture also contributes to increasing climate variability and change through emission of greenhouse gases, land degradation and deforestation (FAO, 2001).

Anthropogenic activities which have had an effect on precipitation, evaporation, transpiration and aerodynamic roughness include deforestation (Pielke et al., 2007), which reduces the infiltration rate of surface water which in turn enables crop and vegetation growth. Rainfall is critical to maize seed germination. The soil moisture, where the seed is embedded enhances seed germination (Finch-Savage et al., 2001). Ayanlade et al. (2009) assesses crop yields responses to inter-annual variability in rainfall in middle belt of Nigeria. Ayanlande et al. (2009, p. 462) concludes that “the sensitivity of crop yield to rainfall variability appears to be subject to the ‘ecological law of the minimum’ propounded by IPCC”. The ecological law of the minimum means that crops are sensitive to minimum amounts of moisture and rainfall. Rainfall variability, the low asset base of poor rural households, inhibits household crop management strategies and overall crop-water interaction productivity (Graef & Haigis, 2001).

In Nigeria, Odekunle et al. (2007) investigate the effects and constraints of the variable rainfall amounts in relation to farmers’ resource endowment and subsequent cropping strategies. Wealthy farmers are able to cope with rainfall variability and its impacts on crop productivity while poorer farmers struggle as they lack the asset resources like money and draught animals (Odekunle et al., 2007). Yengoh (2010) identifies the trends in rainfall-related climatic indices that are agriculturally relevant to small-scale farmers of the northern region of Ghana. One of the trends is deforestation. The absence of vegetation, which minimizes and inhibits the regulation of rainwater flows causes flooding for natural resource dependent communities (Armah et al., 2010). Anthropogenic activities exacerbate the vulnerability of smallholder farmers and must be mitigated through sustainable climate policies and actions plans (Yengoh, 2010).

To enable adaptation to rainfall variability, Burkina Faso farmers use five descriptors to characterise seasonal precipitation: (1) the onset date of the rainy season, (2) the cessation date of the growing period, (3) the rainfall amount per rainy day, (4) the number of rainy days within the season, and (5) the total amount of precipitations (Allen & Ingram., 2002). Lodoun et al. (2013) applies the standardized anomalies index (SAI) to document the evolution of the five seasonal descriptors from 1941 to 2000, based on daily rainfall records of 36 stations. The analysis shows that while both the average rainfall per day and the monthly precipitation amount increased the number of rainy days per season decreased, resulting in longer dry spells and vulnerability to crop failure. The adaptation strategies aimed at improving crop productivity should include rainwater harvesting (Lodoun et al., 2013). Also, while rainfall is good for crop production “intensive rain concentrated in a particular month has a devastating effect on crop production” (Prakash et al., 2011). To determine the sensitivity of maize crop to rainfall variations Antwi-Agyei et al. (2012) apply the crop-yield sensitivity index. Maize is selected as the test crop due to its ubiquitous use as both a staple in Ghana as well as for its importance in the country’s economy (Kasei & Afuakwa, 1991). The same is true for many African States.

Due to erratic rainfall variability, Swaziland has not been able to meet its maize requirements, further plunging the country into deepening food insecurity in the face of rising unemployment and abject poverty (Oseni & Masarirambi, 2011). The synchronization of the crop planting season with soil moisture; the introduction of robust drought tolerant maize varieties; diversification from maize to millet or sorghum (Chipanshi & Ringrose, 2001); developing irrigation infrastructure for maize production as well as increasing funding for the National Meteorological Department to procure analysis and forecasting equipment; as well as the provision of crop insurance coverage are possible adaptation strategies that could be employed (Manyatsi et al., 2010). The shift from the food sufficiency strategy to the food security policy strategy has potential to effect significant growth in sustainable agricultural and non-agricultural income and employment generating opportunities. Farmers are encouraged to grow crops according to ecological suitability and market competitiveness (Chipanshi et al., 2003). In semi-arid South Africa, with 464 mm of annual rainfall which is a comparative disadvantage to the world average of 857 mm (DEAT, 2004), mean rainfall is expected to plummet 5 -10 percent within the next 50 years (Durand, 2006).

Thus, climate projections for South Africa indicate a 1.1% maize production decline with every 1% decline in mean annual rainfall yield (Turpie et al., 2002; Blignaut et al., 2009). In the Sekhukhune District Municipality, Limpopo, South Africa, Quinn et al. (2011) identify key multiple stresses including drought, illness and higher maize prices. Households were found to be more sensitive to drought than to higher maize prices. Given poor rural infrastructure and due to reliance on rain-fed agriculture small-scale subsistence farmers are vulnerable to drought (Gbetibouo et al., 2010; Drimie et al., 2011).

However, institutional shortcomings and barriers (lack of provision of irrigation infrastructure and participatory decision-making) preclude increasing adaptive capacity for rural communities. For instance, the utilization of land for mining and encroaching commercial agriculture impedes the ability of rural communities to thrive in communal land (O'Brien et al, 2004; Quinn et al., 2011). While there are numerous studies on the effect of climate parameters; particularly rainfall variability on food security at both global and regional level as indicated in this section; there are a few studies which exhaustively investigate rainfall/food production interactions at the local community level in the Eastern Cape. The Eastern Cape Climate Change Response Strategy employs the climate model data to predict future climate variability– food production/security nexus (Province of the Eastern Cape, 2011, p. 4). However, the strategy does not indicate, illustrate nor reflect local level research studies. Therefore, the adaptive response strategies it proposes may not be adequate and contextualized.

Food prices, food access, global food system and climate variability

> Hunger is caused by poverty and inequality, not scarcity. For the past two decades, the rate of global food production has increased faster than the rate of global population growth. The world already produces more than 1 ½ times enough food to feed everyone on the planet. That's enough to feed 10 billion people, the population peak we expect by 2050. But the people making less than $2 a day - most of whom are resource-poor farmers cultivating unviably small plots of land - can't afford to buy this food (Holt -Gimenez, 2012).

The afore-mentioned quote from Holt-Gimenez (2012) refers to the globalization of the food system as well as the extent to which the poor struggle to put food on their tables in a global community that produces more than enough food for all the people of the world. Therefore, much attention needs be paid to the emergence of the globally integrated food system. The global food system is characterised by the dominance of agriculture. The hegemony ranges from inputs for food production to the producers of raw agricultural products, to the consumer at the grocery store. The transnationalisation of retail is also playing a major role in shaping the agro–business that is affecting food affordability. The retail sector is a representation of the change of decision–making powers about food from the public to the private sector (Hendrickson et al, 2008). Godfray et al. (2010) investigate the effects of urbanisation on food systems, exogenous factors (climate variability and change, competition for water, energy and land), and the future of food supply. The importance of political will to promote research and to be ready for unknown future stresses is critical (Godfray et al., 2010).

To feed a growing population which is estimated to reach 9 billion in 2050, new innovative ways of growing food are essential. These sustainable agro-innovations will have to protect both the environment and humanity. Badgley et al. (2007) investigate the impacts of organic agro-ecological methods in ensuring a bustling global food supply. The leguminous crops fix enough nitrogen in the soil to replace synthetic fertilizer use while significantly reducing the environmental impacts of conventional agriculture (Badgley et al., 2007). Neufeldt et al. (2013) develop a conceptualisation of climate-smart agriculture by establishing scientifically credible indicators and metrics of long-term safe operating spaces for global food systems in the context of a changing climate.

A study on plausible/futures scenarios which was conducted to help inform decision making on Global Environmental Change (GEC) impacts on agriculture shows that food accessibility and utilisation parameters as well as direct GEC -

food systems links were studied to a lesser degree than both food production and food availability parameters (Zurek, 2006). The extent of the adverse effects of the interlinkage between climate and food systems is such that food systems contribute 19%–29% of global anthropogenic greenhouse gas (GHG) emissions, releasing 9,800–16,900 megatonnes of carbon dioxide equivalent into the atmosphere (Vermeulen et al., 2012). Capone et al. (2014) connects the dots of food system sustainability and food security which when they intersect should promote responsible environmental stewardship, greater fairness in food management, in natural resource management and in economic viability. In order to realize the objectives of Capone et al.'s (2014) food system sustainability and food security, Sumner (2011) proposes that the current global food system which destroys local economies, degrading the environment and which thrives on money-values, must be supplanted by another which is based on life-values, centred on the civil commons and rooted on social justice. Central to adaptive capacity and social ecological system (SES) studies on vulnerability to environmental change is the "understanding of synergistic effects of the multiple stresses that interact with food systems" (Ericksen, 2008). Poverty, conflict, and land tenure constraints have interacted with food systems to render households socially vulnerable at local, regional and global levels (Ericksen, 2008). Poverty adversely affects gaining access to food and in turn effects food insecurity because when food prices rise food affordability is not within reach for the poor (Broda et al., 2009).

In the US, lack of food access results in soaring rates of obesity because poorer households do not live close to retail stores which sell quality foods (Crawford et al., 2004; Gittelsohn & Lee, 2013). Obesity as a measure of lack of accessibility to food is not unique to the developed country and is also taking root in South Africa. Big food is to blame for the epidemic of obesity with South Africa experiencing obesity rates currently standing at 42 percent for women and 13.5 percent for men (Marie et al., 2014). In Limpopo (South Africa) human capital, household income and location are determinants of food security (De Cock et al., 2013). The South African government should impose tax for poor–nutrient food products and regulate “Big Food” so that people will have better ‘access … at all times to the food needed for a healthy life’ (FAO, 1997; Igumbor et al., 2012). The obesity is coupled with the stunting of children where rural stunting rates of rural children amount to 26.5% compared to 16.7% in urban areas (Labadarios et al., 2000). Yet close to 57% of South Africa’s poor live in rural areas, with levels of poverty declining from 70% (1993) to 57% (2008) (Roberts, 2001; Leibbrandt et al., 2010; Posel & Rogan, 2012). While some 40,000 commercial farmers occupy almost 87% of the total agricultural land in the country, and produce more than 95% of agricultural produce smallholder farmers are found mostly in the former (vastly rural) homeland areas occupying some 13 per cent of the agricultural land (Republic South Africa, 2009).

Against the backdrop of agri-business, industrial agriculture, more globalisation and global environmental change (GEC) the international food system is ill-equipped for climate variability and change. Industrial agriculture and the Green Revolution (IA) which are being touted as the panacea for the world’s food shortage problem are the engines behind propelling the international food system’s wheels forward in the deleterious direction which has had negative impacts on subsistence farmers’ survival (Rosset, 2006). Industrial agriculture thrives on and is characterised by converting oil into food and its dependence on industrial chemical fertilisers (Carpenter, 2008; Galloway et al., 2008) the destruction of large tracts of land (forests and grasslands) and loss of biodiversity substituted for mono-cultural modes of food production. This is done in order to optimise transnational company (TNC) profits but results in 30 per cent of the global GHG emissions (Bellarby et al., 2008; Smith et al., 2008). TNC operations such as fisheries trawling activities, over-exploitative land use for agricultural purposes, industrial food processing and rail, road and airfreight transportation invariably result in increase in fossil fuel use which contributes to climate variability and change and loss of ecosystem services (International Assessment of Agricultural Knowledge, Science and Technology for Development - IAASTD, 2009).

The TNCs are in their nature monopolistic hegemonies which control seeds, the food market and the value chain while constraining opportunities for the majority of smallholder/small scale farmers the world over. The food price fixing mechanisms imposed by the few TNCs and richer countries gnaw away at the ability of small scale famers to compete in both the global and local food system through speculation in food commodity markets and land grabs, thus making food inaccessible to the poor (Cotula et al., 2009; Borras et al., 2010; Borras et al., 2011; Borras & Franco, 2012). The current food system is characterized by intensification of agricultural techniques of food production, specialization through monocultures, distancing of consumers from producers while stifling feedback and interaction on quality of food, and concentration of the global food market in the hands of the few and homogenization of food production activities (Sundkvist et al., 2005). Industrial agriculturists and the chief proponents, the transnational companies (TNCs), proliferate the ideals of industrial agriculture (IA) under the premise and guise that there is not enough food to eat for everyone in the world, when there is indeed enough food produced for everyone, yet with close to a billion (925 million) food insecure in 2010 (FAO, 2010).

The debate on ensuring the identification of the most relevant issues to food security has shifted to the concept of food systems which underpins the question of "what activities do we do" to insure that we get the quantity, quality, sustainability and safety of what we get – food security (Ingram, 2011). Given that there are more exogenous socio-economic and market forces interactions and interlinkages between global environmental change and food production the outcomes of food security rely on the machinations of food system activities which include food production; food processing and packaging; food retailing and distribution/exchange networks and food consumption; and should underpin further research on the impacts of climate variability and change on food security

(Gregory & Ingram, 2000). The vulnerability of the poor nations and peoples is heightened by the deleterious trends of the current global food system. The crucial issue is ensuring the adaptability of the vulnerable people who are normally from the poorer developing nations. In order for the vulnerable people to increase their adaptive capacity they need access to assets and entitlements which are physical, social and political in nature (Adger & Kelly, 1999).

In Southern Africa access to assets is constrained due to the poor rail and road networks as well as being a consequence of little grain reserve infrastructure, which are crucial to food distribution, particularly in rural areas (Drimie et al., 2011). Also, the self-imposition of trade barriers in the southern African countries of Zimbabwe, Malawi, Tanzania, and Zambia impede inter-country grain trade (Koester, 1993). Food access is also a challenge characteristic of the South African food system accounting to food prices. The country is being infested with the proliferation of supermarkets, which comprise approximately 55% of the food retail market and which are encroaching not only urban areas but also the poorer peri-urban and rural areas of the country (FAO, 2003; Drimie et al., 2011).

Food system activities aimed at increased food production have been blamed for some if not much of the climate variability and change taking place on the planet. High demand for food is an accretion to fisheries subsidence, while the food system industry enterprises such as agricultural production, food distribution, food processing and food retailing are major GHG emitters (Liverman et al., 2009). It is becoming increasingly evident that while food/agricultural production does effect climate variability and change, and is, in turn, affected by climate variability and change, it is not the sole determining factor for the vulnerability of food insecure populations but that food access is a factor worthy of serious consideration. In a UK study, food availability for the vulnerable, even in a changing climate, is not a major predicament but constrained food access is (Alexandratos, 2008.). Yet food access is elastic to changes in food prices which may constrain access to food; especially for the poor in developing countries

(Liverman & Kapadia, 2010). Clearly, people will have sufficient access to food when they have “adequate incomes or other resources to purchase or barter to obtain levels of appropriate foods needed to maintain consumption of an adequate diet/nutrition level” (United States Agency for International Development (USAID), 1992).

One of the factors impacting on food access is the price of food, especially healthy food – the poor may be confined to purchasing less healthy foods and under such circumstances, quantity is not a determining factor of limited access to food (White, 2007). Until 2050, the plight of the poor as well as the attendant food insecurity and food prices, particularly in developing countries, is expected to be exacerbated by the concomitant increase in mean global temperature (FAO, 2009). Given the rising food prices wrought by the global market, poor farming communities whose land rights are often untenable may find it difficult to withstand eviction and displacement by more powerful interest groups with more investment capital within the food system (Charles et al., 2010).

Gladwin et al. (2001) point out that, in Africa, food insecurity is not only a challenge associated with poor food production but one primarily associated with low household incomes and poverty. Indeed climate variability and change has been projected to negatively impact on food prices and hence food security. By 2050 the world wheat price is expected to increase 39% without climate variability and change while it may increase by between 94-111% with climate variability and change (Nelson et al., 2009). The Sub-Saharan Africa household is faced with chronic food insecurity which Gladwin (2001, p. 180) defines as “a long-term problem caused by lack ... of income or assets to produce or buy food adequate for the household”. In some parts of Sub-Saharan Africa, approximately 60-80 percent of poor rural households’ income is expended on food (Ruel et al., 1998). It is in diversifying income sources that rural communities mitigate the effects of having little or no money to purchase food. In Tanzania, the rural village residents employ different strategies such as remittances and related non-farm employment, as well as self-employment (Ellis & Mdoe, 2003).

Mass food production has “externalities” which are not necessarily reflected in the price of food. These externalities include greenhouse gases (nitrous oxide and methane), nutrient run-off, water shortages due to excessive water extraction, soil degradation, loss of biodiversity, disruption and decimation of oceanic ecosystems resulting in fish and other aquatic food abatement (World Resources Institute, 2005; Stern, 2007). During the World Food and Fuel Crisis (2006 – 2009) high prices of fertilisers caused food prices to rise with fertiliser subsidies putting pressure on already marginal national budgets as well as those of the poor smallholder farmers, in developing countries, who were entitled to such fertiliser subsidies (von Braun, 2008; Hella, 2011). While on the one hand there is an encroaching global move away from fossil fuels which intensify the emission of greenhouse gases, the world financial market is witnessing a demand for investments in agro fuels which cause food price spikes yet attracting poorer countries to use their agricultural resource base to attract both direct foreign investment to ensure economic growth and development (Dufey et al., 2007; Gerber et al., 2008; Brittaine & Lutaladio, 2010; Hella, 2011).

A number of studies have been undertaken which predict continued trend in high food prices owing to policies which promote the use of food for fuel; the notion of ‘growing food to put it in a furnace’ is projected to raise food prices for a decade (Banse & Grethe, 2008; Rosegrant et al., 2008; Roberts & Schlenker, 2010). In Tanzania, a country where 40% of the country live in food deficit areas, the downside to this ambition is that land grabs ensue and adversely impact on the ability of local smallholder farmers to thrive, depriving the locals of much needed alternative employment opportunities (UNCTAD, 2009). The International Fund for Agricultural Development (IFAD, 2010) argues that bio-fuels are not inimical to food security policy development and poverty alleviation policies and initiatives in poor developing countries. Also, Brittaine & Lutaladio (2010) are very optimistic about the prospects of crop-based bio-fuel production to positively affect the livelihoods of the poor small-scale farmer arguing that “one possible way to reduce the risk to the poor is to look beyond large-scale, monoculture-oriented production models for growing certain bio fuel feed stocks” (Ewing & Msangi, 2009, p. 251).

Still, with much optimism brimming, additional arguments against the use of crops for fuel still resurface indicating that large swathes of grassland and forest areas could be destroyed resulting in significant carbon leakages into the atmosphere. The argument for low-carbon emissions, which the pro-agro fuel regime advocates will not stand the test for sustainable food production that, reduces the impacts of food production on climate variability and change (Fargione et al., 2008). It is critical that modelling studies are conducted on how food prices brought about by bio-fuel mandates will affect the poor whose majority live in the low–income Countries (Chakravorty et al., 2011). To militate against the negative effects of bio fuel production on food prices in low–income countries the necessary shifts in policy that would accommodate appropriate reforms in marketing, production, and distribution would make life easier for the poor farming communities in the developing world (Ewing and Msangi, 2009). The high prices of food surplus in food sufficient areas of developing countries can help save the affected region’s economic situation as they can sell their surplus at high prices and make good profits. However, the same cannot be stated about the marginalised food deficient farming communities of Tanzania and elsewhere (Hella, 2011). Tirado et al. (2010) argue that even in countries which are net exporters of food the small-holder farmers and agricultural labourers are net purchasers of food. The economic status of subsistence farmers and smallholder farmers is even direr in Sub-Saharan countries where there is hardly any evidence of this sector enjoying the benefit of the designation of net food sellers.

It is not alarming to learn that the status quo of small-holders is currently untenable given that between 85% and 87% of the world's farms comprise of small scale farmers, whose farms are less than two hectares in size. Yet, 0.5% of farms which exceed 100 hectares disproportionately get a sizable chunk of the market share with concomitant perks such as favourable concessions with policy makers (Hazell et al., 2007). The relatively inequitable Global North government subsidies enjoyed by the farmers in these affluent nations weigh down on the ability of unsubsidized Global South smallholder farmers to thrive and compete in the global food market since commodity prices, trade agreements and policies are dictated by their Global North counterparts (Hazell et al., 2007).

In the Zambian context smallholder farmers are those who own less than 20 hectares of arable land (Haggblade & Tembo, 2003). In the Caribbean and Latin American countries smallholder farms are those depending on family members for labour, with little or no hired labour, and whose capacity to work the land dictates the measure of agricultural inputs and outputs. Their labour on these farms may be the only means by which they will ensure staple food availability (Hazell et al., 2007; Reardon et al., 2009).

To reduce the impacts of poverty and food insecurity, governments must move away from concentrating their efforts on intensive food production, rather to employ cash-cropping and non-farm micro-enterprise programmes (Sen, 1981). In rural communities of Tanzania, Zimbabwe, Ethiopia and Malawi the challenge against the employment of cash-cropping and subsistence farming turns out to be the "de-agrarianisation" and "depeasantisation" of rural communities which was a product of Structural Adjustment Policies (SAPs). The SAPs impaired the economic development of small-holder farming activities through the imposition of commodity standards and single channel marketing facilities. The latter standards and marketing policies resulted in controlled and fluctuating producer prices as well as "rocketing input prices and tenuous input supply" (Bryceson, 2000, p. 2). In Tanzania, while the persistence of rural villagers with their subsistence food production activities bears testament to the villagers' reliance on "soil in their doorsteps and backyards", it also ensures food securing livelihood/income diversification (Bryceson, 2000).

In South Africa, 1.13 million households were food insecure because they could not afford to purchase food (Bonti-Ankomah, 2001). However, the social security system (social grants) used in South Africa is helping the poor rural communities to cope with high inflation but it is not clear whether the grain- based biofuel policies will sustain the ability of households, and small scale farmers to cope with diminishing access to food. For easier access to agricultural trade investment the small scale farmers need market access and information on agricultural technology and science which will enhance the opportunity to compete in agricultural trade (Von Braun, 2008). It is in subsistence/smallholder farming practices that the sting of food insecurity can be palliated (Ruel et al., 1998). Therefore, it is important to have accurate climate forecasts that are accessible to the smallholder farmers to help manage, plan and minimise the associated climate risks that would affect stable food security (Ziervogel et al., 2005). Seasonal climate forecasts help the farmers from both ends of the crop farming spectrum, those who grow food for subsistence and those who grow food for profits, to adjust their agricultural exploits according to their needs. The poorer farmer in Limpopo Province (South Africa) thrives on the news of above average rainfall forecasts, in the hope that their subsistence needs will be slaked. Also, when the farmer has access to irrigation and the climate forecast news predict subsiding rainfall the farmer becomes hopeful for better financial returns as lesser numbers of households will grow crops, thus presenting an opportunity for comparative advantage in the food market.

Yet the affluent farmer's market is not easily disturbed by negative climate forecast news, given that he can afford to transport food to his doorstep for both subsistence and market purposes (Ziervogel et al., 2006). Despite the precarious climate variability circumstances that may be conspicuously threatening, poor smallholder farmers who are invariably dependent on favourable climatic conditions for their farming activities adapt to climate variability and market failure through various strategies which include planting nitrogen – fixing crops with other robust crops. The constraints which exacerbates their vulnerability to climatic variability and change hinge on their ever dwindling supply of sufficient funds to purchase the perpetually highly priced agricultural inputs such as fertiliser, pesticides and fungicides which the more affluent farmers can muster to sustain their mono-crop plantations for further financial gain (Ziervogel et al., 2006).

Musemwa et al. (2013) investigate the factors which affect household food access in the Eastern Cape with the Ngqushwa Local Municipality as a case – study. The study (Musemwa et al., 2013) looks at the role played by agriculture and fisheries in food security in the coastal villages of NLM. The community's reliance on food sold at the market makes it vulnerable to constrained food access due to rising food prices and "does not explore agriculture up to its potential" (Musemwa et al., 2013, p. 84). The abandonment of crop field farming activities is rife in the NLM, where only 11, 5% are cultivating their arable land (Musemwa et al., 2013) and so is climate variability and change a major threat to rural livelihoods (Republic of South Africa, ECCCRS, 2011). While studies (Musemwa et al., 2013; Republic of South Africa, ECCRS, 2011) explore the plausibility of various factors impacting on food security in the Eastern Cape there is paucity of studies specifically investigating the impact of climate variability and change on rural livelihoods and food access.

South Africa's climate change and agriculture/food security policies

Given that the least developed countries are dependent on sustainable natural resources for their economic development, adaptation to climate climate variability and change is measured by the efficiency of a country's social institutions in ensuring the resilience of vulnerable poor populations to adverse actual and potential climate variability and change impacts. Successful adaptation is also measured by the robustness of the biotic and abiotic systems to climate stress, and by the reduction of vulnerability to climate variability and change (UNDP, 2007). The roles of the various social and governmental institutions are critical to shaping the agricultural, food and climate policies to ensure systemic adaptation. In this respect, the overlapping and interlinked function of state and civic institutions to meet the demands of reduced vulnerability to food insecurity and the causal climate stress is most fitting. However, the co-ordination of such overlaps is tantamount to both successful mitigation and contextualised adaptation to ensure sustainable rural livelihoods (Agrawal & Perrin, 2008).

Yet close to 57% of South Africa's poor live in rural areas (Roberts, 2001; Leibbrandt et al., 2010; Posel & Rogan, 2012). While some 40,000 commercial farmers occupy almost 87% of the total agricultural land in the country, and produce more than 95% of agricultural produce smallholder farmers are found mostly in the former (vastly rural) homeland areas occupying some 13% of the agricultural land (Kirsten, 2012). The Black Administration Act of 1927, the Natives Land Act of 1913, the Natives Contract Service Act of 1932, the 1936 Natives Trust and Land Act, the Native Labour Regulation Act, the Rural Areas Act of 1987, the Prevention of Illegal Squatting Act, and the 1950 Population Registration Act of Apartheid South Africa caused lasting damage on the non–white segment of the economy and inflicted severe wounds on the general wellbeing of households in both the entire rural landscape and small-scale farming sector (Greer-Love, 2003). The aforementioned laws reduced the non-white population to slave farm labour and deprived them of the right to own land, the right to work the land for profit and to 'enjoy' the fruits of their labour. They worked long hours and were punished severely for non-compliance to the stringent farm rules. One incident took place – the death of a black farm worker at the hands of White farmers. The incident gave impetus to great upheaval; the 1959 Potato Boycott (Nair, 2001).

The agricultural land issues got exacerbated in 1949 after the National Party assumed power. The governmental nutrition support for non-whites was abolished on the basis that it would encourage lack of parental responsibility and dependence. The abolished governmental support included the African school nutrition relief aid programmes. Hunger and stunting affected the emaciated African child and sent hunger pang waves through the international community which condemned the draconian austerity programmes. The apartheid government denied the existence of the programmes and continued to develop its separate development policies which were characterized by forced removals into the marginal rural areas, homelands and townships (Greer-Love, 2003).

In South Africa, as a means to combating food insecurity at grassroots level, "about four million people (or about 2.5 million households) are engaged in some kind of own production, of which approximately 300 000 to 400 000 are full time subsistence farmers" (Altman et al., 2009). Also, the majority of small scale subsistence farmers is found in the former homelands of the country, which are predominantly characterised by rural settlements/ municipalities particularly within the Vhembe, OR Tambo, Amathole Municipalities (Altman et al., 2009). Therefore, the nature of agro – socio – economic and environmental policy imperatives and indicators should be relevant to the rural setting and culture within which the largest number of subsistence farming exists (Aliber, 2009, Altman et al., 2009).

The universal human right to food which is a vital determinant of secure livelihoods and adequate living standards was enshrined in 1976 in tandem with the universal measures enshrined in both the United Declaration of the Human Rights – 1948 (UDHR) and the International Convention on Economic, Social and Cultural Rights - 1966 (ICESCR). The ICESCR provides that member states ensure that all necessary measures geared towards the achievement of food security be instituted without partiality and favour. In South Africa the right to access to food is entrenched in Section 26 and 27 of the South African constitutional law of 1996. One of the main mandated protagonists of food security is the Department of Agriculture, Forestry and Fisheries (DAFF). The primary task of the DAFF is to foster and promote citizen participation in agriculture since the sentiment that South Africa is food self-sufficient does not hold true at household level, particularly for the vulnerable poor who are the stark representation of the 80% of South Africans who are food insecure (Aliber & Hart, 2009; Labadarios et al., 2008).

In tandem with the constitutional tenets of food security is the enactment of the Integrated Food Security Strategy (IFSS). The IFSS (2002) seeks to redress the imbalances of apartheid policies which were littered with austerity measures which impacted on the livelihoods, nutrition and general well-being of the rural poor who were forced to live in poverty stricken marginal homelands (Bantustans) of apartheid South Africa (Greer-Love, 2003). The IFSS (2002) commits itself "to attain universal physical, social and economic access to sufficient, safe and nutritious food by all South Africans at all times to meet their dietary and food preferences for an active and healthy life" (ibid:6). The Department of Agriculture's IFSS primarily seeks to vanquish rural food insecurity by strengthening food access, availability and utilisation in partnership with social cluster departments, which include: the Department of Land Affairs, Health, Public Works, Social Development, Water Affairs and Forestry and Trade and Industry. The various programme initiatives which are aligned to the objectives of the IFSS include:

> land reform; production of food; procurement marketing of food products; processing, storage and transportation of food; development and micro finance; infrastructure development; human resource development; education and training; research and technology development; food prices; international trade; fiscal and monetary policies; ailments related to hunger and malnutrition; social security grants and food emergencies and access to food legislation (IFSS, 2002, pp, 8 - 9).

The relationship between the Department of Agriculture and Land Affairs and the Department of Social Development is manifested through the Social Security Agency of South Africa (SASSA). SASSA has, amongst its arsenal of developmental social security entitlement security strategies (the state Old Age Pension, the Disability Grant, the Child Support Grant, the Foster Child Grant and the Care Dependency Grant) a food security component which offers food grants/food parcels to the vulnerable members of the population. The food security component of SASSA is a robust manifestation of Section 27 (1) of the South African Constitution, which inexorably states that "Everyone has the right to have access to … sufficient food and water … (and that) the state must take reasonable legislative and other measures, within its available recourses, to achieve the progressive realisation of each of these rights" (IFSS, 2002).

In the face of imminent climate impacts on food security the South African National Climate Change Response Strategy Green Paper of 2010 emphasises "the prioritisation of climate change mitigation and adaptation actions that ensure human dignity, especially considering the special vulnerabilities of the poor and in particular of women, youth and the aged" (Republic of South Africa, 2010). The Green Paper categorically lists water and agricultural sectors as the principal priorities without which its "people centred approach" would not be fully realized. The prioritisation of the water sector and by implication and causation is articulated as critical due to the prognostication that "by ~2050 the frequency of storm-flow events and dry spells is projected to increase over much of the country, especially in the east (over much of the Eastern Cape and KwaZulu-Natal" (Republic South Africa, 2010, p. 9). This places the region of the Eastern Cape which covers the rural Ngqushwa Municipality at risk and vulnerable to much desiccation and the resultant stress of reduced agricultural yield and elevated food insecurity. In mitigation the effects of higher temperatures which are projected to reduce water run-off to the rivers and dams the paper further promises the development and implementation of a household rainwater harvesting incentive programme. The environmental changes which may manifest themselves in water insecurity are projected to negatively impact the livelihoods, production levels and farming systems of the small-scale dry land farmers while those of the large scale irrigated farmers will be least vulnerable (Republic of South Africa, 2010).

With respect to policy relevance at the lower spheres of government the green paper also calls for the maintenance and updating of the South Africa Risk and Vulnerability Atlas (SARVA) which would be a tool for helping the provinces and municipalities to better plan their adaptation strategies. Despite the afore-mentioned ambition 39 % of South Africans live in rural areas which are "under-represented in the climate monitoring network despite the fact that they are likely to be earliest and most significantly affected by climate variability and change" (ibid, 2010, p. 27). Putting more emphasis on the need to address the issues fanning rural community vulnerability to climate variability and change e change the Green Paper makes pronouncements for measures which reduce their vulnerability. The Green Paper states that to address rural vulnerability to climate variability and change it is critical to

> Scale up programmes to reduce rural vulnerability and enhance local food security by educating subsistence and small holder farmers on the potential risks of climate change and support them in developing adaptation strategies, including conservation agriculture practices and water harvesting by means of participatory, on-farm demonstration and experimentation. In this indigenous knowledge and local adaptive responses will be prioritised and the ownership of adaptation programmes by local communities and their empowerment in the process of implementation will be a key objective (ibid, 2010, p. 27).

One of the envisaged strategies for ensuring adequately capacitated public policy institutions as well as the general public by 2012 is to "support the development of risk and vulnerability service centres at universities supporting resource constrained municipalities" (ibid, 2010, p. 37). The National Climate change Response Strategy Green Paper of 2010 further encourages the implementation of developmental and environmental programmes such as the working for water, working for wetlands, working for fire coupled with further designing and implementation of macro and micro livelihood diversification in rural areas. In response to the Green Paper mandates the Risk Assessment matrix was developed in the Eastern Cape Climate Change Response Strategy (Province of the Eastern Cape, 2011). With respect to food security the risk assessment matrix identifies possible vulnerabilities ranging from crop yield reduction due to flooding, drought, and heat to reduced precipitation which would exacerbate the plight of the poorer rural subsistence farmers (Province of the Eastern Cape, 2011). In order to address food security needs the Eastern Cape province needs to tackle these risks and mitigate their impacts, especially if it still has ambitions to place 30 000 ha under maize cultivation as part of the ASGISA Eastern Cape Project in addition to 460 00 ha for crop cultivation (food and bio-fuels) for its Provincial Growth and Development Programme (PGDP) (Republic of South Africa, 2011).

It will be interesting to observe what the impacts of using so much land to grow food to burn it into fuel will be and how such an initiative will influence the overall food price dynamic. With respect to water security and hence food security, in 1996 the Department of Water Affairs and Forestry introduced the Working for Water Programme (WfW) to help eradicate the encroaching water thirsty alien invasive species and provide jobs to the people through invasive alien species clearing. Allocated to the Amathole District Municipality were nine districts of the WfW Programme, yet none of those districts includes the NLM (SEAR, 2005). With a huge problem of desiccating invasive alien species which constrict the natural proliferation of indigenous species and natural biodiversity in the NLM through lack of proper management strategies such as the WfW Programme, the NLM rural community needs to find innovative adaptation strategies to both the effects of climate variability and poor land use management on food security and livelihoods. To countervail the lack of institutional capacity the NLM is also considering partnerships with Monsanto (cotton trials) and Parmalat (dairy) which wish to set up irrigation scheme investments in the municipality (SEAR, 2005). Hopefully the people and the environment will benefit.

Conclusion

The chapter explained that the factors influencing perception ranged from farming experience, household size, years of education, access to credit facilities, access to extension services and off-farm income. From across the globe, particularly in poor rural communities the factors determining adaptive capacity ranged from planting trees, soil conservation practices, changing planting dates, rainwater harvesting, adopting crop varieties and utilising irrigation. The impact of rainfall variability is also explained to be closely linked with the ecological law of the minimum which means that crops are sensitive to minimum amounts of rainfall. Yet rainfall is a low asset base of poor rural communities. The chapter also described the complex relationship between climate variability and change, food access, the food system and food insecurity. Even so, the chapter draws from a number of policies which clearly show that South Africa recognizes the need to empower rural communities in order to help them adapt to climate change. The next chapter describes the study area – Ngqushwa Local Municipality.

CHAPTER III

THE HISTORICAL VULNERABILITIES OF PEDDIE DISTRICT AND ITS STATE OF THE ENVIRONMENT UNDER THE NGQUSHWA LOCAL MUNICIPALITY (NLM)

Introduction

The chapter gives a comprehensive yet concise account of the historical and current vulnerabilities of Peddie District and its state of the environment under the Ngqushwa Local Municipality (NLM). The chapter further presents the economic facts of the NLM as obtained from STATS SA and other relevant authors. The livelihoods and the attendant vulnerabilities of the communities as drawn from various sources are also described.

The study area

The study was conducted in Ngqushwa Local Municipality. Ngqushwa is predominantly rural with 95% of the population residing in the rural areas. The study location is one of the eight municipalities which fall under the Amatole District Municipality located in the Eastern Cape Province of South Africa. The municipality is comprised of 118 villages, with two commercial towns, Peddie and Hamburg. Figure 3.1 shows the map which presents the 118 villages of Ngqushwa Municipality. The population is 72,190 and 21,384 households of which 12,178 are agricultural households. As part of the NLM population, 99% is black African and 51% of the households are female headed. Of those aged 20 years and older, 8.7% have completed primary school; 35.2% have some secondary education, 15% have completed matric, 3.9% have some form of higher education; and 13.7% have no form of schooling (Stats SA, 2011). While the sampling techniques will be dealt with in a later chapter the sampled villages Benton, Mgababa, Mgwalana and Prudoe (as shown in Figure 3.2) represent the state of the environment of the Ngqushwa Local Municipality (NLM) as well as the socio-economic characteristics of the NLM (P. Katata & S. Ngcaba, personal communication, 14 February, 2012). The NLM is a municipality with a rich culture and history which significantly serves the purpose and objectives of the study.

A brief history of the Ngqushwa/Peddie Magisterial District

The South African History website narrates an abridged history of Peddie prior to 1910 – the year of the declaration of the country as the “Union of South Africa” when the unification of the previously separate contiguous colonies of the Cape, Natal, Transvaal and the Orange Free State was enacted. Victoria, a major division of the Cape Colony under British Rule of the Republic of South Africa changed the name of the southern districts of the Victoria division to an area named Peddie whose eponym is Lt -Col John Peddie of the British Army.

In light of the name changes of towns and streets in South Africa since 1994 – the year of the first democratic elections - the name must have survived the political and social changes in South Africa because of its significance to the amaMfengu refugees who had been evicted from Gcalekaland when Fort Peddie was built to protect the refugees from militant amaXhosa tribesmen. The Fingos, a name used by the British in an attempt to pronounce Mfengu, were the first Bantu people to accept British protection and consequently conceded to be drafted into the British military force and subsequently gaining rewards amounting to extra grants of land awarded by the government (Potgieter et al., 1970). The British needed assistance in driving away the territorial amaXhosa tribes whose land they had monopolistically colonised and were willing to give it to the new coming loyal refugees known as the Fingos.

The contentment of owning land given by the British was short-lived with the promulgation and implementation of Betterment Planning. The plan was made in the 1930s and implemented in the 1960s; demanding that blacks move to new areas of

Figure 3.1 : The 118 NLM villages (Source: SEAR, 2005)

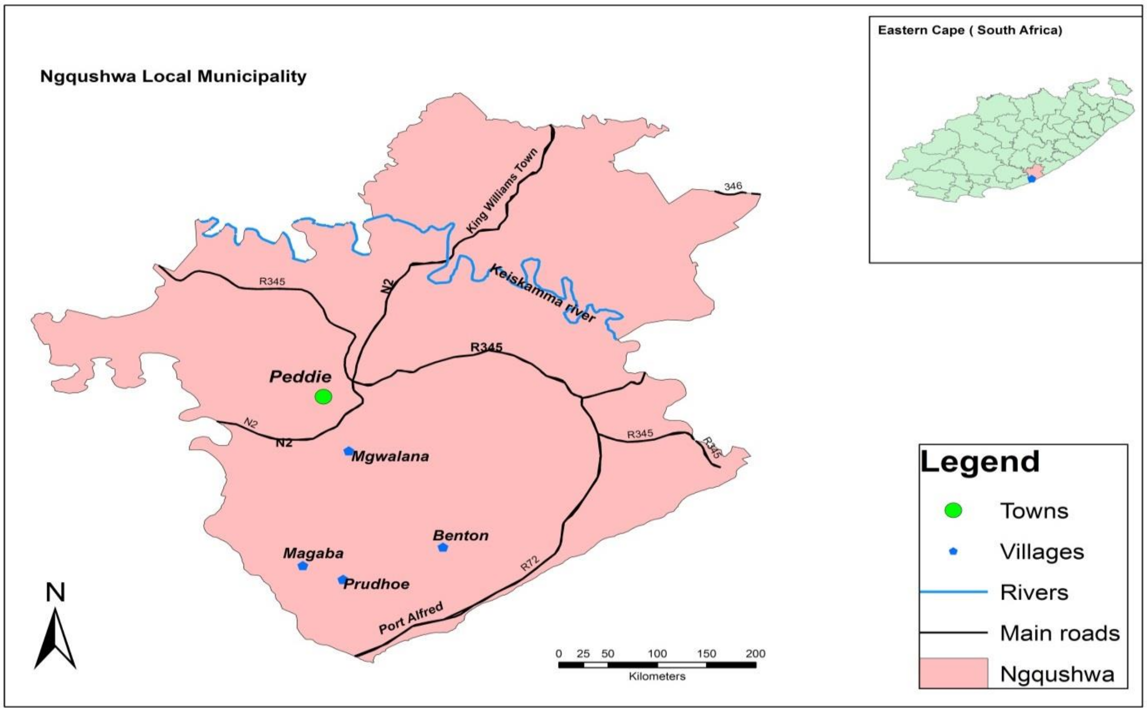

Figure 3.2: The Four Sampled Villages (Benton, Mgababa, Mgwalana and Prudoe in the NLM (Source: Author)

"betterment" under the pretext of better social cohesion and peasant farming. A dubious report called the "Reclamation and Settlement Report" compiled in the 1940's sealed the fate of the people of Peddie claiming that moving the blacks to the homeland of Ciskei would be profitable to the blacks because the soils were good; rainfall consistently reliable and the earth not susceptible to erosion (De Wet & Bekker, 1985). Given access to little land to thrive in, in the first quarter of the 20th century, overpopulation and overstocking in the Ciskei led to serious soil erosion and land degradation that significantly brought about a reduction in subsistence benefits that were previously derived by the rural communities from the land (Switzer, 1993). As a consequence of the afore-mentioned events and the effects on the environment Figure 3.3 shows the recent tenure areas of Peddie District/NLM (Kakembo, 2001).

Population Dynamics, Unemployment and Migration

The Ngqushwa Local Municipality with its administrative headquarters stationed in Peddie Town is bordered by the Great Fish River to the west and by the Keiskamma River to the east, covering an area of 2 245 km^2 which consists of 118 rural villages in which the majority of the population live (NLM Integrated Development Plan, 2012; SEAR, 2005). The NLM consists of 14 wards which are classified as urban, rural or peri-urban depending on how close they are from Peddie Town. In light of the adopted afore-mentioned categorisation of residential areas in this locality the SEAR (2005, p. 23) estimates "that the urban population of the local municipality is probably in the region of 6.4 %, the peri-urban population around 27% and the rural population around 66% with 53% of the population being women and 46.9% men".

Of the estimated 21891 households in the municipal area there are on average 4.5 persons per household size, 2.7% of households are headed by persons under the age of 20 years and 18.6% are headed by persons over the age of 64 years. 52% of households are headed by women (NLM Annual Report, 2009/10). The idiosyncrasy of rural men migrating to urban areas to find work in urban centres is shown in the positive variance in the percentage number of women over that of the men (Smit, 1998). It would be of no alarming effect for the majority of men to migrate to urban centres when 66% (as indicated in Table 3.1) of NLM households live under the poverty line (Stats SA, 2011).

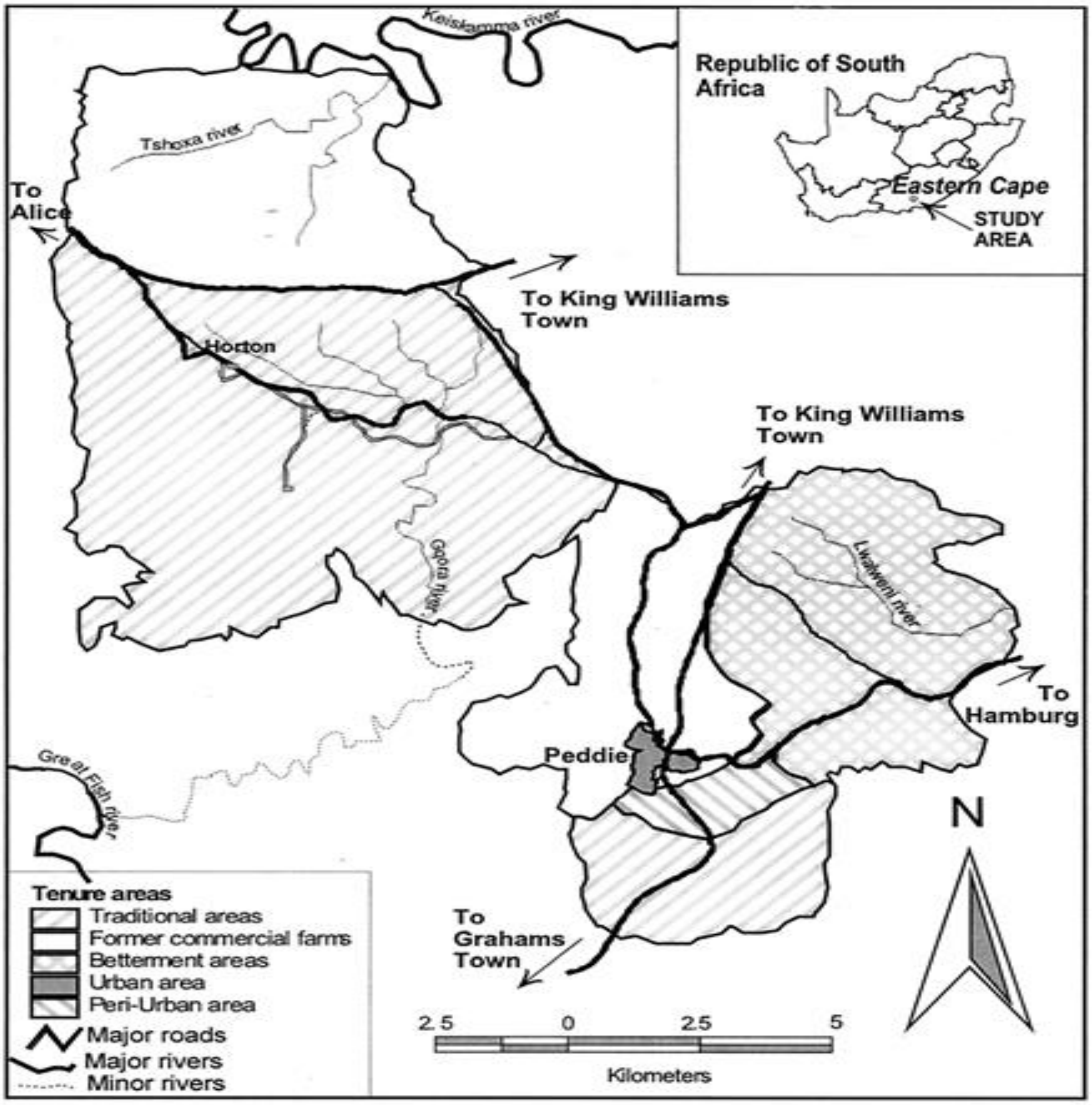

Figure 3.3: The different tenure areas in the Peddie District (Source: Kakembo, 2001)

Such migration is a malaise of the scourge of unemployment which stands at 78% (Stats SA, 2011) at approximately 25 percent above the Eastern Cape Province average of 53.5%. Table 3.1 indicates the comparative list of the rates of unemployment figures of the different municipalities of the Eastern Cape.

Table 3.1: Unemployment and Household (HH) income for the Amathole District

PLACE	UNEMPLOYMENT	HOUSEHOLD INCOME < R1500/MONTH
Amathole	52.7	67.0
Mbashe	75.8	71.6
Mnquma	65.4	76.0
Great Kei	38.2	76.0
Amahlathi	59.4	73.5
Buffalo City	44.8	55.0
Ngqushwa	78.0	66.8
Nkonkobe	65.9	77.8
Nxuba	57.4	61.8

Source: Amathole Growth and Development Summit Socio-Economic Profile (2007)

Economic status of Ngqushwa Local Municipality

There are 13 443 people that are economically active (employed or unemployed but looking for work), and of these 25.8% are unemployed. Of the 6 030 economically active youth, which is the (15–34 years) age group in the area, 64. 1% is unemployed. Figure 3.4 shows the number and percentages of agricultural households which fall under 6 income brackets. While the working age group (15-64) comprises 58.1% of the population the municipality has a 52.8% unemployment rate which in turn comprises a 64.1% youth unemployment rate (Stats SA, 2011). There is a high dependence on social grants with 72.5% of households receiving grants. A large portion of spending by the social grants beneficiaries is on food. Gutura & Tanga (2014, p. 104) point out that social grants have markedly "improved food accessibility and availability among beneficiaries and has most importantly reduced both child and adult hunger". Yet Gutura & Tanga (2014) are uncertain about the future and cite the decline in nutritional value and the state of poverty which is super-imposed by escalating food prices.

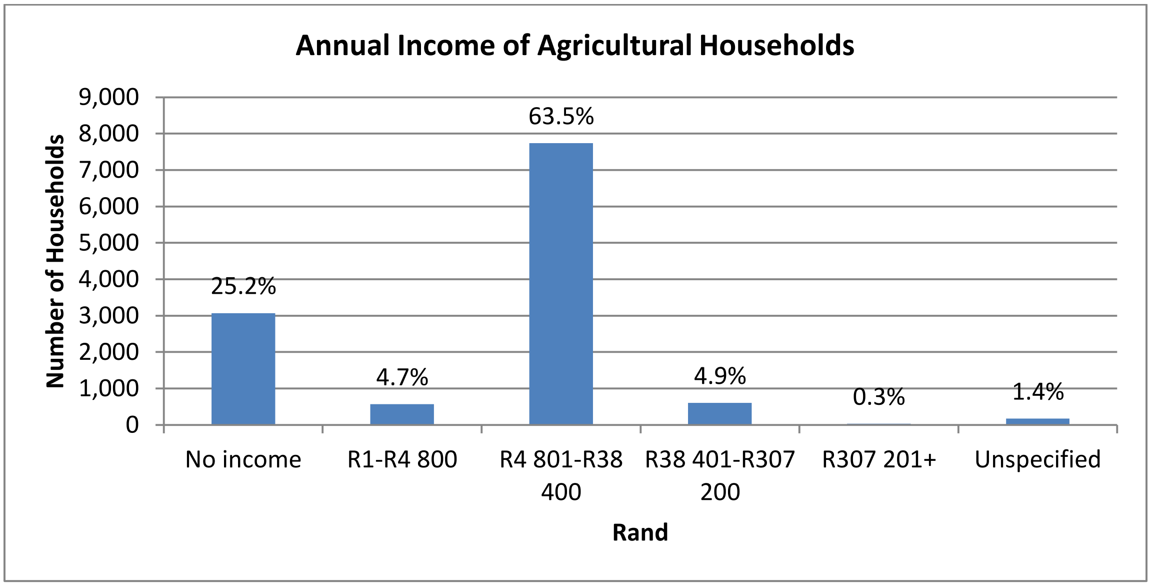

Figure 3.4: Annual Income of Agricultural Households (Source: Stats SA, 2011)

Livelihoods and attendant vulnerability

Consistent with Posel & Casale's (2006) findings on remittances, livelihoods in this predominantly rural municipality vary from on-farm and off-farm sources with the off-farm sources ranging from wages; to remittances from migrants and commuters; to income from informal economic activities; and to state transfers such as welfare grants. Remittances are significantly the main source of income for about 36 percent of rural households (Posel & Casale, 2006). Figure 3.5 shows the population density in the NLM and indicates the highest density being in the Peddie Town area. Such migration patterns are consistent with prevalent global population migration trends to the urban - economic hubs of cities and towns and suggest the change of lifestyles into more modern means of livelihoods (Amin, 1994; Sibanda, 2004). The migration implies that the traditional livelihoods are becoming vulnerability to the effects of both socio-economic and environmental stresses and shocks (Kakembo, 1997; Palmer, 2004).

However, households which have migrant workers tend to be suffering more severe poverty than non-migrant households (Leibbrandt et al., 1996). It is these households whose land-based livelihoods are critical to food security and their survival and whose underestimation of the importance of quantifying their worth in monetary value is perceived by Andrew et al. (2003) to be erroneous. It has proved to be confounding to estimate the value of these land-based livelihoods without the degree of fallibility consistent with the underestimation of the value of both the livestock and cropping agricultural undertakings (Shackleton et al., 2001). When the savings on food purchases earned through the sale of natural resources and harvested crops from household gardens and ploughing fields are not factored in to the calculations of rural household incomes; the estimation of the value of rural livelihoods becomes significantly flawed (SEAR, 2005). Shackleton et al. (1999, 2000) calculated the value of natural resources by taking into account the value derived by the rural communities from the exploitation of wild herbs - imifino/spinach, wood for household items, fuel wood, wild fruits, sand, grass hand bushes, insects for food, poles for fencing/kraals, thatching, and twig bushes.

In ensuring a proximately reliable assessment of the value of resource use per household per annum the SEAR (2005) argues that it may be more meaningful to use the lower values of the estimates of natural capital (Shackleton & Shackleton, 2000), shown in Table 3.2, than the higher value estimates given that the Peddie District is vulnerable to lower rainfall events, which impact on crop and livestock farming, than other high rainfall areas. In a cross-cutting declaration of committing to sustainable development and sustainability in combating poverty, the NLM IDP (2012) states that "Ngqushwa Local Municipality intends to find new ways to sustain their economy, build their society, protect their environment and eliminate poverty."

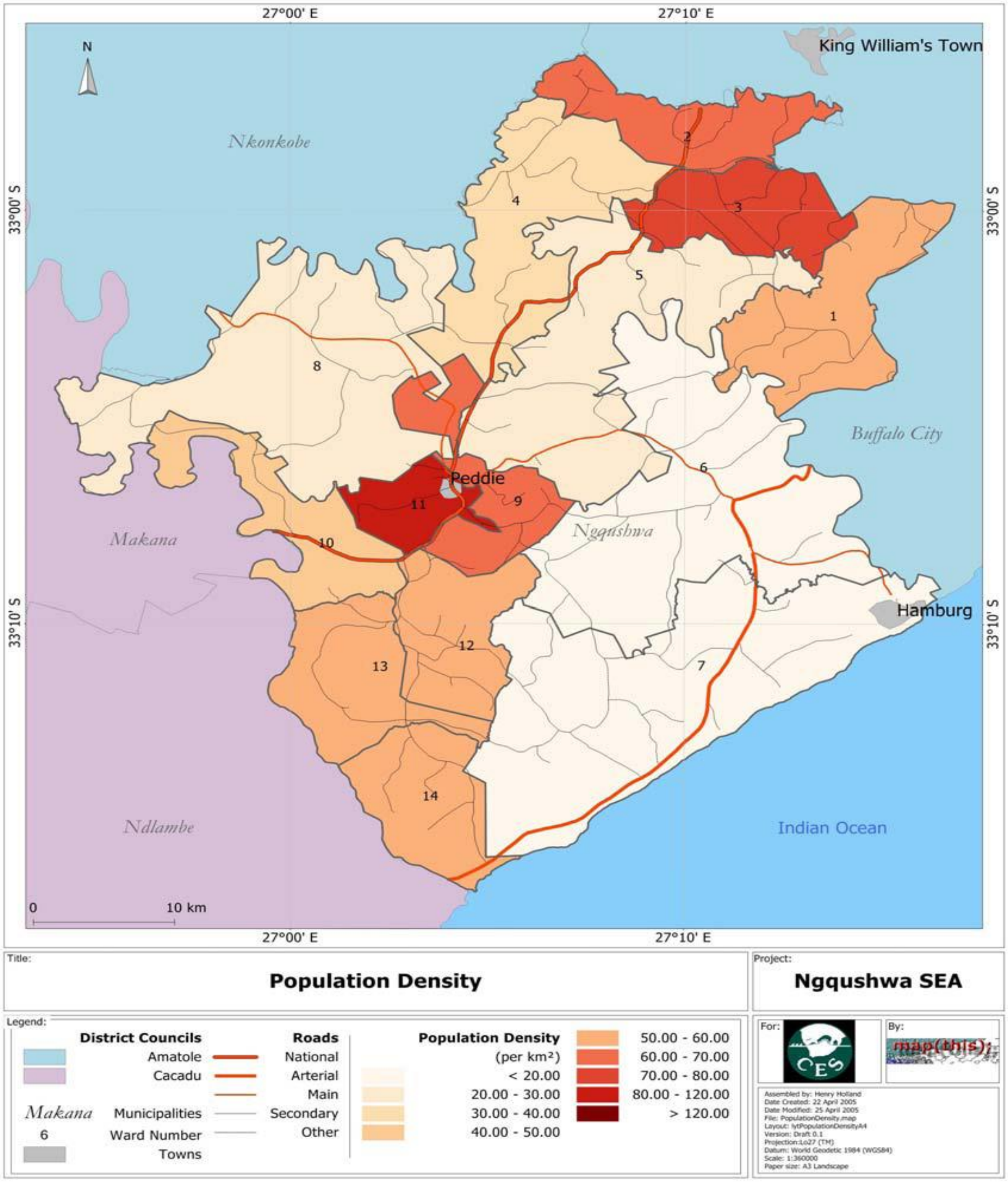

Figure 3.5: The population density in the NLM (Source: Stats SA, 2011)

It is poverty which renders rural populations vulnerable to both socio- economic and environmental shocks. Such “social groups are ‘vulnerable’ when their livelihood systems are sensitive to modest climate changes, and they lack supportive institutions or social networks” (Richards, 2003, p. 2).

Table 3.2: Value and number of households (HHs) per natural resource/land use

Land Use Resource	**2000 value per HH per annum**	**No. of HHs**	**Total value for Rural areas of Focus Area**
High Estimate			
Cropping	R1 543.00	18398	R28,388,593.75
Livestock Production	R1 200.00	18398	R22,077,973.11
Natural Resource Harvesting	R2 792.00	18398	R51,368,084.09
Total	R5 535.00	18398	R101,834,650.95
Low Estimate			
Cropping	R771.50	18398	R14,194,296.88
Livestock Production	R1 200.00	18398	R22,077,973.11
Natural Resource Harvesting	R2 792.00	18398	R51,368,084.09
Total	R4 763.50	18398	R87,640,354.07

(Source: SEAR, 2005)

Another major factor of environmental consideration is the steady abandonment of cultivation of traditional household or communal arable fields in the rural villages which began in the 1940's coinciding with the introduction of betterment planning. Andrew et al. (2003) point out to the different factors contributing towards this forced desertion of the villagers' 'forefathers' land, which include: population growth; loss of access to agricultural markets; crop theft and damage due to untended livestock attributed to the absence of herders; increased labour migration leading to labour shortage in rural villages; declining per capita livestock critical in ensuring capacity to plough as well as declining soil fertility. The afore-mentioned factors provoke this study to investigate the extent to which the impact of climate variability and change has had on the abandonment of cultivation in the NLM/Peddie villages. Most of the cultivation that is being practised is concentrated at the household food garden plots which allow for lower labour capacity and less mechanised technological or animal traction demands (Kakembo & Rowntree, 2003).

The decline in ownership of livestock for cultivation of arable fields became significantly steep between 1948 and the year 2000 from 71% to 30% respectively (Andrew et al., 2003). The land tenure changes in the NLM that were effected in the 1940's and subsequent years during apartheid South Africa have impacted on the poor; whose livelihoods have largely been dependent on natural resources for both subsistence needs and the sale thereof. Consequently, the land degradation that ensued the betterment-planning era has made the plight of the poor precipitously untenable and worse, given their dependence on natural resources whose growth and survival is contingent on good soil fertility and stability (Andrew et al., 2003). Despite these environmental challenges, there is a notable reliance and ubiquitous practice of urban agriculture in the District of Peddie which includes "low-intensive, small-scale cultivation of maize, the rearing of small herds of livestock (goats, pigs, cattle, chickens), and vegetable gardening (from 50 to 100 m^2) in both the informal settlements and formal government-subsidised housing settlements (Thornton, 2006, p. 58).

In their study of vegetation analysis in the Peddie District rangelands Palmer et al. (2001, p. 5) found that "in the communal rangeland, vegetation cover was lower and presented weaker barriers to water and nutrient movement across the lands cape" which would impact on the natural resource base on which the poor so depend for their livelihoods. Also, and typical of Peddie District, especially over a protracted period of time, the areas with free ranging herbivory have been found with characteristic lower green biomass and unpalatable dwarf shrubs and grasses, particularly the invasive alien species *Pteronia incana* (blue bush) (Kakembo, 1997; Palmer and Avis, 1994; Kiguli et al., 1999; Palmer et al., 2001).

The vulnerability of the farmer in the NLM is further compounded by the lack of effective market avenues which allow for the lucrative commercialisation of cash crops. The Massive Food Production Programme (MFPP), an agricultural development initiative evinces symptoms of the malaise of exploitation, poor planning on the part of the Eastern Cape Department of Agriculture and Land Affairs as well as the failure of the proliferation of genetically modified organisms/seeds in meeting the farmers' expectation of better yields, transparent agreements to trade markets, and poverty eradication (MEDPT, 2010). Such vulnerability to the machinations and interplay which are embedded in the partnerships between the state and the agro-industrial business complex are not better evidenced than in the biotechnology (bt) maize, chicory, and cotton projects jointly initiated by the state and the complex in two farming villages of the NLM - Mgababa and Prudoe (MEDPT, 2010).

Conclusion

The chapter was a synopsis of what are the foundations and background to the nature of the state of environmental and economic affairs at the study area ahead of this study. The demographics, the economics as well as the political history which shaped the environmental landscape of the NLM were concisely described. The agricultural landscape which defined both the economic and food security status of the study area was also described. The next chapter will elucidate on both the conceptual framework and the appropriate research methodologies that were adopted to achieve the specific objectives for addressing the research problem.

CHAPTER IV

CONCEPTUAL FRAMEWORK AND RESEARCH DESIGN

Introduction

The chapter begins by describing the conceptual framework as well as how it was applied for the purpose of encapsulating and informing the research design in order to achieve the research objectives. The research methodologies and techniques are both qualitative and quantitative and are employed to ensure that triangulation is achieved. These research methodologies include the use of questionnaires, unstructured interviews, focus group discussions and meteorological data analysis. The research techniques include statistical analysis and desk-top reviews. Furthermore, the chapter explains the relevant sampling technique informing the choice of the respondents as well as a detailed breakdown of the methodology and analysis techniques for each of the study objectives.

The conceptual framework

The concept of food security that advocates the accessibility; availability and nutrition of food to all peoples at all times can be easily sullied by the climatic changes influencing food production and associated agricultural activities. When much of the control over the food market system is in the hands of a few transnational corporations which know no borders; thriving on neoliberal policies and trans-boundary trade agreements, in the face of climate variability and change which can cause soil erosion through wind and rain run-off, land degradation and nutrient run-off, the soils from which poor rural subsistence growers rely on for their livelihood will be a fleeting rustic illusion (Patel, 2007; MEDPT, 2010).

Faced with a double digit fluctuating unemployment rate of 25.2 in the first quarter of 2012 (Statistics SA, 2012) the South African government is confronted with the reality that food secure rural livelihoods can be systemically threatened and affected by climate variability and change particularly when food prices rise. Urgent mitigation and adaptive action should cascade to the lowest levels of grassroots reality, where the people, the subsistence crop dependent rural individuals live. The people themselves must gain all the indigenous, traditional and conventional agricultural skills and expertise adapted to a changing climate, including access to markets in order to eradicate poverty, hunger and food insecurity. When both market and anthropogenic effects of climate variability and change threaten livelihoods, it is in the context of food sovereignty (Patel, 2007) and for the noble cause of ensuring the sustainability of livelihoods, that rural communities will adapt to the challenging effects of climate variability and change and variability. Sustainable livelihoods, a term which was inspired and influenced by the proceedings of the WCED (1987) for the purpose of advancing sustainable development is defined in Chambers & Conway (1992) as

> the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term.

Scoones (1998) states that to better apply the conceptual framework of sustainable rural livelihoods the 5 sub-components of the above-mentioned definition need to be integrated and disaggregated. These components include: the creation of working days; poverty reduction; well-being and capabilities; natural resource sustainability and livelihood adaptation and resilience. The significance of the latter component rests on the focus it places on the ability to both adapt and cope to natural, social, economic and human capital stresses and shocks. Resilience to natural shocks and stresses is central to climate variability and change adaptation. Adaptation involves longer-term adjustments to stresses and shocks while coping strategies are transient in nature. In this study, the assessment of the vulnerability and resilience of the NLM rural communities to climatic stresses and shocks also includes the evaluation of historical adaptation strategies. Relevant to climate change adaptability and change the assessment of vulnerability includes investigation the extent to which communities have access to livelihood resources as well as the trends to that access to the resources (Scoones, 1998).

The beginnings of the sustainable livelihoods approach find their provenance in Robert Chambers who co- authored a book on the sustainable livelihoods with Gordon Conway (Chambers & Conway, 1992). They both coined a definition of sustainable livelihoods which states that

> A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living; a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long-term (Chambers & Conway, 1992, p. 7).

In their discussion paper, Chambers & Conway (1992) refer to the work of Sen (1981) by developing the sustainable livelihoods policy framework under three headings:

- Enhancing capability – in facing change and unpredictability, people are versatile, quick to adapt and able to exploit diverse resources and opportunities;
- Improving equity – priority should be given to the capabilities, assets and access of the poorer, including minorities and women;
- Increasing social sustainability – the vulnerability of the poor should be minimised by reducing external stress and shocks and providing safety nets

(Chambers & Conway, 1992, p. 31).

In the 1997 White Paper on international development, the Department for International Development (DFID) adopted the ‘sustainable livelihoods approach (SLA)’, as a core principle of its strategy for pro-poor policy-making (Solesbury, 2003). Consequently, the DFID describes a sustainable livelihood as comprising

> the capabilities, assets (including both material and social resources) for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (DFID, 1999).

Knutsson (2006, p. 90) states that the SLA appealed to the donor organisations because “it offered a fresh vision of a holistic and/or integrative approach with the capacity to analyse and understand the complexity of rural development”. Because the SLA is integrative it allows for the employment of both quantitative and qualitative research methods to enable the comparative analyses and triangulation of the research methods. The Sustainable Livelihood Framework (SLF) provides that household is dependent on its asset endowments comprising human capital (H), social capital (S), physical capital (P), financial capital (F) and natural capital (N) which enable households to pursue a sustainable livelihood (Demeke et al., 2011). The Sustainable Livelihoods Approach (SLA) provides a framework for research that encapsulates many of the concepts related to the household capital accumulation relationship to a number of vulnerabilities. The DFID (1999) model is depicted in figure 4.1.

Demeke et al. (2011) reveal that the ‘asset pentagon’ in the framework diagram comprises human (H), natural (N), financial (F), physical (P) and social (S) capital assets; of a particular household’s livelihood asset profile. The framework is inherently qualitative but quantitative data can be used as indicators for different levels of capital and vulnerability (DFID, 1999). Capital generation includes human capital, which is a function of knowledge, health and labour. Natural capital comprises fauna and flora, forests and grasslands, while physical capital is a function of infrastructure like road networks. Financial assets, such as cash and stocks, characterize financial capital. Social capital is quite elusive to measure as it is difficult to measure the social interactions of people, which may be formal and informal; yet these interactions may be discernible in times of a shock. Human capital is a function of knowledge production

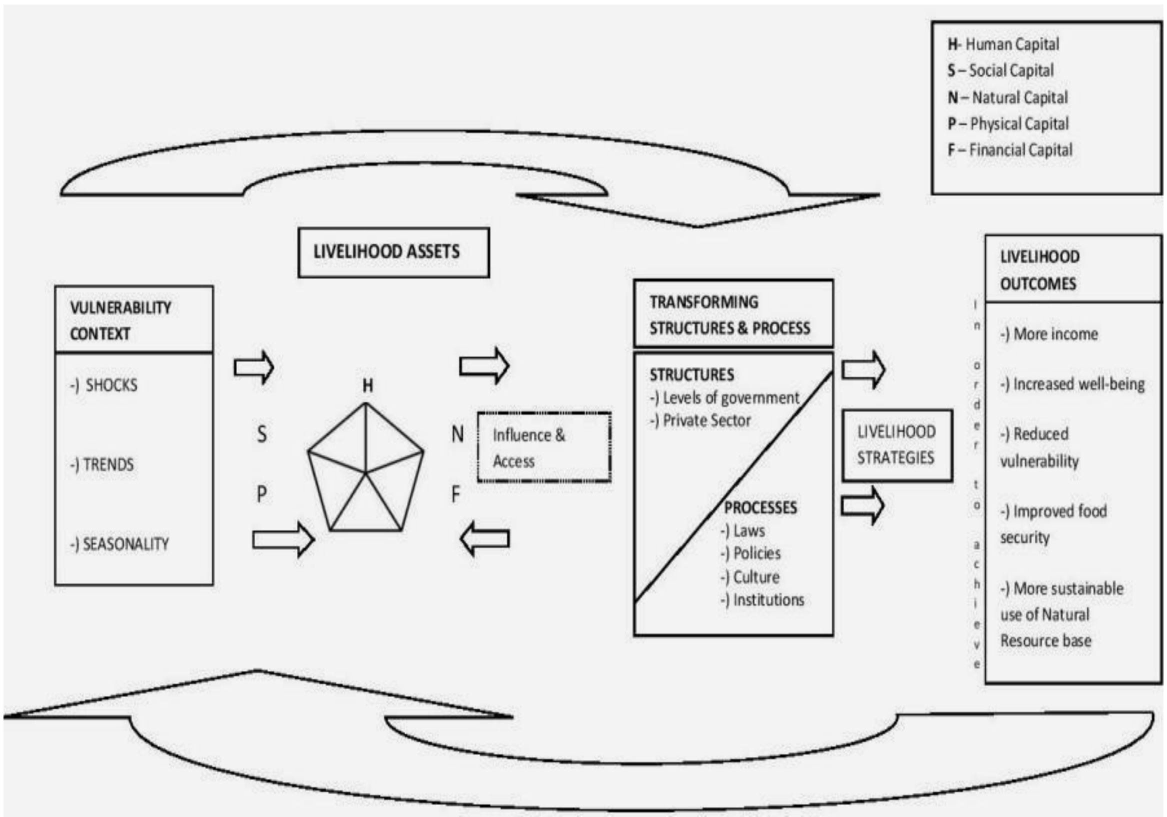

Figure 4.1: The Sustainable Livelihoods Conceptual Framework Model (Adopted from Department for International Development, 1999)

which has long been associated with academic knowledge production. Nowotny et al. (2001) and Gibbons et al. (2004) argue that knowledge production is not confined to the academic milieu but is also shaped by stakeholders outside the academic environment. The Sustainable Livelihoods Approach is about context specific and problem solving and therefore about inter-disciplinarity and transdisciplinarity so that contextualized knowledge integration is achieved for environmental policy-making and decision-making (Klein, 1991; Hisschemöller et al., 2001; Mulder, 2001).

The application of the Sustainable Livelihood Framework

Figure 4.1 shows the climate variability vulnerability context which the study seeks to first unearth through interviews and focus group discussions. This unearthing exercise includes the interrogation of the extent as well as the description of the farmers' vulnerability with respect to the asset pentagon capitals: (human (H), natural (N), financial (F), physical (P) and social (S). The questions on the informal interviews, questionnaires and focus group discussions will reflect on the 5 asset capitals which signify the livelihood diversification of the rural community of NLM. The factors influencing perception which this study seeks to identify also stem from the socio-economic attributes which are in turn tied to the 5 asset capitals. The livelihood strategies are inclusive of adaptation strategies which in turn determine the extent of adaptive capacity. However, livelihood strategies are closely linked to the involvement of different structures, processes and institutions (government departments, non-governmental organisations and private sector). Within the context of NLM these government departments include the Department of Agriculture and Land Affairs, Department of Environmental Affairs, Economic Development and Tourism and the Department of Social Development.

Through the findings of this study the villagers and farmers' perception should inform policy while both the planned and nascent government programmes either meet the farmers' needs half way or work efficiently and concurrently to achieve the goals of livelihood outcomes – increased adaptive capacity and food security. Therefore, livelihood outcomes should be linked to risk management, which in turn reduces vulnerability. The government's developmental agenda is envisaged to be a mandate of the people of the people of South Africa. Therefore, mutual interest should be reflected in policy decision making and systematically translated into general well-being; more financial security for households; improved food security; reduced vulnerability; and more sustainable use of the natural resource base in the face of climate variability and extortionate food prices.

Research design

The study employs a mixed method approach whereby both the problems of subjective qualitative methods are tampered with the objectivity of quantitative research methods (Phillip, 1998). With respect to quantitative objectivity, the study employs both meteorological analyses of rainfall trends as a component of climate variability while interviews and questionnaires (APPENDICES A, B, C, D, E, F, G, H) are employed as subjective qualitative method tools. Aligning perceptions with meteorological/scientific observations has been used in several studies (Twomlow et al., 2008; Deressa et al., 2009; Gbetibouo, 2009; Mongi et al., 2010; Makundi & Lyimo, 2015). One of the objectives of this study links meteorological data with the respondents' perceptions of climatic changes.

Qualitative research methods: Questionnaires and interviews

With respect to the perspectives of the participants; the adaptive activities to climate variability and change; food price dynamics and coping strategies for food system stresses; the relationship(s) between food security, gender and climate variability and change, the qualitative research paradigm was adopted. Qualitative research was adopted because it enables the study to unearth for comprehension, the phenomena in the respondents' own setting (Strauss & Corbin, 1990). Therefore this study employs a qualitative research approach which is not limited to be being interpretive but both critical and positivist (Olivier, 2004). Yet, still, from a qualitative perspective, less theoretical studies have been undertaken on the perceptions of ordinary citizens, scientists and different publics on global climate variability and change issues (Lofstedt, 1992; Bostrom et al., 1994; Read et al., 1994; Burgess et al., 1995, Kasemir et al., 2000; Gbetibouo, 2009; Maponya & Mpandeli, 2013).

Therefore, interviews and a questionnaire were administered to all the 13 agricultural extension officers of the NLM municipality in order to identify the implementation of agricultural policies which may impact on the villagers' perception of climate variability in the selected wards. In order to better select more representative wards ten random household surveys are conducted in each of the 13 wards/118 villages of the municipality to assess the extent of food insecurity and its links with climate variability and change and variability as well as the impacts of extreme weather events (droughts and floods) on subsistence farming and gardening activities. To extend the sample within the villages of Peddie District and with the intent to establish as diverse a pool of participants as possible, factors such as age, gender, income, educational level and attitudes towards the environment (feelings and perceptions about how important the environment is affecting their livelihoods) were taken into account.

In addition, 308 questionnaires were administered with continuous data gathering and analysis as well as intervening interviews as espoused in Glaser's (1992) methodology. Data from interviews and questionnaires were recorded by hand with the possibility of the limitations of language and the marginal loss in direct translation from isiXhosa to the English language. This study endeavours to localise the study of local perceptions of climate variability and change to the rural community of Ngqushwa Local Municipality by also employing the focus group discussions.

Focus group discussions

In discussing issues pertaining to the ambiguities and doubts experienced by lay people, Kasemir et al. (2000) adopts the Integrated Assessment (IA – Focus Groups). In this study, in order to eliminate bias, several focus groups (APPENDIX E) of six to eight people each are conducted with food security project members currently running in the Ngqushwa Local Municipality, in the villages of Mgababa, Prudoe, Mgwalana and Benton which had experienced flooding in 2011. The focus group members were selected because of their involvement in community and subsistence food security projects, whose experience ranged from 20 - 30 years.

There is the danger of the dominant, assertive and talkative members of the villages whose valuable and well-meaning yet domineering views may stifle other less talkative members' views and opinions. In this regard care was be taken by the moderator to give due credence to the less talkative and to administer tactful control of the more assertive members of society (Morgan & Krueger, 1998). The focus group prompting questions which guide the discussion will include: 1) what they thought Ngqushwa will generally look like in the next 10 years in the face of climate variability and change; 2) their perceived impact of climate variability and change e change on vegetation cover; 3) their own projected impact of climate on food security in the next 5 years; 4) their perceptions on what is being done by the province to mitigate and adapt to climate variability and change; 5) their own adaptive capacity to climate stresses and extreme weather events; variability and change; 6) which crops they find to be more adaptive to climate variability and change; 7) what they consider as climate variability and change and the impact of droughts on their crop production and livestock; 8) the frequency of extreme weather events in Peddie; 9) what causes climate variability and change and since when did they learn about climate variability and change; 10) the link between climate variability and change and high food prices; 11) social beliefs on climate variability and change; and 11) global warming and food security.

Quantitative research methods: meteorological observations

Peddie District is susceptible to dry spells. The analysis of dry spells is essential to determining and estimating intra-season droughts and helps plan for appropriate impact management (Kumar & Rao, 2005). In determining rainfall variability, a quantitative method for data collection was adopted. Due to the reliance on rain-fed agriculture and natural resources for household and subsistence food security in the semi-arid Peddie District, a study of spatial and temporal rainfall variability is crucial to agricultural planning and understanding the impact weather and climate variability has on rural livelihoods.

Notwithstanding the importance of corroborating crop farmers' perceptions, the study also seeks to address the systemic paucity of spatial and temporal rainfall variability data identified by Mzezewa et al. (2010). According to Hassani & Stern (1988, p. 101) "the success of crop establishment and growth depend largely on the availability of adequate rainfall". Therefore, the study focused on the importance measuring rainfall variability since it defines the success of cropping activities that are the bedrock for food security in the rural communities of Ngqushwa Local Municipality. Monthly rainfall data of 112 years (from the Grahamstown Weather Station), from 1900 to 2011 was collected from the South African Weather Services and analysed by first recapitulating it into monthly and annual totals. Ziervogel et al. (2006, p. 295) argue that case studies are important for their role "in helping to illustrate local dynamics and underlying vulnerabilities that need to be acknowledged before pursuing adaptation support. This study focused principally on two aspects of food crop systems vulnerability: the sensitivity of crops to climate variability and change, particularly vulnerability to rainfall variability as well as the adaptive and resilience capacity of crop farmers. The following section discusses the sampling technique.

Sampling technique

The study is conducted in the Ngqushwa Local Municipality which is comprised of 118 villages, divided into 14 Wards. The study is conducted in 3 of the most vulnerable Wards. Each ward consists of approximately 1500 households. However, due to limited resources (time, financial and human resources), surveying 4500 households is not plausible. Therefore the researcher conducted preliminary visits with the NLM officials and traditional leaders in order to better select the villages which represented the myriad of challenges faced by the food producing households/subsistence and small-scale farmers. Thus, due to research resource constraints the representability of 4 villages in Ward 7

(Mgwalana), Ward 9 (Mgababa and Prudoe) and Ward 13 (Benton) of the historical and environmental landscapes of the NLM the study is conducted. The four villages are indicative of the representative characteristics of parched dry lands resulting from declining rainfall and incessant droughts. Indications from preliminary interviews with three Ward agricultural extension officers, whose experience spans more than 30 years, reveal that these rural villages are farther away from the Great Fish River and the Keiskamma River. As these are the main water sources, the villages consequently have limited access to potable water made available for both smallholder and subsistence farming purposes and for exclusive personal consumption for each household. These factors indicate that the villagers' food security may be compromised (Z. Gwabana, N. Mgijimi & P. Katata (extension officers), personal communication, 03 July, 2011).

Furthermore, the researcher had personally witnessed the state of the environment in these villages and are convinced that these villages represent the state of the NLM environment with respect to the inter-linkages between socio-economic and environmental factors and variables. The four villages depict and illustrate the severity, extent and duration of water scarcity and may provide valid, representative, replicable and reliable data. Crop production is largely dependent on rainfall. The extent, duration and scale of droughts in this area have rendered the area covering these villages a water scarce disaster area as mentioned under the research problem heading.

For the intent to achieve representation, the study employed both the stratified sampling and the purposive sampling method (Dhakal et al., 2013). Purposive sampling is best executed by using the guiding principle of maximum variation; which means that "researchers should seek to include people who represent the widest variety of perspectives possible within the range specified by their purpose" (Higginbottom, 2004, p. 17). The purpose and aim of the study is to link climate variability and food security and identifying the reasons for food insecurity and the environmental and socio-economic consequences of adaptive responses to a changing climate. For the intent of this study purposive sampling meets the requirements of evident interconnected interpretive methods, pragmatism, multiple realities, and scientific objectivity.

Based on a Ward population of 1500, using a 95% Confidence Level and Confidence Interval of 5, a sample size of 306 households was required. Given that there is a sufficient number of farming households, to even out the number of the surveyed households and, the survey was administered to a purposive sample of 77 households from each of the four selected villages totaling 308 households. Members of the Siyophumelela and Siyakhula Small-holder Agricultural Projects were included in the surveyed household members and form the core of the 4 focus group (APPENDIX E) discussions held in each village (Mgwalana, Mgababa, Prudoe and Benton).

The following section is a detailed account of the methodology and conceptual framework that was employed in this study.

Objective 1: To describe the socio-economic characteristics of the respondents as well as to determine the factors influencing the existing perceptions of climate variability and change at the household level.

Methodology for describing the socio-economic factors influencing perception

Below et al. (2012) investigate whether farmers' adaptation to climate variability and change can be explained by socio-economic household level variables. There are several multi-dimensional socio-economic, demographic and institutional factors which influence the adoption of adaptation strategies (Deressa et al., 2009). Household socio-economic livelihood and adaptation strategies should be allowed to play a major role at informing the policy decisions that will take into account the needs of the local people (Teshager et al., 2014). To describe the socio-economic factors influencing the respondent's perceptions on climate variability and change variables change, the study employs descriptive statistics. The output of the analysis procedure was expressed in graphs, statistical formula and tables. To measure the perceptions of changes in climate the statistical package for social sciences (SPSS) 21 was used with Excel spreadsheets as a supplementary tool for data capturing, entry and importation. Descriptive statistics was computed as frequency, percentage, mean and standard deviation. Ten climate variability and change and variability perception questions with 5 - Point Likert Scale configuration are administered. The 5 Point Likert Scale is calibrated as Strongly Agree (SD=5; Agree (A) = 4; Undecided (U) = 3; Disagree (D) = 2; and Strongly Disagree (SD) = 1. The total for the ten questions was 100; therefore a score of equal to and greater than 60 signified Perception (Sato, 2005) with dependent variable value of 1 while a score of less than 60 signifies Non-Perception designated as 0 as shown below in the model description. This method is in keeping with Alwin's (2007) Feeling Thermometer which ranges from 0, the coldest perception toward alternatives, to 100, being the hottest, with 50 as the neutral score (Zadra & Clore, 2011). Therefore any score above 60 was designated as reflecting perception.

Methodology for determining the factors influencing perception

The Multiple Regression Model which was also used by Salau et al. (2012) and Sangeda et al. (2013) in determining the factors influencing perception of climate variability is adopted as it indicates how well a set of predictors estimate the dependent variable Y. Multiple Regression also provides the proportion of criterion variance accounted for by the set of predictors. It also allows for a more accurate and precise understanding of the association of each individual factor with the outcome by indicating the relative contribution of each variable in predicting the dependent variable (Marill, 2004), normally designated as Y, and is given as: $Y = b_0+b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8... + e_1$

Where: Y = Perception Index (Perception = 1, Non-Perception = 0)

b_0 = Constant

$b_1 – b_8$ = Regression Coefficients

X_1= Gender (male = 1, female = 0)

X_2 = Age

X_3 = Marital Status (Married = 1, Single = 2, Divorced = 3, Widowed = 4)

X_4 = Education

X_5 = Household Size

X_6= Annual income (in Rands)

X_7 = Farming Experience.

X_8 = Farm Size

e_1 = Error term

In order to eliminate both the incidence of the variance of the error term being not constant for all values of the independent variable and for removing redundant independent variables, before the data was entered to the models the data was examined for multicollinearity and heteroskedasticity by using the Variance Inflation Factors (VIF) test and Breusch-Pagan Test respectively.

Objective 2: To interrogate the determinants of adaptive capacity of both small-scale and subsistence farmers as well as to investigate the nature of both the perceived vulnerabilities and of the adopted adaptation strategies.

Methodology for interrogating the determinants of adaptive capacity

To identify the determinants of adaptive capacity 25 questions in the form of a questionnaire were asked as employed by Alberini et al. (2006) and Juhola & Kruse (2015). To measure adaptive capacity a functional relationship equation was used. In this respect the study uses the binary logistic regression model. The logistic regression measures the relationship between a categorical dependent variable and one or more independent variables, which are usually continuous, by using probability scores as the predicted values of the dependent variable. Several studies (Asante et al., 2012; Below et al., 2012; Teshager et al., 2014; Tiwari et al., 2014) have adopted the logistic regression model to study the determinants of adaptive capacity. The logistic regression can be used to predict a categorical dependent variable on the basis of continuous and/or categorical independents; to determine the effect size of the independent variables on the dependent; to rank the relative importance of independents (Pregibon, 1981); to assess interaction effects; and to understand the impact of covariate control variables (Hosmer & Lemeshow, 1989). The binary logistic regression can be used to describe its relationship with several predictor variables, $X_1, X_2, ..., X_k$ and an (adjusted) odds ratio can be estimated.

This function is well-suited for modeling a probability because the values of f(z) ranges from 0 to 1 as z varies from $-\infty$ to $+\infty$.

The binary logistic regression model

The dependent variable, Y, is the binary response or dichotomous variable.

Let Y be Adaptive capacity, a dichotomous variable which is defined as

Y : 1 = Adaptive Capacity 0 = No Adaptive Capacity

and p = Pr(Y=1| $X_1, ..., X_k$).

$$p = \frac{1}{1+\exp[-(\beta_0+\beta_1X_1+\beta_2X_2+...+\beta_kX_k)]} \quad \text{.......................} (1)$$

and $$\hat{p} = \frac{1}{1+\exp[-(\hat{\beta}_0+\hat{\beta}_1X_1+\hat{\beta}_2X_2+...+\hat{\beta}_kX_k)]}$$

The relationship of a dichotomous variable with its predictors is quantified with the odds ratio.

Since odds (D) = $\frac{\Pr(D)}{1-\Pr(D)}$,

$$\text{odds}(Y=1) = \frac{p}{1-p}.$$

The “logit” is the natural log odds of the event, Y=1, that is,

$$\text{logit}[p] = \ln[\text{odds}(Y = 1)] = \ln\left[\frac{p}{1-p}\right]$$

$$\text{logit}[p] = \beta_0 + \beta_1 X_1 + ... + \beta_k X_k \qquad \text{..................................(2)}$$

Where,

K, the subscript k represents the k th observation in the sample.

P is the probability of adaptive capacity occurring, which refers to the adoption of adaptation strategies for an observed set of variables X_k.

The denominator (1- p) is the probability of non-adoption.

The parameter β_o gives the log odds of the dependent variable.

β_o is the intercept term, and

β_1, β_2 …….. β_k are the coefficients of the explanatory variables X_1, $X_{2,}$ X_2 ……… X_k .

The specific variables for the logistic regression model include:

Y = Adaptive Capacity

X_1 = Gender

X_2 = Age

X_3 = Marital Status

X_4 = Education

X_5 = Household Size

X_6 = Income

X_7 = Farming Experience

X_8 = Farm Size

X_9 = Change in Planting Dates

X_{10} = Soil Conservation

The 5 point Likert Rating Scale (LRS) is employed to rate the respondents’ general (Indigenous, traditional and contemporary) perception about climate variability and change. The LRS is expressed as Strongly Agree (SA) = 5; Agree (A), Undecided (U) = 3, Disagree (D) = 2; Strongly Disagree (SD) = 1. The analytical procedure of the Likert scale was also employed by Fatuase & Ajibefun (2013); Ofuoku (2011); Mustapha et al. (2012) and Alarima (2011). There were 25 likert scale questions administered to the respondents and the total score was (5X25 = 125). Any scores less than 75 which is 60 percent of the total score signified NO ADAPTIVE CAPACITY represented as 0 while those equal to and greater than 75 signified ADAPTIVE CAPACITY represented as 1.

To investigate the nature of both the perceived vulnerabilities and of the adopted adaptation strategies, 4 focus group discussions (APPENDIX E) from each village were held. The focus group discussions targeted five members of the small-scale projects as well as another. random five from the households. As discussed in the results section these focus group discussions also comprehensively prompted further responses on coping strategies, adaptive capacity strength and resilience.

Objective 3*:* To determine the impact of rainfall variability on crop cultivation in the study area; on maize crop farming, rural household gardening, small-scale and subsistence farming as well as to quantify rainfall variability.

Methodology for determining the impact of rainfall variability on crop production

Maize is a major staple food for the majority of South Africans (Schulze et al, 1993; Durand, 2006). Agronomic data on annual Maize yield (for the period of 1971 to 2011) used in this study were collected from the Eastern Cape Department of Agriculture and Land Affairs. A period of more than 30 years is more than qualified to study the effects of climate variables (rainfall and temperature) on yields of food crops as response to climate variability (IPCC, 2007). Rainfall data were collected from the archives of the South African

Weather Service. The Ngqushwa Local Municipality does not have a designated meteorological station to analyse possible trends in temperature and rainfall changes which necessitates obtaining the data nearest meteorological station. The closest stations are located in Grahamstown and King Wiliams' Town. The meteorological and maize agronomic data include average monthly and annual rainfall as well as the average annual output per hectare of maize in Ngqushwa Local Municipality. The time series data (1971 - 2011) covered 40 years which is considered adequate for agro-meteorological planning (Todorov, 1985). The monthly rainfall data that were available for analyses from Grahamstown spans 112 years (1900-2011) while at Peddie the data are from 1900-1987 (88 years) and from King William's Town the data range from 1970-2011 (42 years)

Data analysis

In order to determine whether there is any correlation r between crop yield and rainfall variability the mean annual rainfall scores were compared with the mean crop yield for 30 years (1982 to 2011). The maize production figures and rainfall data set was analysed using correlation analysis (Adejuwon & Odekunle, 2006). The Excel and SPSS statistical method employed for this study includes correlation of crop yield with annual rainfall total. The limitations of this exercise are that the Department of Agriculture and Land Affairs does not have records dating back more than 30 years owing to 'historical imbalances and resource constraints'

Data analysis and quantifying rainfall variability

To analyse the long-term trend in inter-annual rainfall variability at the station for the individual recording period the annual absolute deviation from mean annual rainfall (absolute deviation) were analysed. To analyse rainfall variability, Kakembo (2001) and Kakembo and Rowntree (2003) use the z-score which is computed as follows:

$$\text{Z-score} = \frac{\text{raw value} - \text{mean annual rainfall for station (for the recording period)}}{\text{standard deviation of rainfall (for the recording period)}}$$

The data is filtered with a five year running mean. A z-score below 0 indicate a dry phase while z score above zero a wet phase. From the filtered data very dry and wet phases (max z-score above 0.5 and below -0.5) occurring at Grahamstown were identified. Seasonality can be described through the monthly rainfall totals as a percentage of the total annual rainfall (Nel & Sumner, 2006). However, to define the intra-annual variability and its temporal trends a modified version (De Luis et al., 2000; Ceballos et al., 2004) of the precipitation concentration index (PCI) was applied:

$$PCI = 100\frac{\sum_{i=1}^{12} P_i^2}{\left(\sum_{i=1}^{12} P_i\right)^2}$$

where P_i is the precipitation of the month *i*. Values below 10 indicate a uniform distribution of rainfall throughout the year. PCI values from 11 to 20 indicate a seasonal trend and values above 20 indicate a considerable variability of the distribution of monthly rainfall (Ceballos et al., 2004). Therefore, an increase in the PCI value over time indicates an increase in the variability of the distribution of monthly rainfall. The seasonality of rainfall in the study area can be observed by the mean PCI for the recording period that range between 13 and 15.

To analyse the long-term trend in intra- annual rainfall variability the PCI was calculated for the two long-term stations and the linear regression plotted. Pearson correlation coefficient was applied to the station data to quantify any trends with the related degree of significance. Even though both stations show an increase in PCI values from the 1900 the increase is not statistically significant. To further test the changes in intra-annual rainfall the monthly rainfall linear trend for Grahamstown for the recording period were analysed.

To investigate the effect the ENSO has on summer rainfall totals in the study area the summer rainfall (November to March) for Grahamstown (1900-2011) and Peddie (1900-1987) were determined. To calculate the SOI, the method used by the Australian Bureau of Meteorology is the Troup SOI, which is the standardised anomaly of the Mean Sea Level Pressure difference between Tahiti and Darwin (Troup, 1965). The SOI data were retrieved from the Internet on October 31 2013 from the Australian Bureau of Meteorology's website (http://www.bom.gov.au/climate/current/soihtm1.shtml). To test if there is a non-lagged relationship between summer rainfall and the SOI the average of November to March SOI was compared with the summer rainfall (November to March) of the stations. The Pearson Product Moment Correlation parametric test was applied to test the strength of the relationship with the related degree of significance. The SOI was also computed for preceding periods lagged at least one month to test if there is a lagged relationship between the SOI and the summer rainfall in the region and if this correlation is strong enough to be used as an indicator for seasonal rainfall.

Objective 4: To investigate the impact of both the food price dynamic and the global food system on rural livelihoods and food availability and access.

Methodology for investigating the impact of food systems

Both secondary and primary data were collected. Secondary sources included published research papers and relevant reports (legislation, working papers, and Integrated Development Plans) and internet sources, international agricultural trade agreements, climate variability and change policies, and agricultural policies. Primary data were collected using questionnaires (APPENDICES A, D, C & H) to investigate the level of household food access as well as 4 focus groups discussions focusing on the members of the Siyophumelela and Siyakhula Crop Farming Projects. 308 household interviews were conducted at 4 villages (Mgwalana, Mgababa, Prudoe and Benton – 77 households in each village) which have significant historical agricultural production (with approximately 90% of households practicing crop production). Using the questionnaire (APPENDIX F) the data about the afore-mentioned villages was obtained from the manager of the Department of Agriculture and Land Affairs –

Peddie Town (P. Mninzi, personal communication, 10 July, 2011). Also, to quantitatively measure the extent of household food access the study employs both the Household Food Insecurity and Access Scale (HFIAS) and the Household Dietary Diversity Score Measurement (HDDS). The HFIAS (APPENDIX I) and HDDS (APPENDIX H) are discussed below.

The Household Food Insecurity Access Scale (HFIAS)

Both the Household Food Insecurity Access Scale (HFIAS) and the Household Dietary Diversity Score (HDDS) were used to assess food insecurity, availability and access. The HFIAS was analysed based on the guidelines formulated by Coates et al. (2007). The HFIAS scores range from 0 to 27. The higher scores (greater than 18) indicate lower food security status while those greater than 9 but less than or equal to 18 indicate moderate food insecurity. Those lower than or equal to 9 were considered to be food secure. Quantitative data were edited, coded and entered into an MS Excel spreadsheet and analysed through frequency and percentage.

The Household Dietary Diversity Score Measurement (HDDS)

The household dietary diversity score, as a measure of household food access and food consumption was used in this study to triangulate the results of the household food insecurity access scale (HFIAS). Several studies show that an increase in dietary diversity is associated with socio-economic status and household food security (Hatloy et al., 2000; Hoddinot & Yohannes, 2002; Swindale & Bilinsky, 2005; Daniels, 2009). The Dietary Diversity Scores were calculated for each household head using a set of 12 food groups according to the categories set out in Table 4.1. The Household Dietary Scores were calculated by summing the number of food groups consumed by each Household within the last 24 hours. The Lowest dietary diversity is categorized as (≤ 3 food groups – Cereals, Green leafy vegetables; Vitamin A rich fruit); Medium dietary diversity (4 and 5 food groups - Cereals, Green leafy vegetables, Vitamin A rich fruit, Oil); and High dietary diversity (≥ 6 food groups - Cereals, Green leafy vegetables, Vitamin A rich fruit, Other vegetables Fish, Legumes, nuts and seeds). The results of the HDDS are represented as formulas, percentages and tables.

Table 4.1: The Dietary Diversity Score Food Groups

Rural Food Category	**Food Groups Consumed over the last 24 hour period-**
A.	Any samp and beans, bread, rice noodles, biscuits, or any other foods made from millet, sorghum, maize, rice, wheat?
B.	Any potatoes, sweet potatoes, beetroot or any other foods made from roots or tubers?
C.	Any vegetables?
D.	Any fruits?
E.	Any beef, pork, lamb, goat, rabbit wild game, chicken, duck, or other birds, liver, kidney, heart, or other organ meats?
F.	Any eggs?
G.	Any fresh or dried fish or shellfish?
H.	Any foods made from beans, peas, lentils, or nuts?
I.	Any cheese, yogurt, milk or other milk products?
J.	Any foods made with oil, fat, or butter?
K.	Any sugar or honey?
L.	Any other foods, such as condiments, coffee, tea?

The formula for calculating the HDDS is as follows (Swindale & Bilinsky, 2005)

HDDS (0-12)	Total number of food groups consumed by members of the household. Values for A through L will be either “0” or “1”. Sum (A + B + C + D + E + F + G + H + I + J + K + L)

$$\text{Average HDDS Sum (HDDS)} = \frac{\text{Total (Sum of HDDS)}}{\text{Total Number of Households}}$$

With climate variability and change affecting food production and food prices this study draws on both secondary and primary data. A synopsis of macroeconomic performance relies on the most recent Census 2011 report produced by StatsSA. The analysis of price trends is based on systemic price collection of the National Agricultural Marketing Council (NAMC). The Food Price Monitor Report of the NAMC provides wholesale prices of agricultural commodities and food items by comparing the price differences between the urban and rural areas. The global food system has had profound impact on the volatility of global food prices which can have adverse impacts on the welfare of poor rural communities, particularly on their food access and dietary needs. Volatile price levels have been set in motion by a complex set of concurrent factors behind the food price crises in the years 2007–2011. The concurrent factors included the diversion of crops for biofuel because of climate variability and change, as well as its impacts such as droughts, which led to low grain stocks, lofty agricultural trade deals which marginalise developing nations and financial speculation. The study sets out to systematically review both the historical and latest literature as well as the economic developments related to the global food system. The methodology therefore consists in a review of how this system's machinations has been and is being siphoned, cascaded and translated into the lowest levels of society: rural communities; through food prices, price volatility and constricted food sovereignty.

This study seeks to capture the nature of, as well as the extent of agricultural adaptive capacity in the face of rising living costs and global environmental change induced food prices. In each selected village, structured questionnaires, semi -structured questions, as well as open-ended questions and focus group discussions are used to capture the contextual significance of landlessness, market access, trends in prices, and prevailing village adaptive strategies which influence food security. Data are also collected from key informants (government department administrators) (APPENDICES F and G), councillors and extension officers (APPENDIX F). The questionnaire was designed to collect reliable information within the time and resource constraints. Respondents were expected to rely on recalls of their food security status over the past few days and weeks, and where plausible over months, in order to assess changes caused by the high food price trends in their livelihoods.

Objective 5*:* To investigate the extent of the impact of the interaction between South Africa's climate change, food and agricultural policies and how these are articulated to galvanise food security programmes as well as how they influence the perceptions of risk and vulnerability in the Ngqushwa Local Municipality.

Methodology for investigating influence of policies on perceptions of vulnerability

Currently the National Development Plan is the over-arching strategy which seeks to guide all government programs and policies related to, but not limited to food access, security, agriculture and the environment. This study involves a review of the relevant literature, including environmental vulnerability reports for various South African governmental which affect the Eastern Cape and the Ngqushwa Local Municipality' s economy. Also, a review of related agricultural and environmental response strategy documents and analyses were conducted in order to understand priorities for Ngqushwa Municipality, and to assess possibilities for vulnerability incidence and adaptation opportunities in the study area. The methodology focuses on collecting, collating and reviewing the NDP aligned legislation, intergovernmental initiatives and programmes on climate variability and change, agriculture and the food system in South Africa which are geared toward adaptation and resilience building for the resource poor communities of rural South Africa. These policy priorities and targets were also measured against respondents' perceptions of vulnerability in order to determine how these targets and priorities impact on the respondents' livelihoods and socio-economic standing.

The analysis draws heavily from documented national and provincial studies on climate variability and change, existing environmental policies and implemented agricultural strategies and their alignment with the NDP. This is meant to be predominantly a desktop study; however, due to the limited available documents on climate variability adaptation strategy implementation at local level and particularly in the Eastern Cape, interviews with key informants from the Eastern Cape Department of Environmental Affairs and Economic Development, Department of Agrarian Reform and Rural Development were held to fill in the information gap on the implementation of food security and climate variability and change government policy aimed at improving food access, availability and dietary diversity. The methodology adopted embraces web-based and online databases, interviews, questionnaires and focus groups and it scrutinises the impact of both current and planned government programmes which impact on food security in this rural local municipality. Questionnaires and interviews with 15 government officials were planned however due to circumstances beyond the researcher's control there were limitations that precluded the administration of the questionnaires. The following sub-section expatiates.

Limitations of the methodology

Five of the 15 (5 agricultural extension officers) planned government official questionnaires were successfully administered. Over a period of about 8 months the rest of the extension officers and two provincial department officials were either unavailable or too busy either to complete the questionnaires or to make 'time to schedule an interview'. However the 5 responses that were received included three from the extension officers administering agricultural extension programmes in the study area (Municipal Wards 7, 9 & 13 and for the villages –

Mgababa, Prudoe, Mgwalana and Benton). Given the representativeness of the study area the responses from the three overseeing extension officers was found to suffice the objectives of this study.

The other two responses were from the manager of the extension officers as well as another from the Department of Social Development. The other responses were solicited through interviews with junior administrative staff members of the 'Eastern Cape Provincial Department of Economic Development, Environmental Affairs and Tourism' and the 'Department of Agriculture and Land Affairs'.

Conclusion

The chapter constituted the methodology and the analysis techniques that were adopted. These techniques ranged from quantitative (questionnaires, interviews and focus groups) to qualitative techniques (statistical computations and analysis) in order to safeguard objectivity, particularly in a largely subjective study theme that solicits respondents' perceptions. The chapter also outlines the limitations of the techniques as well as how those weaknesses were compensated for through other means. The effective of the methodology is measured by the strength of the reliability and coherence of the results. The next chapter elucidates the results of the study.

CHAPTER V

PART I: HOUSEHOLD AND FOCUS GROUP FINDINGS

Introduction

The chapter uses descriptive statistics to describe the socio-economic characteristics of the respondents as well as inferential statistics to analyse both the factors influencing perceptions of climate variability and change and the determinants of adaptive capacity. It further outlines the divers' perceptions of vulnerabilities as well as the findings of the meteorological data. Most of the descriptive findings point out that the respondents are poor and that food insecurity is quite rife. The meteorological data corroborates the extent of rainfall variability as perceived by the respondents. While there are slight nuances of difference the perceived vulnerability and risk is therefore legitimised by the scientific data enough to warrant the attention of policy makers.

Objective 1: The description of the socio-economic characteristics as well as the factors influencing the existing perceptions of climate variability and change at the household level.

The socio-economic characteristics of the respondents

The majority of the respondents are female (77%). The marital status of the respondents indicates that 71 percent of the respondents are married while the rest are single. Fifty - one percent of the respondents are equal to or over 62 years old and this also signifies that they are eligible for old age grants. Only 17 percent attended high school while 53 percent attained lower and higher primary school. The rest (30 percent) reported that they either had no education or obtained informal education. Sixty-nine percent of the households had 6-10 occupants, 13 percent had between 11 -15 members and 9 percent had more than 16 members. Thirty percent earn more than R2000 while 52 percent earn more than R500 but less than R1000 a month. Yet according to the Basic Conditions of Employment Act, no 75 of 1997 the minimum wage for farmworkers is R1503.90 (Republic of South Africa, 1992) therefore the majority of the respondents are poor and this may have a significant effect on their perceptions of risk and vulnerability. With respect to farming experience, 55 percent had over 30 years of experience while 33 percent had more than 10 years' experience but less than thirty years. Such farming experience is indispensable to the objectives of this study in as far as gleaning many memories and experiences which straddle both climate related issues and food security status over time.

According to the leader of The Siyophumelela Project (Mgababa) the project had rights to 100 hectares of land, but had access to only 5 hectares due to rainfall and climate unpredictability and variability (N. Nkahla, personal communication, 14 August, 2013). Approximately 80 percent of the households reported that they had had to abandon crop field farming due to climate variability and its related changes. Nowadays they farm in the backyards on patches of land which are greater than 0.01 to a little over 0.06 ha. Seventy- eight percent grow their crops on less than 0.06 while 22 percent of the households farm on more than 0.06 ha. They reported that the sizes of their planted and harvested gardens have been receding over the years due to environmental/climate unreliability.

The Siyakhula (Mgwalana) project has access to three hectares of land and has obtained restricted and community controlled irrigation infrastructure access. The irrigation infrastructure is connected to a pond. In this way the Siyakhula project is able to offset the limitations posed by climate variability. The Mgwalana community is keeping a close eye on the use of the dam by the Siyakhula Crop Farming Project. The community shares the 'dam' with the crop farming project. The community also relies on the dam as a source of water for their livestock and during both dry spells and the frequent intermittent stand-pipe tap water shortages. Table 5.1 shows the socio-economic characteristics of the respondents.

Table 5.1: The socio-economic characteristics of the sample

Gender	Frequency	Percentage
Male	70	23%
Female-	238	77%
MARITAL STATUS (MARSTS)	Frequency	Percentage
Married	217	71%
Single	20	6%
Divorced	16	5%
Widowed	55	18%
AGE	Frequency	Percentage
≤35	44	14%
(36-50)	53	17%
(51-61)	55	18%
≥62	156	51%
EDUCATION LEVEL (EDLVL)	Frequency	Percentage
no education	40	13%
(informal)	54	17%
(grd 0-7)	162	53%
(grd8-12)	52	17%
(tertiary education)	0	0%
HOUSEHOLD SIZE (HHSIZE)	Frequency	Percentage
≤5	28	9%
(6 to 10)	211	69%
(11 to 15)	40	13%
≥16	29	9%
INCOME LEVEL (INCLVL)	Frequency	Percentage
≤R500	52	17%
(500-1000)	109	35%
(1000-2000)	45	15%
(2000 - 3000)	91	30%
> 3000	10	3%
FARM EXPERIENCE	Frequency	Percentage
≤10	37	12%
(11-20)	45	15%
(21-30)	55	18%
(31-40)	157	51%
≥41	14	4%

FARM SIZE (HA)	Frequency	Percentage
<0.01	112	36%
(0.011 to 0.03)	102	33%
(0.031 to 0.06)	27	9%
≥0.06	67	22%

The general perceptions of climate variability and vulnerability

Seventy four percent of the respondents perceived that climate variability and its changes were happening at alarming rates. The incidence of dry spells and droughts were the most concerning characteristics of the variability and related changes in weather patterns and consistency. There were none who "Disagreed" that climate irregularities were occurring. Yet the remainder, 26 percent were undecided what the problem precisely was. They vacillated between soil quality, climate and the nature and lack of agricultural inputs.

Fifty-one percent of the respondents disagreed that their climate related woes were a consequence of the concealed workings of the Almighty God. In this respect, there were references to stories which they had heard over the radio about factory gas emissions adversely affecting the 'oxygen' in the air and subsequently the weather. Seventy seven percent of the respondents agreed that their livelihoods were affected. They cited the rife dependence on food purchases for 'virtually everything' as opposed to yester years when households were self-sufficient at feeding themselves. The inability to afford to purchase food was also perceived to be a matter of concern. Table 5.2 shows the general perceptions about climate variability and its related changes.

Table 5.2: The General Perceptions of Climate Variability

	SA- A- U- D- SD	Number	Percent
Climate Variability and Change is Occurring	Strongly Agree	108	35
	Agree	119	39
	Undecided	81	26
	Disagree	0	0
	Strongly Disagree	0	0
Climate Variability is an Act of God or Ancestors	Strongly Agree	18	6
	Agree	16	5
	Undecided	55	18
	Disagree	63	20
	Strongly Disagree	156	51
Climate Variability is affecting our Livelihoods	Strongly Agree	129	42
	Agree	108	35
	Undecided	57	18
	Disagree	14	5
	Strongly Disagree	0	0

Factors influencing the perception of climate variability

Gender was a significant factor influencing perception at the 95% confidence level as shown on Table 5.3. The following studies observe a high vulnerability of women to climate variability and change (Cutter et al., 2003; Paavola, 2008; Omari, 2010; Kakota et al., 2011; Vincent et al., 2010) therefore the high significance co-efficient of 0.05 for perceptions of climate variability may be linked to the incidence of perceptions of vulnerability among the females. Age is significant at the 99 percent confidence level and this may be attributable to the fact that descriptive statistics indicates that those who are equal to or older than 62 constitute the majority (51%) of the respondents. The older respondents also seemed to demonstrate more farming experience which in turn may be linked to many years of perceived climatic changes over the course of time. Marital status also influences the perception of climate variability and is significant at the 95 % confidence level. In respect of marital status 71% were married while 29 % were single, widowed or divorced. It is therefore derivable that the significance of the perception for marital status is attributable to the married folk.

As suggested by Ani (1998) education is important for decoding or evaluating data and information whether agricultural or climate related. Therefore, the significant relationship between education and perception of climate variability at the 99% confidence level is a plausible outcome. Household size was also significant at the 99% confidence level. Such a high relationship between household size and perception of climate variability and associated vulnerability is ascribable to the stress that might be placed by climate variability on crop production which has resulted in food insecurity in large poor households (Puttergill et al., 2011). For instance, those households with more than 16 members, as shown in Table 5.1, may experience and perceive more climate related strain on their food security than those households with only 5 members. Household size vulnerability is also linked to the level of income.

Income was significant at the 90 % confidence level. While income does influence the perception of vulnerability (Oseni & Masarirambi, 2011) the respondents' incomes do not vary significantly enough for the income levels to elicit a statistically significant confidence level on the perception of climate variability. Farm experience was statistically significant at the 95% confidence level. Given that 73 % of the respondents have gained more than 20 years farming experience the 95 % confidence level reflects on the significant number of years of climate variation the respondent must have perceived over time. Farm Size also elicited a statistically significant relationship with perception of climate variability at the 99 % confidence level. This is also an indication of the actual shrinkages and abandonment of field cropping owing to perceived impacts of climate variability on crop production and yields (N. Nkahla, personal communication, 14 August, 2013). Table 5.4 shows the results of the Likert scale and the extent, as percentages, to which different adaptation strategies/variables had been adopted by the respondents. Table 5.4 also shows SD - Strongly Disagree; D – Disagree; U – Undecided; A – Agree; and SD – Strongly Disagree in the first column as well as the adaptation variables which include the following:

CRDTS – Change of Cropping Dates

SOILCON – Soil Conservation techniques

DRRES – Drought Resistant Seeds

RWHST – Rainwater harvesting

SOCGRT – Social Grants

IRRIG - Irrigation

Table 5.3: The multiple regression results of the factors affecting the perception of climate variability

	coeff	***std err***	***t stat***	***p-value***
Intercept	-1.60481	0.14316	-11.21	1.4E-24 *** ** *
GENDER	-0.1282	0.057431	-2.2322	0.026342 ** *
AGE	0.152178	0.026602	5.720464	2.58E-08 *** ** *
MARSTS	-0.12683	0.053563	-2.36787	0.018527 ** *
EDUC	0.469219	0.02976	15.76667	3.53E-41 *** ** *
HHSIZE	0.215668	0.031535	6.839033	4.5E-11*** ** *
INCOME	0.040931	0.021632	1.892168	0.059435 *
FMEXP	0.05206	0.024642	2.112631	0.035461 ** *
FRMSIZ	-0.11479	0.020326	-5.64718	3.79E-08 *** ** *

Significant at 0.01%*** 0.05%** 0.1%*

Table 5.4: The Likert scale responses to adaptation strategies

	CRDTS	**SOILCON**	**DRRES**	**RWHST**	**SOCGRT**	**IRRIG**
SD	3%	6%	3%	4%	14%	11%
D	47%	57%	53%	51%	34%	64%
U	8%	8%	6%	8%	16%	6%
A	28%	18%	25%	24%	26%	12%
SA	14%	11%	13%	13%	10%	7%

According to Table 5.4 change of cropping dates is the most adopted adaptation strategy followed by the adoption of drought resistant seeds. The following section elucidates the results of the binary logistic regression in order to help investigate the determinants of adaptive capacity.

Objective 2: To interrogate the determinants of adaptive capacity of both small-scale and subsistence farmers, as well as to investigate the nature of both the perceived vulnerabilities and of the adopted adaptation strategies.

The Interpretation of the logistic regression results about the determinants of adaptive capacity

The following analysis is derived from Table 5.5 below:

Table 5.5: The Logistic Regression Results for the Determinants of Adaptive Capacity

	coeff b	s.e.	Wald	p-value	exp(b)
Intercept	0.144555	1.129321	0.016384	0.898148	1.155525
GENDER	0.168523	0.390069	0.186654	0.665716	1.183556
AGE	0.449458	0.233027	3.720213	0.053758	1.567463
MARSTS	-0.55172	0.371898	2.200827	0.137937	0.57596
EDUC	-0.42403	0.202379	4.390053	0.036149	0.654402
HHSIZE	0.576287	0.233794	6.075916	0.013704	1.779419
INCOME	-0.03629	0.152971	0.056295	0.812451	0.964356
FMEXP	-0.63493	0.185021	11.77622	0.0006	0.529974
FRMSIZ	0.106082	0.146527	0.524139	0.469081	1.111913
CRDTS	0.244322	0.108562	5.064916	0.024415	1.276756
SOILCON	0.003644	0.112544	0.001048	0.974169	1.003651
SOCGRT	-0.43107	0.165185	6.810014	0.009065	0.649815
IRRIG	0.219918	0.121886	3.255476	0.071185	1.245975
EXTSERV	-0.03168	0.113437	0.077992	0.780037	0.968817

Chi-Sq	40.13571
df	13
p-value	0.000131

GENDER – exp (b) = 1.18

The odds of adaptive capacity are higher for a male than for a female. For an additional unit male the odds of adaptive capacity increase by 18 %. While good for progress in adaptation this 18 % increase of odds of adaptive capacity for males may also entrench the 'feminisation of poverty' (Terry, 2009). However the number of women farmers is more than 3 times that of the males, standing at 77% while that of males is at 23 %. In respect of the feminisation of poverty such a bigger number for females than that of males may swing the pendulum of socio-economic stability in favour of the women with positive implications for an inclusive government policy milieu. Nakuja et al. (2012) also found that women farmers had tremendous difficulty at crop farming in dry seasons than their male counterparts.

AGE – exp (b) = 1.56

The probability of adaptive capacity also increases by 56% with an additional year in age. This might be the case because the older the person the greater the likelihood that they might have gained more farming experience to help boost adaptive capacity (Salau et al., 2012). Similar to Salau et al's (2012) study age is also significant at the 90 percent level of confidence ($p \leq 0.1$) which implies the relevance of age when poor health has not affected the ability to engage in physical labour (Hogan et al., 2011).

MARITAL STATUS (MARTS) – exp (b) = 0.57

The odds of adaptive capacity decrease by 43% with a decrease in the number of married folk (marital status). Decrease in marital status refers to the state of not being married. Marital status may be linked to higher income for households. Therefore, the lesser the number of people who participate in both income generating activities and livelihood diversification strategies, the lesser the odds of adaptive capacity. Odebayo (2012) agrees that “marital status is of great importance in rural setting as it serves as potential source of labour” (Odebayo, 2012, p. 24) and therefore essential to adaptive capacity.

EDUCATION (EDUC) – exp (b) = 0.65

The probability of adapting decreases by 35% with a decrease in educational level. From the descriptive statistics, a considerable number of respondents, 83%, only obtained grade 0-7 education. Yet education is linked to the ability to decipher information (Ani, 1998) on weather and climate through books, newspapers and other relevant literature as well as to job opportunities which may help offset the effects of climate variability on food security and general livelihood.

HOUSEHOLD SIZE (HHSIZE) – exp (b) = 1.77

The probability of significant adaptive capacity increases by 77% when household size increases by a unit member. This may be associated with the availability of human capital to help plant crops and to help water the homestead farm as well as the possibility to divert on-farm labour onto other off-farm income generating activities in the face of socio-economic and environmental pressures on food security (Tizale, 2007). All things considered (income, etc), the 77 percent probability figure for adaptive capacity for the large sized households offers the possibility of many adaptive capacity building options from a number of individuals.

INCOME – exp (b) = 0.96

The odds of adaptive capacity decrease by 4% with a decrease in income. While the findings from Bryan et al. (2009) identified wealth/income as a factor influencing farmers’ adaptation in Ethiopia, the incomes of the respondents in

NLM are quite low and may bear heavily and negatively on the positive outcome of adaptive capacity. The respondents are quite poor and lack the financial resources necessary for adopting resilience building adaptation strategies.

FARM EXPERIENCE (FMEXP) – exp (b) = 0.52

In Salau et al's (2012) study farming experience had positive significance which implied increases in the probability of adoption of different adaptation strategies. In the NLM study the probability of a household's adaptive capacity decreases by 48% with every unit decrease in years of farming experience yet farming experience is significant at the 99 percent confidence level. This implies the criticality of farming experience in this community and how any major decrease in farming experience would adversely affect the ability to enhance adaptive capacity by 48 percent.

FARM SIZE (FMSIZE) – exp (b) = 1.11

The odds of adaptive capacity to multiple changes in climate for someone with a larger unit farm size increases by 11%. Also, the farmers have more chances of adapting by utilizing crop diversification due to the availability of a larger cropping surface area. With respect to food security Wright et al. (2012) state that in their study 75% of food insecure farming households owned and farmed on less than ½ acre of land while "74% of households that owned more than one acre of land reported having no food shortages at any time of the year" (Wright et al., 2012, p. 11). It is therefore plausible that a bigger farm size fosters food security, reduces vulnerability and enhances adaptive capacity. Yet none of the NLM farming households farmed on neither acre/hectare sized household farms. Hence food insecurity is rife in the respondents' households. Nevertheless farm size is a significant determinant of adaptive capacity in the NLM study area.

CROP DIVERSIFICATION AND CHANGING OF PLANTING DATES (CRDTS) – exp (b) = 1.27

Crop diversification is a farming system which promotes ecosystem services for pest ad disease control. Crop diversification also strengthens resilience to climate variability and change, helping to lower the risk to production loss (Lin, 2011). Fittingly there is a 27% probability of the incidence of adaptive capacity occurring with a unit increase in the adoption of Crop Diversification and Changing of Planting Dates in the study area. Crop diversification increases resilience and crop yield. Reduces vulnerability and also provides economic benefits in the long run for the small-scale farmer. Since Crop Diversification and Changing of Planting Dates is a determinant of adaptive capacity there are several benefits for the community if it would be promoted. If promoted as an effective adaptive strategy there is a possibility that in a larger scale than usual some crops may facilitate the growth of the other intercropped plants because of induced soil fertility, pest control and pollination (Hauggaard – Neilsen & Jensen, 2005).

SOIL CONSERVATION TECHNIQUES (SOILCON) – exp (b) = 1

The probability of significant adaptive capacity is the same whether the farmer is adopting soil conservation or not. This may be the case if the soil quality of the area is good. Notwithstanding that the measurement of soil quality is not within the scope of this study the respondents as well as the extension officers stated that the soil quality of the study area was relatively good. The extension officers and farmers stated that climate conditions and other fringe issues like soil erosion (Kakembo & Rowntree, 2003) had negatively affected the performance of crops (Katase, 2013; Mgijima, 2013; Speelman, 2013).

SOCIAL GRANTS (SOCGRT) – exp (b) = 0.64

The probability of a household achieving adaptive capacity decreases by 36 % with every unit decrease in the number of social grant beneficiaries. From the descriptive statistics it is derived that 36% relied on social grants to build adaptive capacity, while 64% did not rely on social grants for strengthening adaptive capacity. Yet social grants are significant at the 99 percent confidence level ($p \leq 0.01$). Perret et al.'s (2005) study in rural Limpopo finds that "the types (of rural folk) which resort only or mostly to welfare to make a living are amongst the poorest of all" with the implication that the poorest need social grants to enhance their adaptive capacity (Perret et al., 2005, p. 39). Thirty six percent is a rather large figure for reliance on social grants and that implies that this NLM community needs considerable institutional support to lift it out of poverty.

IRRIGATION and RAIN-WATER HARVESTING (IRRG) – exp (b) = 1.24

In the study area the odds of adaptive capacity increases by 24% with every unit increase in irrigation. Irrigation ensures the availability of water for crop sustenance, survival, bountiful harvest and food security and wherever "agriculture still forms the mainstay of the community, development of basic infrastructure like irrigation facilities is a must" (Piya et al., 2012).

EXTENSION (SERVICES EXTSERV) – exp (b) = 0.96

While extension services and access thereto are essential to knowledge and technical support (Bryan et al., 2009; Frank & Buckley, 2012) in this study area the probability of a household adapting decreases by 3% with every unit decrease in extension services. This implies that extension service access in this community is not extensively available. The next section covers the focus group discussions which reveal the perceptions of the respondents about the perceived risks and vulnerabilities over the last 40 years.

Mgababa focus group discussion findings

Perceived rainfall variability and related weather changes

The respondents pointed out that they used to receive rains in July and that the rainy season would end in January the following year. The rain would come back in April, separating summer and winter and would be called "Isahlula Hlobo", which means the rains which 'separate summer from winter. According to their perception, in the year of the discussion, the rain arrived in July and did not continue at all as usual. One of the respondents stated “We hear about it in other parts but it does not come here” (N. Maradebe, 2013, personal communication, 15 September, 2013). In addition, the respondents reported that during the summer season in recent years, there has been too much heat in the morning hours of the day then cold weather during sundown. The year 2011 had had torrential rains/floods which eventually damaged their crops.

“Even though we live relatively near the ocean yet we do not have any rains. People from other villages used to come to ask for our water but now we have to go ask for their water” (N. MaNkala, personal communication, 16 September, 2013). The respondents were concerned that the same fate that used to befall other villages was an experience that they have been forced to experience in recent times. The elusive and intermittent tap water supply was also a menacing challenge for this community of Mgababa.

Perceived Vulnerabilities

General Water Shortages

The taps in this community are few and far in between. This challenge of unreliable tap water supply has continued to force the community to go to the dams/ponds and water streams. The reasons for the intermittent and sparsely reticulated water supply range from the unknown to reports about the Amatola Water Board’s interference. The respondents seemed not to be persuaded that the Amatola Water Board, which is responsible for the water resource management in the Amathole District of which the NLM is part of, is working in their favour and in their best interest. They would rather have the municipality fight for their right to water, because they are vulnerable to climate unreliability and reduced dependability. They would like to have taps within the perimeters of their respective homesteads than at sparsely located positions throughout the village (Figure 5.1). This sentiment is not without its concomitant protest response. Some of the villagers, and those who can afford to buy the necessary pipes, admit that they have reconnected the pipes so that they can direct the water into their yards, gardens and small farms. The respondents also admitted that while they did not have to pay for the water the municipality and the water board should afford them the courtesy of informing them about any water related maintenance procedures, water conservation programmes or imminent shortages in their water supply well ahead of disconnections and discontinuation of supply. The respondents also pointed out that they used to be able to predict future weather conditions, but that they had been battling to do so in recent times.

Figure 5.1: The stand pipe tap at considerable distances from villagers' homesteads

Late Rains

The respondents seemed not to have long-term memory of the years which had had major climate impacts on their livelihoods and food security. However, they did not seem to have a problem with mentioning the years 2009, 2010, and 2011, which were described as "bad years for our crops because of drought". It is also critical to point that much of the field crop cultivation have been abandoned by the villagers (Musemwa et al., 2013) in all the study area with the exception of those in Mgababa due to lack of predictable rainfall and absence thereof. The crop fields are overgrown with umnga (Acacia tree). During the FGDs those respondents who are members of the Siyophumelela Agricultural Project mentioned that they would normally grow crops in the month of August but that recently they had been forced to delay planting due to two reasons; both drought and the unavailability of tractors.

> After we had been waiting for the rains to come, we went ahead and applied in July for a tractor from Tractor World – East London and it arrived late in September and so we had to plant in October but then the drought did not abate. Had we had tractors in time we would have planted crops early as usual. Yet the irony is that the rains did come in July and then by the time we planted the drought overwhelmed us and destroyed our crops. We had planted maize. For three years the tractors were not coming in time. "Uthi usafixa umbona kufike imbalela – uphelela mbona usoma ngoba ungafumani mvula"(P. Makalima, personal communication, 14 September, 2013).

The respondents went on to tell of their history as both household farmer s and small-scale maize commercial farmers. Figure 5.2 shows the tractor parked inside the yard of one of the Siyophumelela Agricultural Project members.

Figure 5.2: Tractor awaiting the granting of the application for the driver and keys

The Massive Food Production Programme

The chair lady of the agricultural project proceeded to explain that

> We were involved in the Massive Food Production Programme. However, a vast majority of the people would not go on because of the 2009 drought and subsequently got discouraged. The Massive FPP had more men than women and we respected them, we were doing whatever they said. Now we are the owners and leaders of this project. It was a maize project. That year the Massive FPP yielded a R100 000 profit. With the same money we had to hire tractors/vehicles to haul the maize from the fields and to deliver it to the market such as pension pay points; buy sacks for the maize; buy the thread for closing up the sacks. We used so much money and had to pay back our creditors as well. Had we had our own tractors/cars we wouldn't have used so much money. The following year we could not make as much money. So people got discouraged and the men decided to disband the project and to divide the money amongst the members. Due to the desperation over the division of revenue, one member even said 'Had I died before the money was allotted I would have died with my head turned backwards, longing for the reward'. Then in 2012 we, as women started the Siyophumelela (meaning - we will ultimately succeed)

> Project. Tractor hire is R300 from our villages and is too expensive for our little pockets. Even now we do not have tractors. There is a tractor here at this venue and the key is here but the driver is in East London. In order for us to operate it we have to apply to get a grant from the Amathole District Municipality. As we speak we have already applied for two tractors as well as for a driver for these tractors. Whenever our request is granted the driver would normally live here in Mgababa until the work is finished. The land that we hold is 100 ha but most of it is fallow because of poor rainfall. Also the heat is extreme for our ailing old bodies" (N.Nkahla, personal communication, 15 October, 2013).

In the quest to find seed varieties which would withstand environmental unpredictability, the respondents told how the government introduced hybrid seeds which were purported to be drought resilient and adaptive to environmental shocks and pests. The respondents pointed out that while the seeds were considerably resistant to droughts and pests, they were also too expensive to purchase for household benefit. The discussants also emphasised that Umtiza Farmers Corp and Kwa Dudumayo (SuperSpar), which sell the drought tolerant hybrid and GMO seeds were too far distant from where they lived and that the costs for travel to and fro were rising quite steeply. The respondents cited the limitation of not being able to use the seed from the harvested crops for future planting dates. The respondents explained that they needed to have lots of money in order to sustain their livelihoods and crop production business which was heavily dependent on rainfall. The discussants also expressed concern over the moribund quality of life in the community which is perceived to be fuelled by rising food and farming input prices.

Yet, they were also quite grateful for the contribution of the Ward extension officer who provided them with the seedlings and seeds where applicable, and subject to availability. They were also concerned about being unable to access outside markets, enough credit as well as the lack of opportunity to negotiate business contracts which affected their livelihoods in a transparent manner. The

Massive Food Production Programme was clearly not sufficiently transparent to optimally serve the farming project members' financial and socio -economic interests. In their opinion the consultative process always needed a middle man who was introduced by what they perceived to have been both the NGOs and government department representatives. Their vulnerability remains threefold: economic, ethical and environmental. Figure 5.3 shows some of the few remaining male members of the MFPP, most of whom are elderly and frail.

Figure 5.3: The remaining male members of the MFPP

Weather forecasting

The respondents would watch the lunar phases. When the waxing crescent moon is facing upwards as depicted in Figure 5:4, that would signify that rain was on its way. There was concerted sentiment that they do not see as much of that sign anymore. The respondents also agreed that in recent times they listen to the radio for forecasting and have grown particularly confident of the Television weather forecasting news.

Figure 5.4: Waxing Crescent Moon Predicting Rain

Imibundane (Pests)

As a challenge to adaptive capacity the discussants also expressly stated that they found it challenging to deal with pests during the dry spells and drought. They also indicated that they use Omo (a laundry cleaning powder) water solution as well as cow dung to ward off and to kill the pests. However, they pointed out they in order to maintain the quality of the soil and to prevent the contamination of their crop nutrients they would apply these pesticides well ahead of planting as a preventative measure against rampant encroachment and proliferation.

The most vulnerable among the community

When asked to explain precisely who in the community were most vulnerable to climate irregularities and changes, the house agreed that the women were most vulnerable and the most burdened. The women have to walk to far distant dams and streams to get the water for both the crops and household use (cooking and bathing). The discussants pointed out that the water cuts are frequent during the dry spells and when approached the Amatola Water Board would explain to them about the importance of water restrictions and water conservation which would eventually necessitate water cuts for some days of the week.

One elderly lady explained the vulnerability of women and emphasised that

> You may travel maybe 3 times a day. The man may help the women with their wheelbarrows. But some women if not most do not have men in their households to help them carry the water (B. MaMiya, personal communication, 14 October, 2013).

"Also", continued MaMiya (personal communication, 14 October, 2012), "the youth do not help. Even in the projects we have young members; but it seems they do not want to be dirty. We eat together through hard toil and labour but the youth do not show the commitment to want to work".

Adaptation as an option

The respondents explained that they use soil conservation techniques, such as mulching. The use of drought resistant hybrid variety seeds was also cited as quite effective. The old strategy of both food and water storage was touted to be most effective. The respondents emphasized that those who had rainwater harvesting tanks in their homes were in a better position to assuage the impact of drought and long dry spells. However, it emerged that there were no easy resilience enhancing solutions to the impact of floods and gale force winds.

Next to rainwater harvesting tanks the respondents strongly suggested that dams needed to built, and closer to the fields. The rainwater harvesting tanks are perceived to be most effective at watering household garden crops. While the tanks were effective at household level, the respondents also agreed that since many had abandoned crop field farming, the erection of tanks closer to the fields would also be a lasting solution to the water shortage challenges.

The most significant natural climate disasters

- The 1970 flood rains which have had the highest intensity in remembrance,
- The 1981/2 drought which brought cholera and shigella,
- The 1993 drought and shigella,

- The 2009 drought and loss of crops and affected the MFPP,
- The 2011 flood Rains after a long dry spell, and
- The long dry spells and low frequency of rains in 2013.

Observed impacts of climate irregularities and variability

The beans are adversely affected when they become and remain amacabhela (empty pods) due to drought. With respect to maize, the maize has been observed by the respondents to have an outward look of being ripe but that when one looks inside after peeling it, it remains umpha (cobs without grains). Izikhwebu (cobs) from the stock also tend to prematurely fall to the ground.

One of the elderly men of the village, and a member of the Siyophumelela Crop Farming Agricultural Project explained what the villagers termed the "iintshaba" (enemies) of sustainable livelihood and food security. He expatiated that

> Wild pigs coming from the forest devour our maize in our gardens and the fields. We cannot grow sorghum anymore because you have to be there to ward off the predators all the time. Now most of us are old and can't spend so many hours there at the fields. These wild pigs do not have a pen and run wild doing as a please. Nevertheless we will not stop eating from the soil because when the rains come we gain a lot for our livelihoods. We will fight on. We will continue to send our dogs to hunt them so that they do not get too familiar with our crop fields (S. Rungqu, personal communication, 13 August, 2013).

When the group was asked to opine on what they thought was the cause for the observed changes and irregularities in climate and weather conditions, the same old man retorted that

"Thina ke asinakuyazi, ino kwaziwa kwanini nina bantu bafundileyo, ngoba le nto yenzeka pha phezulu esi bhakabhakeni, inene thina asinakuyazi njengokuba singamebi balapha e Ngqushwa nje".

The English translation is as follows:

> We as common people may not know, it should be you who knows because you seem to have better education, and also these changes seem to be happening up in the clouds. We live down here in Ngqushwa and we do not know what is happening up there.

The group proceeded to explain how the wild birds were in competition for food and crops with the villagers.

Competition over food with wild bird life

The respondents were also confounded by the queer behaviour of the birds. Some of the birds which they mentioned include:

Unomyayi - Corvus capensis (Cape crow, Black crow) – Unomyayi

Figure 5.5: Image of Unomyayi - Cape crow (by Gerhard Theron)

These birds are such a nuisance such that one of the respondents observed to the amusement of her peers that back in the day

> Unomyayi (Figure 5.5) could be warded off by creating scarecrows and erecting them on the crop field or garden. Nowadays they do not run away and are not scared of people or the scarecrow anymore, they simply sit on top of the scarecrow (N. Mawushe, personal communication, 15 August, 2013).

Idada Dendrocygna bicolor (Fulvous duck)

Figure 5.6: Idada (Photo by Callie De Wet)

The ducks were reported to have a specialty meal, much to the chagrin of the farmers: the peas and beans. The subsistence farmers stated that they had been struggling to reap a good peas/beans harvest for a good while. The respondents presumed that the localized ducks species may be struggling for food in their invariably desiccating pond/small dam habitats. While the vulnerability of these villagers was becoming more palpable, they still maintained a good sense of humour and had their own way of sympathizing with the lower creatures. Given their mature age and social responsibility projects it is not the view of the researcher that the respondents could be found to be flippant when they mirthfully observed that "the ducks were trespassing territory and crossing borders as destitute refugees". The respondents also mentioned that the most vulnerable crops during extreme weather events are maize, sweet potato, beans, butternut, and ertjies. They also mentioned that given high input and food prices, it did appear to them that they may have to consider processing their own staple foods such as 'samp millies' by grinding it on the grinding stone (ukungqusha in IsiXhosa). Figure 5.7 shows the landscape that is devoid of trees and extensive habitats for bird life.

Figure 5.7: Landscape devoid of trees and extensive habitat for bird life

Prudoe focus group discussion

Perceived rainfall variability and related weather changes over time

The villagers of Prudoe re-affirmed that the climate was changing. They confirmed what the people of Mgababa had observed about regular weather events. There used to be rains in summer right through winter.

One of the respondents described the irregularities when he stated that

> In recent years, spanning the past 15 years the weather pattern has changed. It becomes too cold to grow food and there would be no rain even in the summer months. The year 2009 had too much heat and no rain to the extent that the municipal truck would have to bring water for us to use for household use. 2010 was quite dry. Then a torrential rain came in December 2010 and caused irreparable damaged.

The respondents perceived that there used to be little rain in January till March. The first rains would come around April (Autumn). The area used to receive winter rains, which were not coming at all in recent years. For the spring time months the respondents also complained about strong gale force winds which had damaged their homes. During this new advent of spring time the gale force winds would come with the cold. Typically, there would be thunderstorms during August coupled with lots of rain. The same was not perceived in 2013 and in recent years, there is ‘no rain’.

In the year 2011, there were good rains; but “black rain water” came down. One of the respondents recounted that the intensity of the rainfall was so high such that “

> the outside walls of our homes had cracks.The affected people called for inyangas/witchdoctors to come intervene and to ward off the ‘black water spirits’. There was sediment (black) at the base of the water containers. The sediment had a sticky and oily consistency. Yet the taste of the water was not bad and it did not smell. We learned from our children who are in school that the coal mines and the smoke from factories could have been the cause of the black sediment. There was also a thunderstorm during this time.

Predicting weather

Ukuthwasa kwe Nyanga (Full Moon)

The respondents recalled how in yester years their forebears predicted the onset of rain. They pointed out that to them “Ukuthwasa kwe nyanga” was important for predicting the beginning of the rain season. The eldest man in this group discussion explained that “ukuthwasa kenyanga” signified the appearance of a red light orb around the perimeter of the full moon which indicated the change of season and the emergence of good rains.

The old man went on to state that “Nowadays the red-light orb appears but it takes a while for the rain to come. Yet back in the day the rain would fall as immediately as the moon gets full”

After the rain had fallen the people would say the rain is washing the moon (imvula ihlamba inyanga) followed by umgca mabele (the rainbow) and then by the appearance of imbuzane –insects as well as by ants which had wings.

> These phenomena would seal the fate of the villagers' livelihoods. It was nature which told us what she was going to do and we followed her, yet today we can't follow her at all. Judging by her strides, she appears to be highly intoxicated as she straddles her seasonality dividing lines" (Z. Dapho, personal communication, 17 October, 2013).

The next harbinger of weather conditions were the birds. The Prudoe villagers had full confidence in the ability of the Intsikizi (Figure 5.8) to predict rainfall.

Figure 5.8: Intsikizi - Southern Ground-Hornbill (by Duncan Robertson)

In a similar tone as that of Mgababa the villagers once believed in the Hornbill's abilities to accurately prediction the onset of rainfall. "When it chirped and sang; we would know that the rain was coming. Yet these days the intsikizi appears and makes its sounds yet the rain never comes."

Temperature

Winter is perceived to be too cold and overly windy, damaging the crops and causing the soil to be dry and powdery. The discussants agreed that in yester years it was normal to see dew in the mornings but due to the gale force wind the dew is non-existent. They said that the dew was important for crop growth and vital soil moisture. In summer they complained about experience too high temperatures and the strong gale force winds. According to the focus group discussants, normally these winds would come in August, but now the whole summer season is tempestuous. When asked how they were adapting to the gale force winds they said that they have had to harness their roofing through anchors on the ground. In as far as crop production and the strong desiccating gale force winds, they sought to plant right behind their home buildings as a shield against the wind. From their answer of “not much we can do” they appeared to be inadequate equipped to deal with the strong winds and were defeated but had to learn to cope for as long as they can.

Perceived vulnerability to climate parameter changes

The respondents reiterated the challenge of water shortages. They cited that livestock are fatally affected and afflicted by the lack of rainfall consistency and predictability. One of the respondents stressed that

> When our small dams dry the livestock get stuck in the mud. After many attempts the poor animal may be rescued but then after being rescued the animal seldom regains its strength and good health. Some animals only get discovered days later and get cold and fall ill from over – exposure to the cold muddy environment, exhaustion and toil overnight. Another problem that we have is the strong wind which comes and blows the leaves away from the trees causing the livestock, particularly the goats to suffer immensely because they feed on the leaves (T. Thole, personal communication, 14 August, 2013).

In this community matters have gotten rather worse when the communal water generating engine malfunctions. The discussants also expressed their concern over the quality of the water coming out of the water generating engines. They explained that the water from the taps smelt like diesel. The water was also perceived to be characterised by a sharp astringent taste which was making it unpalatable for human consumption. This tap water has also been blamed for damages to the crops with plant leaves taking on a reddish hue. One of the discussants went to explain that “the soil becomes solid dry and the water leaves a salt-like deposit on the soil, but after the rains had come the crops blossom and flourish” (T. Thole, personal communication, 14 August, 2013). With respect to crops the discussants mentioned that there are crops which perform better than others even under dry weather conditions. These include the gourd family, the Cucurbitaceae: intyabontyi (water melon) and ithanga (pumpkin). Yet the most vulnerable is maize.

Adaptation amidst drought

The Prudoe discussants reported that they had last received significant rainfall early in year, in January. (The focus group discussion was held in October 2013). As consequential, the discussants mentioned some inconveniences which include: dams drying up and being forced to double up the purpose of water; for instance having to use water previously used for clothes washing to water plants. The respondents perceived this practice as being unnatural and while they were not certain how, but to a certain extent, harmful to their crops.

The discussants felt that the high temperature were drying up the soil and as a coping strategy for building resilience, they have resorted to watering the plants in the evening. Their scientific understanding was that when you water at night, the water cools down the roots of the crops and that enhances crop growth. However, when the crops are watered during the day the soil dries up and the roots suffer from heat exhaustion.

Wildlife competing over food with villagers

Birds

Maize is damaged by the same unomyayi as experienced by Mgababa villagers except that the unomyayi is perceived to look which ihlungulu (Corvus albicollis - White-necked raven). One of the discussants, a man whom some of the respondents appeared to hold with high regard but also with some contempt asseverated that

> Aba nomyayi batya amantshonstsho eenkukhu zethu. Ezi ntaka ziza ne mbalela. Yayi ngekho kudala le ngxaki. Wayesitya apho kude woneliseke, ngoku ngenxa ye ndlala utya apha kuthi. Unomyayi naye ngoku ufana ne hlungulu. Le nto ke iyafana na ba bantu bangamasomali. Intombi zethu zina bantwana bala ma Somali. Kodwa ke kuyacaca ukuba yindlala yonke le izise ono myayi apha bade bafana nama hlungulu nabo ke ngoku (M. Spondo, personal communication, 17 October, 2013).

EnglishTranslation:

> The crows are eating the chicks. These birds come to feed at our homesteads due to the effects of droughts. They used to feed far away from here and they would have enough food to survive in their own habitat. The crow is looking like and behaving like a white-necked raven. This phenomenon is the same as that of Somalis breeding with our daughters to bring forth a different race. These are the results of drought and poverty

Moles and Bugs/Pests

The respondents explained that Imibundane (pests) and intuku (moles) are everywhere.

"You would be walking and suddenly stumble over a number of mole holes on your garden. Yet the mole used to like to eat sweet potato, carrot and potato but now it eats the leafy plants such as spinach, lettuce and green onion" (N. Goniwe, personal communication, 17 October, 2013).

Seeds and perceptions of vulnerability

The respondents expressed concern over the seeds in a different way than about their prices but about their presence in society which seemed to portend ominous climate events and both unsustainable agriculture and livelihoods. In this respect, the discussants agreed with the following statement uttered by one of their elders when he stated that

> Enye into eyingxaki zezi mbewu zithengwayo. Kusuke kube ngathi zizo ezi zina le tyefu iza nezi nkathazo zininzi kangaka ze simo sezulu esingagqibekiyo. Kuthiwa le mbewu emva kokuba uyi thengile wayiplanta yantshula kufuneka uye kuthenga enye entsha ubuye uplante yona. Ndiyakrokra ukuba nook zi nyamezela, sithengiselwa ityefu . Zizo ezi zize nale ntlalo siyangayiqhelanga apha kwilizwe loo bawomkhulu.

English translation:

> One of our most recent challenges is these seeds which are sold at the stores. It seemed like since we used them our environment has been poisoned to die and caused our climate to be awfully unpredictable. It is said that after you buy these seeds and have planted them, you must come back to buy some more after the harvest. I suspect that we are buying poison. These seeds have brought great calamity and harm to the land of our forefathers (P. Mthimkhulu, personal communication, 17 October 2013).

Those perceived to be most vulnerable

The discussants listed the following issues:

- The crop growers who laboriously toil for a harvest but have many times met failure.
- Students and children who depend on cash crop money for support
- The unemployed.

The respondents further explained that many of the farming folks are unemployed and have no money to buy food and seedlings. Even when one has finally found some money to buy the seedlings at the local seedling vendor one has often not found the crop seedling available, due to shortage of stock because of climate challenges. The person will consequently have to commute to town (Peddie or Port Alfred); and this has added unforeseen extra costs. In addition, during times of little crop productivity the crops are expensive.

What can be done to build resilience and adaptive capacity?

The respondents suggested that:

- Water pumps be built for irrigation for our gardens;
- To dig up the existing (ponds) dams and to fence them so that some will be for human consumption and not for animals. Also, 5 children have drowned at the ponds over the years;
- To reticulate water from the quarry. The quarry area has a fountain which does not run dry.

Mgwalana focus group discussion

Changes in climate parameters and major climate related events

At the end of 1970 there were floods. Yet there had been little rain during the rest of the year. The 1980's droughts were also mentioned as having threatened livelihoods. In 2003 the respondents recounted that there were extreme rainfall events - floods. The following statement uttered by one of the Mgwalana focus group discussants is a summative representation of the long-time perceived changes in climate.

> Nowadays the rainy months during which we would grow our crops are characterised by high temperature and strong winds. Back in the day we used to know when to plant, but nowadays the weather is unpredictable. What we are experiencing now is more temperature rises and wind than rain during the planting season. During this month of October we would be planting and harvesting and eating our maize in December. This is no longer happening now. We have not planted at all this year. Back in the day we would be harvesting ripe pumpkins and maize by the month of December, that is not happening that way anymore because of the high

temperatures and strong winds which have replaced good rains (B. Noncedile, personal communication, 17 October, 2013).

The respondents all agreed that they had not planted at full thrust all during 2013. They cited the October rains of 2013 as the best they have had had throughout the year. The first rains would be take place during July. They claimed that such a climate/weather pattern is not consistent anymore. These representatives of the village considered 2009, 2010, 2011 as bad years for both their livelihoods and agricultural lifestyle.

Weather forecasting

The respondents confirmed what the discussants in both Prudoe and Mgababa said about the emergence of Intsikizi and small earth worms ahead of rainfall. They claimed that in their locality the Intsikizis do not show up at all. They also mentioned another bird – uthekwane (Figure 5.9), the scopus umbretta (Hamerkop) which also signified the imminent onset of rainfall.

Figure 5.9: The scopus umbretta - uthekwane (Hamerkop). Photo by Duncan Robertson

Perceived vulnerabilities over the years

The range of perceived vulnerabilities included:

- Usikholimanzi in Figure 5.10 – the blue cranes are eating the chicks;
- Ingqawa (Caracal) (Figure 5.11) sucks the blood of, and kills the livestock in our homestead;
- Rats are eating spinach, carrot and cabbage;

To this effect, one respondent called out "I have seen them running way with the crop leaves toward their holes" (P. Nomisile, personal communication, 17 October, 2013).

- Livestock is struggling and a bale of good green feed (hay/lucerne) for cattle is hard to come by at R100 excluding transport costs, from Umtiza farmers corp (Peddie Town), which is the closest outlet.

With respect to the last mentioned area of vulnerability, one of the discussants explained that

> The kind of feed sold at Dudumayo (referring to Superspar which bought the premises from a dealer called Dudumayo) is R65 but is not as good and green as the kind from Umtiza Farmers' Co –operative Ltd. That is too expensive for our meagre earnings. We are desperate for help. The government is also not helping us at all.

During the droughts the respondents perceived that the young livestock do not get fed by the cows. N. Nosimilo (personal communication, 17 October, 2013) argued that

> This affects us negatively because livestock is a livelihood diversification strategy and it constitutes a long term investment portfolio for us. It is also a health insurance measure because in our old age we do not have money, so when we get sick and we need money for food and health we sell our livestock and get the money in order to sustain good health.

Figure 5.10: Usikholimanzi - the blue crane

Figure 5.11: Ingqawa, the caracal. Photo by Duncan Robertson

A common thread among the sample is that the discussants voiced concern over the quality of tap water which they find themselves forced to use for watering their plants. They unequivocally stated that they preferred rainwater to tap water.

In Mgwalana, water from the taps is perceived too salty for the crops. “We are forced to use the tap water which we collect from the stand pipes because the rains do not come as often as they used to before” (N. Mankala, personal communication, 17 October, 2013).

Another common thread is the concerned over the pests and the green locusts which destroy their crops. While different to the other village’s scientific pesticide innovation of using clothes washing powder solution, the Mgwalana discussants mix warm water with dishwashing liquid as pesticide to kill the pests. The following statement galvanizes the sentiments of the respondents about the impacts of dry spells in their small scale and subsistence farming landscape. “These locusts come when there is a dry spell or a major droughts and as you might imagine we have many of these insurgencies given that we have had many droughts in recent times” (N. Mankala, personal communication, 17 October, 2013).

Similar to the testimony of the Mgababa and Prudoe participants, in the Mgwalana discussants’’ eyes the birds were the precipitated culprits of climate irregularities and variability. One of the female respondents quipped that “birds never used to come to our homes to feed. Nowadays they come to eat our baked breads which we had put outside to cool off (V. Nothile, personal communication, 17 October, 2013). Given that wild (bird) life feeds on fruit trees, the respondents connected and ascribed the proliferation of both bird and other animal life in their homesteads as a consequence of the receding wild fruit tree ecosystem. Table 5.6 and 5.7 list the relevant trees and animals respectively.

Table 5.6: Wild fruit and medicinal trees which are perceived to be near extinct or extinct

IsiXhosa Tree Name	English Name	Scientific Name
Intlolokotshane	April Fool	*Haemanthus coccineus*
Ingwenye	Wild Plum	*Harpephyllum caffrum Bernh*
Umgxube	Small-Bone Apple	*Coddia rudis*
Intsenge	Mountain cabbage tree	*Cussonia paniculata Eckl*
Umnqabaza	Karoo Crossberry Raisin	*Grewia robusta*

The respondents also made mention of other unwelcome visiting wild life in their homestead which include the following bird life (Table 5.7):

Table 5.7: Wild birds which are perceived to be climate variability refugees at homesteads

IsiXhosa Bird Name	Common English Name	Scientific Name
Ubhobhoyi	African hoopoe	*Upupa africana*
Unomyayi	Cape crow or Black crow)	*Corvus capensis*
Isinqolamthi	Cardinal woodpecker	*Dendropicos fuscescens*
Ihlungulu	White-necked raven	*Corvus albicollis*
Ihobohobo	Cape weaver	*Ploceus capensis*

The following are some of the comments made about the wild birds:

- "Unomyayi utya amantshontsho nama qanda, kodwa ke waye fudula esitya umbona"

English Translation:

"The Cape Crow is feeding on the chicks yet it used to feed on maize"

- "Amahobohobo ahlala emlanjeni kodwa ngenxa yemeko alapha emakhayeni ngoku, siphangelwa yi ndlala asityi"

English Translation:

The Cape Weaver used to live and feed by the river but now it is frequenting our homesteads. We are not eating as much; the creatures are competing for food resources with us”

The Most Vulnerable people in Mgwalana

There was a tacit general consensus among both women and men that women were the most vulnerable

In respect to women vulnerability, one of leading women in agriculture in the village had this much to say:

> Women are the most involved in agriculture and crop production. The husband wants food from the woman. The women have the responsibility to feed the whole family, including the grandchildren. Also, whenever there is a problem with water access in our village, the women have to go to the river or to another village to fetch and beg for water so that we will cook, water the crops, wash clothes and the children, and clean our homes with it (X. Mdwabi, personal communication, 17 October, 2013).

The respondents mentioned that the list of things that they have to go at the store is getting longer due to climate variability. They stated that not so long ago they never had to go buy mngqusho (samp millies), ubisi (cow milk), isinkwa (bread) and amasi (sour milk) from the supermarket. They could make it themselves. In the case of milk, they used to trade the cream for the local businesses in Peddie Town which used to process cheese and yoghurt. Where the majority of the respondents are pension social grant beneficiaries, the cost of living is getting rather too high. “We buy groceries for a month. From our meagre R1290, we buy from Superspar. R34 is the transport fee to go to Superspar (Dudumayo). Plus a transportation fee for the food you bought. And then you have to give to church as well”.

Right at the end of the discussion, an incisive question from one of the devote participants rang out:

> Can we really change the climate to work in our favour, without God's hand in it? Could this climate and rainfall scarcity be a plague from Jehovah? These climate pattern changes may be indications of the signs of the times. We are witnessing the end times. Olu tshintsho lubonakalalisa ukufika kwe xesha. Kuzaliseka isibhalo (C. Nozibhalo, 2013, 17 October, 2013).

While the participants agreed that such adaptation strategies as rainwater harvesting, soil conservation techniques, mulching, and others are effective. They pointed out that they were not gaining ground against the fight for a conducive environment for sustainable agriculture and livelihoods. Their vulnerability and risk exposure was largely perceived to be closely tied to food insecurity.

The other respondents also made the following closing arguments:

- To better adapt we need to pray more. God will hear us.
- Everyone needs to go to the mountain and pray to God and the rain would come. God needs unity from us. We are not doing what our ancestors used to do. They were united in prayer. God is not pleased with us, because we are not united in prayer.
- We need more clean dams. We allowed only one project to use the pond/dam for irrigation. If we had more dams we would use them to water our gardens as well.

Benton focus group discussion

Changes and Vulnerability as perceived by Benton discussants

The discussants stressed that they used to get good maize harvest from their gardens in March. In recent times, the discussants explained, that the climate has shifted and that they have been compelled to start planting in March and to harvest in June. There seems to be a general consensus between the four villages that the first rains used to come between July and August but that seasonality is highly variable.

The respondents pointed out that they used to plant different crops at different times of the year. Table 5.8 shows the breakdown of some of those crops that the village farming households were accustomed to planting during the planting season:

Table 5.8: Erstwhile and current planting seasons of major crops

Erstwhile Planting Month	Current Planting Month	Type of Crop
August	March	Pumpkins and water melons
September	To much variability and have ceased to plant sorghum	Sorghum
October to December	To cold and to much variability after April/not much planting	Maize

One of the elders, a man of 45 years farming experience explained that

> Nowadays the rains do not come when we expect them. It is October now; we have not planted this year. We planted maize earlier this year in March, but we did not derive much harvest. The rains do come but they are too little and they come during winter, which is a strange phenomenon to us. The first rains used to come during August. Besisithi ke ezi mvula xa sizibiza sisa hlula hlobo nobusika (We used to call these rains the summer and winter separating rains). (T. Sobukhwe, personal communication, 17 October 2013).

Another discussant noted that there was another peculiarity. He stated that

> After these dry spells we have experienced floods. The rainfall intensity would be too much for our crops. Thereafter we would experience strong winds. The wind would desiccate our soil. Also, when the rains come as they have come during the nights,

> we would notice that on the following morning after the rains, the soil would remain dry and the crop leaves would have a characteristic red tinge on them (N. Sojola, personal communication, 17 October, 2013).

The incident of physical changes in rainwater is also a big challenge for the common folk of Benton. “The rainwater is black in colour. Those of us who collect the rainwater find that the colour of the water is dark, so we call it black water”. Another discussant pointed out the lack of clear seasonal weather features. She pointed out that “there are no distinct seasons anymore, it may be too hot in winter and very cold in summer” (F. Nozibele, personal communication, 17 October, 2013).

One of the questions that was prompted during the discussion was “Is weather predictable enough for farming purposes’? The response to that question was summed with the following statement

> We used to wait on the intsikizi (Southern Ground-Hornbill) to show up as sign that the rains were coming. The cows would also gather together and become energetically excited and supercharged. Uthekwane (Hamerkop) would also show up and the rains would come. We do not see that happening anymore. Also, the men would go to the dams to clean up the mud at the bottom of the dam and the rains would come. Nowadays even when the men have cleaned up the dams the rains do not come as expected (F. Nobuzwe, personal communication, 17 October, 2013).

Another respondent agreed that the climate has had too many changes to fully predict its course. She seemed to suggest that the climate defies even the spiritual world when she continued and retorted that “we used to resort to prayer and the rains would come. But in recent times even prayer seems not to work. The rains do not come (D. Nozizwe, personal communication, 17 October, 2013).

The perceived risks and vulnerabilities brought by changes in climate conditions

- The crop leaves become yellowish. This has been consistent with cabbage, spinach and beans.
- We get sick from bad tap water. We had shigella – a disease/medical condition whose symptoms include stomach aches, loose stools/diarrhea and fatalities.

These leaders of the Benton village community linked the incidence of shigella to bad tap water which is also linked to the drought period. The respondents lamented that the tap water has on numerous occasions run dry because of some leak elsewhere or for some undetermined reason. The water is managed and administered by the Amathole Distrcit Municipality. The discussants proceeded to mention that after the Shigella aftermath the water became black. This was noticed when they collected the rainwater from the rainwater harvesting tanks. This phenomenon also corroborates the account of the Prudoe discussants who live approximately 15 kilometres away. The respondents all agreed that there was black sediment at the bottom of the container. In addition, the pond/dam water had a terrible stench coming from it and the water turned greenish in colour. The incident was reported to the extension officers in 2012.

The researcher wanted to make sure that what they had observed was not algae – ubulewu. The respondents rebutted that it was not, and that it was the colour of the water itself that had turned greenish. Of concern to the respondents was that while the pond/dam water is used by livestock the same water is used for human consumption whenever the taps run dry. Some of the vulnerabilities in this community are attributed to the incidence of strong winds which desiccate the soil and destroy buildings and homes. The mud brick homes are most vulnerable during the strong winds and floods. One of the more educated respondents qualified the testimony of strong winds by asseverating that

> after the storm, the affected people always need additional building supplies. Invariably most of the people who live in these mud brick homes are the most poor among us. They have always struggled to get the necessary supplies needed, not only to rebuild their homes but also to reclaim their lost dignity and heritage (W. Dingiswayo, personal communication, 17 October, 2013).

Increased incidences of droughts

In respect of drought, the respondents agreed with one of their peers when she said that

> We have had drought this year. The livestock is also dying. We do not have money to buy feed for them. They are emaciated as we speak. Invariably they die. Then the hospital also tells us that should anyone get sick form eating dead livestock they will not be able to treat us because they do not have a remedy for such illnesses. During the droughts we find the birds being our main enemies. These include unomyayi (Black crow), inxanxadi (Fiscal shrike), amahobe (Pigeons), dig up the potatoes and then one sees amasongololo (Millipedes). These eccentricities happen during the drought season and the long dry spells (K.Nosango, personal communication, 17 October, 2013).

The respondents told how during drought, both tap and dam water are causing their crops to take on a yellow to pinkish colour and then eventually die. Again, the challenge locust infestation was brought up. Yet the respondent voiced their own superstitions about their own reluctance to killing the locusts when they cautioned that they “want to kill them, but we are also afraid of killing them because it is said that “if you kill one many more will come” (N.Nikiwe, personal communication, 17 October, 2013).

Yet another male participant expressed concern over the recurrent dry spells affecting his food security status “because my crops are withering such that they look like the indigenous AmaXhosa (tribe) tobacco” (P. Mdingi, personal communication, 17 October, 2013). It was at this point that another participant interjected citing that “It is undeniable that our soils are very fertile. We do not blame the soil. It is the drought" (B. Mlungiseleli, personal communication, 17 October 2013).

Extreme temperature levels as cause for concern

In respect of temperature, the respondents mentioned that it is both extremes which have negatively affected them. They told of how unaccustomed to temperatures which on occasion had risen up to 35 degrees Celsius and fallen as low as 10 Celsius degrees. They also claimed that the winter days had become rather much warmer than usual.

What the community does to adapt in times of adverse climatic changes

The respondents stated that back in the day they would build underground (isisele) food storage (idladla) facilities in the middle of the kraal/pen. However they also pointed out that they were not using these food storage technologies anymore because there is no food anymore. The droughts are making it difficult for us to produce enough food to store in the food storage tanks. They also mentioned that beside the newly introduced utilization of some of the drought tolerant seeds adaptation to climate irregularities was not so expensive because they could store their food and process their own food like mngqusho, bread, amasi (sour milk), and using imithombo (fermented sorghum or maize) for processing their own alcohol. They also said that people shared and battered more of their resources among each other, but that in these modern times of unprecedented scarcity of food resources it not as easy to share. The respondents were asked the following question:

Where did the respondents hear about climate variability and change as a challenge facing humanity?

The answers ranged from students to meetings at the head man's council meetings to the radio. The level of knowledge about modern environmental issues was not advanced as might be expected from people of lower levels of education. However the keenness to know and follow global change issues cannot be denied. One of the answers bears testimony to the level of environmental awareness about climate variability and its attendant changes. The answer was as follows:

> I once heard on the radio that climate variability and change was taking place in South Africa. What I heard was that all the countries which had been affected by the climatic changes, including South Africa, were advised to send money to some far away country so that they could receive the oxygen which is needed to regulate the climate.

Objective 3: To determine the impact of rainfall variability on crop cultivation in the study area; on maize crop farming, rural household gardening, small-scale and subsistence farming as well as to quantify rainfall variability.

Type of farming in the NLM

Household farming is done on relatively small plots whose average size per farm household ranges from 0.01 ha to about 0.06 ha. The crops which are grown the most in these four villages include; beans, peas, cabbage, spinach, green pepper, potato, butternut, pumpkin, sweet potatoes, and maize as the main cereal crop. The other main cereal crop that was historically grown is sorghum, but in recent times sorghum farming has been abandoned due to “droughts, high input costs and the invading animals”, particularly the birds which favored the sorghum field as their food reserve/granary over other crops like legumes and groundnuts.

The nature of farming in the study area is labour intensive and capital-extensive farm inputs are non-existent. The type of farming is characteristically rain-fed with evidence of only one irrigation scheme enjoyed by a small woman led agricultural project - Siyakhula in the Mgwalana village. This project owns about 5 ha of land. Also, in Mgababa, there is the Siyophumelela project which is the continuation of the ailing Massive Food Production Progamme. The project has rights to farm 100 ha but have no productivity access to the entire site due to lack of capital resources, technical assistance, and irrigation infrastructure. Hence the maize yields in these villages have been perceived to have been reduced over time.

While it used to be traditional practice to store seeds for future planting the proliferation of hybrid and genetically modified seeds has made it difficult for the farming villagers to save the seeds. Therefore, they have been compelled to wait on the extension officer to provide the seed or to go buy the seeds from the store before the beginning of each planting season. However, for leafy vegetables, the farmers claim that it is easier to buy seedlings and to harvest only what is essential for the moment in order to save the stock while nourishing the soil by using animal manure and regular watering whenever it is possible to do so; given the water restrictions.

Abandonment of maize crop field farming

In the study area there is extensive abandonment of crop field farming, which, in the not-so-distant past used to be the main source of food security for the patrons. While households still owned homestead gardens, historically, maize field farming was the main origin of the stable availability of the staple food. Consistent with the findings of (Fay, 2010; Hebnick et al., 2011) it emerged that there is robust and intensive cultivation of homestead gardens. The shift from pure production for sale to consumption for food security is evident in the study area and is widely perceived to be a consequence of the impact of rainfall variability. Rainfall variability from season to season adversely affects soil water access to crops, and hence poses crop production risks and vulnerability to crop stunting (HarvestChoice, 2010). Therefore, field cultivation has been rather risky for the resource poor community where both the economies of scale and the spread of risks and costs over large tracts of land are not financially insured (Gautam, 2006).

These small scale and subsistence farmers have no safety nets to fall back onto should financial capital vulnerability exist as it did during the downturn of the MFPP (MEDPT, 2010; Mtero, 2012). With regard to the entire Eastern Cape

Province and owing to the high input costs, most farmers harvested crops for homestead food security because most MFPP projects did not achieve big enough yields to sell maize to enable them to raise a cash deposit for the conditional grant contract requirements (Mtero, 2012). While farmers have conspicuously abandoned the cultivation of the distant maize crop fields there is undeniable evidence of robust intensive inter-cropping of maize and other food crops in the homestead gardens of the NLM. Such a movement to proximate agricultural land is also an indication of the constraints presented by rainfall variability on the long-term sustainability, expansion and intensification of maize-crop field cultivation towards the ends of sustainable livelihoods. Due to the high input costs most farmers harvested crops for homestead food security and most projects did not realise a big enough yield to even consider selling maize to be able to place a cash deposit as required by the conditional grant contract (Mtero, 2012).

Extension services, maize cropping and climate resilience

Extension services for sustainable climate resilience and drought management did not appear to be the priority nor the current practice of both the agricultural department and the municipality at large. This dearth of these services renders the NLM households unable to access effective climate information or key agricultural inputs that diminish exposure to drought risk and its effect on maize production. The greatest challenges for rural farmers arise from extreme events and the difficulty with predicting weather changes beyond a week and more (FAO, 2001). The municipality is perceived by the respondents, and has been earmarked by the state as a drought-prone and vulnerable area which needs to be integrated into municipal and provincial agricultural extension systems and disaster risk management systems.

Yet the level of state intervention is not manifested in recognisable coordinated efforts of key institutions such as meteorological services, agricultural extension services, water affairs services and environmental agencies. With respect to increasing rainfall variability (drought and dry spell) resilience of maize cropping systems the extension officers were not readily able to state what interventions they were implementing either under Asgisa or the NDP. The ward extension officers cited their need for more disaster risk management support systems which will enhance their ability and capacity to strengthen coping strategies and build climate variability resilience within their serviced farming communities. While the adverse impact of rainfall variability is inimical to the realization of sustainable livelihoods the community is, as stated in the chapter on perceptions of vulnerability and adaptation strategies, the communities are forging ahead with resilience building practices.

Sustainable livelihoods and Maize resilience

To reduce their vulnerability to rainfall variability the subsistence household farmers estimate the timing of the cropping season of maize by observing the weather changes as well as by employing intercropping of different crops species such as combining less productive drought-resistant cultivars with high-yielding but water-sensitive crops for instance, maize with beans (Kariaga, 2004) or with sweet potato. On smaller plots such as those the household farmers own in their backyard gardens the efficacy of intercropping is noticeable, yet on the much larger swathes of agricultural crop fields the adverse effect of water scarcity is felt on both their stomachs and pockets. To achieve sustainable livelihoods, and notwithstanding rainfall variability and its influence on locally grown staple maize yield dependency, some of the members of the community adopt livelihood diversification strategies such as off-farm income generating or industrial employment opportunities.

CHAPTER V

PART II: RAINFALL RESULTS & POLICY FINDINGS

The Quantification of Rainfall Variability from 1900 – 2011

Given the rural nature of the study area, very few long-term, reliable weather stations have been operating in this area. The study area falls within a homogeneous rainfall and vegetation zone (Van Rooy, 1972; Acocks, 1975; 1976) and the study focuses on the records available from 3 South African Weather Services (SAWS) stations in the region. The stations are situated in Grahamstown, Peddie and King William's Town (KWT). The stations are well established, with long-term rainfall data covering most of the last century and provide a good geographical coverage of the region. The monthly rainfall data that were available for analyses from Grahamstown spans 112 years (1900-2011) while at Peddie the data are from 1900-1987 (88 years) and from King William's Town the data range from 1970-2011 (42 years) (Table 5.9)

It must be noted that rainfall data from some months of certain years were missing from the records. Those affected years were deleted from the record used for analysis (Table 5.9. From the Pearson Product Moment Correlation the rainfall of Grahamstown and Peddie are strongly correlated at the 99% confidence level (r=0.63; P<0.01).

Table 5.9: Rainfall characteristics measured at the recording stations

Rainfall Station	Date	Mean (mm)	CV (%)	Abs Dev (%)	PCI	Missing Data (years)
Grahamstown	1900-2011	686.4	23	18	13	7
Peddie	1900-1987	499.2	29	24	15	10
KWT	1970-2011	610.0	26	25	15	0

Trends in inter-annual rainfall variability

Analysis of annual rainfall as measured at the longest running stations (Grahamstown and Peddie) indicates no significant change in annual rainfall over time (Figure 5.12). The 5-year moving average of annual rainfall (Figure 5.12) shows cyclic oscillations between approximately 2 to 5 years as well as oscillations between 10 and 20 years. Much of the summer rainfall area of South Africa does experience a quasi 20-year rainfall oscillation (Mason & Jury, 1997).

Inter-annual rainfall variability in the region is high with the coefficient of variation (CV) measured at the stations ranging between 23 and 29% and the mean absolute deviation of annual rainfall as a percentage, range from 18 to 25% (Table 5.9). To analyse the long-term trend in inter-annual rainfall variability at the station for the individual recording period the annual absolute deviation from mean annual rainfall (absolute deviation) were analysed. The Pearson Product Moment Correlation parametric test as well as linear regression was applied to all data to discern any temporal trends with the related degree of significance. Both Grahamstown and Peddie show an increase in inter-annual rainfall variability with the variability measured in Grahamstown significant at the 99% confidence level ($r=0.26$; $P=0.01$). From linear regression the absolute deviation around the mean has increased from 85mm to 170mm over the 112 years. To analyse rainfall variability, Kakembo (2001) and Kakembo and Rowntree (2003) use the z-score which is computed as follows:

$$\text{Z-score} = \frac{\text{raw value} - \text{mean annual rainfall for station (for the recording period)}}{\text{standard deviation of rainfall (for the recording period)}}$$

The data is filtered with a five year running mean. The computed z score for Grahamstown is given in Table 5.10. A z-score below 0 indicate a dry phase while a z score above zero a wet phase. From the filtered data very dry and wet phases (max z-score above 0.5 and below -0.5) occurring at Grahamstown were identified (Table 5.10).

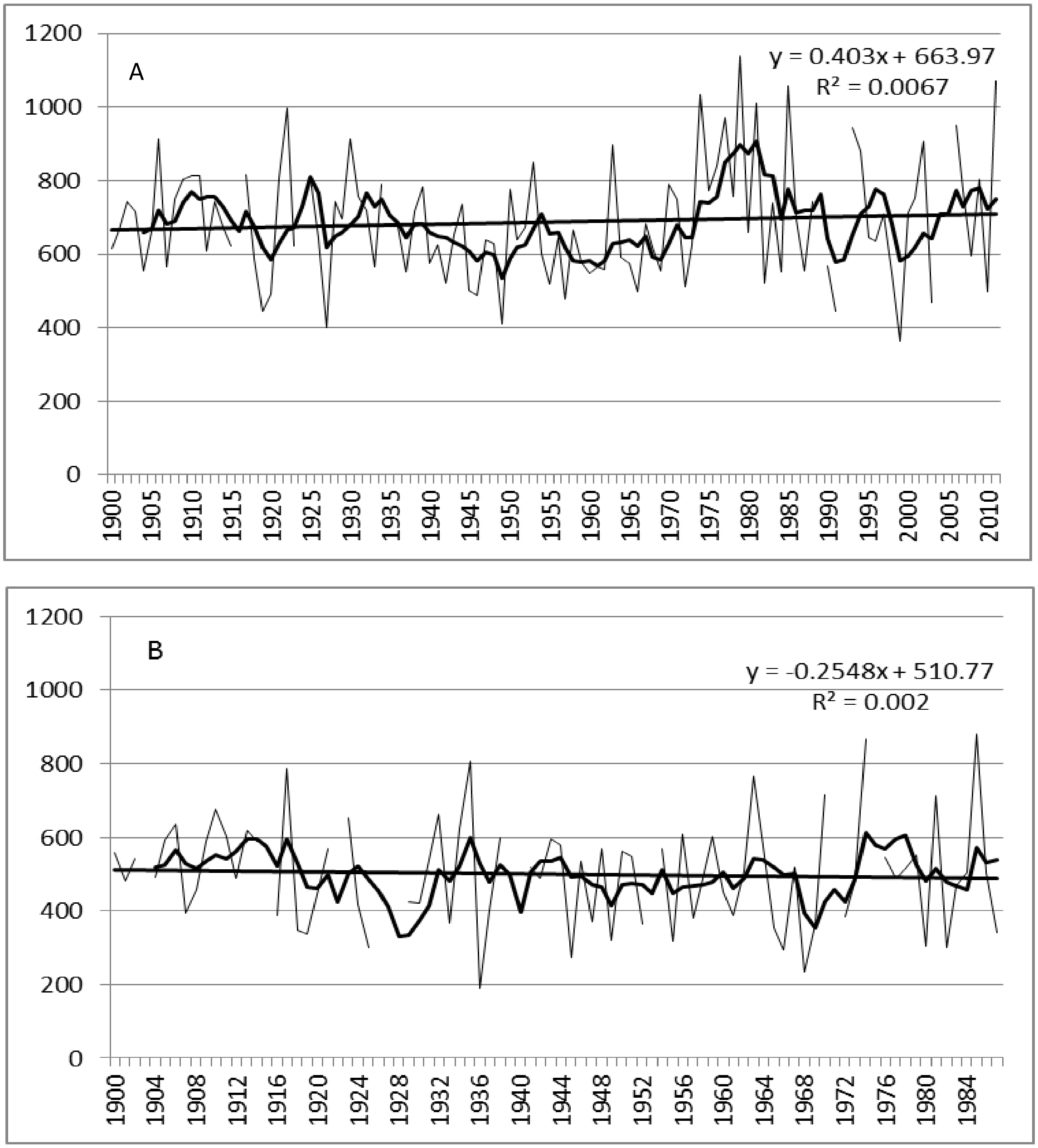

Figure 5.12: Annual rainfall trends with linear regression and 5 year moving average for A) Grahamstown and B) Peddie {Y-Axis: Annual Rainfall (mm) and X-axis: the study period (years)}.

Table 5.10: Wet and Dry Phases 1906 - 2009

Period	z-score	Rainfall status
1906-1910	0.52	Wet phase
1916-1920	-0.64	Dry phase
1921-1925	0.78	Wet phase
1942-1950	-0.96	Dry phase
1954-1962	-0.75	Dry phase
1964-1969	-0.64	Dry phase
1973-1983	1.39	Wet phase
1987-1992	-0.68	Dry phase
1993-1996	0.57	Wet phase
1995-2000	-0.67	Dry phase
2002-2006	-0.56	Dry phase
2005-2009	-0.59	Dry phase

Most significant is the prolonged dry phase during the 1940's. This dry phase persisted intermittently until the end of the 1960's. This latter-mentioned dry phase was also observed by Jury & Levey (1993). A very wet phase (maximum z-score for the period was 1.39) followed from 1973 to 1983. The last 30 years have been dominated by dry phases.

Trends in intra- annual rainfall and seasonal variability

To analyse the long- term trend in intra- annual rainfall variability the PCI was calculated for the two long-term stations. Pearson correlation coefficient was applied to the station data to quantify any trends with the related degree of significance. Even though both stations show an increase in PCI values from 1900 the increase is not statistically significant. To further test the changes in intra-annual rainfall the monthly rainfall linear trend for Grahamstown for the recording period were analysed (Table 5.11 and Table 5.12).

Table 5.11: Intra-Annual Rainfall and Monthly Linear Trends

Month	Linear correlation (r)	Significance (P)
January	0.02	0.87
February	0.01	0.96
March	0.14	0.16
April	0.03	0.76
May	0.06	0.52
June	0.04	0.67
July	0.12	0.20
August	0.20	0.04
September	0.06	0.52
October	0.04	0.67
November	0.05	0.59
December	0.01	0.93

From linear regression only rainfall in August shows a statistically significant trend (1900-2011) with the rainfall in August doubling from 26.8mm to 52.8mm over the 112 years. According to the extension officers (Katana, Mgijimi, Ngcaba, personal communication, 14 September, 2013) the implication for crop farmers was that during the beginning of the traditional planting season (August) the crops have been flooded by heavy rainfall and in recent years there has been loss of produce. At the focus group discussions several household and agricultural project respondents also complained and affirmed the meteorological findings which stress the variability of rainfall of ‘either too much or too little rain and rather late than early or none at all’. The annual rainfall trends with linear regression and 5 year moving average for Grahamstown and Peddie (Figure 5.12) indicate that there is a slight/insignificant upward trend in annual rainfall at the Grahamstown weather station while the Peddie weather station indicates a downward rainfall trend. The latter-mentioned trend (Peddie) is consistent with the perceptions of the Peddie/Ngqushwa respondents.

While Pearson's correlation coefficient for the two weather stations stood at 0.63 the discrepancy in the rainfall trends may be attributable to the remaining 0.37 (37%) which imply an indication of the unaccounted or missing (recorded) years(1985 -2011) from the Peddie weather station. Therefore, these missing years pose a limitation which can be best compensated by the restoration of the weather station at the Ngqushwa Local Municipality. Such a restoration would also aid the farmers to better prepare for any eventualities consistent with the effects of a highly variable climate system (Gleason et al., 2008; Bhaduri, 2014). Early warning systems/decision support systems help with strengthening adaptive capacity as well as in combating pest and crop diseases (Gleason et al., 2008). For now and through trial and error, the respondents' adaptive capacity heavily relies on changing the cropping dates as the safeguard against the elusive rainfall variability. Given that most rainfall occurs during the summer season the next section defines rainfall variability in terms of the southern oscillation.

The southern oscillation and summer rainfall

The Southern Oscillation influences the rainfall variability of the southern hemisphere and research has shown that the Southern Oscillation in turn is connected to the El Niño/La Niña phenomenon (Hydén & Sekoli, 2000). The effect the El Niño/Southern Oscillation (ENSO) has on the Southern African rainfall is well known (eg. Lindesay et al., 1986; Lindesay, 1988; Van Heerden et al., 1988; Jury et al., 1994; Mason, 2001) and that ENSO warm events (negative values of the Southern Oscillation Index) are frequently associated with less than average rainfall and drought over much of southern Africa (Tyson, 1986; Ropelewski & Halpert, 1987; Janowiak, 1988; Van Heerden et al., 1988; Mason & Jury, 1997). During an El Niño phase (warm event) the cloud- band convergence zone moves offshore and with it the highest rainfall. Cold events (La Niña) as expressed by positive values of the Southern Oscillation Index (SOI) bring increased rainfall because of the location of the cloud band over southern Africa (Tyson & Preston- Whyte, 2000).

The influence of ENSO events is strongest during the summer rainfall months of December to March when the El Niño/La Niña events have reached maturity (Mason & Jury, 1997). Van Heerden et al. (1988) found a strong relationship between summer monthly SOI values and corresponding summer monthly rainfall in South Africa. It is likely that there exists a simultaneous, non-lagged relationship between the ENSO and rainfall in Southern Africa (Hydén & Sekoli, 2000). However, due to this persistence of the ENSO equally significant correlations were found between winter three-month mean SOI values and individual summer month district rainfall (Van Heerden et al., 1988). This indicated that lagged correlation between the SOI and summer rainfall existed. Hydén & Sekoli, (2000) successfully used this lagged correlation to forecast early summer rainfall from preceding months SOI values in the Lesotho lowlands.

A statistically significant correlation exists between summer rainfall in the region and the contemporaneous SOI (Grahamstown: r= 0.60, P<0.01; Peddie: r= 0.41, P<0.01) (Table 5.9D(12). Also, summer rainfall correlates well with spring and early summer SOI (September to January). The SOI was also computed for preceding periods lagged at least one month to test if there is a lagged relationship between the SOI and the summer rainfall in the region and if this correlation is strong enough to be used as an indicator for seasonal rainfall (Table 5.12). All lagged correlations that were tested for the two stations are significant for P=0.05. The correlation coefficients between summer rainfall and preceding months are all above 0.3 for Peddie, but much higher correlations exist for Grahamstown. The strongest correlation at Grahamstown where summer rainfall which is correlated at 0.80 with Jun+July+Aug+Sept+Oct SOI.

Table 5.12: Correlation coefficient r with the relevant level of significance P between station summer rainfall and the mean SOI values for certain periods.

Rainfall period	Period of SOI values (non-lagged)	Grahamstown		Peddie	
		r	P	r	P
November-March	Nov+Dec+Jan	0.60	<0.01	0.41	<0.01
	Nov+Dec+Jan+Feb+Mar	0.22	0.02	0.40	<0.01
	Period of SOI values (lagged)				
	May+Jun+Jul+Aug+Sep	0.61	<0.01	0.35	<0.01
	Jun+Jul+Aug+Sep	0.41	<0.01	0.36	<0.01
	Jun+Jul+Aug+Sep+Oct	0.80	0.02	0.36	<0.01
	July+Aug+Sep	0.74	<0.01	0.35	<0.01
	Jul+Aug+Sep+Oct	0.77	<0.01	0.35	<0.01

The relationship between crop yields and rainfall data

Given that the rainfall data for Ngqushwa Local Municipality as recorded at the Peddie Weather Station goes as far as 1984 weather data from the Grahamstown station will be used for investigating the relationship between rainfall and crop yield. Essentially the rainfall for Peddie and Grahamstown are strongly correlated at r=0.63. Therefore, the use of the Grahamstown station for this exercise yields reliable and relevant data. The extension officers supplied the researcher with estimated maize yield estimates as shown in Table 5.13.

Table 5.13: The estimated smallholder crop yields over 30 years

Year	Ward 7 (Maize)	Ward 9 (Maize)	Ward 13 (Maize)	Mean
1982	621 kg/ha	740 kg/ha	733 kg/ha	698 kg/ha
1983	1169	1257	1297	1241
1984	1140	979	1193	1104
1985	1036	1253	1263	1184
1986	1154	1076	1200	1143
1987	1154	1375	1467	1332
1988	1223	1207	1428	1286
1989	1321	1346	1233	1300
1990	654	703	677	678
1991	670	687	725	694
1992	1007	1034	979	1006
1993	982	1359	1298	1213
1994	1265	1335	1470	1356
1995	1065	1119	1005	1063
1996	933	1347	1476	1252
1997	1123	906	1324	1117
1998	1300	1007	1450	1252
1999	1058	1231	1075	1121
2000	898	1054	1098	1016
2001	1172	1103	1198	1157
2002	1006	1129	1260	1131
2003	863	927	823	871
2004	972	1229	1267	1156
2005	1022	1457	1432	1303
2006	1063	1105	1223	1130
2007	892	1048	952	964
2008	985	957	985	975
2009	895	947	913	918
2010	699	705	676	693
2011	821	813	721	785

Table 5.14: Z-scores for 30 Year Maize Crop Yield

Year	Z-Scores for Crop Yield	p-values
1982	-0.30	0.4880
1983	-0.09	0.4641
1984	-0.38	0.3520
1985	2.94	0.9984
1986	-0.15	0.4404
1987	-0.77	0.2206
1988	0.40	0.6554
1989	-1.41	0.0793
1990	-1.10	0.1357
1991	-0.65	0.2578
1992	-0.65	0.2578
1993	2.41	0.9920
1994	1.24	0.8925
1995	0.25	0.5987
1996	1.52	0.9357
1997	-0.97	0.1660
1998	0.12	0.5478
1999	-0.88	0.1894
2000	0.33	0.6293
2001	-0.01	0.4960
2002	0.05	0.5199
2003	-0.83	0.2033
2004	-0.80	0.2119
2005	0.31	0.6217
2006	-0.32	0.3745
2007	-0.18	0.4286
2008	-0.35	0.3632
2009	-0.27	0.3936
2010	-0.69	0.2451
2011	1.22	0.8888

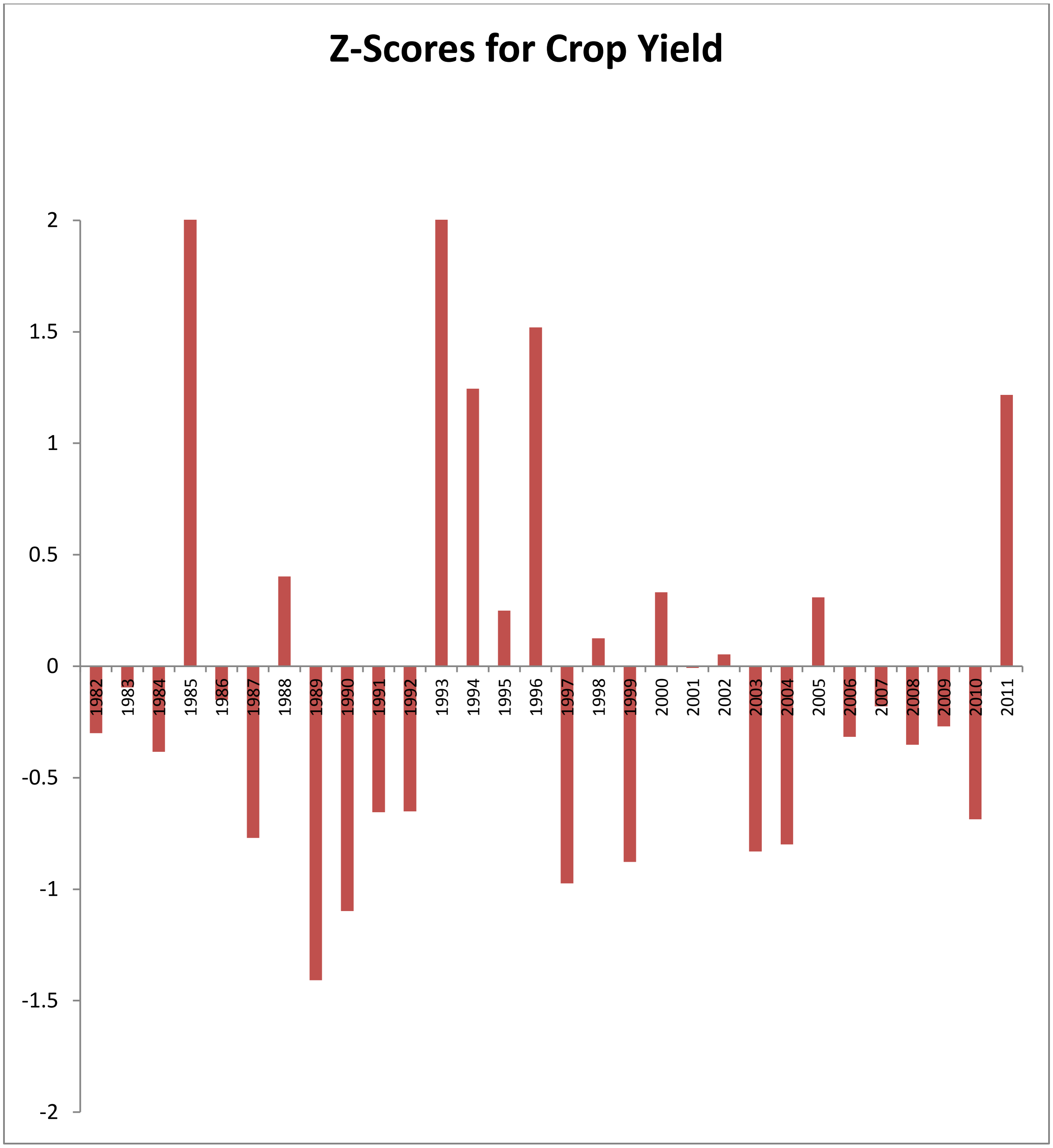

Figure 5.13: Z-Scores for 30 Year Crop Yield

Table 5.15: Z-Scores for 30 Year Mean Annual Rainfall

Year	Z-Score for 30 Year Rainfall	p-values
1982	-0.97	0.1660
1983	-0.90	0.1841
1984	-0.58	0.2810
1985	1.39	0.9177
1986	0.87	0.7794
1987	-0.37	0.3557
1988	-0.40	0.3446
1989	-0.74	0.2296
1990	1.42	0.9222
1991	0.02	0.5080
1992	-0.86	0.1949
1993	1.33	0.9082
1994	1.26	0.8962
1995	1.38	0.9162
1996	0.1	0.5398
1997	0.14	0.5557
1998	-0.41	0.3409
1999	-0.15	0.4404
2000	-1.05	0.1469
2001	1.80	0.9641
2002	0.88	0.8106
2003	-0.63	0.2643
2004	-1.18	0.1190
2005	-1.18	0.1190
2006	1.71	0.9564
2007	-0.14	0.4443
2008	0.08	0.5319
2009	-1.73	0.0418
2010	-0.88	0.1894
2011	-0.21	0.4168

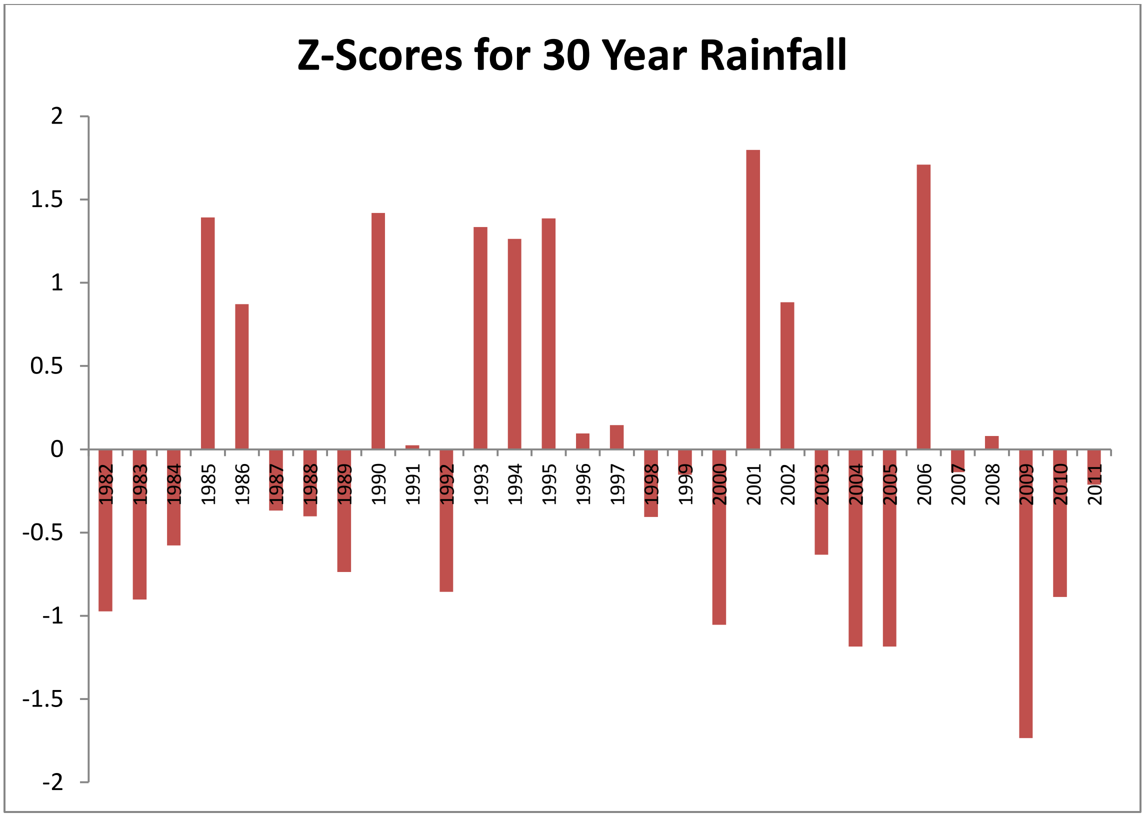

Figure 5.14: Z-Scores for 30 Year Mean Annual Rainfall

Eighty-two percent of the Ngqushwa Local Municipality respondents categorically perceive climatic changes chiefly as manifesting in the form of rainfall variability. Perceived rainfall variability includes delayed onset and shorter rainy seasons; and increased frequency of heavy rainfall events, and more frequent and prolonged dry spells during traditionally expected rainy seasons. Rainfall variability is perceived to have had the most adverse impact on community - wide food security and sustainable livelihoods. The Pearson's correlation coefficient between mean annual rainfall and estimated mean annual maize crop yield is 0.69 (Table 5.16 and Figure 5.15) which indicates a strong positive linear relationship between rainfall and crop yields. This co-efficient implies that 69% of crop yield is attributable to rainfall variability. The remaining 31% of crop yield may be attributed to soil chemical properties (Belay et al., 2002), plant pathology (Ncube et al., 2011) and geomorphological factors (Kakembo & Rowntree, 2003), which are not part of the scope of this study).

The p –value (p= 0.00002) for the linear regression between mean annual rainfall and mean annual crop yield for 30 years is statistically significant at the 99% confidence level as shown in Table 5.16. The raw rainfall data scores are normalized by converting them into z-scores (standardized anomalies) as shown in (Table 5.15 and Figure 5.14). The z score is calculated relative to the mean annual rainfall/maize crop yields and standard deviation for the years (1982–2011). Z-score normalisation ensures that the resultant anomaly series has the mean = 0 and the standard deviation = 1 (Kumar et al., 2007). Also, the raw crop yield data scores are normalized by converting them into z-scores (standardized anomalies) as shown in Table 5.14 and Figure 5.13).

In respect of inter-annual variation rainfall data indicate that in Ngqushwa Local Municipality, the major (rainfall anomalies) drought occurred during the early to late 80s (1882/83/84) and (1987/88/89), 90s (1992/98/99) and during the first decade of the 21st (2000/03/04/05/07/09/10/11) century cropping seasons. These results were also corroborated by Zengeni et al. (2014) who found that over a 41 year period (1970 – 2010) there was a highly variable and declining trend in annual rainfall over time at several Eastern Cape weather stations, including Grahamstown. The small-scale farm production output of maize was perceived to be in a moribund state by the respondents and was corroborated by the correlation analysis and the standardized anomalies (z-scores) to be declining due to both the low precipitation and significant rainfall variability levels. For both rainfall and crop yield the negative z-scores (standardised anomalies) indicate drier than normal conditions while the negative z-scores for crop yield indicate moribund crop production respectively.

For both rainfall and crop yield the positive z-scores (standardised anomalies) indicate wetter than normal conditions while the positive z-scores for crop yield indicate swelling crop production than normal respectively. The standardized anomalies for crop yield account for 18 years of the 30 year (Long-term averages (LTA). There are 6 years maize crop yield decline anomalies in the 80s (82/83/84/86/87/89); 5 years in the 90s (90/91/92/97/99) and 7 years in the 21st (2003/04/06/07/08/09/10). It follows that below-average rainfall is strongly linked to below-average crop productivity for the water-limited and rain-fed production systems of the Ngqushwa Local Municipality.

There has been a steady decline in crop yields over the 30 years (Figure 5.16) in all the Wards. This decline is largely attributed to wide-scale crop field abandonment which in turn is underpinned by water scarcity and dry spells. Apart from household subsistence farming, the respondents have also organised themselves into community agricultural projects and have consequently built considerable, yet nascent resilience to climate variability and food insecurity. Varying percentages of the respondents use various resilience building/adaptation strategies and activities such as crop diversification and the changing of cropping dates (48%), rainwater harvesting (36%), drought resistant seeds (32%), soil conservation techniques (28%) and (35%) social grants and stokvels.

Table 5.16: 30 year Mean Annual Rainfall and Mean Crop Yield

Year	Rainfall	Crop Yields	Summary Output	
1982	43.55	43.55	R	0.6912551
1983	61.70833	49.376615	R Square	0.4778336
1984	45.825	41.161789	Adjusted R Square	0.4591848
1985	88.225	135.62931	P -Value	0.00002
1986	58	47.792637		
1987	46.33333	30.191526		
1988	61.875	63.518032		
1989	48.96667	12.057512		
1990	47.38333	20.875372		
1991	37.15	33.46871		
1992	39.15455	33.574509		
1993	78.65833	120.57306		
1994	73.40833	87.442738		
1995	53.68333	59.142271		
1996	52.875	95.267782		
1997	59.00833	24.413266		
1998	45.70833	55.625555		
1999	30.45	27.124157		
2000	59.34167	61.496876		
2001	62.78333	51.870149		
2002	75.49167	53.593794		
2003	39	28.466767		
2004	43.125	29.360306		
2005	48.04167	60.839473		
2006	79.125	43.083694		
2007	64.45	46.953207		
2008	49.55	42.082482		
2009	66.79167	44.389262		
2010	41.575	32.547332		
2011	89.25833	86.636659		

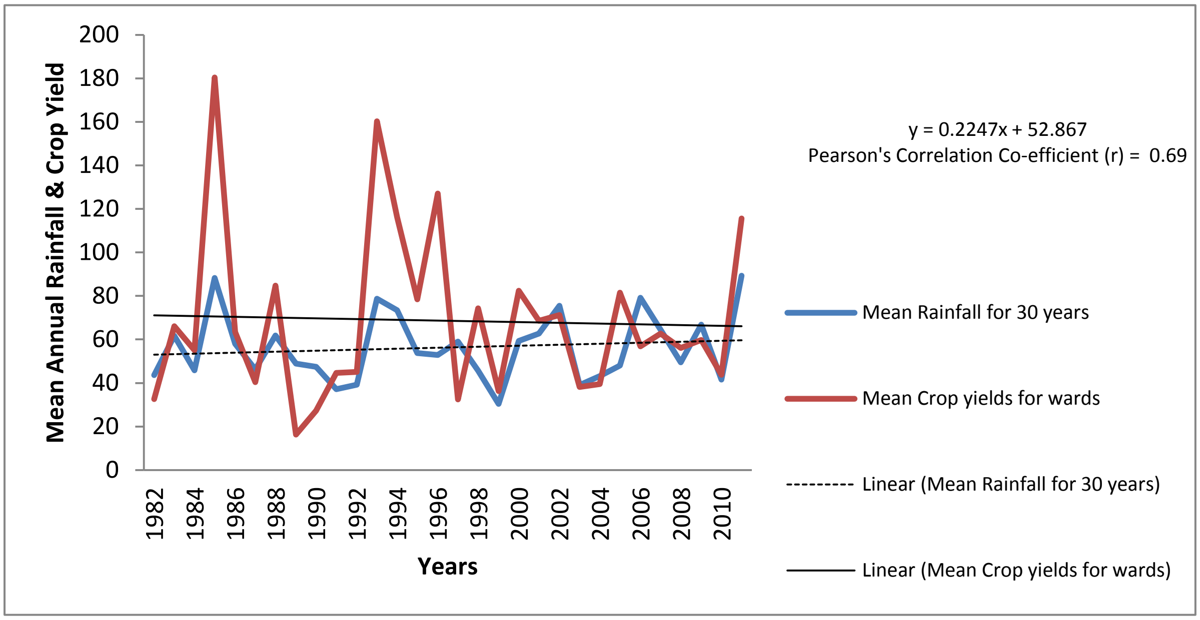

Figure 5.15: The 30 - year Mean Annual Rainfall and Crop Yield

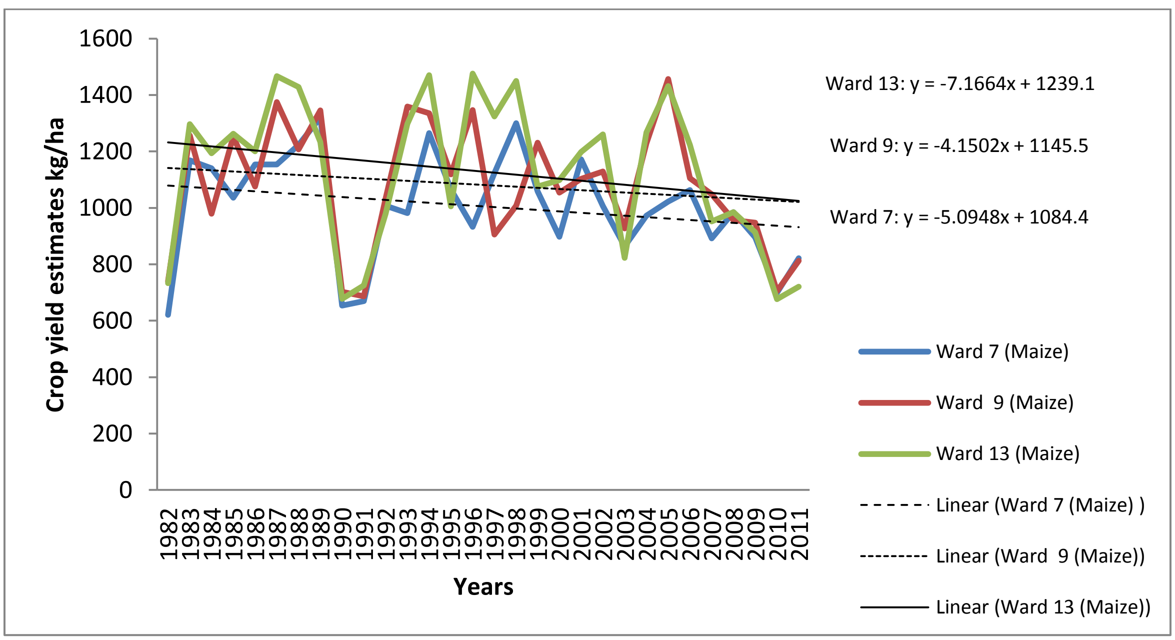

Figure 5.16: The 30 – year Crop Yield Trends for Ward 7 (Mgwalana), Ward 9 (Mgababa and Prudoe) and Ward 13 (Benton)

Objective 4: To investigate the impact of both the food price dynamic and the global food system on rural livelihoods and food availability and access.

The HFIAS Survey

The HFIAS survey revealed that there were 22 percent food secure households, 36 percent were moderately food secure and 42 percent were low food secure. Therefore the total number of people who are food insecure amounts to 78 per cent of the sample. Figure 5.17 indicates the information graphically.

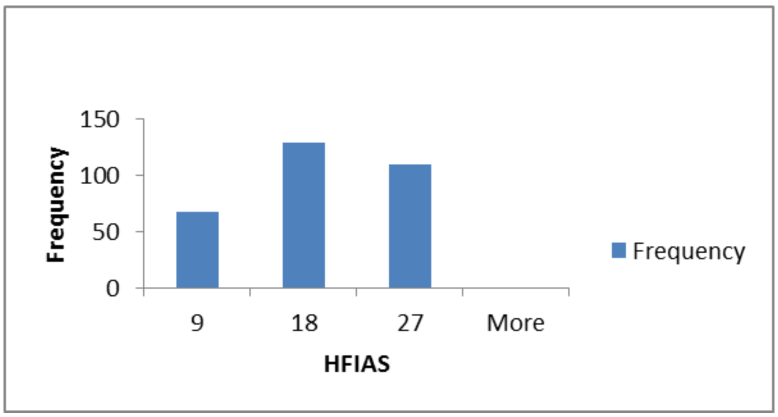

Figure 5.17: HFIAS Scores and Frequency

During the focus group discussions, when asked to describe their perceived main causes for their food insecurity and declining food access the respondents stated that unemployment was one of the main reasons. They indicated that climate variability and change or weather changes which were becoming increasingly unpredictable were the other cause of their food insecurity, vulnerability and lack of adequate food access. The respondents cited that they would not consider the land as their reliable source of food supply like it used be the case in the olden days due to the attendant risks and vulnerabilities posed by climate variability. The perceived risks and vulnerabilities included unpredictable crop failure, soaring livestock mortality rates, long term hunger, malnutrition, poverty and increased migration into urban centres with ostensibly better livelihood opportunities.

The price of inputs

The households also referred to the cost of inputs such as fertilisers and pesticides that were rather too expensive to access. The respondents were concerned about the new seeds which one “cannot save in order to use for the next season”. The subsistence farmers and or households stressed that while the seeds give good yield due to their drought resistant properties they were expensive to purchase. The small-scale farmers also expressed that it was the government and its partners that had introduced the seeds to them and that they were not too familiar with the seeds since they seemed to vary from time to time. The nature of the seeds necessitated constant guidance form the extension officers on how to derive the best yield. The households also indicated that the extension officers had been providing them with the hybrid seeds whenever they needed them.

To avoid dependency on the government’s subsidised or donor seeds the chief extension officer of the Ngqushwa Department of Agriculture stated that she has been encouraging the farmers to purchase their own seedlings and seeds. Meanwhile the farmers refuted that the uMtiza co-operative farmers business from which they buy the seeds is too far away in Peddie Town. On average, a trip to Peddie Town can take up to 45 minutes by car. That means that there are transportation costs when sourcing the seeds from the supplier. Many cannot afford to go to town to buy them since they spend most of their wages on food. Paying for transportation to buy something that you are not going to eat now is a luxury. The older generation among them; those who had lived to see the pleasures of eating everything from the soil voiced their discontent with the current local food system. These are the ones who form the majority of household garden owners and whom are members of farming projects.

The Household Dietary Diversity Score as measure of food insecurity

The HDDS for the sample was calculated as follows:

HDDS (0-12)	Total number of food groups consumed by members of the household. Values for A through L will be either "0" or "1". Sum (A + B + C + D + E + F + G + H + I + J + K + L)

$$\text{Average HDDS Sum (HDDS)} = \frac{\text{Total (Sum of HDDS)}}{\text{Total Number of Households}}$$

$$\frac{1101}{308}$$

$$= 3.57$$

$$= 3.6 \text{ (Between low to medium HDDS)}$$

Table 5.17 indicates the food groups which are the most consumed by the people of the four villages as well as the percentage of consumers of the food group over the last 24 hours.

Table 5.17: Types of Food Groups consumed over last 24 hours

Food Groups	Percentage
Cereals and Maize	83
Potatoes and Tubers	72
Vegetables	44
Fruits	24
Meat	20
Eggs	33
Fish	14
Beans and Lentils	67
Dairy Products	35
Butter and Oil	43
Sugar and Honey	47
Coffee and Tea	76

The household dietary diversity scores indicate that the majority (56%) of the households (≤ 3 food groups – Cereals, Green leafy vegetables; Vitamin A rich fruit) have the lowest dietary diversity scores, 37% have the medium dietary diversity score (4 and 5 food groups - Cereals, Green leafy vegetables, Vitamin A rich fruit, Oil) and that only 7 % are in the high dietary diversity score range (≥ 6 food groups - Cereals, Green leafy vegetables, Vitamin A rich fruit, Other vegetables Fish, Legumes, nuts and seeds). The average HDDS falls between 3 and 4 at a marginal 3.6, which is an indication that the sampled households are predominantly food (diversity) insecure and may suffer from malnutrition. The most consumed food group is group 1 (Table 5.18) with 83% households consuming it, followed by coffee and tea at 76%, potatoes and tubers at 72%. The consumption of vegetables is at a paltry 44% which is a perceived indication of the decreasing crop production levels in the area. The least consumed food groups include meat and fish at 20% and 14% respectively, which some respondents have attributed it to high meat prices and the abandonment of livestock farming.

Table 5.18: Household Dietary Diversity Scores

Lowest dietary diversity	Score	1	2	3		Total	Percentage
	N	12	42	118		172	56%
Medium dietary diversity	Score	4	5				
	N	71	42			113	37%
High dietary diversity	Score	6	7	8	9		
	N	11	6	5	1	23	7%

Concerns about the local food system

The concerns were that the food that they eat today comes from far away and has to be trucked into retail stores and warehouses. The elders told of how food was grown at home and the home was self-dependent in as far as food is concerned. The home was a haven of food security – a granary of many months’ supply and a storehouse of seeds for future generations. The respondents blame poor and intermittent rains for complicating access to food in the traditional sense. They also pointed out that they were aware that their declining food access is also linked to food prices which are linked to fuel prices. The villagers also noticed that whenever they go to buy fertilizer after successive fuel price hikes, the price of fertilizer also goes up. They told the researcher that they have always wondered what the reasons were. The elders pointed out that they had never thought that they would have to eat chickens that came all the way from Brazil. They had learned the news about the imported chicken from a radio show. They pointed out that they had thought that the only thing that one can import were “shoes, cellphones and perhaps cars but not food; especially not meat”. Therefore they were also concerned about issues of food safety and stressed that having little money does not give one too many options.

Water scarcity and market access limitations

During the focus group discussions the small-scale/subsistence farmers representing the Siyophumelela and Siyakhula Agricultural Project cited the unfortunate failure of the Massive Food Production Programme. The members referred to the problems of constricted market access as, primarily, their main challenge as small-scale food growers. The MFPP failed because there were insufficient profits made to continue with the sustained purchase of inputs. Thus, the project became unsustainable and it was injudicious to persist. The villagers explained that they have had to be price takers and that the agricultural extension officers normally tell them the price they negotiated for their produce in (Peddie) town. They also indicated that they were not so certain as to whom the extension officers sold their produce. Some farmers mentioned the chain store, (Kwa Dudumayo) SuperSpar and in another village they mentioned another middle man who came and collected the produce to also sell it in town and possibly in East London.

Further reference was also made to the unavailability of water taps within the perimeters of homesteads. On average people have to walk approximately 500m/day to fetch water from the communal taps which are located on the perimeters of the villages. The villagers stressed that food access is made easier by food/vegetable gardens that are invariably located in their backyards. Given that the majority of the village household heads is elderly and earns pension grants, life without the taps in close proximity to the home gardens is quite challenging to the frail frames of the elderly.

With respect to general livelihood sustainability and livestock keeping and because of a drying landscape, some farmers have sought distant pastures for their livestock. Long dry spells and insufficient dams have forced them to keep their livestock in faraway places, as far afield as the contiguous Buffalo City Municipality where the rains are perceived to be not as scarce as in the NLM.

Lack of political will to revive a localised food system

In one village, the respondents were despondent about the promises that had been made by the national, provincial and local political establishment with respect to providing farming machinery such as tractors. The community cited that there were 8 -12 tractors that had been donated 3 years ago. Apparently, the tractors were bought overseas without the blades. Subsequently the blades were ordered from abroad and were delivered and received but were later found not to be compatible with the tractors. The villagers expressed their discontentment with the lack of political will to revive the tractors which were brought to the community through the auspices of President Gedleyihlelikisa Zuma's Masibambisane Agricultural Project. The villagers re-iterated that they were elderly and that they needed the machines in order to turn the soil. Yet the tractors were parked next to the clinic "as if waiting in line to receive medication". The issue of the tractors has reached an impasse of which the farming villagers do not see the immediate end in sight. To adapt to the situation the villagers are using a local resident's tractor that he rents out for between R200 and R300. At the time of conducting surveys and FDGs the tractor had mechanical problems.

The study area is also continuing with the Massive Food Production Programme (MFPP) initiatives of the Accelerated Shared Growth Initiative of South Africa (ASGISA). Respondents from both the Siyophumelela and Siyakhula Agricultural Projects indicated that they had encountered problems related to food sovereignty during the undertaking of the MFPP. They indicated that they had been given loans to undertake their crop production which would be repaid later in phases. They had to sign contracts with their lenders in order to secure the agreements for loan repayments. The farmers were to derive benefits such as access to markets through a middle man/company which entered into negotiations with clients on their behalf.

Yet, they indicated that they encountered a number of challenges which infringed on their right to food sovereignty. The challenges caused the formalized MFPP programme to fail when the farmers could not repay the loans as agreed. The farmers continued with their regular household gardening/farming endeavours while manning the large-scale MFPP farms which were showing signs of rebating. Yet the inertia of the cultural and traditional way of household and community livelihood was too strong for the farmers to discontinue their farming, hence they continued amidst the challenges. The Siyophumelela and Siyakhula projects are offshoots of the MFPP and for purposes of the study are defined as MFPP projects. The challenges inherited and experienced by these projects included:

- The farmers not being sure of the nature of the seeds they had been using (if GM or 'hybrid seeds') and that the farmers were not saving their traditional seeds;

- The contracts were written in English and only translated orally into isiXhosa, leading to lack of understanding about the terms of the contracts and loan repayments ;
- Farmers did not know or understand how and what amounts of the funds were spent and ended up in debt;
- There was no emphasis on the importance of transparency, management, financial accountability, etc.);
- Erratic and late rainfall caused crop production failure;
- Late arrival of production inputs delayed planting;
- No reliable access to irrigation water and no control over suppliers;
- The farmers were price takers and had little negotiation power;
- Agro-chemical inputs were preferred in the place of traditional seeds and fertilisers;
- Insufficient knowledge about the potential long-term impacts of GMOs.

Objective 5: To investigate the extent of the impact of the interaction between South Africa's climate change, food and agricultural policies and how these are articulated to galvanise food security programmes as well as how they influence the perceptions of risk and vulnerability in the Ngqushwa Local Municipality.

Implementation of the National Development Plan

The Agricultural Extension officers indicated that there were not any policies that they were implementing to bridge the awareness, adaptation and resilience-building gap in the community. They gave terse answers with respect to the relevance of policies and the priorities that underpin rural development, agricultural reform and climate change. For instance the questionnaire asks the question “How are you implementing the priorities of the National Development Plan, and one of the answers was “by encouraging farmers to secure food”. The limitations posed by the lack of transparency during the interviews and survey sessions cause the researcher to understand why some of the village respondents were cynical and skeptical about the motives and priorities of the extension officers.

The National Development Plan

Currently the National Development Plan is the over-arching strategy which seeks to guide all government programs and policies related to, but not limited to food access, security, agriculture and the environment.

South Africa’s National Development Plan (2030) and Rural Food Security

The NDP and The Right to Food

Overall, including the controversies surrounding the adoption of GM foods for subsistence, South Africa is a food secure nation. Yet the rural households who constitute a large percentage of the country’s poor experience food insecurity at all times (Altman & Jacobs, 2010). Therefore, under such famishing circumstances the right to food is, either, by design, misfortune or accident being infringed upon. Also in the fight to ensure the right to food the Millennium Development Goals set an ambitious target of halving hunger and poverty by 2015 (Stats SA, 2010). The right to food is recognized in the 1948 Universal Declaration of Human Rights (Art. 25) as part of the right to an adequate standard of living, and is enshrined in the 1966 International Covenant on Economic, Social and Cultural Rights (Article. 11). The right to food has gone through a trajectory spanning many years. The UN Special Rapporteur on the Right to Food, De Schutter (2010), sets out a historical chronology of international “right to food” milestone agreements which include (See Table 5.19).

Table 5.19: Milestone Agreements on the Right to Food

YEAR	EVENT
1948	Universal Declaration on Human Rights Art.25
1976	International Covenant on Economic, Social, Cultural Rights, including Art.11
1987	The Committee on Economic, Social, and Cultural Rights (CHSCR)
1988	Adoption of the Right to Food (Art.12) in the Additional Protocol to the American Convention on Human Rights in the Area of Economic, Social and Cultural Rights (the “Protocol of San Salvador”)
1996	FAO Food World Summit – Rome Declaration on World Food Security
1999	1999 - Adoption of General Comment N.12 ‘The Right to Adequate Food’ by the Committee on Economic, Social and Cultural
2000	Establishment of a Special Rapporteur on the Right to Food
2000	Adoption of the Millenium Development Goals, including Goal 1 to eradicate extreme poverty and hunger by 2015
2002	Rome Declaration at the World Food Summit calling for the establishment of an intergovernmental working group right to food
2004	Adoption of the FAO Voluntary Guidelines on the Right to Food which offer guidance to States on how to implement their obligations on the right to food
2009	Adoption of the Optional Protocol to the International Covenant on Economic, Social and Cultural Rights, making the right to food justifiable at the international level

Source: (De Schutter, 2010)

The South Africa’s Section 27.1 (b) of the bill of rights which was promulgated to protect the right to food, states that every citizen has a right to access to sufficient food and water and the state must take reasonable legislative and other measures within its available resources to achieve the realisation of this right.

There are many definitions to food security, but the most applicable for the context of the study is the FAO (1996) definition of the World Food Summit 1996: “A situation that 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 for an active and healthy life”. All things considered, including the controversies surrounding the adoption of GM foods for subsistence, South Africa is a food secure nation. Yet the rural households who constitute a large percentage of the country’s poor experience food insecurity at all times (Altman & Jacobs, 2010). Therefore, the NDP was adopted in order to help guide the measures taken by the state and its partners in ensuring the realisation of the right to food.

Ngqushwa Local Municipality and other similar rural communities should benefit from the NDP because the plan seeks to ensure zero hunger or a significant reduction thereof for the country’s rural population. The global recession of recent times and the global food crisis (2007/08) raised the alarm on the importance of nations taking account of the need to develop national food security policy strategies. There have been several government department responses to the call for programmes and policies which safeguard the right to food. The first discussed is a joint venture from the Department of Social Development (DSD) and the Department of Agriculture, Forestry and Fisheries (DAFF).

DSD and its programmes in the NLM

In the Ngqushwa Local Municipality the DSD is promoting the establishment of irrigation schemes and while the schemes are not as pervasive as needed by most villages of the municipality which are far away from natural or man-made water sources it is changing most households’ and farmers’ lives for the better.

Of the four sampled villages (Benton, Mgababa, Mgwalana and Prudoe), only one has an irrigation scheme. The Mgwalana Irrigation Scheme is connected to a pond that is approximately 600m^2 big. The Siyakhula Agricultural project is the main beneficiary of this initiative while the community is regulating the extent to which the water is used by Siyakhula.

The (NPFNS) National Policy on Food and Nutrition Security (2013), South Africa

The South African government employed the Integrated Food Security Strategy (2002) but has since identified the need for an interdisciplinary food security strategy which will enable mitigation of the challenges of climate variability and change, food price volatility and the incidence of economic downturn. Department of Social Development and the Department of Agriculture, Forestry and Fisheries developed the National Policy on Food and Nutrition Security (2013) which are their broad framework for the fulfilment of the NDP and National Growth Plan's constitutional imperative to protect the right to food for the population. The strategic goal of the National Food and Nutrition Security Policy is to reduce inequality and poverty and redress the imbalances of apartheid South Africa thereby taking the offensive on systemic hunger by doing the following:

- Increasing public spending in social programmes/ food security;
- Increasing access to production inputs for the emerging agricultural sector;
- Increasing state food procurement to support community-based food production and smallholders; and
- Use of strategic market and trade measures

The National Policy on Food and Nutrition Security (2013) identifies the Eastern Cape as the hardest hit with respect to food insecurity with the prevalence of hunger standing at (66.7%), Northern Cape (65.3%) and Limpopo (63.2%), with the Western Cape having the lowest prevalence (29.3%). Child hunger remains high, ranging from 9% in the Western Cape to 43% in the Eastern Cape and

Limpopo (The National Policy on Food and Nutrition Security, 2013). Ngquswha Local Municipality, the study location is in the Eastern Cape.

The National Policy on Food and Nutrition Security 2013 and its impact on NLM

The Department of Agriculture and Land Affairs extension officers (Mbiko, Mgijimi & Katana, personal communication, 14 September, 2012) reported that with respect to the provision of agricultural inputs they have been giving seeds erecting fencing of agricultural lands so as to protect them from livestock. The respondents seemed to be discontent with the way in which the agricultural inputs were distributed among them and have cited the prevalence of what they term “favoritism”. The regulation of the manner in which the distribution and provision of services is conducted might require the intervention and monitoring functions of the provincial department.

The policy also takes cognisance of the Report of the United Nations (2012) Special Rapporteur on the Right to Food which identified challenges facing South Africa’s food security needs. These include:

- 9 million tons of food wasted each year;
- Lack of knowledge about safe and nutritious food;
- Inadequate food safety nets in preparation for natural disasters;
- Rising input costs which undermine sustainable food production;
- Climate variability and change, and over grazing, use of land for mining and urban development;
- Limited market access opportunities and platforms for smallholder farmers; and
- Insufficient monitoring, evaluation and reporting on food security.

Rising input costs have been identified as a major challenge for the inhabitants of the NLM. Both climate variability and change, and overgrazing have ravaged the landscape such that crop field farming has been extensively abandoned (Musemwa et al., 2013). There were limited market access opportunities for the smallholder farmers and lack of transparency on how the funds were used for the purpose of long-term viability and sustainability of agro-business endeavours. The lack of accessible documented reports on the food security status of the local people is also a challenge for both food security and climate smart agricultural policy synergy and its targets.

The National Policy on Food and Nutrition Security (NPFNS) and Climate Change

The policy recognizes the need for investment in research and technology development which must address climate variability and change and its impact on food security. The policy envisages that research must prioritise “production input costs, crop varieties adapted to adverse climate conditions, pest and disease control methods, and improved irrigation management and farming systems that blend traditional knowledge with innovative research” (NPFNS, South Africa, 2013).

The policy further makes recommendations for the establishment of Regional Food Reserves, the enactment of the National Food Security and Nutrition Act, and the installation of subsidies for agricultural production and farming in South Africa so that the country will attain comparative advantage in the global economic system. In order to achieve the national food security goal, the policy recognised the need for the participation of numerous government departments. The departments should consider economic transformation principles and values and help implement transformation initiatives, social development programmes such as nutrition education as well as the establishment of home and community gardens for the poor.

The NPFNS, climate change and Intergovernmental Intervention Pogrammes

Again, the Department of Social Development is supporting the establishment of food gardens in the NLM, including irrigation schemes and only to those villages which are closer to water courses such as streams, rivers, ponds and dams. Those villages without proximate dams are left vulnerable to climate vagaries. Possibly the future might see more and more villagers migrating to irrigated areas of the municipality and even to neighbouring or distant municipalities and urban centres. Next up, the Department of Rural Development and Agrarian Reform (DRDAR) also developed its own NDP-aligned Policy for the Recapitalisation and Development Programme (Republic of South Africa, 2013b).

Policy for the Recapitalisation and Development Programme (PRDP)

The policy seeks to reverse the legacy of the 1913 Natives Act which dispossessed South Africans of their land. The historical exclusion policy of Apartheid South Africa is to be abolished and replaced with programmes which ensure access to food, household food security and national food sufficiency. The policy is also aligned with the constitution. Section 25 states that "the state must take reasonable legislative and other measures … to foster conditions which enable citizens to gain access to land on an equitable basis".

The PRDP seeks to function in tandem with the over-arching policy of the Department of Rural Development and Agrarian Reform – the Comprehensive Rural Development Plan (CRDP). The CRDP is designed to ensure "vibrant, equitable and sustainable rural communities and food security". The CRDP has a 3-tiered employment creation model which, firstly, seeks to achieve the rural sustainability by inspiring the mobilisation of and organization of rural people to participate in job creation programmes which require its employees to share at least half of their wages. Secondly, the CRDP fosters the development of entrepreneurial skills, and thirdly, the establishment of small, medium and large agro-businesses which are sustained by rural communities and in turn, sustained by local credit facilities.

The CRDP is closely aligned with chapter 6 of the NDP which proposes the carefully worded “rapid transfer of agricultural land to blacks without distorting the land market or business confidence”. In a somewhat paradoxical tone, the policy also noted the collapsed projects of the Land Redistribution for Agricultural Development Programme which lay fallow and were on the verge of being auctioned or up for sale or sold. The most targeted properties are those which were acquired since 1996 under the Restitution of Land Rights Act 22 of 1994. As a measure to address the shortcomings of the Act, the policy proposes a strategy which will include co-management of agribusiness; mentorship programmes; share-equity arrangements; and contract farming and concessions.

The policy envisages that with its revamped strategy it will redress the shortcomings of the previous policy by ensuring the following:

- Ensuring that land reform farms are 100 % productive farms;
- Restoration of the Natives Land Act (1913) acquired black commercial farms; and
- Reduction of incidence of rural to urban migration.

The PRDP and its implications for the Ngqushwa Local Municipality

During the focus groups the respondents expressed concern over the forced removals from areas where their forefathers used to live to areas which were characterised by a poor natural resource base; foundering road networks, and remote locations from trade, education, training and job opportunities. It is therefore the imperative of the local municipality to translate “the co-management of agribusiness; mentorship programmes; share-equity arrangements; and contract farming and concessions” of the PRDP into workable outcomes for the local communities of the municipality.

The Reversal of the Legacy of the 1913 Natives Land Act and 1936 Native Trust and Land Act, of the apartheid era which left land owned by blacks amounting to 13% resulted in a highly controversial policy document entitled "Strengthening the Relative Rights of People Working the Land (2014)".

The strengthening the relative rights of people working the land policy proposal

With respect to land tenure security, one of the comments made by one of the NLM respondents at the FGD was that

> Currently it is alleged that according to the books (legal property rights documents) the land that we are occupying and working does not belong to us but to a man called Kelly (A white farmer who had left the land during the Ciskei political upheavals of the mid- eighties). This whole area that we farm, on which some of us have built homes belongs to him. Many of us are still awaiting a final order from the courts giving us the final word about our application for secure tenure here. Some of us grew up on this farmland as small children but were later forced to leave and those who remained worked as farm workers. We had heard from our parents that this land used to belong to our forefathers who were chased away under some segregation law of Apartheid South Africa. We need this land. It is fertile and we need it for our children as an inheritance (Nomisile, personal communication, 2013).

"Only about 80 000 land restitution claims were lodged by the 1998 deadline and it is estimated that there are up to five times as many valid cases that can be brought by victims of apartheid-era forced removals" (Mail & Guardian, 2014 b).

The ANC - led government justifies its adoption of the policy on the basis that the Constitution, the Freedom Charter, the National Development Plan and "Agenda 21″ of the United Nations are the broad framework which underpin its essence. The spokesman for the Ministry of Rural Development and Land Affairs, Mxotwa (2014) stated that the Relative Rights Policy enshrines a cordial relationship between the farmer and the farm worker; that the farmer will continue to farm on his portion while the farmworkers will farm will do their own farming. He also states that “this is meant to ensure food security for the country and to increase the dwindling number of commercial farmers in the country, which is about 35 000”. The Department of Land Reform and Rural Development notes that the policy is important because there exists the “necessity to address historical land hunger, which could be absolute in most instances; and, extreme concentration of land ownership and control in a few hands, on the other hand." Hence in a bid to redress the imbalances of Apartheid South Africa and to "de-racialise South Africa’s rural economy, the policy aims to democratise the allocation and use of land and ensure food security as well as food sovereignty for the country.

While the policy promotes a share equity scheme which could see farm owners retaining 50% of the ownership of their farms and ceding 50% ownership to workers its constitutionality is under question (Dube, 2014). Section 25(1) of the Constitution provides that "No-one may be deprived of property except in terms of law of general application, and no law may permit arbitrary deprivation of property" (Dube, 2014; Trollip, 2014). The Mail & Guardian (2014a) reported that “the policy proposal, which involves giving 50% of land to farmworkers, was lambasted as ill-considered and unacceptable by farmer representative bodies”. Also the uncertainty around the policy is further confabulated by the incoherency and incongruency characterising the statements of Zizi Kodwa, the national ANC spokesperson and that of the Minister of Land Reform and Rural Development. According to the Mail and Guardian (2014 a) the ANC national spokesperson told City Press “that the party did not have a policy position on the mooted 50% share equity scheme for farm dwellers”.

Yet the Minister (Nkwinti) argued that the Mangaung ANC national policy conference of 2012, approved the recently released policy paper on land reform and restitution, “which seeks to give farmworkers 50% ownership of the farms they work in" … (Mail & Guardian, 2014 a). The issue of land reform is a highly politicised issue which has been berated by opposition parties, farmers' organisations and farm owners. In particular, the DA's leader Helen Zille argued that the policy proposal was not in line with the NDP and stated that "it exclusively focused on how to enforce redistribution (without compensation) of productive agricultural land, while ignoring the vast tracts of land under state control and the millions of immensely fertile (but unproductive) hectares under communal ownership" (Makinana, 2014). The KwaZulu –Natal Agricultural Union (2014) reports that the "Freedom Front Plus MP Pieter Groenewald said it was "irresponsible", and that farmers had told his party that it would prompt them to leave the country".

Eastern Cape DA leader Atholl Trollip (2014) wrote an article in the Farmer's Weekly magazine and argued that it was important "to note that the multiple billions of rand (in excess of R50bn) that have been spent on restitution and reform have not delivered the stated targets due to many restitution beneficiaries choosing financial settlement rather than land. This choice cannot now become the sole onus of Agricultural Land owners alone". Agri SA, the commercial farmer's group stated that "the proposal by Rural Development and Land Reform Minister Gugile Nkwinti contained elements of what had happened in Zimbabwe … Evidence of this can be found in the struggling economy and unfavourable food situation experienced by our northern neighbor (SAPA, 2014 a). Moreover the President of South Africa, Jacob Gedleyihlekisa Zuma, speaking about the newly enacted Restitution of Land Rights Amendment Bill which is closely aligned with the "Strengthening the Relative Rights of People Working the Land Policy Proposal" was quoted as saying

> Many who were excluded by the previous cut-off date (December 31 1998) now stood a chance to regain their land. A critical problem was that while the process of taking land from South Africa's original inhabitants had taken centuries, we are only given a few years to deal with this matter…The previous process had excluded many people, particularly those in rural areas who did not receive the Government Gazette,

> had not been aware of the deadline, and were therefore automatically excluded. We must reopen [this matter]. This law will do so. I'm hoping that during this period, we will also do one thing – enact the act (SAPA, 2014 b).

The issues around land reform and restitution have to consider the cross-cutting issue of global proportion – climate change. The DAFF has the right tool up its sleeve – the Climate Sector Plan for Agriculture, Fisheries and Forestry.

Climate Sector Plan for Agriculture, Fisheries and Forestry (2013)

Yet the Climate Sector Plan for Agriculture, Fisheries and Forestry (Republic of South Africa, 2013a) promotes adaptation to climate variability and change by fostering the use of climate smart agriculture which includes conservation agriculture and best practices which ensure the retention of soil nutrients and the restoration of soil moisture and degraded land. The plan recognizes the impact of climate variability and change on food and cites the loss of value of maize production amounting to R681 million. The sector plan aims to institute both vulnerability assessments to climate change and early warning systems as a means to facilitating adaptation. With respect to the dissemination of climate change information and awareness, the plan is considering doubling funding for post graduate study in climate variability and change and encouraging the significant inclusion of climate variability and change in the school curricula. While the plan comprehensively serves the interests of its mandate it recognises the over-arching mandate of the Department of Environmental Affairs on climate climate variability and change issues and the importance of the National Climate Change Response Strategy White Paper (Republic of South Africa, 2011b).

The Climate Sector Plan and the NLM

In respect to the 'doubling funding for post graduate study in climate variability and change and encouraging the significant inclusion of climate variability and change in the school curricula', when the chief extension officer was required to state the qualifications of the extension officers on the questionnaire it emerged that of the 14 extension officers that 10 of them had diplomas, the rest bachelors degrees and one in particular was doing post graduate study at the University of the Free State. The lack of preparedness to engage about knowledge on effective adaptation strategies to climate variability and change appeared to indicate the lack of in-depth study about climate variability and change. When the extension officers were asked to state where they had heard about climate variability and change, most stated that the radio and television had been their primary sources. It would have been expected that they would cite some government documents or indicate some other peer reviewed literature. There appears to be a lack of extensive knowledge on climate variability issues among the extension officers. Perhaps, this very study is a means to an end in as far as climate related information dissemination is concerned.

The National Climate Change Response Strategy (NCCRS) White Paper

A brief history of the NCCRS

The beginnings of the National Climate Change Response Strategy were inspired by the research of the IPCC when in 1990 the Intergovernmental Panel for Climate Change (IPCC) presented significant scientific evidence of climate change in their first Assessment Report which elicited worldwide concern. The evidence gave rise to the 1992 United Nations Framework Convention on Climate Change (UNFCCC). Hence the National Climate Change Committee (NCCC) was formed in 1994. In 1997 the Kyoto Protocol was finalised and lead to some of the 2011 COP17 negotiations.

In 2001 over 180 Heads of State who met at the World Summit on Sustainable Development in Johannesburg agreed that climate variability and change was a matter of political consideration. The South African Government acceded to the Kyoto Protocol, which set specific targets for reductions in greenhouse gasses. However, certain key players, including one of the leading greenhouse gas emitters, the United States of America (USA), did not sign the Protocol. In 2005, during the third IPCC Assessment Report, South Africa realised that decisive action needed to be taken. Given that the country is coal-dependent South Africa needed to consider policy imperatives which will help guide the reduction of coal –induced emissions. In 2005, the National Climate Change Conference in Midrand was convened to discuss the way forward. The Conference had to map out how it would meet its UNFCCC Article 2 commitment to greenhouse gas stabilization by a process called the Long-Term Mitigation Scenarios (LTMS).

The LTMS process found that South Africa needed a climate variability and chang policy to decline carbon emissions and that adaptation would be required to deal with the inevitable, yet less known impacts of climate change. The ensuing 2009 Climate Change Summit, which launched the policy-making process, also decided that sustainable development and poverty eradication should be prioritised. A draft Green Paper was published in November 2010 followed by the White Paper which was approved by Cabinet on 12 October 2011 and published in the Government Gazette on 19 October 2011. The policy outlines two important objectives: managing inevitable climate variability and change e change impacts by building resilience and response capacity; and making a fair contribution to the global effort to stabilise greenhouse gas (GHG) concentrations (Republic of South Africa, Department of Environmental Affairs, (2011).

The National Climate Change Response Strategy (2011) and Food Security

In addition, the strategy acknowledges that globally, agriculture is a key contributor to cli climate variability and change mate change and that it is responsible for about 14% of all GHG emissions. Therefore, there is a need to build climate-resilience which will address the plight of those most impacted by climate variability and change – the rural poor. The strategy recognises that the rural poor are most vulnerable to food insecurity, water shortage, health and land issues and that small-scale and subsistence farmers are most vulnerable to the impacts of climate variability and change. The strategy declares that the rural communities with the highest dependence on natural water sources are in KwaZulu-Natal, the Eastern Cape and Limpopo.

In this respect, the strategy makes several recommendations which include:

- Building resilience to climate variability and change, by integrating agriculture and forestry into climate resilient rural development planning process which address job creation, food security and livelihoods while taking into account both adaptation and mitigation measures;
- Taking into consideration the nascent and available risk and vulnerability studies in order to help reduce the impacts of climate variability and change on existing agricultural potential;
- Investing "climate-smart agriculture" that lowers agricultural emissions in order to ensure resilience while boosting agricultural yields;
- Using early warning systems to give timely warnings of adverse weather; and
- Investing in education and awareness programmes in rural areas through "agricultural extension activities to enable both subsistence and commercial producers to understand, respond and adapt to the challenges of climate change" (Republic of South Africa, 2011, p, 19).

The Policy further makes reference to issues of nutrition and HIV/AIDS/TB and states that

> The negative impacts of climate change on the socio-economic standing of the most vulnerable communities, and the consequences in terms of food security and the nutritional status of individuals within these communities threatens to further undermine their resistance to diseases such as HIV/AIDS and (TB) tuberculosis (Republic of South Africa, 2011, p.19).

The Department of Water Affairs (DWA) and Water-Scarcity Adaptation Plans

Water availability and access are the most important factors limiting agricultural production. It is projected that South Africa may run out of water by 2025

(Blignaut & Van Heerden, 2009). Agriculture is allocated the largest measure of South Africa's fresh water systems, with close to 63% going to irrigation. South Africa has half the average global annual rainfall and 98% of its water systems are in crisis mode (Gbetibouo & Ringler, 2009). In order to address the challenges posed by the impacts of climate variability and change on agriculture the DWA has developed the Department of Water Affairs' Strategic Plan for the fiscal years 2013/14 to 2017/18.

The Department of Water Affairs Strategic Plan identifies the following risks facing the country: climate variability and change, flooding and water security/drought. These same risks have been identified by the NLM respondents as the most pertinent for their livelihoods. The Department of Water Affairs (DWA) is addressing these three issues and plans to tackle them at the national, catchment and household level. The DWA recognizes that adapting to climate variability and change is crucial to the water sector and that this sector is most vulnerable to climate variability and change impacts.

The strategy also recognizes that while the 94.8 per cent access achievement is a desirable outcome it does not remove the challenges faced by farmers in rural areas who still lack access to quality water and adequate quantity. The strategy is promoting programmes such as rainwater harvesting and new initiatives to increase access to those who never had water in the first place. The strategy also sets out the budget for municipal water infrastructure grant to provide for interim water supply to rural households to R4.3 billion in the medium term.

Due to water scarcity and deteriorating water quality and the challenges of climate variability and change, the strategy recognizes the development of new infrastructure, particularly for rural development and rural livelihoods. The strategy is targeting the municipalities and has adopted Municipal Water Infrastructure Grant as the vehicle through which the budget will be administered.

The grant is will continue until 2015/16, subject to review. This grant is specifically geared towards assisting the Water Services Authorities (WSA) to provide water supply services to consumers without services, particularly those in rural areas.

While the Department of Environmental Affairs, which is the leader in the country's climate variability and change agenda with respect to responding and adapting to climate variability and change, has devised its own Climate Response Strategy, the DWA is also developing its own Climate Change Response Strategy for Water Resources in South Africa. In line with the priorities of the NDP this strategy, which will be finalised in 2014 will provide guidance on adaptation to the water-related impacts of climate variability and change and will focus on actions that support both adaptation and mitigation.

The Eastern Cape Climate Change Response Strategy (ECCCRS) of 2011

The ECCCRS emphasises the importance of food security for the Eastern Cape Province and states that

> It should be noted that food security also represents a strategic risk to the Province. This has particular reference to the possibility of future food price shocks related to global population expansion and issues of future water scarcity and oil scarcity associated with the notion of "peak oil". The stronger the provincial commercial and subsistence food production system, the less vulnerable the Province is to food price and scarcity shocks (Province of the Eastern Cape, 2011, p. 27).

The ECCCRS developed a climate change risk assessment matrix which was aimed at facilitating a step-wise approach to understanding which climate variability and change impacts may affect the province and which provincial plans, agencies/ departmental and municipal mandates are adversely affected. Therefore, the Province of the Eastern Cape (2011) recognises the Agricultural Sector as an important source of employment, and is critical to rural livelihoods and food security. Climate Change impacts are relevant to the Province with respect to being a threat to:

- The goals of the Provincial Growth and Development Plan (PGDP);
- The goals of Asgisa and the Massive Food Programme;
- The goals of the Eastern Cape Development Corporation; and to
- The entire Eastern Cape Economy.

The strategy identifies the following food security pertinent system and sector vulnerabilities to climate variability and change as seen on Table 5.20:

Table 5.20: The climate variability and change vulnerabilities of Eastern Cape Sectors and Systems

Sector	Climate Effect	Vulnerability
Agricultural Sector and Social & Economic Systems	More hot days, dry spells and heat waves	Loss of crops and infrastructure; Financial and household loss of subsistence farming benefits Declining rural livelihoods; Reduced food security.
Social & Economic Systems	Longer dry spells and increased likelihood/ severity of droughts	Increased mortality and reduced crop productivity.

Source: Adapted from the Province of the Eastern Cape (2011)

The Eastern Cape Climate Chane Response Strategy (ECCCRS) recognises the (PGDP) Provincial Growth and Development Plan as the strategic framework aimed at a rapid improvement in the quality of life for the poorest people of the Province by targeting economic growth, employment creation, poverty eradication and income redistribution for the 10-year period (2004 – 2014). The ECCCRS stresses that “the successful outcomes of the PGDP particularly in regard to poverty alleviation and food security, will increase the resilience of vulnerable communities to climate change” (Province of the Eastern Cape, 2011, p. 36). The PGDP strategy framework aims to achieve food security by fostering and implementing agrarian transforming measures and policies.

The PGDP plans to halve poverty by 2014 by enhancing democratic participation by the poor. The PGDP also aims to strengthen household food security by:

- Promoting small-scale farming and homestead agricultural production;
- Promoting the effective use of land;
- Promoting the expansion of commercial agricultural enterprises, especially in the former homelands;
- Promoting the planting of crops that are appropriate that are able to withstand climate extremes;
- Promoting the harvesting and storage of water at the subsistence level;
- Promoting the adoption of cultivation techniques that improve soil moisture retention;
- Prioritising support to existing food security programmes.

The Eastern Cape PGDP also plans to make a further 460,000 hectares available for food and biofuel. It is envisaged that the local government will take it upon itself to make further inroads into climate variability and change adaptation strategies and effective food access measures that boost sustainable livelihoods. Next up, we will look into the agricultural/climate priorities and mandates of the Ngqushwa Local Municipality IDP.

The Ngqushwa Local Municipality (IDP) Integrated Development Plan (2012 – 2017)

In order to boost food security the municipality is reviving the Livestock Improvement Scheme – a beef farming project in the villages of Ngqowa, Gcinisa and Mpekweni. Revival and expansion of Ngxakaxha and Gcinisa North Irrigation Schemes - The revival of Tyefu irrigation scheme is said to be in progress and is claimed to be implemented by the Department of Agriculture and Land Affairs while the Municipality provides the support needed. The municipality is also stated to be supporting a food security initiative in Glenmore which forms a part of the Tyhefu Irrigation scheme. As a means to opening the market for small-scale farmers and to boost employment and livelihoods there are plans to establish a municipal fresh produce market which will accommodate all produce that comes from local farmers. The IDP recognises climate variability and change as a factor that has high impact on local economic development and rural livelihoods yet there is no clear decisive directive on the matter especially in relation to implementation. The NLM needs to have its own municipal climate change response strategy. Therefore the implication is that perceptions and experiences of vulnerability to climate variability and change may persist for longer than desirable.

Conclusion

The chapter shows the results of the descriptive statistics on socio-economic characteristics of the respondents. Also the general perceptions of the respondents were outlined as captured during focus group discussions and questionnaires. Inferential statistics were interpreted to explain the factors influencing the perception of climate variability as well as the determinants of adaptive capacity. The chapter outlines the results of the relations hip between climate variability and change, food systems, food access and food prices and how these factors are perceived to effect vulnerability. Amidst many perceived vulnerabilities one of the most prominent was rainfall variability. Therefore, rainfall variability is e measured against crop yields and the quantification of rainfall variability is addressed in a holistic manner. While there are consistencies with perceptions in the meteorological records there also exist discrepancies and incongruencies. The incongruencies are addressed in this chapter and food systems and food prices are found to be out of reach of the respondents. The chapter ends with a review of policies which impact on the conditions which are observed both quantitatively and qualitatively in the study area

CHAPTER VI

DISCUSSION

Introduction

The chapter discusses the perceptions of the NLM respondents about climate variability and change as well as the factors influencing perception and the determinants of Adaptive Capacity. The sustainable rural livelihoods approach is adopted to discuss how the five capital assets affect and are affected by climate variability and change. Crops and rainfall variability are also discussed as well as the nuances characterizing the current and historical effects of food systems on the climate, food prices and food access. The chapter also discusses issues of food safety amidst the scourge of food insecurity and malnutrition in the study area.

The perceptions of the NLM respondents about climate variability

The imperative to funnel United Nations Framework Climate Change Convention (UNFCCC) mandates to the lowest levels of society stands by linking global contexts to local context (Burgess et al., 1995); as well as linking relevant research which seeks to understand vulnerability from the perspective of the vulnerable were achieved in this study (West et al., 2008). The study also gives credence to the assertion that "integrating the views of the people most affected by droughts with scientific views on rainfall trends is crucial if we are to understand the effects of regional climate variability and change on societies and their ability to adapt" (West et al., 2008, p.302). Incidentally the findings on the perceptions of the impacts which result in sustained vulnerability also indicated that climate variability as a phenomena is a 'social ecological system' which "cannot be understood relying on science alone" (Byg & Salick, 2009, p. 156).

The rural communities of Nqgushwa Local Municipality perceived that climate variability and change had made their livelihoods difficult to manage like it used to be in the days of their youth. The vulnerability of rural households and communities' livelihoods were mostly perceived to be manifested through the difficulties with food production. The survey questionnaire, the HFIAS, and the HDDS indicated the extent of food insecurity in the study area. The cultural and social context within which the environmental/climate variability changes were perceived to occur indicated that the perceptions and experiences of rural communities can be different to those of the American public (Leiserowitz, 2005) who were predominantly concerned with non-human nature impacts of climate variability on the poor as experienced by the farmers of the NLM study area.

It is evident that climate variability and vulnerability to its adverse effects is highly perceived by the Ngqushwa farmers. With a 84% climate variability and change perception score and 26% undecided, the odds of climate variability not occurring in the area are quite low. The involvement of women in agriculture is also a determining factor of perceptions of climate variability and its related changes. Income was not a significant factor influencing perception and was only statistically significant at one confidence level yet income decreases the probability to adapt. This signifies the low incomes in the area, where homogeneity of income is the norm with the least variation. This study also profiles the extent and nature of determining factors adaptation strategies to climate variability and its related changes.

An interesting finding from this study was that the majority of the respondents had experienced the severity of changes brought by climate variability on their livelihoods as well as its impact on their food security. Yet the adaptive strategies adopted at the study area are not well coordinated to the extent that everyone benefits equally from their adoption. While perception of the changes is rife and almost uniform, different households adopt different adaptive strategies and the resultant positive impact on their crop production is not entirely similar due to the factors presented in the results section which include the necessity of better income for better adaptation. The stark reality is that the majority (52%) of the respondents is very poor and they earn less than R1000/$90 per month. In addition, this individualistic manifestation of adaptive capacity could be attributable to the observations of Kahan et al. (2011) which hold that the cultural commitments at the collective level can be characterized by citizens' failure to converge on the best available means on how to promote their common welfare.

While common welfare may be challenging to galvanise where household have very little to share it has indeed been fostered through the small-scale crop farming (food security) projects whose success is largely dependent and reliant on the availability of rainfall. Still the adaptive capacity of those practicing rainfall - dependent food production is not adequate and leaves the community vulnerable to socio-economic vagaries and related vicissitudes. Hence, the fluctuation of rainfall incidence has led to the large scale abandonment of field cultivation in the study area. These vagaries and vicissitudes include the inability to make profit from sales of produce, poverty and hence the relegation of one's social status. In a country (South Africa) that has one of the widest inequalities, income gaps and the highest Gini Co-efficient (the aggregation of the gaps between people's incomes into a single measure) which stands at 65.0, (Rawson, 2012, Kiersz, 2014) climate impacts such as have been perceived by the farmers of Ngqushwa Local Municipality, will only deepen the severity of the vulnerabilities and escalate the associated risks even further. Access to social grants, have, to a great extent been able to assuage the impact of low incomes as well as to help adapt to climate variability by supplementing domestic food reserves through food purchases. Despite the short-comings of poverty and limited access to livelihood diversification strategies the determinants and enablers of adaptive capacity vary in their effectiveness and will be discussed below.

Factors influencing perceptions

The NLM study revealed that while high perceptions of climate variability and its changes by this rural community are influenced by age, farming experience, gender, marital status, education, household size, income, and farm size the most significant influential factors are age, education, household size and farm size. All the factors were found to be significant for determining perception. It is highly likely that in a community which has experienced historical marginalisation the level of livelihood asset deprivation may foster the significance of the afore-mentioned factors in influencing perception. From the interviews, it emerges that these villagers are using all the necessary resources which are deemed essential to perceive the changing world around them in order to ensure survival and to boost resilience.

The age of the respondents influences perception of climate variability and change relative to the length of the time the related changes were perceived to occur. The results indicated that the longer the person lived the higher the likelihood that climate variability and concomitant weather event changes would be perceived. As shown by the results, while the difference in educational level was not significantly variable for the community, education influenced the perception of the incidence of climate variability and change. The value of education to help better inform public opinion about socio-economic and environmental changes was also a matter of significance in galvanizing awareness about the climate variability risks and vulnerabilities faced by the community. Yet while this study finds the degree of perception to be linked to educational level Kahan et al. (2012) found that people with degrees of science literacy were not most concerned about climate variability and change and its impacts.

The household size also impacted the extent of perception. The larger the household size the greater need to be reliant on various livelihood assets to feed its members. These assets included the household gardens and small-scale farms. Farmers with large households felt the adverse impact of climate variability on their farming since more resources were essential to sustain livelihoods for larger families. Moreover, the impact of climate variability on farm size was perceived. In this predominantly rain-fed agricultural landscape the impact on farm size has been manifested through the shrinkage of farm size which is largely attributed to perceived rainfall variability. Therefore, one of the greatest limitations which has been experienced in the four village households includes the lack of access to varied water sources. Water scarcity is a threat which is significant in the sampled NLM study area while poverty and low incomes are also impacting on the capability of the households to offset lack of income diversification. Water scarcity has exacerbated food insecurity and aggravated the impact of climate variability on the poor rural communities of the NLM.

The Determinants of Adaptive Capacity

The determinants and enablers of adaptive capacity have included gender. The majority farming participants, who are household heads, are female. This category of household heads and the uneducated are invariably poor (Leibbrandt et al., 2010). Yet this gender category may be critical to ensuring greater adaptive capacity. While in an environment of little to no mechanized farming tools physical strength is crucial for better adaptation, the strength of the man may not determine adaptive capacity than the numbers of women farmers. Also, while age is a weakness when considering hard farming labor, age can be an enabler of adaptive capacity when considered as a possible contributor towards greater knowledge output and experience. In order to counter physical strength weakness and the vulnerability of this community to food insecurity, an increase in the number of the unemployed youth in farming could play a significant role at assuaging the vulnerability of the elderly (Aliber, 2001) as well as to stem the tide of future climate risk. Indeed, and sometimes, age may not always come with experience but the youth have cellphones and modern information technology tools to help access the most effective adaptation trends under climate stress.

The family unit is also crucial to adaptive capacity. While marital status may come with possible pecuniary stability as more people devise and undertake income generating activities and livelihood diversification strategies, it is not a determinant of adaptive capacity in this study area. As stated in the previous section on factors affecting perception, poverty is an impediment to adaptive capacity, spurs risk on, exacerbates vulnerability and impedes socio-economic growth.

According to the results of the regression analysis, while the people of this study area do not have higher education qualifications, the educational levels are low, and homogenous the slight differences and decreases in educational level seemed to indicate the probability of decreases in adaptive capacity. Therefore, educational level is therefore not an enabler/determinant of advancing adaptive capacity in the study area. Also, for those farming households whose numbers are high the ability to adapt to the impacts of climate variability increased in this community. This increase in the odds of adaptive capacity for bigger farming households also increases the odds to the availability of human capital for working the land. To this effect there is historical evidence that this rural community/study area had been practicing both household farming and field farming for many generations.

The growing of crops and livestock farming has been both a family and community tradition until land degradation (natural capital depletion) (Kakembo, 1997) and climate impacts (as found in this study) slowed the community's agricultural impetus down. While this tradition has been moribund in recent history the people of Ngqushwa used to supply raw materials to the white traders who used to live in Peddie Town (Peddie Town was once a "whites only" residential area during the early Apartheid South Africa era). The raw materials included cow-milk which would be sent to East London for processing into cream and cheese as well as sheep wool to be processed by Wool and Mohair Buyers Association (Menyo, 2013, personal communication). While on the one hand livestock farming had been a means to connect the marginalized rural black communities with the outside world through milk and wool trade, on the other crop production had always been predominantly used for subsistence purposes (Bryceson, 2000; Puttergill et al., 2011). Only in recent years (over the past 40 years), during the era of the now defunct land-locked South African homeland of the Republic of Ciskei did crop production and large-scale farming develop into a rural-urban trade commodity spurred on by the Tyhefu Irrigation Scheme.

The Ngqushwa area was also known to be a haven of vegetable, pineapple and oranges agricultural production supplying the length and breadth of South Africa and other foreign nations. Therefore, household farming was indeed a family/household tradition which had helped the communities to adapt to the diverse adversaries of food production and food security. The importance and essence of household bonds and cohesion is historically embedded in the study area. It would therefore be appropriate to deduce that “A family that farms together adapts together”.

The aforementioned state of declining economic affairs in the study area has impacted on household income. Income also decreases the odds of an increase in adaptive capacity and has had an adverse influence on the ability of households to keep their children in school past basic education (Sayed & Soudien, 2003). The regression analysis clearly shows that income is a determinant of adaptive capacity. Hence the low rate of higher education levels in the study area is a consequence of low incomes. In turn, the lack of higher education affects income levels, livelihood diversification, sustainable livelihoods and adaptive capacity. Farm size also determines the adaptive capacity of the households and small-scale farmers. The larger the farm the better the chances for the farmer to adopt to a larger surface area crop diversification strategy. From the findings, some of the largest odds for adaptive capacity to increase are attributable to both changing of cropping dates (27%) and to irrigation (24%). The changing of cropping dates has been widely adopted and is consistent with the daily household monitoring of daily weather patterns. It is consistent in the sense that the larger scale monitoring of seasonal climate for better alignment of planting dates has been a trial and error undertaking for many years since the respondents discovered the anomalies in the incidence of both rainfall and favourable temperature conditions for crop cultivation. To a somewhat favourable extent, the respondents have been able to plant their crops at later dates in consonant with what they call "late rainfall patterns". However, the inability to rely on their indigenous knowledge forecasting mechanisms such as the appearance of the itsikizi (Southern Ground-Hornbill) has limited their ability to prepare for planting. Invariably the intsikizi appears too often to tell of imminent favourable climate conditions such as rainfall – the intsikizi comes only to feast and share with humans on the food produced by the households.

Such a limitation and other similar forecasting limitations as set out in the results chapter have portended the demise of crop production for many seasons within this community, leading to shattering vulnerability and increased risk to food insecurity. Even though forecasting is a major challenge, irrigation and rainwater harvesting have enabled an increase in the capacity to adapt by providing water reserves in times of prolonged water scarcity. Irrigation, which for purposes of this study includes the use of rainwater harvesting tanks at household level, increases the odds to adapt to climate variability and rainfall scarcity.

The provision of irrigation is linked with the availability of adequate extension services. The agricultural extension officers in the study area did not seem to be adequately trained to deal with the consequences of climate variability on food security. There was no evidence of training programmes for the famers for the purposes of fostering efficient adaptive capacity and resilience building. Hence, the regression results clearly showed that there is a link between decreased extension services and the high probability of a decrease in adaptive capacity. Consistent with some of the findings of this study Acquah (2011) in Ghana;

Hassan & Nhemachena (2008) in 11 African countries; Mulatu (2011) in Ethiopia find that changing planting dates, different crop varieties, soil conservation and water harvesting were the major adaptation measures to climate variability and change impacts. It is therefore a trend in Africa to find rural farmers adopting similar adaptation strategies to cope with the impacts of climate variability and change. The significance of the homogeneity of the challenges of the African rural landscape is reminiscent of the damage caused by endemic colonial rule which left Post-Apartheid South Africa and other states lagging behind in finding their agricultural trade, technologies and adaptation footing amongst the nations of the world. It is therefore a welcome gesture of historical significance and climate justice for food security, that the top polluters of the world; the United States of America and The Peoples' Republic of China have reached an agreement to significantly reduce carbon emissions. The United States would cut its 2005 level of carbon emissions by 26-28% before the year 2025. China will peak its carbon emissions by 2030 and will also aim to get 20% of its energy from zero-carbon emission sources by the same year (Hoye & Yan, 2014). The following section will discuss the findings of the focus groups from a sustainable rural livelihoods perspective.

Sustainable rural livelihoods approach, adaptive capacity, vulnerabilities and risks

Natural capital

The extent to which the respondents have reported water scarcity tells of the significance of ensuring adaptation strategies that will help mitigate the impact of climate variability. In order to establish a society based on democratic values, social justice and fundamental human rights the constitution of the Republic of South Africa {Section 27(1) (b)} provides that everyone has the right to have access to sufficient water. While it may sound banal, while the provision of water taps for each household is essential to adaptation, sanitation and environmental health standards yet the expedited access to this natural resource right is not prioritised by the NLM for its predominantly household farming community. In a historically agriculturally active landscape the natural capital asset base of the study area is largely dependent on the availability of water resources. In its estimates, the World Health Organization states that a human being needs between 25-50 litres of water a day to maintain basic health and hygiene. The afore-mentioned amount of water is called a human being's Basic Water Requirement (Gleick, 1996). The distance, availability, assurance of supply, and upgradability of water services is essential to sustainable livelihoods. In consonant with the priorities of the Reconstruction and Development Programme as well as the NDP mandates availability must be on a regular basis; assurance of supply is synonymous with clean water supply; and upgradability refers to the extent to which communities can upgrade a basic service to a higher-level household connection (Republic of South Africa, 1994). Firstly, the latter mentioned issue of the upgradability of water supply services to meet the needs of the NLM community is a challenge that is stalled by the long-standing approach of communal taps. While the rural households used to draw water from communal rivers and streams, times have changed and the environmental toxins pose many health related risks and threats to modern rural folk.

Therefore, in every sense of the word upgradability of water services in the study area is a "watershed" undertaking that requires prioritization to help build resilience, adaptive capacity and food security. Secondly, the respondents were critical of the quality of water they have been accessing and expressed doubt about its suitability for human consumption ever since they suffered from shigella after consuming it. Shigella is "a genus of Gram-negative, facultative anaerobic, nonspore-forming, nonmotile, rod-shaped bacteria closely related to Salmonella (Rigi et al., 2013). The (CDC) Centre for Disease Control (1996) found that in the United States of America Shigella was associated with drinking water as was the case in the NLM study area. Linked to natural capital is financial capital.

Financial capital

As stated before the community in this study area is very poor. The inability of NLM patrons to adequately stretch their incomes to help enjoy retirement like the middle class and the bourgeoisie is a great challenge of global proportion. The elderly comprised much of the farmers in all the 4 villages. Consequentially they earn old age pension grants. These elderly people did not leave the impression on the researcher that they were farming or growing crops in their gardens and fields, because they just 'love' to farm but because they were forced by life's circumstances to work the land. Many have seldom taken a break from hard labour since their youth. Yet the old age pension grants which they now have access to have had a long history of financial capital deprivation. In what could be perceived as generosity that began in the 1920s and the Great Depression, the world witnessed the enacting of the old age social security/ pension grants as is currently the case in South Africa and many other countries today.

In South Africa, during the 1920's, the old age grant was first distributed among the poor elderly white population as largesse and was extended to the coloured and black population during the late 1930's and early 1940's (Callinicos, 1993). The coloured folk earned more than their African counterparts. The value of the grant for a white person was seven times the value of the old age pension grant for an African. The disparity was corrected at the dawn of Post-Apartheid South Africa in 1993 so that the different racial group recipients can access welfare benefits on a level playing field. To some degree the disparity has been able to restore human dignity to the black people of South Africa. However, the generosity referred to above belies nobility and altruism, and is much more akin to largesse and political expediency.

In the 1930s the Great Depression caused soaring unemployment and worldwide poverty. The families in the rural areas and particularly those in the reserves suffered the most and the black women were migrating to urban centres to seek employment as domestic workers so that they could feed their emaciated children. The political climate was also quickly charged and changing as more black people were forming unions while the ANC was gaining favourable political ground among the black races. There were also reports of political unrest and instability in many other parts of the world - Asia, Australia, Europe, and North and South America. Such political unrest was met with divers' forms of dictatorships (Digital History, 2014). For instance, it was military dictatorship in Argentina; fascism and militarism in Germany (Adolph Hitler and his Nazi Party), Italy, and Japan; totalitarian communism in the Soviet Union (Joseph Stalin's Great Purge of peasant farmers); and welfare capitalism in Canada, Great Britain, France and USA (Digital History, 2014) (enacted as national old age pensions, unemployment compensation, aid to dependent children, public housing, and federally subsidised school lunches).

In South Africa the same welfare capitalism was enacted, yet it was mixed with segregation legislation against Black, Indian and Coloured South Africans, primarily to ensure the curtailment of black economic freedom, including a prohibition on forming unions which had the potential to express the growing black political discontentment (Callinicos, 1993). Essentially, South Africa's form of inequitable welfare capitalism was for political expediency because it sought to stem the tide of political unrest for the benefit of white minorities as well as to pacify the black political milieu for a few years until the calamitous 1960 events of Sharpeville unearthed and upended the peaceful underground anti-apartheid movement.

The financial capital of the NLM residents is largely comprised of social welfare grants. While such a benefit is not a great means to economic emancipation, it is a step forward for millions of South Africans who would have otherwise gotten destitute and grossly disadvantaged. This South African story of social grants also reminds one that even the worst of times such as those of the apartheid era can have the potential to lay a foundation for economic relief and adaptive capacity in times of dire vulnerability and risk. Undeniably, today the ANC government is reaping the benefits which its predecessor sought to gain, albeit its predecessor's approach and political formula was not universally acceptable and sustainable in a world of changing social values and political imaginations. It is these same imaginations and ideals which equip the people of NLM with the will and resilience to survive the perceived impact of climate variability and change on their food security and rural livelihoods. Before the researcher parted with one of the elderly respondents, he said to him "While we do not know what else this climate variability and change will change we must make sure that it does not change us but only itself".

Physical capital and human capital

The respondents of the NLM do not have access to affordable transport, adequate water supply and access to information about climate adaptation. The influence on the sustainability of their livelihood system is manifested as food insecurity. Consequentially, in this community there are limited opportunity costs or 'trade-offs' as suggested by Kollmair & St. Gamper (2002) as ideal alternatives for access to climate variability and change education and off-farm income generation opportunities which help offset the impacts of climate variability on livelihoods. The households of NLM are largely without access to physical infrastructure such as irrigation facilities and the few who can afford have relied on rainwater harvesting tanks. Bulcock & Schulze (2011) model just how often a typical family's daily household water needs can be fulfilled by rainwater harvesting (RWH) under present and future climate variability and change conditions in the eastern parts of South Africa which include the NLM. Yet a 2500 litre rainwater harvesting tank costs approximately R3000/$270. Many of the households earn far less than R3000.

Owning a rainwater harvesting tank is a luxury in this study area. The long periods of time spent by the majority women who are burdened with making sure that homes are food and water secure average an hour. This could be time better spent on more productive activities such as helping the children with their schoolwork and other less labour intensive work around their homesteads. In a global society where women labour is not highly valued, it is essential to both social and environmental justice that all forms of climate justice and transformation recognize the burdensome impact the lack of physical infrastructure has on women. The following quote indicates the plight of the majority of the world's population, women, who live below the poverty line in rural areas such as the Ngqushwa Local Municipality.

> Rural women the world over are an integral and vital force in the development processes that are the key to socio-economic progress. Rural women from the backbone of the agricultural labour force across much of the developing world and produce 35-45% of Gross Domestic Product and well over 50% of the developing world's food. Yet, half a billion rural women are poor and lack access to resources and markets (Geneva Declaration for Rural Women, 1992).

Food processing largely rests on the hands of women who comprise a majority of the agricultural human capital. The women are involved in all the processes of food production; essentially from "farm to fork". Women produce more than 60% of all food grown in developing countries yet the value of women's unpaid housework and community work is estimated at between 10-35 % of GDP worldwide, amounting to $ 11 trillion ($11,000,000,000,000) in 1993. The world is robbing women of their dues. Since in the form of women's labour, human capital is invariably available to feed the mouths of the NLM families, the multiple contributions of the women to the family, to democracy and to development must be acknowledged and properly valued through equitable wages and assistance from both men folk, the market place, the governments and the entire civil society. Still the contributions made by both women and men in strengthening adaptive capacity and resilience of rural farming systems are evident through social capital relations.

Social capital

'Social capital' describes the extent and nature of relationships people have with others, services, institutions and systems. The concept is linked to social cohesion, economic wellbeing and sustainability. The concept can also be adopted to broaden sustainability to include adaptation and resilience to climate impacts. The various networks of social who come together to collectively resolve problems they face in common is the one of the greatest measures of the strengths of social capital (Lochner et al. 1999). The social capital of the study area has been found be evident in networks of trusting and reciprocal relationships which have been forged through constant intermingling during the agricultural endeavours. During the ploughing and cultivation of soils the community, both men and women get to engage in ways they seldom do in their cultural or traditional roles. Agriculture was found to unite both and women by focusing their collective goals towards the common good. The common good in this locality has been, is, will in future be, food security. Everyone understands that all need to eat and so it is common knowledge that this common good can only achieved through traditional common labour.

It is said that in this community it was common for a stranger passing by the road to assist a farmer who was working on the land. The stranger would offer his help by tilling, watering or harvesting, depending on what the farmer's need was at the time. As stated in previous chapters the community had also perceived the myriad environmental changes besetting the community. Although they had limited understanding on how to build resilience, they resolved to take collective and decisive adaptive action to ensure sustainability of food production and food security for their families. This environment of shared knowledge, labour and equal representation of ideas on how to adapt food production to divers' is akin to the concept of the commons (Dietz et al., 2003; Ostrom et al., 1999). The social capital networks and reciprocal relationships build the community's resilience to the negative impact of climate variability and have also shown their effectiveness at looking after the environment for many centuries (Ostrom et al., 1999).

The “commons” concept has its critics, including Harding (1968) whose” tragedy of the commons” held that human behaviour is inherently selfish to be allowed to be left to their own devices. Harding (1968) argues that users of natural resources will deplete them in the absence of governance by some higher authority such as by a private enterprise system or by ownership and regulation by the state – socialism. Indeed, at some stage, part of the natural capital of the NLM has been depleted through overgrazing; however, the depletion was a consequence of institutionalised apartheid forces that sought to keep the black population in the marginal areas of the landscape.

Overpopulation ensued and overgrazing took root as well and manifested as environmental degradation/soil erosion (Kakembo, 1997). Despite these challenges, the rich heritage social capital of the NLM has flourished. The NLM social capital creates an enabling environment for its members to learn how to co-operatively work with each other for the common good – water and food security. The history of food production through the MFPP and the off-shoots of the MFPP – the Siyophumelela and Siyakhula agricultural projects as well as the household gardens/small farms is an indication of the will to co-operate, survive, adapt and thrive. An example of effective resource management by the commons of NLM is related to the researcher by the leader (Mrs Mgwayi) of the partially irrigated Siyakhula project (Mgwalana village). Mgwaba (personal communication, 12 October 2013) stated that the community was keeping a close eye on the water consumption of the project. For instance, during a dry season the project members were summoned to a community meeting when the elders of the village got concerned about the receding levels of the local dam (pond) from which the irrigation infrastructure was connected.

The project members were reprimanded and given a quota on how much water and on how many days they could turn on the water-pumping generator. Indeed, as Ostrom (1999) asseverated, the cultural commons (social capital) are effective at managing natural resources without the interference of state and/or private enterprises. The commons concept, as exemplified by the social capital of NLM reminds the researcher that sharing is caring and that sharing is not only about caring for oneself, one's family but also about caring for both the environmental and socio-ecological relations affecting sustainability and sustainable livelihoods for the greatest number of species for the longest of times.

The impact of climate variability and change on food access is closely linked to the food system and its value chains. The following section discusses the interconnected of the global change trends influencing food prices and food access.

Maize/Crops and rainfall variability

South Africa is characterised by water scarcity which places considerable strain on rural communities which rely on rainfall to sustain their livelihoods. The irregularity in occurrence, timing and distribution of rainfall renders these rural communities susceptible to low crop yields just as the results have shown for the study area. The study has shown that the household farmers perceived climate patterns to have changed considerably over the past 40 years. The climatic patterns impacting on household food production and primarily on crop production are largely perceived and manifested as both erratic and decreased incidence of rainfall.

While it is possible for meteorological data not to validate the perceptions of humans (Moyo et al., 2012) the results from this study show that there are plenty of corroborations. The climatic data corroborated the farmers' perceptions which indicated that significant rainfall variability had occurred over the 40 years. The perceived timing of drought and dry spells as well as that of the incidence of other anomalies such as flooding were corroborated by meteorological data.

However, over the longer time period of a century meteorological data shows rainfall variability to be a normal feature of the study area.

The cyclical incidence of rainfall anomalies over the century (1900 – 2011) indicates that rainfall variability has been a characteristic of the NLM. Yet over the 30 years under analysis (1982 – 2011) the occurrence of drier than normal years has been more frequent than in the other years. The inability to obtain crop and maize yield estimates and records for the past century also posed a limitation to a more in-depth rainfall-crop correlation study. Even a 50 year -long study could have unearthed some significant trends about the time-scale trend of the link between rainfall and crop yield. While the study does not use spatio-temporal analysis tools like GIS and Remote Sensing to interrogate the extent of the rainfall-crop trends as adopted by Odekunle et al. (2007), the use of empirical data analysis methods has yielded relevant results for future applicability and policy formulation.

Surely, and besides their relevance to researcher output records, the farmers who live in large spatial areas would need relevant maps which detail rainfall variability affected areas, to better plan for “precision agriculture”. However, the spatial scale of the study area is rather too small to allow the maps to be of significant applicability as decision support systems for household precision agriculture. The perceptions of rainfall variability and its attendant changes linearly corresponded with the crop yield decline estimates, both perceived and recorded. The cropping seasons have been invariably affected by the variability as shown by the correlation analysis.

The other limitation of the study is that it does not analyse the other climatic parameters (e.g. vapour pressure, temperature, solar radiation and wind speed) owing to the relevance of the most highlighted and most perceived parameter, rainfall infrequency, as a major contributor to the vulnerability of crop yields in the study area. Therefore there is still a need for future studies to investigate the extent of the afore-mentioned climatic parameters on crop yield in the study area.

Because of rainfall decline, large-scale communal field maize and crop farming have been abandoned. In a land that is historically and traditionally a farming haven in the Eastern Cape, south of the Kei River, the large scale abandonment of field cultivation signified an historical anomaly for staple food production. Some of the climate variability challenges of the study area may be linked to vulnerability to El Niño phenomena.

The El Niño Southern Oscillation (ENSO) and crop/maize yield

A group of climate scientists (Lizumi et al., 2014) sought to examine the reliability and timeliness of global crop failure forecasts in order to help governments, insurers and farmers to plan accordingly. At this global scale, Lizumi et al (2014) assess the effect of the climate phenomenon on global yields of maize, wheat, rice and soybean. Iizumi et al. (2014) also present a global map of the impacts of El Niño on major crop yields and quantify its impacts on their global-mean yield anomalies. Results show that El Niño likely improves the soybean yield by 2.1—5.4% but decreases the yields of maize, rice and wheat by −4.3 to +0.8%. However, the global yields of all four crops during La Niña (sister phenomenon of El Niño) years show anomalies (−4.5 to 0.0%). El Niño phenomena also caused severe rain shortages 1991/92 and 2006/07 in Southern Africa. Subsequently, regional maize production fell by 10-million tonnes in 1991/92 and caused economic growth to plummet quite steeply (Cropley, 2009). The last time the world experienced an El Niño was in the years 1997/1998. The El Niño Southern Oscillation produced the most severe droughts of the 20th century in Southern Africa, Malawi, Madagascar, and Zimbabwe affecting the production of maize, cassava, and sweet potato.

In South Africa, previous El Niño’s have made summer rainfall months December to February to be drier, particularly in the eastern and north –eastern areas (Nicholson & Entekhabi, 1986; Dyer, 1979). The temperatures have also been found to be warmer than normal. If this trend continues, this could mean greater vulnerability and risk to the rural communities which depend on staple maize farming. The El Niño drying effect could also severely affect South Africa's neighboring countries like Zimbabwe, Mozambique and Botswana who in varying amounts receive maize crop imports from South Africa. In 2014, South Africa has the largest maize surplus and is expected to remain the main regional import market for all SADC member states which are ravaged by maize deficits. These countries, include Botswana, Lesotho, Mozambique, Namibia, Swaziland, and Zimbabwe are very much likely to meet their maize import requirements (projected at 1.4 million MT) from within the region. There is an approximately 66 percent chance that an El Niño will develop by the start of the 2014/2015 cropping/rainfall season (Assumptions for Quarterly Food Security Analysis, 2014).

The impact of the El Niño phenomena can be avoided by big agriculture given that they have access to irrigation water but the small-scale farmer and household subsistence farmer will experience the below average rainfall without abatement. The rural community of NLM is likely to be most vulnerable to the El Niño phenomena and at risk of future difficulties whose scale cannot be precisely determined or measured without early warning systems put in place for their convenience. South Africa saw high food prices and insecurity partially owing to El Niño events. Following the co-incidental El Niño short rain events of 2006/07, in 2008, "slightly more than half of South Africans said there were times in the past 12 months when they did not have enough money to buy food that they or their families needed".

In addition to having little money, NLM famers have grappled with land degradation which has escalated the impact of climate variability and El Niño events on food security. Therefore, the restoration of degraded lands through land rehabilitation techniques such as reforestation, in addition to the already adopted crop diversification, and use of improved crop varieties could position the community to find alternative economic activities that might help overcome poverty and risk. Policy imperatives should include emergency response services that will form the bulk of responses to El Niño events, such as flooding and drought disasters. These emergency response mechanisms should be devised collectively with the residents, and managed at the local municipal level. The approach against vulnerability should no longer be reactional but proactive in order to stem the tide of recurrent incidences of vulnerability. The strengthening of adaptive capacity must be proactive and as required, for effective measures for curbing climate variability risks to be fashioned to include better water management and sharing of weather pattern information. In terms of global change the household farmers of the NLM are not only vulnerable to the environmental and bio-physical changes but also to the economic and trade forces and the entire food value chain. In modern society food access is almost impossible without global agricultural trade. The following section looks into how global change affects food access.

Food systems, food prices and food access

The perceived amount of money that NLM households spend on food averaged R700 for every R1000. The rising costs of buying food were a major challenge facing the palates of the study area. Given that 80 percent of the respondents are social grants beneficiaries, the rate at which food prices rose far outstripped the rate at which their social welfare grants increase over time. Rural households pay more for food than their urban counterparts (National Agricultural Marketing Council, 2013). Jooste (2011) of the NAMC explains that the reason behind higher rural food prices is related to higher transport costs which include the frequency of trips to and from the suppliers as well as volume/no volume discounts, stock losses and loading costs. Table 6.1 shows the food commodity prices over a period of 5 years. The average price increase is 34% which means 6.8% per annum which is well above the Reserve Bank’s targeted inflation rate of between 3 and 6 %.

Table 6.1: Food Commodity Price Increases over 5 years

Food Commodity	Price in Jan 2008 (Rands)	Price in Jan 2010 (Rands)	Price in April 2013 (Rands)	Price Hike in 5 years (%)
White Bread (700g)	5.89	7.83	10.11	42%
T-bone (per kg)	56.02	60.76	78.60	29%
Milk (1 Litre)	8.46	9.89	11.16	25%
Cheese (per kg)	71.73	82.67	100.47	29%
Oil (sunflower 750 ml)	12.70	12.81	17.02	26%
Broccoli (per kg)	20.26	26.33	41.08	50%
White Sugar (2.5 kg)	14.79	18.15	24.65	40%
Chocolate (100g)	7.93	9.44	11.94	34%
Average Price Increase % for the eight commodities over 5 years				34%

Source: Jooste (2011)

The NLM respondents recognised and reported that fuel prices are one of the chief drivers of food prices and food access. The (EFC) Eqstra Fleet Consulting (2014) team draws on startling statistics which show the extent of fuel price hikes. The EFC (2014) states that

> it is alarming to note that within 15 years the price of fuel has increased by more than 560%. This increase is equal to an average increase of 13% year on year. Considering the average CPI over the same period was 5.25%, effectively fuel increases have surpassed the CPI index by a staggering 247%.

Over the past 5 years the price of petrol has risen from the highest price of 10.70 cents to the highest price of 13.55 cents by the end of 2013; by approximately 80% (See the price trend in Table 6.2 below). Over the past 5 years the year with the highest fuel price increase was 2008.

Table 6.2: Price Trends in (R) Rands from 2008 – 2013

YEAR	2008	2009	2010	2011	2012	2013
Low	7.35	6.01	7.86	8.73	10.61	11.86
High	10.7	8.05	8.72	10.77	12.22	13.55
% change/year	31.3	25.4	9.9	19.09	13.2	12.5

Citing the period in 2007-2009, Jacobs (2012) describes how the upsurge in food price inflation as well as the 2008-2009 economic down-turns caused approximately 12% of South African households to report experiences of hunger in 2007 and 24 % by 2010. “From 2007 to 2008, the proportion of households in which adults and children experienced hunger increased in seven out of nine (South African) provinces” (Jacobs, 2012). Jacobs (2010) stresses that

> The combined impacts of two intersecting livelihood shocks - rapid food price inflation and the economic downturn - affected virtually all South Africans in 2008. Evidence of sharply rising food prices- particularly retail prices of staple grains & cereals, most vegetables and meats - had become visible already towards the end of 2007. More recent statistics highlight that soaring food price inflation persisted throughout 2008 and only started slowing or flattening out towards the middle of 2009.

In addition, there have been several other factors which have been attributed to the food price inflation in 2008. These include:

- The prices of fertilisers peaking in 2008 (Okoboi & Barungi, 2012);
- Wheat stockpiles experiencing a 60-year low in the United States, Canada and Russia, the three largest exporters of the grain (Dreibus, 2008);
- Food Speculation. “Banks, hedge funds and pension funds are betting on food prices in financial markets, causing drastic price swings in staple foods such as wheat, maize and soy” (World Development Movement, 2014);

- Abolishment of subsidies, in the interest and under the influence of trade liberalisation (Moseley et al., 2010);
- Food grown for biofuels (Mitchell, 2008);
- Price distorting agricultural subsidies in developed countries (Nath, 2008).

In South Africa when comparing the price of one of South African households' essential food (cooking oil) between 2014 and the year 2000, "fourteen years ago a 750ml bottle of oil cost R4.34. Today, that same bottle costs R17.43 – an increase of more than 300 percent" (Fourie, 2014). Looking at the afore-mentioned figures it is not surprising that the NLM community is concerned about food prices and has surely felt the humiliating brunt of the impact of climate variability, price distortions and fuel hikes on their plates. The following section gives some statistics on the incidence of climate vagaries and its projected effects on food prices both globally and in South Africa.

Food prices and climate change

Food Security scenarios see food prices doubling by 2030. An OXFAM report states that half of this increase is due to changes in average temperatures and rainfall patterns (OXFAM, 2012). Portending food insecurity, in 2007 the world experienced crop failures and the largest spike in food costs was recorded after the first of these – a drought in the United States – drove food prices to unprecedented levels. However when the drought hit Russia exports were freezed and that subsequently pushed food prices further up again. The report "Extreme Weather, Extreme Prices" also warns of two scenarios which include

- A drought occurring in the United States in 2030 and raising the price of global maize by 140%;
- The same happening in South Africa could drive the price of maize and other coarse grains up by 120%, raising the price of a 25kg bag of maize meal to R355 (OXFAM, 2012).

Climate variability and change and its impacts on food prices are also suspected to have caused the Arab Spring. Another article by Tackett (2013) casts more light on the causes behind the Arab Spring uprisings. The article further states that

> From 2006 to 2011, up to 60 per cent of Syria experienced the worst drought ever recorded; it turned the country's verdant farmland into dust. "The worst long-term drought and most severe set of crop failures since agricultural civilizations began in the Fertile Crescent many millennia ago…Because of the devastating drought, hundreds of thousands fled the rural farming areas and moved to the already struggling cities. President Bashar Assad's regime mismanaged natural resources, such as water, and largely ignored sustainable agriculture, thus exacerbating the situation…As water became scarce, and farmers turned to groundwater. Syria's National Agricultural Policy Center reported an increase in the number of wells from "just over 135,000 in 1999 to more than 213,000 in 2007. This caused the groundwater levels to plummet in many parts of the country. Because of the water shortages, unrest and anger at the government grew, ultimately erupting in a revolution in 2011…In Egypt, tensions rose following the skyrocketing price of imported bread from Russia, which was facing a drought of its own in 2010 and limiting exports (Tackett, 2013).

In another 2008 incident which was related to food price hikes, the Haitian lawmakers voted Prime Minister Jacques Edouard Alexis out in the hopes of defusing the looting and rioting that shook the country in the wake of soaring food prices. In Haiti, food prices had risen by between 50 – 100 % (Katz, 2008). In Mozambique there were similar reports of riots which saw at least a dozen dead and 400 people injured. The food price and riot situation got so worse that

> the government … called off a 30% increase in the price of bread. Police said they had to resort to live ammunition against protesters after running out of rubber bullets. The government (has) apologised, saying it had never authorised the use of lethal force (The Economist, 2012).

The OXFAM (2012) report warns that the production of maize, a staple for millions of South Africans, is predicted to plummet by 35% in South Africa by 2030 if climate variability and change continues unabated. Raj Patel, the author of the bestselling book, Stuffed and Starved, which is dubbed an incisive critique of the global food system, told the Mail & Guardian:

> The South African government has made poor choices in its agriculture policy, choosing to shore up the status quo of pre-apartheid land ownership … Look to the continent to see what happens when people reach a zenith of frustration with high food prices, persistent unemployment and a government that won't listen. Policymakers here and around [the world] know all too well—high food prices are revolution's kindling … Food prices have been driving inflation recently. Higher global food prices themselves are the result of high oil prices, food price speculation, bad weather and poor government policies. It's important to ask, though, why these factors matter, why ought oil to have anything to do with food? Why do we allow speculation in markets? Where are the grain reserves to protect us from external price shocks? Why have we become vulnerable to bad weather? Answer these questions and you begin to see that the real culprit is the international food trading system, which discourages grain reserves, encourages the world to be dependent on a few grain-producing countries and requires oil-fuelled industrial agriculture (Tolsi, 2011).

Due to the limitations on personal liberty and human dignity it is amenable to state that "the global corporate food system does not guarantee freedom from exploitation and oppression (Sumner, 2011, p. 66). Further discussion of both the global food system and the interconnectedness of its reach even to rural communities will follow.

Food Prices and Food Systems

> The world produces enough to feed the entire global population of 7 billion people. And yet, one person in eight on the planet goes to bed hungry each night. In some countries, one child in three is underweight. Why does hunger exist? (World Food Programme - WFP, 2014).

The preceding quote bears witness to the plight of rural households which are confronted with every imaginable problem which is associated with poverty. The surfeit state of global food security referred to in the quote, is to a large extent, dependent on the food system's efficiency in producing, distributing, processing, transporting and consumption of food to the most vulnerable members of the global society. Despite significant increases in global food production over the last few decades the number of people suffering from chronic hunger has increased from under 800 million in 1996 to over a billion (FAO, 2009). The NLM drought which was experienced in 2009 going into 2010 did not make things easier for rural communities and the growing number of people going to bed hungry can be attributable to the challenges facing rural communities (FAO, 2009). The state of food insecurity in the NLM study area is significantly associated with climate variability and change. Yet, while agricultural production is responsible for greenhouse gas emissions and climate variability and change (MEA, 2005; Smith et al., 2008) it is also vulnerable to 2°C predictions of global mean temperatures by the end of the 21st century, with major implications for rural poverty and for rural food security (FAO, 2006). The global population is predicted to reach 9 billion by 2050. The FAO (2006) predicts that demand for grain and cereals will increase by 70% by 2050. Clearly, such a growing demand is already having a profound impact on food prices and food access for the rural communities of South Africa. The issues underpinning lack of access to food in the study area, are largely linked to water-scarcity.

This is the case in the NLM because the subsistence and small-scale farmers are largely dependent on rain-fed and labour-intensive agricultural production (Parry et al, 2004; Aggarwal et al., 2004; Calzadilla et al., 2013). The significance of climate variability and change for these communities cannot be over-stated due to the myriad changes in the variability of the hydrological cycle which affects crop production (Easterling et al., 2007). To make the poor rural communities' climate –food security nexus defective and complicated, particularly as evidenced in NLM, there are the associated challenges which include small farm sizes, poor access to food trade markets, low investment in extension services, poor rural infrastructure, lack of sufficient irrigation schemes and inadequate policy directives (Faurès & Santini, 2008; Cousins, 2013). Clearly, the rural farming community of NLM is confronted with the stark contrast of the betrayal assertion that is pinned on the hope that South Africa is a food secure country that will sustainably translate food sufficiency into greater food security and access for the rural NLM. The opposite to that hope is true and sure to challenge rural communities and the consequences are many and unpredictable.

In both general and specific terms, for individual rural consumers and households access to food is associated with the ability to purchase food from the retailers or producers. For consumers and rural communities the price of food is extortionately priced through the mechanisms of the global macro – economic drivers which include, stock-to-use ratios, crude oil and manufacturing prices, the United States dollar exchange rate, interest rates, and income (Baffes & Dennis, 2013). In the words of De Schutter (2014), the UN Special Rapporteur on the Right to Food, “the global marketplace is brutally efficient at allocating resources to the highest bidder - as opposed to where they are needed”. Also, only eight countries which constitute only 11% of the earth’s population produce 70% of cereal exports (FAO, 2013b).

The NLM is grappling with significant inter-annual variability in climate parameters (Akpalu et al., 2008; Kalumba et al., 2013). The impact of climate variability and change on agriculture (Wiid & Ziervogel, 2012) and the associated effects of changing temperature, variable precipitation patterns, and CO_2 elevation on crop yield (Parry et al., 2004; Rosenzweig & Parry, 1994; Schlenker & Roberts, 2009; Dube et al., 2013), need to be gven greater consideration at the rural famring community (Miller et al., 2013). While advances in predicting how climate variability and change will affect future food security are pertinent, the NLM study is a significant case study on the impact of climate variability and change on localized food system strengths and weaknesses. The study shows that the food system is a very complex framework of inter–connected activities, drivers and both desirable and undesirable outcomes as set out by Ericksen & Ingram (2005) in Figure 6.1. The complex framework components clearly demonstrates that there are exogenous challenges facing food security with dire implications for the poorest members of the human race if pro-active and risk management measures are not put in case.

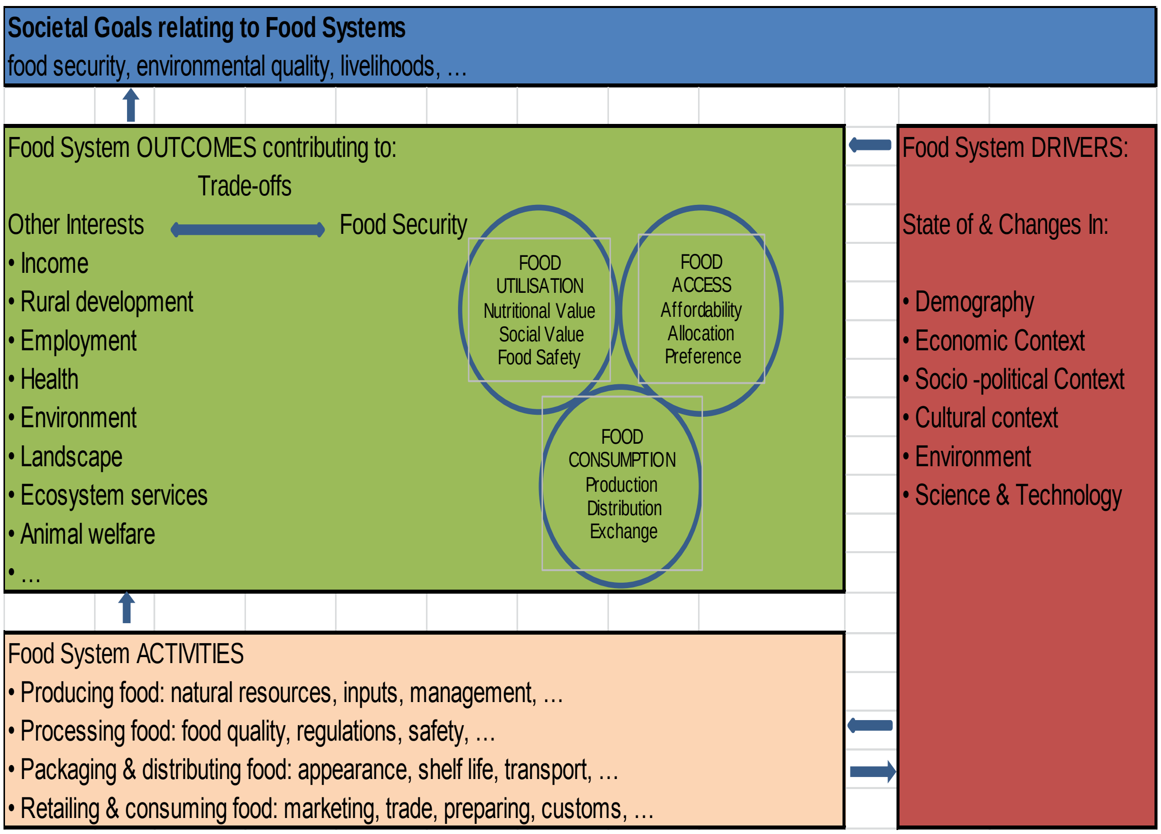

Figure 6.1: Key Food System Drivers, Activities, and Outcomes. [Derived from Ericksen (2005); Ericksen & Ingram (2005)].

One of the greatest inhibitions to food security is vulnerability to international agricultural trade inflexibility and constraints. As a means to addressing the vulnerabilities of food security to climate variability and change and international trade constraints the FAO (2014) recognises the need to remove trade distortion mechanisms and barriers and to enact more secured access to markets for all the regions and rural communities of the world. The extent of the global food system, as well as its market forces' influence on fair trade have had a negative bearing on the integrity of the South African Food System.

Greenberg (2010) points out what is the provenance of some of the challenges faced by rural communities such as the Ngqushwa Local Municipality. In the face of rising food prices and inequalities in the South African agro-food system Greenberg (2010, pp.3-4) argues that

> the apartheid agro-food system grew out of a long series of laws and policies that shifted power towards white commodity producers and agribusinesses at the expense of all consumers…The regulatory structure created what appeared to be racialised urban–rural spatial dualism in the agro-food system. This was particularly pronounced in the relegation of black farmers to the then homelands. Under apartheid, rural distribution to 'white' towns was merely an extension of the urban food distribution system. Millions of black farm dwellers on commercial farms were dependent on these distribution systems for their food. Often the connection was indirect, and they were very adversely incorporated into the value chains, since they were price takers (suppliers had more control over the price of food than buyers) and faced limited choice of product. Agricultural commodity producers and processors sold to regional or local produce markets, general dealers and supermarkets. White farmers bought in bulk and either provided food to black farm workers as part of their wage ('payment in kind'), or resold to black inhabitants on the farms, sometimes at inflated prices. In the homelands, general dealers bought food supplies through the same channels as retailers in the 'whites-only' areas did. Until price and marketing deregulation in the 1980s, retailers were price takers in some key commodities. One important pillar of the apartheid agro-food system was regulation of marketing and pricing. This regulation was a continuation of the earlier regulatory framework stemming from the 1937 Marketing Act and other legislation that regulated marketing and price control over a wide range of products. An important part of the regulatory framework was food price control. There were price controls on milk, butter, cheese,

bread, flour and maize meal. This ensured that food retailers were price takers in the maize, wheat and dairy chains, with limited power.

In the 1970's and 1980's Apartheid South Africa ran into some serious problems in the political and economic front. The global community and the domestic political landscape were demanding political and economic transformation in South Africa. Apartheid South Africa faced economic sanctions. One of the demands of globalisation was trade liberalisation (Louw et al., 2007). The apartheid state had to reduce its regulation of price controls as well as impose deregulation of the entire agro-food system. The apartheid state had little time to protect the interests of the white minority. It had to act decisively and swiftly. Therefore in several commodities this deregulation led to the emergence of systemic private interest from white agri-business and other large agricultural producers (Louw et al., 2007).

Deregulation of the agro-food system had opened up a wormhole of disaster for the consumers. Consumers suffered the most because they are invariably at the bottom of the food value-chain. The promise that deregulation would increase competition did not pay dividends for the consumer and subsistence/small-scale farmer. This meant that food commodity price volatility would shoot through the roof for the consumer; hitting the rural consumer the most as transportation and middle -man costs had to be factored into the price of food (Louw et al., 2007). As a direct consequence of the employment of the modernised food system the poster child of the globalised food system - corporate food retailing has increased in South Africa since the 1980's. For example, the food retail oligopoly (Louw et al., 2007) has six retail chains (Shoprite, Pick n Pay, Spar, Massmart, Metcash and Woolworths) which dominate the corporate food retail sector, "controlling over 94% of the grocery market between them".

Due to the growth of a black middle class, there has been nascent market movement into the urban townships and rural towns of the former homelands - Transkei, Bophuthatswana, Venda and Ciskei (TBVC) States. Spar, 'a collection of independently owned stores united by a common supplier and brand manager' (Bleby, 2012) is the leading act in the encroachment of supermarkets in the ostensibly 'formerly disadvantaged' urban townships and rural areas. In Peddie Town (one of the two urban settlements and the citadel of administration for the Ngqushwa Local Municipality) there is a SuperSpar and it turns out to be the largest and most popular retail store in the whole municipality.

While the encroachment of food retail chains is taking root in South Africa there is further expansion abroad in the rest of the African continent (ACB, 2014). Shoprite has 1674 stores in SA, '214 in 16 other countries on the continent and turnover in its year to June 2012 of R83bn. Based on retail turnover in their latest financial years, Shoprite led Spar by almost R17bn and Pick n Pay by over R26bn' (Thomas, 2012). Coming second is Massmart with 755 stores in South Africa and 58 in 13 African countries. Third is Pick n' Pay with 674 stores in SA and just 36 across four countries in Africa and 84 Franklins outlets in Australia (Bleby, 2012). Throughout the continent of Africa the expansion of the corporations is resulting in the constraint and diminution of both formal and informal small retailer operations (Louw et al. 2007). The rural community of NLM is interspersed with derelict buildings where the local business-people used to sell their merchandise. These small entrepreneurs' enterprises failed since the encroachment of Big Food/Money.

Interestingly, as if the expansion into the rural areas by South African retailers was not enough, Wal-Mart, the US's largest American employer, with a workforce of nearly 2.2 million people, acquired Massmart – a South African corporation of large warehouse-style stores such as Game, Makro and Builders Warehouse. From its Stellenbosch based offices Wal-Mart "exports about 500 000 cartons of citrus to the US, 2.4 million boxes of apples and pears to the UK and 50 000 boxes of grapefruit to Japan" (Bleby, 2012). Therefore Wal-Mart is not unfamiliar with international food trade and import and export operations in respect of South Africa.

The battle for the South African food system took centre-stage when speculation became rife that Pick n' Pay could be acquired by Wal-Mart just in the same manner that DYS (a family owned retailer of 40 years) in Chile was swallowed up by the US giant corporation. As a family owned enterprise in its own right, Pick n' Pay devised a mitigating plan for such an ominous challenge. Pick n' Pay got ready for the battle for the food system wrought about by arrival of Wal-Mart in the food retail market share by increasing its sales in liquor. For Pick n' Pay the competition for market share in the food retail sector is strengthened by selling another high demand product - liquor than by lowering food prices. Pick n' Pay's concept of creating a more inebriating market environment for the South African community may be vindicated by their good standing as the most high paying food retailer in South Africa in terms of employee salaries and wages (Stafford, 2011). Therefore such accounts imply that the placement of profits and markets before moral and ethical values of equitably sharing the world's resources have taken centre stage at shaping the future of our world. The satiation of the pecuniary appetites of the corporate world is not the ideal of the farming rural communities of South Africa. The findings of this study also imply that the NLM respondents were not concerned about the importance of the profits of Spar. Theirs is a battle for the survival of their cultural heritage of food sovereignty and the right to food, irrespective of whether one has money or not. To this community labour - the efforts of design and the willingness to work for one's dignity are more important values than money. Indeed money has value but in and by itself, is not value.

The NLM farming households have been faced with an even bigger challenge of the proliferation of Genetically Modified Organisms (GMOs) or Genetically Engineered Foods in the retail sector since their commercialization in 1999. There is growing uncertainty and controversy among civil society and scientists about GMO suitability for human consumption; nutrition and welfare; general bio safety; and ecological integrity. The origins of the commercialization of GMOs can be traced back to the widely lauded panacea of global hunger – The Green Revolution.

The Green Revolution

The Green Revolution began through the work of the biologist and humanitarian Norman Borlaug, funded by the Rockefeller Foundation, who studied techniques to minimize the loss of wheat production due to stem rust in 1944. Borlaug's team who worked in the Mexican Agricultural Program (MAP) crossbred thousands of wheat varieties of seeds from around the globe to produce high - yielding varieties of seeds. In the 1940s he developed a strain of high-yield, disease-resistant, semi-dwarf Mexican wheat which saved the lives of a billion humans globally particularly those who lived in the developing world. Against the background of famines and hunger that were experienced over many decades the success story of Borlaug's science was most evident in Post-Colonial India.

While the Asian story of Borlaug's science proved successful when it lowered food prices, reducing malnutrition and increasing crop yield (Mellor, 1976; Ryan & Asokan, 1977; Mehra, 1981; Hossain et al., 2007) there are reservations about the suitability of the Green Revolution in Africa. One of the criticisms of the Green Revolution is based on the motives of its proponents. The Green Revolution was understood by the international community to be a US foreign policy arsenal that was launched in India as a measure to impede the proliferation of communism in the face of growing hunger (Cullather, 2010). Also the US government's sentiment which leaned quite closely to the Malthusian theory of bludgeoning population rates leading to hunger and political unrest, gave the US government a reason to seek to find means and strategies to retain its capitalist agenda in India's politics (Cullather, 2010). The US's fear was that when populations experience hunger they tend to resort to communism. Therefore, the Green Revolution has been termed as both a geopolitical and a bio-political tool (Perkins, 1997; Patel, 2013) carefully crafted to serve the interests of the American government.

> The original Green Revolution emerged as a result of thinking about populations and the problem of hunger in very particular ways. Capitalism and the liberal state meet these problems pre-constrained by the sanctity of private property and the desirability of 'individual free enterprise' (Patel, 2013, p.4).

Toenniessen et al. (2008) explain the reasons behind the original/first Green Revolution bypassing the continent of Africa and cite the conditions that would make it more appropriate to implement the Green Revolution in Africa today. The conditions include:

> The "rainbow" of crop improvement revolutions that combine productivity growth for many different crops and place greater emphasis on farmer participation, local adaptation, strengthening national and local institutions, and the building of agricultural value chains that enables farmers to generate profits from surplus production. With such locally well-adapted interventions, most African farmers have the land assets adequate to provide food security and to rise above subsistence farming. To do so profitably, they need to intensify production by combining genetic and agro-ecological technologies that require only small amounts of additional labor and capital, and they need greater access to markets (Toenniessen et al., 2008, p. 235).

Yet Toenniessen et al.'s (2008) romanticised combination of genetic with agro-ecological technologies as a beacon heralding the institutionalisation of GMOs is faced with even more criticisms pertaining to food safety.

Food Safety and GMOs

The criticisms levelled against multinational corporations include trial studies which were done on animals to help determine the effect GMOs would have on them. The trial results indicated serious health risks which include infertility, premature aging, and faulty insulin regulation, changes in major organs and gastro-intestinal system and immune problems (Finamore, et al., 2008; Kroghsbo et al., 2008). Amidst claims of impressive crop yield, the (Monsanto) MON810 genetically modified maize seed variety which was made to ensure insect resistance, failed (and was discontinued as of the 2013 planting season) in South Africa due to increased pest infestation and resulted in substantially huge financial losses for the farmers (African Centre for Biodiversity (ACB), 2013 a). Yet the same MON810 GM technology will be donated 'royalty-free' to a Gates Foundation/Monsanto funded 'philanthropic' project, Water Efficient Maize for Africa (WEMA) that is being undertaken in Mozambique, Kenya, Uganda and Tanzania. "The defective GM maize is set to be approved for commercial growing by 2015" (ACB, 2013a). Yet one of the problems cited by the focus group discussants were the pest infestations which had increasingly become commonplace in the landscape. While the MON810 maize variety has been discontinued since 2013, the long-term implications of the sustained use of this GM variety are unknowable and such complaints of swarming pests during planting season may be an indication of even far greater problem going forward.

Food Processing, GMOs and Food Sovereignty

With respect to issues of nutrition and diminished dietary diversity, it is important to note that the NLM community does not consume their staple food - maize as a raw product but as a processed good – chief of which is in the form of maize meal, whose genetic make-up is predominantly bio–engineered (ACB, 2013a). NLM households, like many other communities across South and Southern Africa, prefer to purchase and consume their maize meal "Super" and "White" (Payne, 2011). During the processing of the South African GM maize, the maize is stripped of roughage and nutrients. The greyish germ of the maize, which contains oil and other nutrients goes into cattle feed.

Interestingly and as an indirect caution to ensure that people were not less healthy than cattle, in 2003, the South African government legislated that maize meal/flour be fortified with a cocktail of micronutrients - vitamin A, vitamin B1 (thiamin), maize mill in vitamin B2 (riboflavin), vitamin B6 (pyridoxine), niacin, folic acid, iron and zinc (Payne, 2011). The three largest maize milling companies — Pioneer Foods, Premier Foods and Tiger Brands which account for about 60% of total maize-meal sales are the only companies that can afford to make the maize-meal white and to also meet the nutrition government regulations. So if one who is not privy to the technology involved in vitamin and mineral fortification happens to buy and consume the maize meal, they could very well be satiated and even podgy but will remain malnourished and susceptible to immune deficiency diseases.

Of the three largest maize milling companies the latter mentioned milling company – Tiger Brands, is considered to be South Africa's largest fast moving consumer goods company (FMCG). Tiger Brands boasts an array of consumer food products which include Albany breads, Golden Cloud flour and Ace maize products, Jungle Oats, Tastic rice, Koo, All Gold, Fatti & Moni's pasta, etc (Payne, 2011). Tiger Brands GM food products are not only made for those who have long lost their milk teeth but for those who need them – the babies. The ACB (2013b) reported that Tiger Brands' Purity Baby's First contained 56.25% GM maize while Purity Cream of Maize contained 71.47% GM maize and that "neither of the products were labelled as containing GM, as required by law". Clearly, South Africans are being bombarded with GMOs from birth to death. The acquisition of the right to seed, the deprivation of capacity for food processing and the impact of climate variability and change conflate to compound the food crisis besetting rural households on a daily basis. The afore-mentioned conflation implies that food sovereignty is under attack and that new ways of feeding the world are not reliable and sustainable and neither are they sustaining.

The preceding observations by ACB (2013a; b) also imply that the people of South Africa have been sacrificial lambs for the sake of market forces. Such observations also imply that the value of corporations is becoming more than that of human beings. In the US, which is the home of the corporate giants of biotechnology, "corporations" have been conferred with 'corporate personhood' rights (Winkler, 2007). Such personhood implies that the corporations are entitled to their rights. In this respect, an indignant Quigley (2004) charges that "corporations are more powerful than any institution other than government, and in many cases, more powerful than governments. Corporations are huge amoral behemoths, acting amorally to expand market share, to hire fewer and fewer people, and to accumulate capital". Therefore, it is not surprising that the US corporations are dominating not only in their own motherland but beyond their shores. The levels of malnutrition which were gathered through the HDDS tool demonstrate the conflation of the personhood rights of corporations, climate impacts, under/malnutrition and poverty.

Since the deregulation of the maize industry in 1997 and the attendant concentration of the entire maize supply-chain around the country's three largest milling facilities, the small farmers whom once provided maize to hundreds of local mills were adversely affected by the exorbitant transportation costs of maize to the three largest milling facilities. With respect to South Africa's maize – meal oligopoly Pichulik (2013) argues that "agricultural industrialisation has hurt those that have stayed in the rural areas as well – primarily from a food affordability standpoint". He further contends that

> the craziest thing is that transport and logistics can account for close to 35% of the final cost of maize products. Therefore consumers in rural Eastern Cape pay

> significantly more for a 5kg bag of super maize meal than patrons of a central Johannesburg grocery store (Pichulik, 2013).

While the Eastern Cape subsistence/small scale farmers may be paying more for their food than their urban counterparts, one of the most ominous accounts about GMOs affecting small scale farmers is the narrative about farmer suicides in India. Thousands of Indian small farmers were killing themselves every 30 minutes because they had fallen into debt over GM cotton seeds which had poor harvest. The seeds needed more inputs, particularly water. The farmers killed themselves by ingesting the same pesticides that were shipped to them by Monsanto and died a horrible death. The NLM farmers, many of whom got discouraged with farming as a consequence of failed crop yields may also resort to drastic measures, given that many, particularly men, were reported to be cheap liquor abusers. The farmers had found theselves owing their funders exorbitant amounts of money and their toil had been in vain. The report by Malone (2008) which called the Indian farmers' suicides "GM Genocide" tells of a story of an Indian farmer and gives the following narrative:

> Shankara, respected farmer, loving husband and father, had taken his own life. Less than 24 hours earlier, facing the loss of his land due to debt, he drank a cupful of chemical insecticide. Unable to pay back the equivalent of two years' earnings, he was in despair. He could see no way out. There were still marks in the dust where he had writhed in agony. Other villagers looked on - they knew from experience that any intervention was pointless - as he lay doubled up on the ground, crying out in pain and vomiting. Moaning, he crawled on to a bench outside his simple home 100 miles from Nagpur in central India. An hour later, he stopped making any noise. Then he stopped breathing. At 5pm on Sunday, the life of Shankara Mandaukar came to an end (Malone, 2008).

Throwing caution to the wind the Prince Charles of Wales, as if to assuage and vindicate his family from the past atrocities which India suffered under the helm of Queen Victoria during the Late Victorian Holocaust era (Davis, 2001), expressed his discontentment and condemned

> “the truly appalling and tragic rate of small farmer suicides in India, stemming … from the failure of many GM crop varieties … any GM crop will inevitably contaminate neighbouring fields", making it impossible to maintain the integrity of organic and conventional crops. For the first time in history this would lead to "one man's system of farming effectively destroying the choice of another man's" and "turn the whole issue into a global moral question” (Malone, 2008; Lean, 2008).

The battle for the global food system rages on and the Prince’s words were not met without refutation and dismissal. Clearly, the food sovereignty and food safety of poor rural farmers are being curtailed by the need for bioengineering intervention as the panacea for the starving rural communities of the developing world. In order to mitigate the impacts of food insecurity and of the lack of food access the policies of the South African government might just offer relief for the rural communities of Ngqushwa Local Municipality. The MEDPT (2010) also concluded that the proliferation of GMOs was of no significant relief, convenience nor benefit to the sustainable livelihoods and food security of the Ngqushwa Local Municipality. The (MEDPT) Masifunde Education and Development Project Trust (2010) conducted a study in the Ngqushwa Local Municipality and the report found that farmers were given inadequate information and support about GMOs and its market, and that “they were exploited by unscrupulous operators when it came to selling their produce to commercial markets” (MEDPT, 2010, p. 1). Such largesse and exploitation was meted out into the NLM under the banner of the Green Revolution.

The Green Revolution in the Eastern Cape – South Africa

South Africa has implemented its own version of the Green Revolution Strategy in the Eastern Cape. The Green Revolution Strategy (GRS) is also called the Massive Food Production Programme, and in the words of the Eastern Cape MEC for Agriculture, Gugile Nkwinti (2008) it “links international markets to domestic production with backward integration reaching right into the heart of the rural areas”. The GRS is underpinned by the Six Peg Policy Framework which focuses on infrastructural and technological development in the rural areas – including but not limited to fencing, dipping tanks, small irrigation units, tractors and stock water facilities. The GRS has also been a protagonist of Monsanto’s Genetically Modified Organisms (GMOs) programme which ostensibly ‘ensures the economic growth of communities’ toiling in the large scale Eastern Cape Massive Food Production Programme. In its website, Monsanto boasts that it is “focused on fighting rural hunger … through partnerships and philanthropy” (Monsanto, 2014).

The Massive Food Production Programme (MFPP) which is aimed at rural agricultural development and food security received R350 million ($35 million) from the South African government as a subsidy for the purchase of the Monsanto products - Hybrid and GMO seeds, fertilisers and pesticides (African Centre for BioSafety, 2007). The losses of the NLM farmers are, nothwithstanding climate factors, due to Monsanto’s “world patent rights” which it holds together with the United States Government for a plant so-called ‘Terminator’ or Genetic Use Restriction Technology (GURT). Terminator is an ominous technology by which a patented commercial seed commits ‘suicide’ after one harvest” (Engdahl, 2007). These terminator seeds are the same as those the subsistence and small-scale farmers in Ngqushwa Local Municipality reported as “unsavable” for future crop production use, hence the yield and financial losses; field cultivation abandonment and abject dejection.

In the Eastern Cape, several multinational corporations were involved in the training of MFPP extension officers and communities on health and safety regulations and practices (when using chemicals in agriculture) and to introduce Monsanto’s Roundup Ready seeds and insect – resistant biotechnology (Bt) maize seeds. These corporations most of whom are involved in chemical engineering research and development, include Total South Africa (energy solutions and petroleum company), Monsanto (chemical and agricultural biotechnology, Agrizone (Agricultural Machinery, Bayer Crops and Life Sciences and Pannar (Seeds). Tellingly, the focus on health and safety training for the rural farming Eastern Cape communities speaks volumes about the safety of these corporation's food production systems. As an example, in the Eastern Cape rural village of Xopozo, Monsanto came over to train the villagers on the safe use of the chemicals and gave them the Bt seeds to try on their homestead gardens as a marketing strategy. As a consequence of her generosity Monsanto gained favour with the traditional leadership as the sole input supplier for Xopozo village (Nilsson & Karlsson, 2008). The NLM repsondents also cite the same happening in their vilages.

To meet the bottom line, Monsanto's inputs (fertilisers and seeds) are sold and distributed by the Umtiza Farm Co-operative. The Umtiza business premise is right at the heart of Peddie Town in the Ngqushwa Local Municipality. Undoubtedly, the control of the food system and the large market share is increasingly being overtaken by corporations which use Bt seeds. The (MEDPT) Masifunde Education and Development Project Trust (2010) cast a shadow of doubt on the Massive Food Production Programme. The MEDPT (2010) made the observation that "the Green Revolution Strategy projects (which included both the MFPP and the Siyakhula Step-Up Food Production Programme) … included the promotion of Genetically Modified (GM) and cash crops, (and) were neither addressing the needs of the rural poor nor leading to increased food security" (MEDPT, 2010, p. 8). According to the MEDPT (2010) and consistent with the related findings of this study the Massive Food Production Programme initiatives in the Ngqushwa Municipality posed the following problems:

- *Lack of clarity on nature of seeds*: Consistent with the findings of this study the farmers were not sure of the nature of the seeds they had been using (if

GM or ‘hybrid seeds’) and that the farmers were not saving their traditional seeds;

- *Language of Contracts Compromised:* “Contracts were written in English and only translated orally into isiXhosa, resulting in confusion and lack of knowledge and understanding of the terms of the contracts and loan repayments” (MEDPT, 2010, p. 37);
- *Lack of Transparency:* While being ultimately responsible for the repayment of substantial financial loans, farmers did not know or understand how and what amounts of the funds were spent;
- *Lack of Training:* Training was confined to basic training in technical crop production and lacking on the importance of transparency, management, financial accountability, etc.);
- *Lack of Water:* The projects relied on rainfall, with erratic rainfall causing crop production failure;
- *Late Delivery of Inputs:* Late deliveries of inputs for production delayed the planting of seeds;
- *No safety nets:* Farmers faced production and financial risks with no reliable access to irrigation water and no control over suppliers/ service providers;
- *Exploitation by Private Sector:* The GM (Genetically Modified) Cotton contract with da Gama left the farmers with partial payments for bales of cotton which were grown;
- *Lack of storage and markets:* Private sector buyers had all the power to determine prices and farmers were price takers;
- *Traditional means of crop production undermined:* Agro-chemical inputs were preferred in the place of cheaper and sustainable seeds and fertilisers;

- *Insufficient knowledge about the potential long-term impacts of GMOs:*
    - yields declining in the long term;
    - Increased resistance to herbicides, requiring greater amounts of inputs, and ever- increasing input costs;
    - Possible contamination of surrounding non-GMO crops; and
    - Negative impacts on health.

Such limitations on the sovereignty of the NLM community to determine the destiny of its food production, soil quality and natural resource base are an affront to the basic human rights of food access, availability and utilisation – food security. The afore-mentioned problems inhibit and infringe on the ability to achieve sustainable livelihoods in a changing climate. The abandonment of field cultivation is not only attributable to less rainfall over time but to the failure of GMO seeds to sustain crop production. Yet no such impact has been more felt as in the moribund yields of maize. The effect of unsavable seeds on continuity of sustainability, as well as the impact of the high prices of fertilisers and seeds on the means of crop production pose insurmountable challenges to adaptive capacity, competitive advantage and traditional food sovereignty. Ninety percent of South Africa's maize is bio-engineered with maize being designated a commercialised staple food in South Africa since the late 1990's. This places South Africa as the number one country in the world whose staple food is a GMO product (ACB, 2013c). The negative influence of GMOs on a country with a largely rural community of subsistence and small-scale farmers is an affront to the equitable distribution of its natural resource base.

Under the banner of a capitalist economic model the rich are getting richer while the poor are getting poorer (ACB, 2013c). It is the opulent food value chain corporations that are maximising their profits, while the poor rural farmers and households are getting minimum returns from the tinkering explorations of agro-business corporations. The rural communities of the developing world have been used as guinea pigs in an experiment whose outcome is unknown and whose log-term impacts on the bio-sphere are unknown. With the uncertainties of climate variability and change besetting the rural community of NLM, the proliferation of GMOs marks ‘the final nail in the coffin of sustainable livelihoods and development. The commons (Ostrom et al., 1999) have been threatened by powerful forces which hail from distant lands and whose technologies have proven to be incompatible with African soils and climates. These technologies and the economics which sanction them, are also incompatible with South Africa’s value system of the commons – Ubuntu. The call for the global food system community to return to the values and principles of Ubuntu are echoed in the words of Martin Luther King Jr when he lamented that

> I am convinced that if we are to get on the right side of the world revolution, we as a nation must undergo a radical revolution of values. We must rapidly begin to shift from a "thing-oriented" society to a "person-centered" society. When machines and computers, profit motives and property rights are considered more important than people, the giant triplets of racism, materialism, and militarism are incapable of being conquered (King Jr, 1967).

This section on global food systems, food access and food prices undertook to bear witness to the saying that “history is but the record of man's agelong food struggle”. The combined manifestation of consolidation of ownership of food production and distribution, and the globalisation of food trade have resulted in a complex set of problems for food security and food access in South Africa’s rural communities such as Ngqushwa Local Municipality. Today there is enough food on the planet to adequately feed everyone alive yet national agricultural policy and international trade do not currently result in adequate access to food for all. South Africa is food sufficient yet millions of people go to bed on empty stomachs. Therefore, in the Ngqushwa Local Municipality, food insecurity is not a consequence of food scarcity but of food inaccessibility. The NDP is touted to be a pathway to a better life for all as well as a mechanism for addressing climate variability and change and food insecurity. The next section discusses the NDP and its implications for NLM.

The NDP and Its Implementation

With respect to the implementation of the NDP and the extent of aloofness of the extension officers with regard to offering precise answers with confidence there appears to be a discordance with service delivery with respect to the commitment of the NLM agricultural department officials. Such apathy from officials suggests that the perceptions of the farmers about the climate risks facing them are sure and real and that these risks render them predisposed to prolonged food insecurity. Neverhtless it does occur to the researcher that the implementation of the NDP and its aligned polices and strategies are critical to the mitigation of vulnerability and risk management yet there are some few challenges.

The Absence of Full-scale DSD Intervention in Water Resource Strengthening

The vulnerability of the communities such as that of Prude, Benton, and Mgababa (with the exception of Mgwalana) is aggravated by the non-availability of irrigation infrastructural schemes. With respect to the DSD's initiative of building irrigation infrastructure for the villages which have natural water bodies running through their land there is much to be lauded. However, the concentration on building irrigation only for those communities which have been fortunate and privileged to have rivers or dams leaves those without these water resources vulnerable to water insecurity and hence food insecurity. Historically the NLM farming community has been reliant on rain-fed agriculture for centuries; therefore, it would be beneficial to have dams and large ponds built for them. The erection of the proposed ponds and small dams as water resource management initiatives would help the farmers to harvest water and to benefit from the DSD irrigation scheme programme. Therefore, the DSD programmes need to be more holistic in their approach to the building of excavated water resources. Given that the National Policy on Food and Nutrition Security (2013) has identified the Eastern Cape as the hardest hit with respect to food insecurity, with the prevalence of hunger standing at (66.7%), the need to reduce both real and perceived vulnerability in this community is urgent. The reduction of vulnerability is best addressed through transparency.

Transparency and Risk Management

In addition, in the face of rising input costs and the impacts of climate variability and overgrazing there is a greater need to ensure market access opportunities for the smallholder farmers' projects. Another factor which influences the perceptions of vulnerability to food insecurity is the lack of transparency characterising the administration of government-led agricultural initiatives and programmes. Therefore, it is imperative to strengthen transparency on how the funds are used for the purpose of long-term viability and sustainability of agro-business endeavours. Transparency reduces vulnerability and aids risk management.

Transparency is closely linked with the dissemination of climate variability and change information and awareness initiatives which are considered by the Climate Sector Plan for Agriculture, Fisheries and Forestry to be critical to climate variability and change mitigation. As stated in the results and findings section, there has been a paucity of both agricultural and environmental education from the extension officers. Therefore, when the extension officers are not readily available to offer their environmental education services specialising on adaptive capacity and resilience building the farmers' perception of vulnerability is heightened and their food insecurity is deepened. Therefore, of critical importance to reducing vulnerability is the need to strengthen monitoring and evaluation.

Monitoring, Evaluation and Vulnerability

The Department of Water Affairs' Strategic Plan (2013 - 2018) has set out to spend R4.3 billion to address water scarcity and quality with the help of the targeted municipalities. Looking into this Strategic Plan it is not clear how expenditure is going to be monitored and evaluated and whether there is any relation between the municipality, district and provincial government in tackling the water resource challenges at municipal level. Monitoring and evaluation of both budgeting and spending initiatives on water demand and scarcity in the local municipalities, particularly with respect to the impact of climate variability and change, should form the core of the intervention programmes aimed at providing adequate water resource services.

Central to climate change policy and adaptation is the need to ensure that adaptive capacity becomes an integral part not only of stated policy plans but also of tangible actions which strengthen coping strategies, fortify resilience and reduce risk and vulnerability for rural communities. The goal of increasing adaptive capacity and reducing vulnerability is without traction if it is not coupled with community based natural resource management (Ayoo, 2007) to help better inform budget and environmental policy decisions which direst resources where they are needed most. Therefore, the author hopes that this study will shed light on the need for well-coordinated, well-planned and well - informed policy decisions that are not generalised but grounded on localised research outputs in order to help direct budgets and expenditure in a way that truly reduces vulnerability to food insecurity in a sustainable manner.

Conclusion

This chapter discussed the state of agricultural and socio-economic affairs in the NLM. The common thread that ran through the chapter was that of vulnerability to climatic changes and their effect on crop production and hence food security. The extent of food insecurity is further validated by the results of both the HFIAS and HDDS. With the HDDS as low as 3.6, malnutrition is a serious challenge in this community. Invariably food access is therefore an issue which is linked to both rising food prices and how the food system is escalating food insecurity through 'unfair' agricultural trade policies which cascade to the lower levels of society. Linked to agricultural trade is the proliferation of food with questionable food safety standards. The poor rural communities of South Africa are most affected since food prices for most food items are higher in rural communities than in urban centres.

Climate variability and change mitigation has had a profound impact on the need to divert silos of food to burn it for agro-fuel production. Therefore, lack of food access is further exacerbated. When food prices and agricultural input prices are too high, climate variability and change has made it hard for the rural communities to continue to embark on prolonged and sustainable large -scale food production. Therefore, sustainable livelihoods are hampered and paralysed by the double exposure of climate/rainfall variability and food system/agricultural trade policies which preclude robust adaptive capacity. In a severely water scarce area of the Eastern Cape subsistence farming is therefore the last frontier for ensuring realistic levels of food security for many farming households and small-scale farmers in the study area. Government's policies are very ambitious and they seem to show respectable levels of commitment to changing the lives of poor rural communities for the better. Yet the implementation programmes are lacking in virtue and vigour.

CHAPTER VII

CONCLUSION AND POLICY IMPLICATIONS

Households and focus group perceptions

The perceptions of vulnerability to food insecurity because of climate variability and change are clearly expressed by the respondents. The respondents pointed out that their level of adaptive capacity had deteriorated over time owing to the rapidity of environmental changes which were predominantly perceived as climate related. The climate had considerably changed for the MLM respondents over recent decades and so has the agricultural landscape been adversely affected. The scale and extent of the perceptions of climate variability inform this study that for a farming community which has relied on rain fed agricultural for many centuries the elusiveness of favourable climate has rendered most of the households unable to cope with climate pressures on their food security. The Household Food Insecurity Access Scale revealed that a staggering 78% of the household respondents were food insecure. Morevover, the Household Dietary Diversity Score indicated that dietary diversity was quite low. Therefore, the study gives evidence that there is a serious case of food insecurity in the NLM which needs urgent attention and institutional intervention. The study further makes a link between big food, food security and poverty.

Poverty, food insecurity and 'Big Food'

This strategic position of multinational firms in the value chain, gives them the ability to exploit the global and national food system due to their comparative advantage. They control vast tracks of land through mono-crop and bio-technological inventions. Small scale producers in developing countries have suffered huge income losses while multinational traders have reaped significant gains. The downstream effects of the consolidated food industry and market include the increased incidence of reduced entitlements and poverty as well as growing household food insecurity. World food price hikes that result in global food insecurity have been the major cause of the incapacitating grip on livelihood assets for the majority of the world's poor. Climate variability and change has also contributed quite significantly to rising global food prices as witnessed in 2007/08. Financial speculation on food commodities has also crippled the lives of the poor; particularly the rural poor who spend considerable amounts of money on food. The food price disparity between what the urban consumer and rural consumer pays for the same food basket is fraught with challenges for the rural households, since they pay more for it. The unfair practice of price fixing by the few companies which own the global, regional and national food market is a huge burden on the rural poor as well as on small-scale farmers.

While there are other factors that may have had an influence on such parameters as soil erosion and lack of farming implements for field cultivation the prevalence of perceptions about the impact of climate variability and change is irrefutable. The vulnerability of the households to historical injustices of apartheid also adds to the vagaries of a perceivably changing climate. The existence of poverty in this NLM community is quite evident and is deepened by the risk of the inaccessibility of both farming inputs and purchased foods as a consequence of high agricultural production prices. Food is extortionately priced and it appears that there is little that the common people of NLM can do to reverse the process of escalating prices that are arbitrarily set by Big Food. The proliferation of retail food chains as well as that of corporations which own seeds and fertilisers has created a monopoly to access to good and nutritious food. This monopoly is controlled through the price gun. Ironically powerful nations have conquered nations through loaded guns, so it is no surprise that the price gun is also used by most of the same nations who used the cocked guns to take over nation after nation through the price gun. Therefore, this study has elucidated both the historical and current global food system machinations for world domination as well as how global industrial agriculture (a brainchild of the nations of the North) has contributed to the single greatest threat to humanity in the 21st century – climate variability and change. However, for this rural study area no effect of climate variability has been as concerning for the respondents as the effect of rainfall variability.

Rainfall variability and adaptive capacity

In tandem with its mixed method research approach the study also shows that the respondents claimed that rainfall variability was too elusive to help the households to better allocate agricultural resources and labour to co-incide with the incidence of rains. Therefore, the study sets out to investigate the extent of rainfall variability and concludes that there has been considerable variability over the past 112 years with most notable variation within the first decade of the 21st century. The co-incidence of global high food prices with rainfall variability over that decade has caused the study area to further plummet into an abyss of food insecurity and unsustainable livelihoods. As a result, the respondents unequivocally stated in the focus group discussions and questionnaires that their livelihoods had been adversely affected on the human, physical, social, natural and financial capital front. Certainly, the effects of the threat to food security have been greatly demonstrated in the story of maize production in the study area.

Maize and other crops in the Ngqushwa Local Municipality in both subsistence household farmers' homestead gardens and small scale farmers' fields are significantly subjected to a combination of climatic stresses, gale force wind, high and low temperatures, and rainfall infrequency and unpredictability. However, the re-occurrence of drought and long dry spells has exacerbated the incidence of crop yield decline the most, particularly with respect to the staple food - maize. Even though the farmers are using the Massive Food Production Programme era drought tolerant varieties, the recurrent drought episodes have rendered these hybrids and genetically modified maize breeds highly susceptible to drought stress in the rain-fed dependent agricultural system of the study area. The NLM community has thus significantly scaled down on maize crop cultivation and production due to large-scale withdrawal from maize crop field activities.

The study also shows that the determinants of adaptive capacity depend largely on the availability of human, financial, natural, social and physical resources. When the farmers do not have enough financial capital they struggle to secure food because of the limitations posed by the extortionate (agricultural inputs) seed and fertilizer prices. Also, related to financial capital is the decline in the quality and availability of physical resources such as greenhouse enclosures and irrigation systems for the protection and watering of crops. Adaptive capacity of food security systems in this community is severely impaired by the challenges presented by natural capital degradation due to incessant droughts and occasional floods. Human capital has also impinged on the realization of the farmers' sustainable livelihoods due to the old age of the majority of the farmers. The social capital of the village farmers is also untenable because the younger the generation which participates in agriculture and food production the better the chance for the sustainability of the rural food production trade. The younger generation is not interested in agriculture. In the rural context and taking into account the socio-economic circumstances underpinning sustained adaptive capacity, the bequeathal of agricultural skills to succeeding generations is critical to food security. In addition, rural people are yet to be exposed to relevant and efficient environmental education which is specifically designed to help mitigate the impact of the long-term unpredictable yet short term forecastable climatic changes and variability.

Adaptation Strategies and rainfall variability

The results have shown that the farmers are aware of climate variability and its related changes. The household and small-scale farmers perceptions' are quite revealing of the high level of indigenous knowledge and the attendant interpretations of the climate phenomena affecting their food security and livelihoods. While formal education has been a great challenge in more than 90 percent of the households in the study area the epistemological reflections of the respondents' perceptions show that the value of informal education is still critical to adaptation in rural communities. With respect adaptation the use of common sense and trial and error as learning curves has been the mainstay of the NLM community; albeit there have been too many weather changes for the community to keep up with. The adaptation strategies adopted to combat the adverse effects of climate variability and change included the following; rainwater harvesting; intercropping and mixed farming; use of improved seed varieties; social security grants; off-farm employment; mulching and cover cropping, changing planting and harvesting dates; and irrigation where possible. While an elusive undertaking given the scale of rainfall variability, the most adopted adaptive strategy has been the changing of planting dates. However, land issues have always been affected the food security of the rural poor.

Biotechnology, land issues and food price disparities

With respect to the land issue, while the South African Land Reform issue is worthy of attention and action for food security and market access sake, it is quite contentious. The land issue requires a close scrutiny of other non–South African policies which have yielded the best results and best practices on how to meet the needs of both the beneficiaries of both Apartheid and of Post-Apartheid land reform and restitution legislation. The problem seems to be that there is not a single African/ post-colonial country that has had land reform success stories which South Africa could confidently emulate. One of the latest newsworthy land reform exploits has been in Zimbabwe. Zimbabwe's dilemma was also confounded by the fact that some land restitution agreements were made with another government (British) while the South African farming conundrum purely and largely rests in the hands of South Africans – both black and white, commercial, subsistence, farmworkers and the landless. South Africans can resolve these issues through better transparency of intent and by minimising bureaucracy and corruption with regard to the formulation, enactment and implementation of sound land reform statutes. Moreover, the danger with stepping on the toes of the constitution as noted by Dube (2014) is a matter that requires urgent attention – the 50% expropriation which is to be done without compensation to the current owner. Also, Trollip (2014) points out that

> it is almost impossible to trace and prove that current commercial farm owners own their land directly due to colonialism, wars of dispossession, land dispossession by the 1913 Native Land Act as many farms have changed hands many times in the past centuries and, certainly, since 1913.

There are also reports that the government has not budgeted enough money for the new land claims and that it already has a back log of 30 000 dating back to the land claim era of 1994 – 1998. An estimated 379 000 new claims are likely to be lodged over the next five years (SAPA, 2014c). The questions around how South Africa will avoid a massive flight of capital, loss of investor confidence, and the collapse of the rand as witnessed during the Zimbabwean dollar's decline in recent years should haunt the land reform pundits and politicians. Also, comprehensive studies on the reasons why previous land claimants, particularly the rural claimants, have abandoned or avoided farming and opted for cash claims should be commissioned by the state.

Food security is most vulnerable to productivity shocks such as climate and weather variability and poorer countries suffer the ramifications of attendant price volatility because some sectors of the population may not be able to afford purchasing food. In a world where most of the natural assets are compromised through degradation, conquest and land tenure and environmental change, people are increasingly forced to consider purchasing their food from the market.

The study also shows that South Africa has also contributed to the proliferation of GMO foods, particularly maize, to both within its borders and internationally. Clearly, the ostensible contributions of GMOs to health and the environment in general, are under question and such issues have been extensively dealt with in this study. Similarly, the exportation of South African agricultural trade and food chains to other African states is discussed at length. The study also makes special reference to how specious it is to claim that South Africa is truly food secure when GMOs are a staple food for South Africans. Dietary diversity has not been proved to be better available through GMOs and neither have the agricultural methods for growing them been proved to enhance either soil quality or quality of health. Actually, this study also refers to the studies which question the veracity of the various claims made by the GMO pundits and protagonists.

Therefore, the introduction of biotechnology in the food sector is deemed to have far–reaching consequences for the future of the planet as well as its population. Within the scientific community there is growing uncertainty and negative sentiment about the prospects of GMOs being able to sustainably feed the world's growing population in the face of global change (IAASTD, 2009). With the high dependence of conventional agriculture on fossil fuels the battle for the global and regional food system is being won by the transnationals at the expense of planetary ecosystem stability and resilience. Climate change and growing environmental degradation pose a great threat of epic proportions to the ability of poor rural communities to adapt and build resilience. Futhermore the study showed that political and economic stability have also taken a heavy blow due to riots and other uprisings as witnessed during the Arab spring, the Mozambique Bread Riots and the Haiti Rice Riots. Therefore, it is imperative to to foster decision support systems which help to mitigate the unexpected imoacts of climate variability.

Decision support systems and climate variability

Natural capital acquisition and conservation are essential to the benefitting of the majority of farming households. Adequate natural capital can be a firm foundation for the other sustainable livelihoods factors and is essential to creating the suitable platform (soil nutrients, quality) for better maize yields. While climate/rainfall variability cannot always be positively manipulated by any single municipality, let alone a village, the offshoots from an integrated sustainable livelihoods strategy can never be over-emphasized, particularly for the benefit of those who practice subsistence maize farming. This study also recognises there are other factors that might influence the extent of maize yield and other crops. One in particular is temperature. The impacts of temperature rises which surpass temperature-tolerance thresholds, on crop growth are well represented in Schlenker & Roberts (2009).

The study also shows that the reliance on rain fed agriculture is also detrimental to crop yield since inter-annual and seasonal rainfall trends are highly variable. This implies that the small-scale farmer is at greater risk given the uncertainty of future climate variability parameter shifts. The intensity and extent of the variability cannot be predictable in the short-term/ seasonal time-frame. Hence, the local municipality should make concessions to offer alternatives such as large-scale irrigation schemes. While there are reported significant decreases in annual precipitation in the south-eastern regions of the Eastern Cape (Kruger, 2006), which include NLM, the impact of irrigation on yield is positive and it may partially mitigate the impact of decreased precipitation on yield as reported by Akpalu et al. (2008) about the Limpopo Basin of South Africa. Given that there is no weather station in Peddie/NLM to help the farmers prepare themselves for targeted crop farming season the municipality should consider restoring the weather station infrastructure (Gleason et al., 2008). In addition, the municipality could use other decision support systems and information and communications technologies (ICT) related mechanisms such as cellphones for easy access to weather forecasting data (Uddin & Awal, 2013).

Food Sovereignty and overhaul of food system

The South African government should rather support and facilitate a research agenda that focuses on new methods that enable the further development of people’s initiatives as well as ensuring support for the provision of the right to choice. The right to choice about the food we eat should not solely rely on the conventional food production model which is ostensibly touted to increase yield. The right-to-choice is being usurped by Big Food – a few companies/corporations which make food choices for millions of people across the globe. The right not to be exposed to GMOs and under-handed science must be promoted and fostered through participatory decision-making with small-scale farmers. Traditional food production methods as well as modern agronomic methods should be combined to develop a science that benefits both the people and the planet. The entire South African food system needs an overhaul. The beginnings of which should include the employment of sound sustainable land reform policies that respect the right to food access at all times. The country should also invest in food reserves, irrigation schemes and dams for times of great depression, climate vagaries and economic instability. The climate change and food security polices of the South African government are world famous for being both progressive and highly democratic. This is indeed, a good indication that government is committed to reversing the legacy of apartheid. However, it is evident that the state is still grappling with how to best institute and foster equity and equality. The “strengthening the rights of people working the land policy proposal” is the best example of the conundrum facing the ANC led government. There is hope that there will come a time where meaningful and mutually beneficial propositions will emerge which will settle the dust of uncertainty about land reform and restitution. The essence of democracy should be to share fairly and without prejudice and to protect the interests of future generations of all the peoples of South Africa.

Local economic development and vulnerability

The Ngqushwa Local Municipality, provincial government and the national government should seek to address the asymmetrical nature of power in the national and local food value chains since they lead to unequal distributions of income. Small-scale farmers often bear the brunt of social, economic and political exclusion. Through their Local Economic Development strategies and IDPs the municipality must help fast track the inclusion of local food producers in the food and land politics of the 21st century. Therefore, financial and technical assistance is required to enable the respondents to implement the best practice in proposed climate change adaptation policies and embedded strategies. In cognisance of the vulnerability of the Ngqushwa Local Municipality to the adverse effects of climate variability, this study recommends that the respondents be assisted both financially and technically in order to build the capacity needed to adopt their indigenous strategies as well as the climate variability adaptation policies and response strategies as specified in the National Development Plan aligned intergovernmental climate change strategies.

Agro–forestry, agro–ecological methods and inter-cropping

The perceptions of the impact of climate variability and change on food security are shaped by several issues that range from poverty to lack of knowledge to the ever-expanding food system. Yet the confluence of the global food system, local food access and climate variability and change ate change point the world to a new direction – a new way of thinking about food and the ways in which we grow our food in a sustainable and adaptive manner. Future generations will require food production methods that will not deplete the soil of the most essential nutrients for future sustained yield, as well as farming techniques which are not so dependent on peak oil which causes CO_2 emissions. They will also require a new pricing system that is universally accepted amongst all the peoples of the planet. Therefore, there is an imperative to move further away from Agro-business's mono-cultural practices and employing more agro–forestry, agro–ecological methods and inter-cropping. The robustness of this technique has not been more welcome amongst the common people than when the moringa plant is mentioned. The moringa plant is teaching different populations about the naturally occurring or embedded science of the earth's bio-chemical and geo-chemical properties. The Moringa seed is a natural proven water purifier; high yielding (Foidl et al.,2001); as a food source it improves prenatal nutrition (Diatta, 2001); feeding of livestock; high nutritional value content and good for medicinal use and is drought tolerant.

A new food production model

The developed world and its grip on the World Trade Organisation (WTO) and the attendant agricultural trade agreements should ease their unilateral stance on global agricultural trade and seek to compete on a level playing field with the developing nations. This could be achieved by cancelling the debt owed by the developing nations to the World Bank and the WTO; as well through the abolishing of price distorting subsidies which weigh down on the ability of developing nations to be net food exporting markets. Moreover, the reliance of the MNC's global food system on peak oil should be supplanted by more ecologically compatible crop production methods which promote carbon-sinking and sequestration as well as high crop yields. While the right to food is being threatened and usurped by those who control the food system (the MNCs) the world needs a new way of thinking about the way we produce and distribute food. The right to food can be better realised through the employment of food sovereignty principles at the global, national scale and local scale. Common people do not take issue with food sovereignty as La Via Campesina demonstrates. La via Campesina is a "movement of more than 200 million small-scale farmers and producers, landless farmers, women, youth, indigenous people, migrants and agricultural workers from 164 organizations in 79 countries worldwide" (FAO, 2013a). The network, an autonomous and independent movement, defends small-scale sustainable agriculture as a way of promoting social justice and dignity" (FAO, 2013a).

The Food and Agriculture Organisation also partnered with La Via Campesina through its FAO Strategy for Partnerships with Civil Society Organizations, "which aims to strengthen ties with social movements, member-based organizations and NGOs that share the goal of eradicating hunger, malnutrition and food insecurity" (FAO, 2013a). It is envisaged that the partnership will yield ground-breaking innovations on the future of food politics and that it will leverage the developed world's ties to the FAO to help co-operate with its less developed counterparts on agricultural trade agreements and similar contracts. Therefore governments, including the South African government must also devise policies which promote and support the independent organisation of small-scale and susbsistence farmers to increase their power to engage with government in order to develop alternative models for land and agrarian reform and agricultural production. In order to secure household food security the South African government must foster a new food production model that is not based on the agro-business model and its attendant technologies but on one that is based on robust agro-ecological farming techniques which enhance adaptive capacity and reduce vulnerability.

With respect to land issues, South Africas' land issues will be better addressed through greater transparency and by concerted efforts which minimise corruption. The controversies surrounding land expropriation as highlighted by Trollip (2014) will require the political will which is not only focused on partisanry but the facts as they are presented. South Africa needs a fresh approach to its land restitution problems and not one which drags on and on without decisive finality. The longer the land issues drag the more the likelihood that impatience and political and social upheaval will occur as has happeneded in other parts of Southern Africa.

Collaborations with research institutions

While the IDP (2012-17) plans on food security are beneficent and fairly ambitious, the Ngqushwa Local Municipality does not appear to possess enough capacity to deal with the challenges which impact on food accessibility/food security. These challenges include the high rate of unemployment, poverty, climate variability and change, and ever – rising food prices. Even so, the NLM is advised to campaign, plan, foster and implement its own climate change response strategy which is consistent with the National and Provincial climate change mitigation and adaptation targets. Collaborations with institutions of higher learning should be encouraged in order to advance research in the best practices on food production, food security, the entire food system and climate (variability and change) smart agriculture that is truly ecologically sound. A good example of an institution that could be utilised by government to better support policy targets is the Risk and Vulnerability Science Center which is domiciled at the University of For Hare. The following section elucidates on the policy implications of this study.

Agricultural extension services and best practice

The agricultural initiatives of the study area can be enhanced and protected from the failures and shortcomings of the MFPP through policy actions that are targeted at improving credit programme transparency and inclusion. The NLM small farmers need an expansion of the rural credit systems which is based on a more expeditious legal process which disseminates land titles to smallholder farmers. Such a legal process will aid in legitimizing the rights of the farmers to the land and to build the credibility of the farmers among the private sector credit sector. Secondly, agricultural extension services can be reoriented to target the education and training of the rural farmers about the best-practice adaptation strategies. The extension services can also be equipped to have more expertise in land management practices with focus on the promotion and application of organic fertilizers as opposed to agrochemical fertilisers which are touted as the holy grail of adaptive capacity by the mainstream agro-business sector. Yet, as discussed in this study these agrochemical fertilisers are not climate smart agricultural inputs. Also, the training of the household and small-scale farmer can focus on how to market and administer farming as a business. Fundamental to improving the productivity of crop farmers and taking stock of sustainable adaptation, the involvement of extension officers in the awareness of best practice in adaptive strategies is crucial. Yet the monitoring and evaluation of extension programmes is even more critical. For without standardized yet dynamic indicators the effectiveness of agricultural extension programmes is destined to failure in this municipality.

Traditional custodians of food security and easier access to markets

Given the impassable state of some the roads and the remoteness of the villages and notwithstanding the need to fix the roads, road infrastructural changes for access to markets should be augmented by the erection of agricultural produce depots which are in close proximity to both the villages and the outside markets. Also, in order to reduce water scarcity vulnerability and to minimize extreme climate event risk to food security the irrigation infrastructural programmes such as those initiated by the Department of Social Development in some villages should be supplemented by the building of more ponds and dams to hold water as reserves and irrigation apparatus sources for difficult times. As a measure to upskill the farming population of NLM, policy can foster an environment wherein the farmers can be exposed to the following food business areas: production, processing, marketing, credit and savings. In addition, given that women form the majority small-scale farmers and are the traditional custodians of household food security in the study area, technical, management and leadership skills can form the bedrock of the rural empowerment programmes. And while the study could not conclusively validate the claim by the respondents that the animal kingdom was migrating to their homesteads due to climate variability and change, it is clear that in these uncertain times the animal kingdom is forcing humanity to relearn anew how to share. For only in sharing will we find our way to a world we dream of and one in which future generations will co-exist for the common good – peace and goodwill among all men.

References

ACB. (2013a). Monsanto's failed SA GM Maize pushed into rest of Africa. African Centre for Biodiversity, 24 October 2013. http://www.acbio.org.za/index.php/media/64-media-releases/448-monsantos-failed-sa-gm-maize-pushed-into-rest-of-africa

ACB. (2013b). Tiger Brand snubs consumers on GM Purity baby food concerns. African Centre for Biodiversity, 04 June 2013. www.acbio.org.za/index.php/media/64-media-releases/433-tiger-brand-snubs-consumers-on-gm-purity-baby-food-concerns

ACB. (2013c). GM Maize: lessons for Africa - Cartels collusion and control of South Africa's staple food. http://www.acbio.org.za/index.php/publications/rest-of-africa/449-gmmaize-lessons-for-africa

ACB (2014). Africa an El Dorado for South Africa's Agribusiness Giants. http://www.acbio.org.za/index.php/publications/seedfood-sovereignty/465-africa-an-eldorado-for-south-africas-agribusiness-giants

Acocks, J.P.H. (1975). Veld types of South Africa, edn 2. Memoris of the Botanical Surveys of South Africa, 40: 1–128.

Acocks, J.P.H. (1976). Riverine vegetation of the semi-arid and arid regions of South Africa. ournal of the South African Biological Society ,17: 21–35.

Acquah, H.D. (2011). Public awareness and quality of knowledge regarding climate change in Ghana: A logistic regression approach. Journal of Sustainable Development in Africa, 13: 146-157.

Adebayo, O. O. (2012). Climate Change Perception and Adaptation Strategies on Catfish Farming in Oyo State, Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary Sciences, 12 (6): 22-28.

Adejuwon, J.O. & Odekunle T.O (2006). Variability and the Severity of the "Little Dry Season" in Southwestern Nigeria. Journal of Climate, 19: 483–493.

Adejuwon, J.O. (2004). Crop yield Response to Climate Variability in the Sudano-Sahelian Ecological Zones of Nigeria in southwestern Nigeria. In AIACC Report of Workshop for Africa and Indian Ocean Island. Dakar, Senegal, pp 15-16.

Adger W.N., Agrawala S, Mirza M.M.Q., Conde C., O'Brien K., Pulhin J., Pulwarty R., Smit B., Takahashi K. (2007). Assessment of adaptation practices, options, constraints and capacity. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE (eds) Climate change 2007: impacts, adaptation and vulnerability. Contribution of working group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, pp 717–743.

Adger, W. N. & Kelly, P. M. (1999). Social Vulnerability to Climate Change and the Architecture of Entitlements, Mitigation Adaptation Strategies, Global Change 4: 253–256.

Adger, W. N., Hug, S., Brown, K., Conway, D. & Hume, M. (2003). Adaptation to Climate Change in Developing World. Progress in Development Studies, 3(3): 179-195. doi:10.1191/1464993403ps060oa http://dx.doi.org/10.1191/1464993403ps060oa

African Centre for Biosafety. (2007). Monsanto's "Seed Of Hope Campaign" In South Africa – A Briefing Document. January 2007.

Aggarwal, P.K., P.K. Joshi, J.S.I., Ingram and Gupta, R.K. (2004). Adapting food systems of the Indo-Gangetic plains to global environmental change: Key information needs to improve policy formulation. Environmental Science and Policy, 7(6): 487–498.

Aghajani, G.H. (2007) Agronomical Analysis of the characteristics of the precipitation (Case study: Sazevar, Iran). Pakistan Journal of Biological Sciences, 10(8): 1353-1358.

Agrawal, A. & Perrin, N. (2008). Climate adaptation, local institutions and rural livelihoods. International Forestry Resources and Institutions Program (IFRI) Working Paper # W08I-6, University of Michigan, 2008.

Ajetomobi, J. & Abiodun, A. (2010). Climate change impacts on cowpea production in Nigeria. African Journal of Food, Agriculture, Nutrition and Development, 1(3): 1-14.

Akpalu, W. Hassan, R.M. & Ringler, C. (2008). Climate Variability and Maize Yield in South Africa: Results from GME and MELE Methods. IFPRI Discussion Paper 00843.

Alarima, C.I. (2011). Knowledge and perception of genetically modified foods among agricultural scientists in south-west Nigeria. OIDA International Journal of Sustainable Development. 2(6): 77-88.

Alberini, A., Chiabai, A., & Muehlenbachs, L. (2006). 'Using expert judgement to assess adaptive capacity to climate change: evidence from a conjoint choice survey'. Global Environmental Change 16: 123–144.

Alexandratos, N. (2008). Food Price Surges: Possible Causes, Past Experiences and Relevance for Exploring Long-Term Prospects, Population and Development Review, 34 (4): 663–697.

Aliber, M. & Hart, T.G.B. (2009). Should subsistence agriculture be supported as a strategy to address rural food insecurity? Agrekon: Agricultural Economics Research, Policy and Practice in Southern Africa, 48(4): 434-458.

Aliber, M. (2001). Study of the Incidence and Nature of Chronic Poverty and Development Policy in South Africa: An Overview. CPRC Background Paper 3. Programme for Land and Agrarian Studies, University of the Western Cape, South Africa.

Allen, M.R. & Ingram, W.J. (2002). Constraints on future changes in climate and the hydrologic cycle. Nature, 419: 224–232.

Altman, M. & Jacobs, P. (2010). Household food security in South Africa. Agrekon, 48(4): 345- 361.

Altman, M., Hart, T.G.B. & Jacobs, P.T. (2009). Household food security status in South Africa. Agrekon, Vol 48(4): 345 – 361.

Alwin D. F. (1997). Feeling thermometers versus 7point scales: Which are better? Sociological Methods and Research, 25: 318–341.

Amathole Growth and Development Summit Socio-Economic Profile. (2007). Amathole District Municipality. East London.

Amin, A.T.M.N. (1994). Economics of Rural—Urban relations re-examined in the light of growing environmental concerns. Regional Development Studies, 1: 27–54.

Andrew, M., Anslie, A., & Shackleton, C. (2003). Land use and livelihoods. Bellville: Programme for Land and Agrarian Studies, School of Government, University of the Western Cape.

Ani, A.O. (1998). Assessment of farmers' extension education needs in Yobe State, Nigeria. Nigerian Journal Of Agricultural Education, 1: 52–158.

Antwi-Agyei, P., Fraser, E.D.G., Dougill, A.J., Stringer, L.C. & Simelton, E. (2012). Mapping the vulnerability of crop production to drought in Ghana using rainfall, yield and socioeconomic data. Applied Geography, 32: 324-334.

Anyoha, N. O., Nnadi, F. N., Chikaire, J., Echetama, J. A., Utazi, C. O. & Ihenacho, R. A. (2013). Socio-economic factors influencing climate change adaptation among crop farmers in Umuahia South Area of Abia State, Nigeria. Net Journal of Agricultural Science, 1(2): 42-47.

Apata T.G., Samuel, K.D., and Adeola, A.O. (2009). Analysis of Climate Change Perception and Adaptation among Arable Food Crop Farmers in South Western Nigeria. Contributed Paper prepared for presentation at the International Association of Agricultural Economists' 2009 Conference, Beijing, China, August 16-22,209.

Armah F.A., Yawson D.O., Yengoh G.T., Odoi J.O., & Afrifa E.K.A. (2010). Impact of Floods on Livelihoods and Vulnerability of Natural Resource Dependent Communities in Northern Ghana. Water, 2(2): 120-139.

Asante, F. A., Boakye, A. A., Egyir, I. S., & Jatoe, J.B.D. (2012). Climate change and farmers' adaptive capacity to strategic innovations. The case of Northen Ghana. International Journal of Development and Sustainability, 1(3): 766 – 784.

Assumptions for Quarterly Food Security Analysis. (2014). Famine Early Warning Systems Network.

Awosika, L., Ojo O. & T. Ajayi, 1994. Implications of Climate Change and Sea Level Rise on the Niger Delta, Nigeria – Phase 1.A report for the United Nations Environmental Programme OKAPIS/UNEP, 92 pp.

Ayanlade, A., Odekunle, T.O., Orinmogunje O.I. & Adeoye, N.O. (2009). Inter-annual Climate Variability and Crop Yields Anomalies in Middle Belt of Nigeria. Advances in Natural and Applied Sciences, 3(3): 452-465.

Ayoo, C. (2007). Community-based natural resource management in Kenya. International Journal of Management and. Environmental Quality, 18 (5): 531-541.

Badgley, C., Moghtader, J., Quintero, E., Zakem, E.M., Chappell, J., Avilés-Vázquez, K., Samulon, A., & Perfecto, I. (2007). Organic agriculture and the global food supply. Renewable Agriculture and Food Systems, 22: 86-108. doi:10.1017/S1742170507001640.

Baffes, J. & Dennis, A. (2013). Long-Term Drivers of Food Prices. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/15594 License: CC BY 3.0 Unported.

Banse, M. & Grethe, H. (2008). Effects of the New Biofuel Directive on EU Land Use and Agricultural Markets. Contributed paper at the EAAE-Seminar Modelling Agricultural and Rural Development Policies, 31. Januar–1. Februar 2008, Seville, Spain.

Barnett, J. & Adger, W. N. (2003). Climate dangers and atoll countries. Climatic Change, 61: 321- 337.

Barrett, C.B. & Maxwell, D.G. (2005). Food Aid after Fifty Years: Recasting its Role. New York: Routledge

Bassett, T.J. & Crumney, D. (2003). Contested images, contested realities: Environment and society in African Savannas. In African Savannas: Global Narratives and Local Knowledge of Environmental Change, eds. Bassett TJ, Crumney D, 1–30. Oxford: James Currey Ltd.

Belay, A., Claassens, A. & Wehner, F. (2002). Effect of direct nitrogen and potassium and residual phosphorus fertilizers on soil chemical properties, microbial components and maize yield under long-term crop rotation. Biology and Fertility of Soils, 35(6): 420-427.

Bellarby, J., Foereid, B., Hastings, A. & Smith, P. (2008). Cool Farming: Climate impacts of agriculture and mitigation potential. Greenpeace International, Amsterdam, the Netherlands.

Below, T.B., Mutabazi, K.D., Kirschke, D., Franke, C., Sieber, S., et al. (2012). Can farmers' adaptation to climate change be explained by socio-economic household-level variables? Global Environmental Change, 22: 223–235. doi: 0.1016/j.gloenvcha.2011.11.012

Benhin, J.K. & Gbetibouo, G.A. (2004). Climate, water and agriculture: Impacts on and adaptation of agro-ecological systems in Africa: Case study of South Africa. Interim report submitted to the Centre of Environmental Economics and Policy in Africa under the Global Environmental Facility funded Project.

Benhin, J.K.A. (2008). South African crop farming and climate change: An economic assessment of impacts. Global Environmental Change, 18: 666-678.

Bhaduri, A. (2014). Local weather stations greatly improve local crop production. India Water Portal. Arghyam Initiative, November 19, http://www.indiawaterportal.org/articles/local-weather-stations-greatly-improve-local-crop-production

Bhandari, G. (2013). Impact of Rainfall and Temperature on the Yield of Major Cereals in Jumla District of Nepal. Persian Gulf Crop Protection, 2(4): 35-44.

Bleby, M. (2012). SA retailers wait for Wal-Mart to come a-courting. Business Day, 06 August. http://www.bdlive.co.za/articles/2010/09/27/sa-retailers-wait-for-wal-mart-to-come-a-courting---background;jsessionid=A2029AE8E95189BA516E2DA6A799D583.present2.bdfm.

Blignaut, J., Ueckermann, L. & Aronson, J. (2009). Agriculture production's sensitivity to changes in climate in South Africa. South African Journal of Science, 105: 61–68.

Blignaut, J.N. & Van Heerden, J.H. (2009). The impact of water scarcity on economic development initiatives. WaterSA, 35(4):415-420.

Boko, M., Niang, I., Nyong, A., Voge,l C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R. & Yanda, P. (2007). Africa. Climate Change: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry M

L, Canziani O F, Palutikof J P, van der Linden P J and Hanson C E (eds). Cambridge University Press. Cambridge UK. pp. 433 – 467.

Bonti-Ankomah, S. (2001). Addressing food insecurity in South Africa. Paper presented at the SARPN conference on Land Reform and Poverty Alleviation in Southern Africa. 4-5 June 2001.

Borras, Jr., S. & Franco, J. (2012). Global land grabbing and trajectories of agrarian change: A preliminary analysis. Journal of Agrarian Change, 12(1): 34-59.

Borras, Jr., S., Fig, D. & Suárez, S. (2011). The politics of agrofuels and mega-land and water deals: Insights from the ProCana case, Mozambique. Review of African Political Economy, 38(128): 215-234.

Borras, Jr., S., McMichael, P. & Scoones, I. (2010). The politics of biofuels, land and agrarian change. Journal of Peasant Studies, 37(4): 575-592.

Bostrom, A., Morgan, G. & Fischo, B. (1994). What do people know about global climate change? Risk Analysis, 14: 959-969.

Boubacar, I. (2010). The effects of drought on crop yields and yield variability in Sahel. The Southern Agricultural Economics Association Annual Meeting: The Southern Agricultural Economics Association, Orlando FL.

Boudreau, T.E. (1998). The Food Economy Approach: A Framework for Understanding Rural Livelihoods. London: Relief and Rehabilitation Network/Overseas Development Institute, pp 32.

Boudreau, T.E. (1998). The Food Economy Approach: A Framework for Understanding Rural Livelihoods. London: Relief and Rehabilitation Network/Overseas Development Institute, pp 32.

Brittaine, R. & Lutaladio, N. (2010). Jatropha: A Smallholder Bioenergy Crop. The Potential for Pro-Poor Development. Integrated Crop Management, Vol. 8. Report by IFAD for FAO.

Brklacich, M., McNabb, D., Bryant, C. & Dumanski, J. (1997). Adaptability of agriculture systems to global climate change: a Renfrew County, Ontario, pilot study. In: Ilbery, B., Chiotti, Q., Rickard, T. (Eds.), Agricultural Restructuring and Sustainability. CAB International, London.

Broda, C., Leibtag, E. & Weinstein, D. E. (2009). The Role of Prices in Measuring the Poor’s Living Standard, Journal of Economic Perspectives, 23 (2): 77-97.

Bryan, E., Deressa, T.T., Gbetibouo, G.A. & Ringler, C. (2009). Adaptation to climate change in Ethiopia and South Africa: Options and constraints. Environmental Science and Policy, 12(4): 413-426.

Bryceson, D. (2000). Rural Africa at the crossroads: Livelihood practices and policies; Natural Resources Perspectives, no. 52; London: ODI.

Bulcock, L.M. & Schulze, R.E. (2011). Climate Change and a Case Study in Rainwater Harvesting: A 2011 Perspective. In: Schulze, R.E. (2011). A 2011 Perspective on Climate Change and the South African Water Sector. Water Research Commission, Pretoria, RSA, WRC Report 1843/2/12, 8 (4): 249-254.

Burgess, J., Harrison, C. & Filius, P. (1995). Making the abstract real, in A Cross-Cultural Study of Public Understanding of Global Environmental Change, London, University College London, Department of Geography.

Business Report. (2013). Walmart's Massmart, Shoprite in court war. October 16. http://www.iol.co.za/business/companies/walmart-s-massmart-shoprite-in-court-war-1.1593000

Byg, A. & Salick, J. (2009). Local perspectives on a global phenomenon—Climate change in Eastern Tibetan villages. Global Environmental Change, 19:156–166.

Callinicos, L. (1993). A Place in the City: The Rand on the Eve of Apartheid. Johannesburg: Ravan Press.

Calzadilla, A., Zhu, T., Rehdanz, K., Tol, R.S. & Ringler, C. (2013). Economy wide impacts of climate change on agriculture in Sub-Saharan Africa. Ecological. Econonomics, 93: 150–165 http://dx.doi.org/10.1016/j.ecolecon.2013.05.006.

Sustainability and Food Security: Connecting the Dots. Journal of Food Security, 2(1), 13-22.

Capone, R., Bilali, H. E., Debs, P., Cardone, G. & Driouech, N. (2014). Food System Sustainability and Food Security: Connecting the Dots. Journal of Food Security, 2(1), 13-22.

Carew, R., Smith, E. G. & Grant, C. (2009): Factors influencing wheat yield and variability: Evidence from Manitoba, Canada. Journal of Agriculture and Applied Economics, 41(3): 625- 639.

Carpenter, S. R. (2008). Phosphorus control is critical to mitigating eutrophication. Proceedings of the National Academy of Sciences, 105: 11039-11040.

Ceballos, A., Martinez-Fernandez, J. & Luengo-Ugidos, M.A. (2004). Analysis of rainfall trends and dry periods on a pluviometric gradient representative of Mediterranean climate in the Duero Basin, Spain. Journal of Arid Environments, 58: 214-232.

Center for Disease Control (CDC). (1996). Shigella sonnei outbreak associated with contaminated drinking water – Island Park, Idaho, August 1995. Morb Mortal Wkly Rep, 45:229–231.

Chakravorty, U., Hubert, M. H., Moreaux, M., & Nostbakken, L. (2011). Will biofuel mandates raise food prices? Working Paper 2011-01, University of Alberta, May.

Chambers, A. & Chambers, K.S. (2007). Five Takes on Climate and Cultural Change in Tuvalu. The Contemporary & Pacific, 19(1): 294-306.

Chambers, R. & Conway, G.R. (1992) 'Sustainable Rural Livelihoods: Practical Concepts for the 21st Century', Discussion Paper 296. Brighton, UK: Institute of Development Studies.

Charles, H., Godfray, J., Crute, I. R., Haddad, L., Lawrence, D., Muir, J.F., Nisbett, N., Pretty, J., Robinson, S., Toulmin, S., & Whiteley, R.(2010): The future of the global food system. Philosophical Transactions of the Royal Society B, 365: 2769-2777.

Chipanshi, A. C., Chanda, R. & Totolo, O. (2003). Vulnerability Assessment Of The Maize And Sorghum Crops To Climate Change In Botswana. Climatic Change, 61: 339–360.

Chipanshi, A.C. & Ringrose, S. (2001). Reflections on the 1997/98 El-Nino phenomenon in Botswana. Weather, 56: 11-24.

Coates, J., Swindale, A. & Bilinsky, P. (2007). Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide. Version 3. Washington, D.C.: Food and Nutrition Technical Assistance Project

Cotula, L., Vermeulen, S., Leonard, R. & Keeley, J. (2009). Land grab or development opportunity? London/Rome: IIED/FAO/IFAD.

Cousins, B. (2013). Smallholder Irrigation Schemes, Agrarian Reform and Accumulation from Above and from Below in South Africa. Journal of Agrarian Change, 13(1): 116–139.

Crawford, P.B., Townsend, M.S., Metz, D.I., Smith, D., Espinosa-Hall, G., Donohue, S.S. et al. (2004). 'How can Californians be overweight and hungry?' California Agriculture 58(1): 12–17.

Cropley, E. (2009). Southern Africa facing El Niño drought risk. Mail & Guardian, 30 JUL 2009.

Cullather, N. (2010). The Hungry World: America's Cold War Battle against Poverty in Asia. Cambridge, MA: Harvard University Press, pp. 335. ISBN 978 0 674 05078 5.

Cutter, S. L., Byron, J., & Shirley, W. (2003). Social Vulnerability to Environmental Hazards. Social Science Quarterly, 84(2): 242-261.

Daniels, M. (2009). Dietary Diversity as a Measure of Women's Diet Quality in Resource-Poor Areas: Results from Metropolitan Cebu, Philippines Site. Washington, DC: FANTA-2 at FHI 360.

Davis, M. (2001). Late Victorian Holocausts: El Nino Famines and the Making of the Third World, New York. Verso Books. 464 pp.

De Cock, N., D'Haese, M., Vink, N., van Rooyen, C. J., Staelens, L., Schönfeldt, H. C. & D'Haese, L. (2013). Food security in rural areas of Limpopo province, South Africa. Food Security, (5): 269–282. DOI 10.1007/s12571-013-0247-y.

De Klerk, M., Drimie, S., Aliber, M., Mini, S., Mokoena, R., Randela, R., Modiselle, S., Vogel, C., De Swardt., & Kirsten, J. (2004). Food security in South Africa: Key policy issues for the medium term [Online]. Available from: http://www.sarpn. org.za/documents/d0000685/Food_security_SA_January 2004.pdf . Accessed on 20 September 2012.

De Luis, M., Raventos, J., Gonzalez-Hidalgo, J.C., Sanchez, J.R., Cortina, J. (2000). Spatial analysis of rainfall trends: a case of study in Valencia region (E Spain). International Journal of Climatology, 20: 1451–1469.

De Schutter, O. (2010). Countries tackling hunger with a right to food approach: Significant progress in implementing the right to food at national scale in Africa, Latin America and South Asia. Briefing Note 01. United Nations. New York.

De Schutter, O. (2014). Ending hunger - the rich world holds the keys. The Ecologist. 25th March 2014. Available on http://www.theecologist.org/blogs_and_comments/commentators/2333245/ending_hunger_the_rich_world_holds_the_keys.html

De Wet, C. & Bekker, S. (1985). Rural Development in South Africa. Pietermaritzburg: The Natal Witness (Pty) Ltd.

Demeke, A.B., Keil, A. & Keller, M. (2011), Using panel data to estimate the effect of rainfall shocks on smallholders' food security and vulnerability in rural Ethiopia. Climate Change, 108 (1-2): 185 – 206.

DFID. (1999). Sustainable Livelihood Guidance Sheets. Department for International Development: London

Deressa, T., Hassan, R. & Poonyth, D. (2005). Measuring the economic impact of climate change on South Africa's sugarcane growing regions. Agrekon, 44 (4): 524–542.

Dessai, S. & M. Hulme. 2004. Does climate adaptation policy need probabilities? Climate Policy, 4(2):107-128.

Dhakal C. K., Regmi P. P., Dhakal I. P, Khanal B. Bhatta U. K, Barsila S. R. & Acharya, B. (2013). Perception, Impact and Adaptation to Climate Change: An Analysis of Livestock System in Nepal. Journal of Animal Science Advances, 3(9): 462-471.

Diatta, S. (2001). Supplementation for pregnant and breast-feeding women with Moringa oleifera powder. In: Developmental potential for Moringa products. Workshop proceedings. October 29 –November 2, 2001, Dar Es Salaam, Tanzania.

Dickson, A. K. (1997). Development and International Relations - A Critical Introduction. Oxford, Blackwell Publishers LTD.

Dietz, T., Ostrom, E., Stern, P.C. (2003). The Struggle to Govern the Commons. Science, 302 (5652): 1907-1912

Digital History. (2014). The Great Depression in Global Perspective Previous. Digital History ID 3433. http://www.digitalhistory.uh.edu/disp_textbook.cfm?smtID=2&psid=3433.

Dinar, A., Mendelsohn, R., Evenson, R., Parkih, J., Sanghi, A., Kumar, K., Mckinsey, J. & Lonergan, S. (1998). Measuring the impact of climate change on Indian agriculture. World Bank Technical Paper No 402, World Bank, Washington, DC.

Doble, J. (1995). Public opinion about issues characterized by technological complexity and scientific uncertainty. Public Understanding of Science, 4: 95 - 118.

Dovie, D. B. K., Witkowski, E. T. F. & Shackelton, C. M. (2003). Direct-use value of smallholder crop production in a semi-arid rural South African village. Agricultural Systems, 76: 337–357.

Downing, T.E., Patwardhan, A., Klein, R.J.T., Mukhala, E., Stephen, L., Winograd, M. & Ziervogel, G. (2005). Assessing vulnerability for climate adaptation. In Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures. Lim, B., Spanger-Siegfried, E., Burton, I., Malone, E. and Huq, S. (Eds.). Cambridge University Press, Cambridge.

Dreibus, T.C. (2008). Wheat Supplies, Already Tight, May Be Hurt by Global Drought. Bloomberg. March 4, 2008. http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aBXqreFosK5Y

Drimie, S., Arntzen, J., Dube, P., Ingram, J. S. I., Mano, R. T. & Mataya, C. (2011). Global environmental change and food systems in southern Africa: The dynamic challenges facing regional policy. Journal of Geography and Regional Planning, 4 (4): 169–182.

Du Plessis, J. (2003). Maize production. Directorate of Agricultural Information service, Department of Agriculture, in cooperation with ARC-Grain crops Institute, Potchefstroom.

Dube, P. (2014). Strengthening the Relative Rights of People Working the Land: A Rethink Required. Centre for Consitutional Rights. http://cfcr.org.za/index.php/latest/300-article-strengthening-the-relative-rights-of-people-working-the-land-a-rethink-required

Dube, S., Scholes, R.J., Nelson, G.C., Mason-D'Croz, D., & Palazzo, A. (2013). South African Food Security and Climate Change: Agriculture Futures. Economics Discussion Papers, No 2013-12, Kiel Institute for the World Economy. http://www.economics journal.org/economics/discussionpapers/2013-12

Dufey, A., Vermeulen, S., Vorley, B. (2007). Biofuels: Strategic Choices for Commodity Dependent Developing Countries. Prepared for Common Fund for Commodities, Institute for Environment and Development, London

Durand, W. (2004). CROPWAT modeling for 34 districts of South Africa, for the GEF / WB Regional Climate, Water and Agriculture: Impacts on and adaptation on agro-ecological systems in Africa project. Interim Report to FAO and CEEPA June 2004.

Durand, W. (2006). Assessing the impact of climate change on crop water use in South Africa. CEEPA Discussion Paper #28. University of Pretoria, South Africa.

Dyer, T.G.J. (1979). Rainfall along the east coast of Southern Africa, the Southern Oscillation and the latitude of the subtropical high pressure belt. Quart. J. Roy.Meteor. Soc. 105: 445–452.

Eakin, H. (2005). Institutional Change, Climate Risk, and Rural Vulnerability: Cases from Central Mexico. World Development , 33 (11):1923 – 1938.

Easterling, W.E., P.K. Aggarwal, P. Batima, K.M. Brander, L. Erda, S.M. Howden, A. Kirilenko, J. Morton, J.-F. Soussana, J. Schmidhuber & Tubiello, F.N. (2007). Food, fibre and forest products. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, pp. 273-313.

Eastern Cape Drought Impact Assessment Report (2009) Provincial Gazette for Eastern Cape No 2192, 16 (1) 08 September 2009.

Ellis, F. & Mdoe, N. (2003). Livelihoods and rural poverty reduction in Tanzania, World Development, 31(8): 1367–1384.

Engdahl, F.W. (2007). “Doomsday Seed Vault” in the Arctic: Bill Gates, Rockefeller and the GMO giants know something we don’t. Global Research: Centre for Rsearch on Globalization, 4 December 2007. http://www.globalresearch.ca/doomsday-seed-vault-in-the-arctic-2/23503

Eqstra Fleet Consulting(EFC) . (2014). Fuel Price Trends and Forecast, January 2014. http://www.efm.co.za/News%20items/Fuel%20Price%20Trends

Ericksen, P. J. & Ingram, J. S. I. (2005). Global Environmental Change and Food Systems (GECAFS). IHDP Annual Report 2004-5. pp. 45-46.

Ericksen, P. J. (2008). Conceptualising food systems for global environmental change (GEC) research. Global Environmental Change 18(1): 234-245.

Ericksen, P.J. (2007). Conceptualizing food systems for global environmental change research. Global Environmental Change (2007), doi:10.1016/j.gloenvcha.2007.09.002

Eriksen, S., Aldunce, P., Bahinipati, C. S., Martins, R. D. A., Molefe, J. I., Nhemachena, C., et al. (2011). When not every response to climate change is a good one: identifying principles for sustainable adaptation (Report). Climate and Development, 3(1): (7-14).

Ewing, M. & Msangi, S. (2009). Biofuels production in developing countries: assessing tradeoffs in welfare and food security. Environmental Science & Policy, 12(4): 520 – 528.

Fairhead, J. & Leach, M. (1996). Reframing forest history: A radical reappraisal of the roles of people and climate in West African vegetation change.In Time-Scales and Environmental Change, Chapman GP, Driver TS (eds). Routledge: New York, NY; 169– 195.

Fairhead, J. & Leach M. (2000). Desiccation and domination: Science and struggles over environment and development in colonial Guinea. Journal of African History, 41: 35–54.

Fairhead, J. & Leach, M. (2003). Science, society and power: Environmental knowledge and policy in West Africa and the Caribbean. Cambridge: Cambridge University Press.

Falkenmark , M. (1989). Water Scarcity and Food Production in Africa, in D. Pimentel and C. W. Hall, eds., Food and Natural Resources. San Diego: Academic Press, 163pp.

FAO (Food and Agriculture Organisation). (2013). FAO will cooperate with La Via Campesina, the largest movement of small-scale food producers in the world.

Food and Agriculture Organisation of the United Nations, 4 October 2013. http://www.fao.org/news/story/en/item/201824/icode/

FAO (Food and Agriculture Organization). (2013). FAOSTAT: FAO Statistical Databases . Rome: United Nations Food and Agriculture Organization.

FAO (Food and Agriculture Organization). 1996. Rome Declaration on World Food Security and World Food Summit Plan of Action, 13 -17 November 1996. http://www.fao.org/DOCREP/003/W3613E/W3613E00.HTM.

FAO. (1997), Agriculture, food and nutrition for Africa. Food and Agriculture Organization, Rome.

FAO. (2001). Climate Variability and Change: A Challenge for Sustainable Agricultural Production. Committee on Agriculture.

FAO. (2003) Rise of Supermarkets across Africa threatens small farmers: Opportunities and challenges in a changing market. http://www.fao.org/english/newsroom/news/2003/23060-en.html Accessed 12 June 2012

FAO. (2006). World Agriculture: Towards 2030/2050. Food and Agriculture Organization of the United Nations, Rome.

FAO. (2008). An introduction to the basic concepts of food security. Food Security Information for Action Practical Guides. Food and Agriculture Organization of the United Nations, Rome, Italy http://www.fao.org/docrep/013/al936e/al936e00.pdf

FAO. (2009). The State of Food Security in the World. Food and Agri-culture Organization of the United Nations, Rome.

FAO. (2010). The State of Food Insecurity in the World 2010: Addressing Food Insecurity in Protracted Crises. Rome: Food and Agriculture Organization of the United Nations.

FAO. (2014). FAO'S WORK PROGRAMME IN TRADE AND MARKETS UNDER THE REVIEWED STRATEGIC FRAMEWORK. Food and Agriculture Organisation, Seventieth Session Rome, 7-9 October 2014

FAO. 2002. The State of Food Insecurity in the World 2001. Rome.

Fargione, J., J. Hill, Tilman, D., Polasky, S. &. Hawthorne, P. (2008). Land Clearing and the Biofuel Carbon Debt. Science 319: 1235-1238.

Fatuase, A.I. & Ajibefun, A.I. (2013) Adaptation to climate change: A case study of rural farming households in Ekiti state, Nigeria. Impacts World 2013, International Conference on Climate change Effects, Potsdam, May 27–30, 2013.

Fauchereau, N., Trzaska, S., Rouault, M. & Richard, Y. (2003) Rainfall variability and changes in southern Africa during the 20th century in the global warming context, Natural Hazards, 29: 139-154.

Faurès, J.M., & Santini, G., eds. (2008). Water and the rural poor: Interventions for improving livelihoods in sub-Saharan Africa. Rome: Food and Agricultural Organization of the United Nations.

Fay, D. (2010). Cultivators in action, Siyazondla inaction? Trends and potential in homestead Cultivation. Department of Anthropology, University of California: Riverside.

FEMA. (1995). The 1993 and 1995 midwest floods: flood hazard mitigation through property hazard acquisition and relocation program. FEMA (Federal Emergency Management Agency) Mitigation Directorate, Washington, DC.

Finamore, A., Roselli, M., Britti, S., Monastra, G., Ambra, R., Turrini, A., & Mengheri, E. (2008). Intestinal and Peripheral Immune Response to MON810 Maize Ingestion in Weaning and Old Mice. Journal of Agricultural and Food Chemistry, 56 (23): 11533-11539

Finch-Savage, W.E., Phelps, K., Stechel, J.R.A., Whalley, W.R. &. Rowse, H.R. (2001). Seed Reserve-dependent Growth Response to Temperature and Water Potential in Carrot Cdaucis Carota L.X. Horticulture Research International, Welleshounnes, Wrack CV359EF, UK.

Foidl, N., Makkar, H.P.S. & Becker, K. (2001). The Potential of Moringa oleifera for agricultural and industrial uses. Procedings of the 1th Workshop What Development Potential for Moringa Products? 2001 Oct; Dar es Salaam, Tanzania; 2001.

Fourie, B. (2014). SA consumers hit hard by price rises. Business Report. February 7 2014.http://www.iol.co.za/business/news/sa-consumers-hit-hard-by-price-rises-1.1643829#.U7m8D_mSx30

Frank, J. & Buckley, C.P. (2012). Small-scale farmers and climate change. How can farmer organisations and Fairtrade build the adaptive capacity of smallholders? IIED, London

Frayne, B., Moser, C. & Ziervogel, G. (eds). (2012) Climate change, assets and food security in southern African cities. Routledge. Abingdon, U.K.

Galloway, J. N., Townsend, A. R., Erisman, J. W., Bekunda, M., Cai, Z., Freney, J. R., Martinelli, L. A., Seitzinger, S. P. & Sutton, M. A. (2008). Transformation 15/16 GRL-TN-04-2009 of the Nitrogen Cycle: Recent Trends, Questions, and Potential Solutions. Science, 320: 889-892.

Gandure, S., Walker, S., & Botha, J.J. (2013). Farmers’ perceptions of adaptation to climate change and water stress in a South African rural community. Environmental Development, 5: 39–53.

Gautam, M. (2006). Managing Drought in Sub-Saharan Africa: policy perspectives. Invited Paper Prepared for a Panel Session on Drought: Economic Consequences and Policies for Mitigation, at the IAAE Conference, Gold Coast, Queensland, Australia, August 12–18, 2006.

Gbetibouo, G. A., C. Ringler, & Hassan, R.(2010).Vulnerability of the South African farming sector to climate change and variability: an indicator approach. Natural Resources Forum, 34:175-187. http://dx.doi.org/10.1111/j.1477-8947.2010.01302.

Gbetibouo, G.A. & Hassan, R.M. (2005). Measuring the economic impact of climate change on major South African fi eld crops: a Ricardian approach. Global and Planetary Change, 47: 143-152.

Gbetibouo, G.A. (2009). "Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability The Case of the Limpopo Basin, South Africa." IFPRI Discussion Paper No. 849

Gebrehiwot, T. & Veen, van der, A. (2013). Farm Level Adaptation to Climate Change: The Case of Farmer’s in the Ethiopian Highlands. Environmental Management, 52: 29–44.

Geneva Declaration for Rural Women. (1992). Summit on the economic advancement of rural women (Geneva, 25 and 26 February 1992). www.un-documents.net/gdrw.htm

Gerber, N., van Eckert, M. & Breuer, T. (2008). The Impacts of Biofuel Production on Food Prices: a review, ZEF –Discussion Papers On Development Policy No. 127, Center for Development Research, Bonn, October 2008, pp.19.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. & Trow, M. (1994). The new production of knowledge: The dynamics of science and research in contemporary societies. Thousand Oaks: Sage.

Gittelsohn, J. & Lee, K. (2013). Integrating educational, environmental, and behavioral economic strategies may improve the effectiveness of obesity interventions. Applied Economic Perspectives and Policy, 35(1): 52–68.

Gladwin, C.H., Thomson, M.A., Peterson ,J.S. & Anderson, A.S. (2001). Addressing food security in Africa via multiple livelihood strategies of women farmers, Food Policy 26: 177- 207.

Glaser, B.G. (1992). Emergence vs Forcing: Basics of Grounded Theory Analysis. Mill Valley, Sociology Press.

Gleason M.L., K.B. Duttweiler, J.C. Batzer, S.E. Taylor, P. C Sentelhas, J.E.B.A. Monteiro & T.J. Gillespie. (2008). Obtaining weather data for input to crop disease-warning systems: leaf wetness duration as a case study. Scientia Agricola, 65: 76–87.

Gleick, P. (1996). Basic Water Requirements For Human Activities: Meeting Basic Needs, Water International, 21: 83-92.

Godfray, H.C.J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S.M. & Toulmin, C. (2010). Food security: the challenge of feeding nine billion people. Science, 327: 812–818.

Graef, F. & Haigis J. (2001). Spatial and temporal rainfall variability in the Sahel and its effects on farmers' management strategies. Journal of Arid Environments, 48: 221–231.

Greenberg, S. (2010). Status report on land and agricultural policy in South Africa, 2010. Institute for Poverty, Land and Agrarian Studies. Research Report No 40.

Greer-Love, K. (2003). The Constitutional Right to Food in the Republic of South Africa: A Critical Examination of the History of Section 27 and an Evaluation of its Enforcement. Chicago, University of Chicago Human Rights Programme.

Gregory, P. J. & Ingram, J. S. I. (2000). Global change and food and forest production: Future scientific challenges. Agriculture, Ecosystems & Environment, 82(1–3): 3–14.

Gregory, P.J., Ingram, J.S.I. & Brklacich, M. (2005). Climate change and food security, Philosophical Transactions, 360(1463): 2139-2148.

Gulati, A. & Kelley, T. (1999). Trade Liberalization and Indian Agriculture: Cropping Pattern Changes and Efficiency Gains in Semi-Arid Tropics. Oxford University Press, New Delhi.

Gutura, P., & Tanga, P.T. (2014). Boosting Their Stomachs': The Role of Social Grants in South Africa. Journal of Economics and Behavioral Studies. 6(2): 105-119.

Haggblade, S. & Tembo, G. (2003). Development, Diffusion and Impact of Conservation Farming in Zambia. FSRP Working Paper No. 8. Lusaka, Zambia: FSRP.

Hardin, G. (1968). The tragedy of the commons. Science 162:1243-1248

HarvestChoice. (2010). Rainfall Variability and Crop Yield Potential. International Food Policy Research Institute, Washington, DC., and University of Minnesota, St. Paul, MN. Available online at http://harvestchoice.org/node/2240.

Hassan, R., M. & Nhemachena, C. (2008). Determinants of African farmers' strategies for adapting to climate change: Multinomial choice analysis, African Journal of Agricultural and Resource Economics, 2(1): 361 -369.

Hassani, M.D. & Stern, R.D. (1988). A Simple Method for Analysing Daily Rainfall Data : A Case Study for Kota Bharu. Pertanika, 11(1): 101 – 106.

Hathaway, D. (1987). Agriculture and the GATT: Rewriting the Rules. Policy in International Analyses in International Economics 20. Washington: Institute for International Economics.

Hatloy, A., Hallund, J., Diarra, M.M. & Oshaug, A. (2000), Food variety, socioeconomic status and nutritional status in urban and rural areas in Koutiala (Mali). Public Health Nutrition, 3 (1): 57-65.

Hauggaard-Nielsen, H. & Jensen, E. S. (2005). Facilitative root interactions in intercrops. Plant and Soil, 274 (1- 2): 237-250.

Hazell, P., Poulton, C., Wiggins, S., & Dorward, A. (2007). The Future of small farms for poverty reduction and growth. International Food Policy Research Institute (IFPRI) 2020 Discussion Paper 42, May 2007. Washington D.C.: IFPRI.

Hebnick, P., Fay, D. & Kondlo K. (2011). Land and agrarian reform in South Africa's Eastern Cape Province: Caught by continuities. Journal of Agrarian Change, 11(2):220–240.

Hella, J.P., Haug, R., & Kamile, I.M. (2011). High global food prices – crisis or opportunity for smallholder farmers in Tanzania? Development in Practice, 21(4-5): 652-665.

Hendrickson, M., Wilkinson, J., Heffernan, W. D. and Gronski, R. (2008).The Global Food System and Nodes of Power. OXFAM. (August 2, 2008). Available at SSRN: http://ssrn.com/abstract=1337273 orhttp://dx.doi.org/10.2139/ssrn.1337273

Herrmann, L., Gabriela, B. I., van Mourik, T., Traore, P. S., Oumarou, H. M., Traore, K., Ouedraogo, M. & Naab, J. (2013). Coping with climate variability and change in research for development targeting West Africa: Need for paradigm changes. Secheresse, 24: 294-303. ISSN 1147-7806.

Hewitson, B.C. (1999). Regional climate change scenarios. Final Report to the Vulnerability and Adaptation Assessment Section or South African Country Study on Climate Change (SACSCC). National Research Foundation, Pretoria.

Higginbottom, G. M. A. (2004). Sampling issues in qualitative research. Nurse Researcher, 12(1): 7-19.

Hisschemöller, M., Tol, J. & Vellinga, P. (2001). The relevance of participatory approaches in integrated environmental assessment. Integrated Assessment, 2: 57-72.

Hoddinott, J. & Yohannes, Y. (2002). Dietary diversity as a food security indicaton. Washington, D.C.: Food and Nutrition Technical Assistance, Academy for Educational Development.

Hogan, A., Bode, A., & Berry, H.L. (2011). Farmer Health and Adaptive Capacity in the Face of Climate Change and Variability. Part 2: Contexts, Personal Attributes, and Behaviors. International Journal of Environmental Research and Public Health, 8:4055–4068.

Holt-Gimenez, E. (2012). We Already Grow Enough Food For 10 Billion People -- and Still Can't End Hunger. The Huffington Post: Food, 02 May, 2012. http://www.huffingtonpost.com/eric-holt-gimenez/world-hunger_b_1463429.html

Hosmer, D.W. & Lemeshow, S. (1989). Applied Logistic Regression. New York: Wiley.

Hossain, M., Lewis, D., Bose, & Chowdhury, A. (2007). Rice research, technological progress, and poverty: The Bangladesh case. In Agricultural research, livelihoods, and poverty: Studies of economic and social impacts in six countries, ed. M. Adato and R. Meinzen-Dick. Baltimore, U.S.A.: Johns Hopkins University Press.

Hoye, M. & Yan, H. (2014). US and China reach historic climate change deal, vow to cut emissions. Cable News Network (CNN). http://edition.cnn.com/2014/11/12/world/us-china-climate-change-agreement/index.html

Human Rights Watch. (2007). US: Wal-Mart Denies Workers Basic Rights. Weak Labor Laws Perpetuate Abuses, May 1. http://www.hrw.org/news/2007/04/30/us-wal-mart-denies-workers-basic-rights

Hydén, L. & Sekoli, T. (2000). Possibilities to forecast early summer rainfall in the Lesotho Lowlands from the El Niño/Southern Oscillation. Water SA, 26: 83-90.

IAASTD (International Assessment of Agricultural Knowledge, Science, and Technology). (2009). Agriculture at a crossroads. The global report of the International Assessment of Agricultural Knowledge, Science, and Technology. Washington DC: Island Press.

IFAD (International Fund for Agricultural Development). (2010). Global Consultation on Cassava as a Potential Bioenergy Crop. A Stakeholders Conference held in Accra between18-19 October 2010.

IFSS (Integrated Food Security Strategy). (2002). National Department of Agriculture Policy Document. Pretoria, South Africa.

Igumbor, E.U., Sanders, D., Puoane. T.R., Tsolekile, L., Schwarz, C., Purdy, C. et al. (2012). Big Food, the consumer food environment, health, and the policy response in South Africa. PLOS Medicine, 9 (7): 1-7. [http://dx.doi.org/10.1371/journal.pmed.1001253.

Iizumi, T., Yokozawa, M., Sakurai, G., Travasso, M.S., Romanenkov, V., et al. (2014) Historical changes in global yields: major cereal and legume crops from 1982 to 2006. Global Ecology and Biogeography, 23(3): 346-357.

INEGI (2007). Censo Agricola, Ganadero y Forestal. (Instituto Nacional de Estadística Geografíca e Informática). The Institute of Agriculture and Natural Resources Cooperative Extension, University of Nebraska-Lincoln.

Ingram, .J.S.I., Gregory, P.J., Brklacich, M. (eds). (2005). GECAFS science plan and implementation strategy. ESSP report, Wallingford, (2) Interhemispheric Resource Center, 2007.

Ingram, J. (2009). 2. Food system concepts, in: ESF (Ed.), European Food Systems in a Changing World -Report of a ESF/COST Forward Look. European Science Foundation, Strasbourg.

Ingram, J. (2011). A food systems approach to researching food security and its and its interactions with global environmental change. Food Security, 3(4): 417-431.

Ingram, K.T., Roncoli, M.C., Kirshen, P.H., (2002). Opportunities and constrains for farmers of West Africa to use seasonal precipitation forecasts with Burkina Faso as a case study. Agricultural Systems 74: 331–3349.

International Geosphere Biosphere Programme. (2015). Earth System Definitions. Science for a sustainable planet. http://www.igbp.net/globalchange/earthsystemdefinitions.4.d8b4c3c12bf3be638a80001040.html

IPCC (2001a) Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T.,Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, & C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881 pp

IPCC, (2002). Climate Change 2001: Synthesis Report. A contribution of working Group I, II and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (Watson, R.T, et al {eds}). Cambridge University Press, Cambridge, UK., pp: 239-397.

IPCC, (2004). Climate Change 2004: Impacts Adaptations and Vulnerability – Working Group II – Contribution of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

IPCC. (2012). Glossary of terms. In:Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., Barros,V., Stocker T.F., Qin, D., Dokken, D.J., Ebi, K.L., Mastrandrea, M.D., Mach, K.J., Plattner, G.K., Allen, S.K., Tignor, M. & Midgley, P.M. (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on ClimateChange (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 555-564

IPCC. (1996). Climate Change 1995: The IPCC second assessment report, Vol 2, Scientific-technical analyses of impacts, adaptations, and mitigation of climate change, Chaps 13 and 23. In: Watson, R.T., Zinyowera, M.C., Moss, R.H. (eds) Cambridge University Press, Cambridge, p 427–467, 745–771

IPCC. (2007). Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp .

Isik, M. & Devadoss, S. (2006): An analysis of the impact of climate change on crop yields and yield variability. Applied Economics, 38: 835-844.

Jacobs, P. (2012). Protecting food insecure households against rapid food price inflation. A Policy Brief. Human Sciences Research Council. http://www.hsrc.ac.za/uploads/pageContent/1067/Food%20Prices.pdf

Jacobs, P.T. (2010). Household food insecurity, rapid food price inflation and the economic downturn. Paper presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa, September 19-23.

Janowiak, J.E. (1988). An investigation of interannual rainfall variability in Africa. Journal of Climate, 1: 240-255.

Jooste, A. (2011). Food Prices and Food Security in Urban and Rural South Africa. National Agricultural Marketing Council. Southern Africa Food Lab Breakfast Forum, Woolworths DC, Midrand, 20 October 2011

Joshi, N.P., Maharjan, K. L. & Piya, L.(2011). Effect of Climate Variables on Yield of Major Food-crops in Nepal :A Time-series Analysis. Journal of Contemporary India Studies: Space and Society, Hiroshima University. 1: 19-26.

Juana, J.S., Kahaka, Z. & Okurut, F.N. (2013). Farmers' perceptions and adaptations to climate change in Sub-Sahara Africa: A synthesis of empirical studies and implications for public policy in African agriculture. Journal of

Agricultural Science, 5: 121–135.

Juarez, B. & Hansen, E. W. (2012). Mexico: Grain and Feed Annual, Prolonged Drought Devastates Grain and Feed Sector. USDA, FAS, GAIN Report. March 30. Available from: http://www.thefarmsite.com/reports/contents/ mexgandfapril12.pdf

Juhola, S. & Kruse, S. (2015). A framework for analysing regional adaptive capacity assessments: challenges for methodology and policy making. Mitigation and Adaptation Strategies for Global Change, 20(1): 99-120.

Jury, M.R., McQueen, C.A. & Levey, K.M. (1994). SOI and QBO signals in the African region. Theoretical and Applied Climatology, 50: 103-115.

Jury, M.R. & Levey, K. (1993). The Eastern Cape Drought. Water SA, 19:133-137.

Kahan, D, M., Peters, E., Wittlin, M., Slovic, P., Ouellette, L. L., Braman, D., & Mandel, G. N.(2012) The Polarizing Impact of Science Literacy and Numeracy on Perceived Climate Change Risks (December 23, 2012). Nature Climate Change 2: 732-735, 2012; Temple University Legal Studies Research Paper No. 2013-04; Yale Law & Economics Research Paper No. 464; Yale Law School, Public Law Working Paper No. 278. Available at SSRN: http://ssrn.com/abstract=2193133

Kahan, D., Jenkins-Smith, H. & Braman, D. (2011). Cultural cognition of scientific consensus. Journal of Risk Research, 14(2):147–174.

Kakembo, V. & Rowntree, K. M. (2003). The relationship between land use and soil erosion in the communal lands near Peddie town, Eastern Cape, South Africa. Land Degradation & Development, 14: 39-49.

Kakembo, V. (1997) A Reconstruction of the History of Land Degradation in Relation to Land-use and Land Tenure in Peddie District, Former Ciskei. Unpublished MSc Theses. Rhodes University, Grahamstown.

Kakembo, V. (2001). Trends in Vegetation Degradation in relation to Land Tenure, Rainfall, and Population changes in Peddie District, Eastern Cape: South Africa. Environmental Management, 28(1): 39-46.

Kakembo, V., Palmer, A. R. & Rowntree, K.M. (2006). The Use of High Resolution Digital Camera Imagery to Characterise the Distribution of Pteronia Incana Invader Species in Ngqushwa (Formerly Peddie) District, Eastern Cape, South Africa. International Journal of Remote Sensing, 27: 2735 - 2752.

Kakota, T., Mkwambisi, D. & Kogi-Makau, W. (2011). Gender vulnerability to climate variability and household food security. Climate and Development, 3(4): 298 -309.

Kalumba, A. M., Olwoch, J. M., van Aardt, I., Botai, O. J., Tsela, P., Nsubuga, F. W. N., Adeola, A. M. (2013). Trend Analysis of Climate Variability over the West Bank - East London Area, South Africa (1975-2011). Journal of Geography & Geology, 5 (4): pp.131-147.

Kang, Y., Khan, S. & Ma, X. (2009). Climate change impacts on crop yield, crop water productivity and food security – A review. Progress in Natural Science, 19(12): 1665–1674.

Kangalawe, R.Y.M. (2012). Food security and health in the southern highlands of Tanzania: A multidisciplinary approach to evaluate the impact of climate change and other stress factors. African Journal of Environmental Science and Technology, 6: 50 -66. doi: 10.5897/ajest11.003

Kariaga, B.M. (2004). INTERCROPPING MAIZE WITH COWPEAS AND BEANS FOR SOIL AND WATER MANAGEMENT IN WESTERN KENYA. ISCO 2004 - 13th International Soil Conservation Organisation Conference – Brisbane, July 2004. http://www.tucson.ars.ag.gov/isco/isco13/PAPERS%20F-L/KARIAGA.pdf

Kasei, C. N. & Afuakwa, J. J. (1991). Determination of optimum planting date and growing season of maize in the northern savannah zone of Ghana. Soil Water Balance in the Sudano-Sahelian Zone (Proceedings of the Niamey Workshop). IAHS Publ. no. 199.

Kasemir, B., Dahinden, U., Swartling, A., Schule, R., Tabara, D. & Jaeger, C. (2000). Citizens' perspectives on Climate Change and Energy Use. Global Environmental Change, 10:169–184.

Kassie, B.T., Rötter, R.P., Hengsdijk, H., Asseng, S., van Ittersum, M.K., Kahiluto, H. & van Keulen, H. (2013). Climate variability and change in the Central Rift Valley of Ethiopia: Challenges for rainfed crop production. Journal of Agricultural Science, 52, 58–74.

Katz, J.M. (2008). Haiti ousts leader over high food prices. World. Mail and Guardian. 12 April, 2008. http://mg.co.za/article/2008-04-12-haiti-ousts-leader-over-high-food-prices

Kepe, T. (1999). The problem of defining 'community': Challenges for the land reform programme in rural South Africa. Development Southern Africa, 16(3): 415–433.

Kiersz, A. (2014). Here Are The Most Unequal Countries In The World. Business Insider. http://www.businessinsider.com/gini-index-income-inequality-world-map-2014-11.

Kiguli, L. N, Palmer, A. R. & Avis, A. M. (1999). A description of rangeland on commercial and communal land, Peddie District, South Africa. African Journal of Range & Forage Science, 16: 89–95.

Kim, M. K., & Pang, A. (2009). Climate change impact on rice yield and production risk. Journal of Rural Development, 32(2): 17- 29.

King, B. H. & McCusker, B. (2007). Environment and development in the former South African Bantustans. The Geographical Journal, 173(1): 6-12.

King Jr., M. L. (1967) “Beyond Vietnam,” published in A Call to Conscience: the Landmark Speeches of Dr. Martin Luther King, Jr. Edited by Clayborne Carson & Kris Shepard. New York: Grand Central Publishing.

Kirsten, J. (2012) The political economy of food price in South Africa, UNU-WIDER Working Paper No. 2012/102, UNU-WIDER, Helsinki.

Klein, J. T. (1991). Applying interdisciplinary models to design, planning, and policy making. Knowledge In Society, 3: 29 - 56.

Knutsson, P. (2006).The Sustainable Livelihoods Approach: A Framework for Knowledge Integration Assessment. Human Ecology Review, 13(1):90 -99.

Koester E (1993). Agricultural Trade Between Malawi, Tanzania, Zambia and Zimbabwe: Competitiveness and Potential. In: Valdes, A., Muir-Leresche, K. (Eds.), Agricultural Policy Reforms and Regional Market Integration in Malawi, Zambia and Zimbabwe. IFPRI, p. 347.

Kollmair, M. & St. Gamper, J. (2002). THE SUSTAINABLE LIVELIHOODS APPROACH Input Paper for the Integrated Training Course of NCCR North-South Aeschiried, Switzerland (9. - 20. September 2002). Development Study Group. Zurich

Kroghsbo, S.; Madsen, C.; Poulsen, M.; Schrøder, M.; Kvist, P. H.; Taylor, M.; Gatehouse, A.; Shu, Q.; Knudsen, I. (2008). Immunotoxicological studies of genetically modified rice expressing PHA-E lectin or Bt toxin in Wistar rats. Toxicology, 245: 24–34.

Kruger A. C. (2006). Observed trends in daily precipitation indices in South Africa: 1910–2004, International Journal of Climatology. 26: 2275 - 2285.

Kumar, A., Jha, B., Zhang, Q. & Bounoua, L. (2007). A new methodology for estimating the unpredictable component of seasonal atmospheric variability. Journal of Climate, 20(15): 3888–3901.

Kumar, K .& Parikh, J. (1998). Climate change impacts on Indian agriculture: The Ricardian approach. In Dinar A, Mendelsohn R, Evenson R, Parikh J, Sangi A, Kumar K, Mckinse J & Lonergan S (eds), Measuring the impact of climate change on Indian agriculture. World Bank Technical Paper No 402, World Bank, Washington, DC.

Kumar, K.K. & Rao, T.V.R. (2005) Dry and wet spells at Campina Grande-PB. Brazilian Meteorological Society, 20 (1): 71-74.

Kurukulasuriya, P., Mendelsohn, R., Hassan, R., Benhin, J., Deressa, T., Diop, M., Eid, H.M., Fosu, K.Y., Gbetibouo, G., Jain, S., Mahamadou, A., Mano, R., Kabubo-Mariara, J., El-Marsafawy, S., Molua, E., Ouda, S., Ouedraogo, M., Sène, I., Maddison, D., Seo, S.N. & Dinar, A. (2006). Will African agriculture survive climate change? World Bank Economic Review 20, 367–88.

KwaZulu –Natal Agricultural Union. (2014). Minister surprised ANC won't back his plan on land. The Mercury, 2 July 2014. http://www.kwanalu.co.za/default.asp?action=news&Id=1234

Labadarios, D., Steyn, N., Maunder, E., MacIntyre, U., Swart, R., Gericke, G. et al. (2000). The National Food Consumption Study (NFCS) in children aged 1–9 years, South Africa, Department of Health, Pretoria.

Labadarios, D., Swart, R., Maunder, E.M.W., Kruger, H.S., Gericke, G.J., Kuzwayo, P.M.N., Ntsie, P.R., Steyn, N.P., Schloss, I., Dhansay, M.A., Jooste, P.L., Dannhauser, A., Nel, J.H., Molefe, D., Kotze, T.J.W. (2008). Executive summary: National Food Consumption Survey- Fortification Baseline (NFCS – FB-I) South Africa, 2005, South African Journal of Clinical Nutrition, 21(3): 246-300.

Laidler, G.J. (2006). Inuit and scientific perspectives on the relationship between sea ice and climate change: the ideal complement? Climatic Change, 78: 407–444.

Lazarus, C. (2012). Brazil inspires South Africa through its "Zero Hunger strategy". The Inetrnational Center for Inclusive Growth. UNDP, 2 Feburary, 2012. pressroom.ipc-undp.org/brazil-inspires-south-africa-through-its-zero-hunger-strategy/

Lazrus, H. (2011) Climate Change, Water, and Development&in&Daily&Life&in&Tuvalu in Water, Cultural Diversity, and Global Environmental Change. Rose Johnston (ed.) Springer, New York, NY.

Lean, G. (2008). Charles targets GM crop giants in fiercest attack yet. The Independent, 05 October, 2008. http://www.independent.co.uk/environment/green-living/charles-targets-gm-crop-giants-in-fiercest-attack-yet-951808.html

Leibbrandt, M, Woolard, C and Woolard, I. (1996). The contribution of income components to income inequality in South Africa: a decomposable Gini analysis. Living Standards Measurement Survey Working Paper no. 125, Washington Bank.

Leibbrandt, M., Woolard, I., Finn, A. & Argent, J. (2010). 'Trends in South African Income Distribution and Poverty since the Fall of Apartheid'. OECD Social, Employment and Migration Working Papers 101. Paris: OECD.

Leichenko, R. & O'Brien, K. (2002). The dynamics of rural vulnerability to global change: The case of Southern Africa. Mitigation and Adaptation Strategies for Global Change, (7): 1–18.

Leiserowitz, A. A. (2005). American Risk Perceptions: Is Climate Change Dangerous? Risk Analysis, 25 (6):1433-1442.

Lester, A., Nel, E., & Binns, T. (2000). South Africa, past, present and future: Gold at the end of the rainbow? Longman, London, ISBN: 0-58235626-1, 374pp.

Lin, B.B. (2011). Resilience in agriculture through crop diversification. Adaptive Management for Environmental Change. BioScience, 61: 183–193.

Lindesay, J. (1988). South African rainfall, the Southern Oscillation and Southern Hemisphere semi-annual cycle. Journal of Climatology, 8: 17-30.

Lindesay, J.A., Harrison, M.S.J. & Haffner, M.P. (1986). The Southern Oscillation and South African rainfall. South African Journal of Science, 82: 196-198.

Liverman, D. & Kapadia, K. (2010). Food security and the global environment: an overview. In, Ingram, J., Ericksen, P. and Liverman, D. (2010) Food Security and Global Environmental Change. Earthscan. 352 pp. ISBN 9781849711289.

Liverman, D.M., Ericksen, P.J. & Ingram, J.S.I. (2009). Governing Food systems in the Context of Global Environmental Change . Governance as a Crosscutting Theme in Human Dimensions Science, 3: 59 – 64.

Lobell, D. B., & Asner, G. P. (2003): Climate and management contributions to recent trends in U.S. agricultural yields. Science, 299(5609): 1032 -1045.

Lobell, D. B., Cahill, K. N. & Field, C. B. (2007). "Historical effects of temperature and precipitation on California crop yields." Climatic Change 8 1(2): 187-203.

Lobell, D. B., Schlenker, W., & Costa-Roberts, J. (2011). Climate trends and global crop production since 1980. Science, 1. doi:10.1126/science.1204531.

Lobell, D.B. & Gourdji, S.M. (2012) The influence of climate change on global crop productivity. Plant Physiology, 160: 1686–1697.

Lodoun, T., Giannini, A., Traoré, P.S., Somé, L., Sanon, M., Vaksmann, M. & Rasolodimby, J.M. (2013). Changes in seasonal descriptors of precipitation in Burkina Faso associated with late 20th century drought and recovery in West Africa. Environment, Development and Sustainability, 5:96–108.

Lofstedt, R.E. (1992). Lay perspectives concerning global climate change in Sweden. Energy and Environment, 3: 161-175.

Louw, A., Chikazunga, D., Jordaan, D., & Bienabe, E. (2007). Restructuring food markets in the Southern Africa region: Dynamics within the context of the tomato subsector. Regoverning markets agrifood sector studies. London: IIED.

Ludi, E. (2009). Climate change, water and food security. Overseas Development Institute Background Note, ODI, London, March 2009.

Machethe, C.L. (2004). Agriculture and poverty in South Africa: Can agriculture reduce poverty? Paper presented at the Overcoming Development Conference held in Pretoria, 28-29 October 2004.

Mager, A.K. (1999). Gender and the Making of a South African Bantustan: a social history of the Ciskei, 1945-59. Social History of Africa series. Oxford: James Currey; Portsmouth NH: Heinemann; Cape Town: David Philip, 248pp.

Mail & Guardian. (2014 b). President Zuma signs land bill into law. Mail & Guardian, 30 JUN 2014. http://mg.co.za/article/2014-06-30-president-zuma-signs-land-bill-into-law

Mail & Guardian. (2014 a). Land reform proposal not ANC brainchild – report, 29 JUN 2014 http://mg.co.za/article/2014-06-29-land-reform-proposal-not-anc-brainchild-report

Mail and Guardian (2008) How climate change threatens food security in Africa http://mg.co.za/article/2008-07-25-how-climate-change-threatens-africas-food-security.

Makinana, A. (2014). Nkwinti: Policy paper on land reform isn't un-ANC. Mail & Guardian, 01 JUL 2014. http://mg.co.za/article/2014-07-01-nkwinti-policy-paper-on-land-reform-isnt-un-anc

Makundi, P. & Lyimo, J.G. (2015). Influence of Soil Management Practices on Crop Production in the Changing Climate, a Voice from Farmers: The Case of Sanjaranda Village in Manyoni District, Tanzania. Research Journal of Agriculture and Environmental Management, 4(1): 13 – 22.

Malone, A. (2008). The GM genocide: Thousands of Indian farmers are committing suicide after using genetically modified crops.The Daily Mail (Mail Online). 3 November, 2008. http://www.dailymail.co.uk/news/article-

1082559/The-GM-genocide-Thousands-Indian-farmers-committing-suicide-using-genetically-modified-crops.html

Mankiw, N.G. (1995). The growth of nations. Brookings Papers on Economic Activity, 1: 275 – 326.

Manuel, P.R. (2014). NAFTA's 20 Years of Unfulfilled Promises. The trade deal has become an engine of poverty in Mexico. Transnational Institute. 7 January 2014. http://www.tni.org/article/naftas-20-years-unfulfilled-promises

Manyatsi, A.M., .Mhazo, N. & Masarirambi, M.T. (2010). Climate variability and change as perceived by rural communities in Swaziland. Research Journal of Environmental and Earth Sciences, 2(3): 165-170.

Maponya, P. & Mpandeli, S.(2013). Perception of Farmers on Climate Change and Adaptation in Limpopo Province of South Africa. Journal of Human Ecology, 42(3): 283–288.

Marie, N., Fleming, B.S., Robinson, M. et al. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet - 29 May 2014 . DOI: 10.1016/S0140-6736(14)60460-8

Marill, K.A. (2004). Advanced statistics: linear regression, part II: multiple linear regression. Acad Emerg Med, 11:94-102.

Marsh, R., & Runsten, D. (1998). Smallholder fruit and vegetable production in Mexico: Barriers and opportunities. In W. Cornelius & D. Myhre (Eds.), The transformation of rural Mexico: Reforming the ejido sector. San Diego: Center for U.S.-Mexican Studies.

Mason, S.J. & Jury, M.R. (1997). Climatic variability and change over southern Africa: A reflection on underlying processes. Progress in Physical Geography, 21: 23-50.

Mason, S.J. (1998). Seasonal forecasting of south African rainfall using a non-linear discriminant analysis model.International Journal of Climatology, 18: 147–164.

Mason, S.J. (2001). El Niño, climate change, and Southern African climate. Environmetrics, 12: 327-345.

McMichael, A.J., Woodruff, R.E. & Hales, S. (2006). Climate change and human health: present and future risks. Lancet, 367: 859-869.

MEA (Millennium Ecosystem Assessment). (2005). Ecosystems and Human Well-Being: Scenarios(Washington, DC: Island Press.

MEDPT (Masifunde Education and Development Project Trust). (2010). Threats to the Food Security and Food Sovereignty in the Eastern Cape: Impacts of the Massive Food Production Programme (MFPP), GMOs and cash crops in four villages in the Amathole District Municipality. Institute of Social and Economic Research (ISER), Rhodes University. 64 pp.

Mehra, S. (1981). Instability in Indian agriculture in the context of the new technology. Research Report 25. Washington, D.C.: International Food Policy Research Institute.

Mellor, J.W. (1976). The new economics of growth: A strategy for India and the developing world. Ithaca, N.Y. Cornell University Press.

Mendelsohn, R. & Tiwari, D. (2000). Two essays on climate change and agriculture: A developing country perspective. FAO Economic and Social Development Paper 145. Rome, Italy.

Mendelsohn, R., Dinar, A. & Dalfelt, A. (2000). Climate impacts on African agriculture. World Bank.

Mendelsohn, R., Dinar, A. & Dalfelt, A. (2000). Climate impacts on African agriculture. World Bank.

Mendelsohn, R., Nordhaus, W., & Shaw, D. (1994). Measuring the impact of global warming on agriculture. American Economic Review, 84: 753-771.

Mertz, O., Mbow, C., Reenberg, A., & Diouf, A. (2009). Farmer's Perception of Climate Change and Agricultural Adaptation Strategies in Rural Sahel. Environmental Management, 43: 804-816. doi:10.1007/s00267-008-9197-0, http://dx.doi.org/10.1007/s00267-008-9197-0

Mgijima, C. (1999). South African Government: Department of Health. In International consultative conference on food security and nutrition as human rights. Johannesburg: South African Human Rights Commission.

Midgley, G., Chapman, R., Mukheibir, P., Tadross, M., Hewitson, B., Wand, S., Schulze, R., Lumsden, T., Horan, M., Warburton, M., Kgope, B., Mantlana, B., Knowles, A., Abayomi, A., Ziervogel, G., Cullis, R., & Theron, A. (2007). Impacts, Vulnerability and Adaptation in Key South African Sectors: An input into the Long Term Mitigation Scenarios process. Report to: Department of Environment Affairs and Tourism South Africa, LTMS input Report 5 (Summary report), Energy Research Centre, University of Cape Town.

Miller, M., Anderson, M., Francis, C. A., Kruger, C., Barford, C., Park, J., & McCown, B. (2013). Critical research needs for successful food systems adaptation to climate change. Journal of Agriculture, Food Systems, and Community Development, 3(4), 161–175. http://dx.doi.org/10.5304/jafscd.2013.034.016

Mimura, N., Nurse, L., Mclean, R.F., Agard, J., Briguglio, L., Lefale, P., Payet, R. and Sem, G. (2007). Small islands. In Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E. (Eds) Climate Change 2007: Impacts, Adaptation and Vulnerability. Cambridge. Cambridge University Press: 687-716.

Mitchell, D. (2008). A note on Rising Food Prices. World Bank Policy Research Working Paper No. 4682 (World Bank - Development Economics Group, Washington, DC.

Mongi, H., Majule, A. E., & Lyimo, J.G. (2010). Vulnerability and adaptation of rain fed agriculture to climate change and variability in semi-arid Tanzania. African Journal of Environmental Science and Technology, 4(6):371-381.

Monsanto. (2014). Who we are: Fighting Rural Hunger. http://www.monsanto.com/whoweare/pages/fighting-rural-hunger.aspx

Morgan, D. L. & Krueger, R. A. (1998). The focus group kit (1-6). Thousand Oaks, CA: Sage.

Mortreux, C. & Barnett, J. (2009). 'Climate change, migration and adaptation in Funafuti, Tuvalu.' Global Environmental Change 19: 105–112.

Moseley, W.G., Carney, J. & Becker, L. (2010). "Neoliberal Policy, Rural Livelihoods and Urban Food Security in West Africa: A Comparative Study of The Gambia, Côte d'Ivoire and Mali." Proceedings of the National Academy of Sciences of the United States of America, 107 (13): 5774–5779.

Moyo, M., Mvumi, B. M., Kunzekweguta, M., Mazvimavi, R., Craufurd, P. & Dorward, P. (2012). Farmers' perceptions on climate change and variability in semi-arid Zimbabwe in relation to climatology evidence. African Crop Science Journal, 20(2):317-335.

Mtero, F. (2012). Commercialisation, de-agrarianisation & the accumulation/ reproduction dynamic: Massive maize production schemes in the Eastern Cape, South Africa,' Working Paper 23. PLAAS, UWC: Bellville.

Mui, Y.Q. (2009). Area Wal-Mart Workers Join Effort to Unionize. Washington Post. The Business, June 3. http://www.washingtonpost.com/wp-dyn/content/article/2009/06/02/AR2009060203449.html

Mulatu D.N. (2011). Determinants of farmers' preference for adaptation strategies to climate change: evidence from north shoa zone of Amhara region Ethiopia. MPRA Paper 48753, University Library of Munich, Germany.

Mulder, M. (2001). Integrated assessment of land use changes. Integrated Assessment, 2: 73-78.

Musemwa, L., Zhou, L., Ndhleve, S.. & Aghdasi, F. (2013). Factors affecting household access to enough food in the Eastern Cape Province of South Africa.

Journal of Development and Agricultural Economics, 5(3): 84-91. Available online at http://www.academicjournals.org/JDAE.

Mustapha, S.B., Sanda, A.H. & Shehu, H. (2012). Farmers' perception of climate change in central agricultural zone of Borno State, Nigeria. Journal of Environment and Earth Science, 2 (11): 21-27.

Mxotwa, M. (2014). No constructive input on land reform from farmers. Daily Dispatch, 27 June 2014.

Mzezewa, J., Misi, T. & Van Rensburg, L. D. (2010). Characterisation of rainfall at a semi-arid ecotope in the Limpopo Province (South Africa) and its implications for sustainable crop production. Water SA, 36(1): 19-26. ISSN 1816-7950.

Nair, B. (2001). Through the eyes of the workers. In Reflections in Prison: Voices from the South African Liberation Struggle, (Eds) Maharaj, M. University of Massachusetts Press, ISBN 1558493425, 9781558493421

Nakuja, T., Sarpong, D. B., Kuwornu, J.K.M. & Aahante F.A. (2012). Water storage for dry season vegetable farming as an adaption to climate change in the upper east region of Ghana. African Journal of Agricultural Research, 7(2): 298-306.

Nath, K. (2008). Farm Subsidies Are the Real Culprit. Bloomberg Business Week. May 13, 2008. http://www.businessweek.com/stories/2008-05-13/farm-subsidies-are-the-real-culpritbusinessweek-business-news-stock-market-and-financial-advice

National Agricultural Marketing Council. (2013). Food Price Monitor: May 2013. http://www.namc.co.za/upload/food_price_monitoring/NAMC%20-%20Food%20Price%20Monitor-%20May%202013.pdf

National Policy on Food and Nutrition Security, South Africa. (2013). Department of Social Development and Department of Agriculture, Forestry and Fisheries, August 2013

Ncube, E., Flett, B.C., Waalwijk, C. & Viljoen, A. (2011). Fusarium spp. and levels of fumonisins in maize produced by subsistence farmers in South Africa. South African Journal of Science, 107(1-2): 1-7.

Ndhleve, S., Musemwa, L. & Zhou, L. (2013). How severe hunger is amongst rural households of the Eastern Cape Province of South Africa. Journal of Economics and Sustainable Development , 4(3): 220-227. www.iiste.org ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online).

Nel, W. & Sumner, P.D. (2006). Trends in rainfall total and variability (1970 – 2000) along the KwaZulu-Natal Drakensberg foothills. South African Geographical Journal, 88:130-137.

Nelson, G.C., Rosegrant, M.W., Koo, J., Robertson, R., Sulser, T., Zhu, T., Ringler, C., Msangi, S., Palazzo, A., Batka, M., Magalhaes, M., Valmonte-Santos, R., Ewing, M., & Lee, D. (2009). Climate change. Impact on agriculture and costs of adaptation. IFPRI, Washington D.C.

Nelson, R., P. Kokic, S. Crimp, P. Martin, H. Meinke, S.M. Howden, P. deVoil, G. McKeon &. Nidumolu, U. (2010). The vulnerability of Australian rural communities to climate variability and change: Part II – Integrating impacts with adaptive capacity. Environmental Science and Policy, 13:8-17.

Neufeldt, H., Jahn, M., Campbell, B.M., Beddington, J.R., De Clerck, F., et al. (2013). Beyond climate-smart agriculture: toward safe operating spaces for global food systems. Agriculture & Food Security 2(1), 12. Available at: http://www.agricultureandfoodsecurity.com/content/2/1/12 (Accessed: 12 March 2014).

Ngqaleni, M. & Makhura, M.T. (1995). The role of women in the reconstruction of agriculture in developing areas: The case of the Northern Province. Agrekon, 34 (4): 221-225.

Ngqushwa Final Strategic Environmental Assessment Report (SEAR) (2005). Ngqushwa Local Municipality. Available on

Ngqushwa Local Municipality Integrated Development Plan (2009/10). Ngqushwa Local Municipality. http://www.ngqushwamun.gov.za/images/docs/IDP_2009-2010.pdf

Nicholson, S.E. & Entekhabi, D. (1986). The quasi-periodic behaviour of rainfall variability in Africa and its relationship to the Southern Oscillation. Journal of Applied Meteorology and Climatology, 34: 331–348.

Nilsson, A. & Karlsson, H. (2008). The Baby of the Government - A case study of the implementation of the Massive Food Production Programme and genetically modified maize into smallholder farming in rural South Africa. Swedish University of Agricultural Sciences. 54pp. (Unpublished Thesis).

Nkwinti, G. (2008). Eastern Cape Department of Agriculture 2008 Policy Speech. Bisho, Eastern Cape, 11 March 2008.

NLM Integrated Development Plan (2012). Ngqushwa Local Municipality 2012 – 2017.

Nowotny, H., Scott, P., & Gibbons, M. (2001). Re-thinking science: Knowledge and the public in an age of uncertainty. Cambridge, UK: Polity.

Nyanga, P., Johnsen, F., Aune, J., & Kahinda, T. (2011). Smallholder Farmers' Perceptions of Climate Change and Conservation Agriculture: Evidence from Zambia. Journal of Sustainable Development, 4(4), 73-85. http://dx.doi.org/10.5539/jsd.v4n4p73.

O'Connor, B. (2003). A Note on the Need for More Clarity in the World Trade Organization Agreement on Agriculture. Journal of World Trade, 37(5): 839-846.

O'Brien, K., R. Leichenko, U. Kelkar, H. Venema, G. Aandahl, H. Tompkins, A. Javed, S. Bhadwal, S. Barg, L. Nygaard, and J. West. (2004). Mapping vulnerability to multiple stressors: climate change and globalization in India. Global Environmental Change Part A, 14(4): 303-313.

O'Neill, M.S. & Ebi, K.L. (2009).Temperature extremes and health: impacts of climate variability and change in the United States. Journal of Occupational and Environmental Medicine, 51(1):13–25.

Adebayo, O.O. (2012). Climate Change Perception and Adaptation Strategies on Catfish Farming in Oyo State, Nigeria. Global Journal of Science Frontier Research Agriculture and Veterinary Sciences., 12(6): 22-28

Odekunle T. O., Orinmoogunje, I. O. O. & Ayanlade, A. (2007). Application of GIS to assess rainfall variability impacts on crop yield in Guinean Savanna part of Nigeria. African Journal of Biotechnology, 6 (18): 2100-2113.

Oettle, N., Fakir, S., Wentzel, W., Giddings, S., & Whiteside, M. (1998). South Africa: Encouraging sustainable smallholder agriculture. Environment and Development Consultancy Ltd. for DFID, http://www.eldis.org/fulltext/rsa.pdf

Ofuoku, A. U. (2011). Rural farmers' Review perception of climate change in central Agricultural Zone of Delta State, Nigeria. Indonesian Journal of Agricultural Science, 12(2): 63-69.

Okoboi, G. & Barungi, M. (2012). Constraints to Fertilizer Use in Uganda: Insights from Uganda Census of Agriculture 2008/9. Journal of Sustainable Development, 5 (10): 99 -112

Okonya, J.S., Syndikus, K. & Kroschel, J. (2013). Farmers' perception of and coping strategies to climate change: evidence from six agro-ecological zones of Uganda, Journal of Agricultural Science, 5 (8): 252-263.

Oldfield, F. & Steffen, W. (2004). The Earth System, in W. Steffen et al., Global Change and the Earth System: A Planet Under Pressure, IGBP Global Change Series (Berlin and New York: Springer-Verlag).

Olivier, S.M. (2004) Information Technology Research: a Practical Guide for Computer Science and Informatics, 2nd ed. Van Schaik, Pretoria, South Africa.

Omari, K. (2010). Gender and Climate change: Botswana Case Study. In K. Omari (Ed.), Gender and Climate Change: Botswana Case Study. Cape Town.

ONE. (2014). New Alliance for Food Security and Nutrition: Part 1. http://www.one.org/us/policy/policy-brief-on-the-new-alliance/

Ortmann, G. & Machete, C. (2003). Problems and opportunities in South African agriculture. In: Nieuwoudt L and Groenewald J (eds) The challenge of change: Agriculture, Land and the South African Economy. Univ. Natal Press. pp. 47-62.

Oseni T.O. & Masarirambi M.T. (2011) Effect of Climate Change on Maize (Zea mays) Production and Food Security in Swaziland. American-Eurasian journal of agricultural & environmental sciences, 11 (3): 385-391.

Ostrom, E. (1999). Coping with tragedies of the commons. Annual Review of Political Science, 2: 493-535.

Ostrom, E., Burger, J., Field. C.B., Norgaard, R.B. & Policansky, D. (1999). Revisiting the Commons: Local Lessons, Global Challenges, 284 (5412): 278-282.

Ovuka, M. & Lindqvist, S. (2000). Rainfall Variability in Murang'a District, Kenya: Meteorological Data and Farmers' Perception. Geografiska Annaler Series A, 82(1): 107-119.

Oxfam. (2002). Rigged Rules and Double Standards. Trade, Globalization, and the Fight against Poverty. Oxfam International

Oxfam. (2012). Extreme Weather, Extreme Prices. Oxfam Isue Briefing, Oxfam International, September 2012

Paaijmans, K.P., Blanford, S., Bell, A.S., Blanford, J.I., Read, .AF. & Thomas, M.B. (2010). Influence of climate on malaria transmission depends on daily temperature variation. Proc Natl Acad Sci U S A 107:15135–15139. doi:10. 1073/pnas.1006422107

Paavola, J. (2008). Livelihoods, vulnerability and adaptation to climate change in Morogoro, Tanzania. Environmental Science and Policy, 11(7): 642 - 654.

Palmer, A. R. & Avis, A. M. (1994). Land and Agricultural Policy Centre, Mid-Fish Zonal Study: The Description, Mapping and Evaluation of Recent Changes in the Contemporary Vegetation Patterns. Grahamstown: South Africa.

Palmer, A. R., Ainslie, A. & Mase, S. (2005). Clearing of Pteronia incana (Blue bush) and Elytroppappus rhinocerotis (Renosterbos) in Mgwalana catchments, Eastern Cape Province: Rehabilitating degraded rangelands. Special report for the Agricultural Research Council-Range and Forage Institute, Grahamstown.

Palmer, A. R., Ainslie, A. & Mase, S. (2005). Clearing of Pteronia incana (Blue bush) and Elytroppappus rhinocerotis (Renosterbos) in Mgwalana catchments, Eastern Cape Province: Rehabilitating degraded rangelands. Special report for the Agricultural Research Council-Range and Forage Institute, Grahamstown.

Palmer, A.R., Killer, F.J., Avis, A.M. & Tongway, D.J. (2001). Defining function in rangelands of the Peddie district, Eastern Cape, using Landscape Function Analysis. African Journal of Range & Forage Science, 18(1): 53 - 58.

Palmer, T. (1994). Deterioration of Grazing in the Peddie District and Possible Future Actions. Range and Forage Institute, Grahamstown: South Africa.

Parry, M., Rosenzweig, C., Iglesias, A., Fischer, G. & Livermore, M. (1999). Climate change and world food security: A new assessment. Global Environmental Change, 9: 51- 67.

Parry, M.L., O.F. Canziani, J.P. Palutikof, P.J. van der Linden & C.E. Hanson, eds. (2007). Climate Change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge

Parry, M.L., Rosenzweig, C., Iglesias, A., Livermore, M. &. Fischer, G. (2004). Effects of climate change on global food production under SRES emissions and socio-economic scenarios. Global Environmental Change, 14: 53-67, doi:10.1016/j.gloenvcha.2003.10.008.

Pascual, M.,. Ahumada, J.A., Chaves, L.F., Rodó, X., & Bouma, M. (2006). Malaria resurgence in the East African highlands: temperature trends revisited. P. Natl. Acad. Sci. USA, 103: 5829-5834.

Patel, R. (2007). Stuffed and Starved. Power and the Hidden Battle for the World Food System. London: Portobello Books.

Patel, R. (2013). The Long Green Revolution. The Journal of Peasant Studies, 40(1): 1-63, DOI: 10.1080/03066150.2012.719224

Payne, T. (2011). The amazing whiteness of local staples. Mail & Guardian. 11 Nov, 2011. mg.co.za/article/2011-11-11-the-amazing-whiteness-of-local-staples.

Pearson, L., Langridge, J. Crimp, S. & Nelson, R. (2008) 'Climate change vulnerability assessment: Review of agricultural productivity' CSIRO Climate Adaptation Flagship Working paper No.1.

People's Assembly. (2014). Land expropriation without compensation? No thanks, says Minister, 3rd July, 2014.

Perkins, J.H. (1997). Geopolitics and the Green Revolution: Wheat, genes and the Cold War. Oxford: Oxford University Press

Perret, S., Anseeuw, W. & Mathebula, N. (2005). Poverty and livelihoods in rural South Africa. Investigating diversity and dynamics of livelihoods. Case studies in Limpopo. . Pretoria, South Africa, University of Pretoria, Kellogg's Foundation.

Petheram, L., Zander, K.K., Campbell, B. M., High, C. & Stacey, N. (2010). 'Strange changes': Indigenous perspectives of climate change and adaptation in NE Arnhem Land (Australia). Global Environmental Change, 20: 681–692.

Philip, L. J. (1998). Combining quantitative and qualitative approaches to social research in human geography—an impossible mixture? Environment and Planning A, 30(2): 261 – 276

Pichulik, M. (2013). Micro-milling: an obvious solution. Daily Maverick, 14 Jun 2013. http://www.dailymaverick.co.za/opinionista/2013-06-13-micro-milling-an-obvious-solution/#.U6HUc_mSx30

Pielke R. A., Adegoke J., Beltran-Przekurat A., Hiemstra C. A., Lin J., Nair U. S., Niyogi D. & Nobis T. E. (2007). An overview of regional land-use change and land-cover impacts on rainfall. Tellus Series B-chemical and Physical Meteorology, 59: 587–601. (doi:10.1111/j.1600-0889.2007.00251.

Piya, L., Maharjan, K. L. & Joshi, N. P. (2012). Vulnerability of rural households to climate change and extremes: Analysis of Chepang households in the mid-hills of Nepal. Selected paper prepared for presentation at the International Association of Agricultural Economics (IAAE) Triennial Conference, Foz do Iguacu, Brazil, 18–24 August, 2012.

Posel, D. & Casale, D. (2006). Internal Migration and Household Poverty in Post - Apartheid South Africa. In Poverty and Policy in Post-Apartheid South Africa, edited by R. Kanbur and H. Bhorat. Pretoria: Human Sciences Research Council Press, pp.351 – 365.

Posel, D. & Rogan, M. (2012). Gendered Trends in Poverty in the Post-apartheid Period: 1997–2006. Development Southern Africa, 29 (1): 97–113.

Potgieter, D.J. et al. (eds). (1970). Standard Encyclopaedia of Southern Africa, Cape Town: NASOU, v. 7, p. 382.

Pouliotte, J., Smit, B. & Westerhoff, L. (2009). Adaptation and development: Livelihoods and climate change in Subarnabad, Bangladesh Climate & Development, 1: 31- 46.

Prakash S., Wu, X. M. & Bhat S. R. (2011). History, evolution, and domestion of Brassica crops. Plant Breeding Reviews, 35: 19–84.

Pregibon, D. (1981). Logistic regression diagnostics. Annals of Statistics, 9: 705–724.

Preston, B.L., Yuen, E. J. & Westaway, R.M. (2011). Putting vulnerability to climate change on the map: A Review of Approaches, Benefits, and Risks. Sustainability Science, 6 (2): 177-202.

Pretty, J, N., Ball, A.S. & Morison, J.I.L. (2005). Farm costs and food miles: an assessment of the full costs of the UK weekly food basket. Food Policy, 30: 1-19.

Province of the Eastern Cape. (2011). Eastern Cape Climate Change Response Strategy (ECCCRS), Department of Economic Development, Environmental Affairs and Tourism (DEDEAT)

Provincial Gazette for Eastern Cape. (2009).Province of the Eastern Cape, Republic of South Africa, No 2192, 08 Sep 2009, Vol 16, 23pp.

Puttergill, C., Bomela, N., Grobbelaar, J., & Moguerane, K. (2011). The limits of land restitution: Livelihoods in three rural communities in South Africa. Development Southern Africa, 28(5): 597-611.

Quigley, W. (2004). Catholic social thought and the amorality of large corporations: Time to abolish corporate personhood. Loyola Journal of Public International Law, 5: 109-124.

Quinn, C.H., Ziervogel, G., Takama, T., Taylor, A. & Thomalla, F. (2011). Coping with multiple stresses in rural South Africa. Ecology and Society, 16 (3): 2. http://www.ecologyandsociety.org/vol16/iss3/art2/

Rawson. (2012). South Africa's Gini coefficient is the highest in the world, Rwson Property Group, Dec 11, 2012. http://www.rawson.co.za/news/south-africas-gini-coefficient-is-the-highest-in-the-world-id-874

Read, D., Bostrom, A., Morgan, G.M., Fischho, B. & Smuts, T. (1994). What do people know about global climate change? 2. Survey studies of educated laypeople. Risk Analysis, 14: 971- 982.

Reardon, T., Barrett, C., Berdegue. J., & Swinnen, J. (2009). Agrifood Industry Transformation and Small Farmers in Developing Countries. World Development, 37:1717-1727.

Reenberg, A. (2009). Embedded flexibility in coupled human-environmental systems in the Sahel: talking about resilience. In: Hastrup, K. (Ed.), The Question of Resilience. Social implications of environmental changes. The Royal Danish Academy of Sciences and Letters, Copenhagen.

Republic of South Africa. (2002).The integrated Food Security Strategy for South Africa (2002) Department of Agriculture Forestry and Fisheries, [online] Accessed from www.daff.gov.za on 12 June 2012.

Republic of South Africa. (1994). White Paper on the Water Supply and Sanitation Policy, 1994.

Republic of South Africa. (2004). A National Climate Change Response Strategy for South Africa. 2004.

Republic of South Africa. (2009). Overview of South African Agriculture. Department of Agriculture, South Africa. Available at: www.nda.gov.za (Accessed May 2012).

Republic of South Africa. (2010). South African National Climate Change Response Strategy: Green Paper. Department of Environmental Affairs. General Notice 1083 OF 2010.

Republic of South Africa. (2011a). Keynote address by Minister Maite Nkoana-Mashabane on the occasion of the Minister's meeting on Climate-Smart Agriculture. Department of International Relations and Co-operation, 13 September 2011.

Republic of South Africa. (2011b). National Climate Change Response White Paper. The Government of the Republic of South Africa, October 2011.

Republic of South Africa. (2012). Correction Notice Sectoral Determination 13: Farmworker, Worker Sector. Basic Conditions of Employment Act, No. 75 of 1997 Government Notice 24 January 2012. Department of Labour

Republic of South Africa. (2013a). Climate Sector Plan for Agriculture, Fisheries and Forestry. Department of Agriculture, Forestry and Fisheries

Republic of South Africa. (2013b). Policy for the Recapitalisation and Development Programme. Department of Rural Development and Agrarian Reform (DRDAR).

Republic of South Africa. (2014). Strengthening the Relative Rights of People Working the Land. Department of Rural Development and Agrarian Reform (DRDAR).

Richards, M. (2003) Poverty reduction, equity and climate change: challenges for global governance. The Overseas Development Institute, London, Natural Resource Perspectives, Number 83.

Rigi, M., Shafeghat, M.& Saeidi, S. (2013). Antibacterial activity of Citrulluscolocynthis Extract Against Some Human Pathogenic Bacteria Causing Urinary Tract Infection. International Journal of Research and Reviews in Applied Sciences, 5 (6): 727-729

Roberts, B. (2001). Chronic and Transitory Poverty in Post-apartheid South Africa:Evidence from Kwazulu-Natal. Journal of Poverty, 5 (4): 1–27.

Roberts, M. J. & Schlenker, W. (2010). Identifying Supply and Demand Elasticities of Agricultural Commodities: Implications for the US Ethanol Mandate. NBER Working Paper 15921.

Rockström, J., Folke, C., Gordon, L., Hatibu, N., Jewitt, G., Penning de Vries, F., Rwehumbiza, F., Sally, H., Savenije, H. & Schulze, R. (2004). A Watershed Approach to Upgrade Rainfed Agriculture in Water Scarce Regions through Water System Innovations: An Integrated Research Initiative on Water for Food and Rural Livelihoods in Balance with Ecosystem Functions. Physics and Chemistry of the Earth, 29: 1109-1118.

Ropelewski, C.F. & Halpert, M.S. (1987). Global and regional scale precipitation patterns associated with the El Niño/Southern Oscillation. Monthly Weather Review, 115: 1606-1626.

Rosegrant, M.W., Zhu, T., Msangi, S. & Sulser. T. (2008). Global Scenarios for Biofuels. Impacts and Implications. Review of Agricultural Economics, 30(3): 495-505.

Rosenzweig, C. & Parry, M.L. (1994). Potential impact of climate change on world food supply. Nature, 367: 133–138.

Rosenzweig, C. (1989). Global climate change: Predictions and observations. American Journal of Agricultural Economics, 71(5):1265-1271.

Rosset, P.M. (2006). Food Is Different: Why We Must Get the WTO Out of Agriculture New York: Zed Books.

Ruel, M.T., Garrett, J.L., Morris S.S., Maxwell, D., Oshaug, A., Engle, P., Menon, P., Slack, A. & Haddad, L. (1998). Urban challenges to food and nutrition security: a review of food security, health, and caregiving in the cities. Food Consumption and Nutrition Division discussion paper no. 51. Washington DC: International Food Policy Research Institute.

Rawson, B. (2012). South Africa's Gini coefficient is the highest in the world. Rawson Property Group. http://www.rawson.co.za/news/south-africas-gini-coefficient-is-the-highest-in-the-world-id-874

Ryan, J.G., & Asokan, M. (1977). Effects of green revolution in wheat on production of pulses and nutrients in India. Indian Journal of Agricultural Economics, 32(3): 8–15.

Salau, E. S., Onuk, E. G. & Ibrahim, A. (2012). Knowledge, Perception and Adaptation Strategies to Climate Change among Farmers in Southern Agricultural Zone of Nasarawa State, Nigeria. Journal of Agricultural Extension, 16 (2): 199 – 211.

Sangeda, A. Z., Maleko, D. D. & Mtengeti, E. J. (2013). Socio-economic and ecological dimensions of climate variability and change for agro-pastoral communities in central Tanzania. Livestock Research for Rural Development. 25:209. Retrieved May 13, 2014, from http://www.lrrd.org/lrrd25/12/sang25209.htm

SAPA. (2014a). Agri SA rejects land proposals. News24. 24 Jun 2014. http://www.news24.com/SouthAfrica/News/Agri-SA-rejects-land-proposals-20140624

SAPA. (2014b). Land reform laws biased – Jacob Zuma . City Press, 27 Feb 2014. http://www.citypress.co.za/politics/land-reform-laws-biased-jacob-zuma/

SAPA. (2014c). New land bill offers little comfort – ARD (Alliance for Rural Democracy). Fin24, 03 Jul 2014. http://www.fin24.com/Economy/New-Land-bill-offers-little-comfort-ARD-20140703

Sarr, B., Atta, S., Ly, M., Salack, S., Ourback, T., Subsol, S. & George, D.A. (2015). Adapting to climate variability and change in smallholder farming communities: A case study from Burkina Faso, Chad and Niger. Journal of Agricultural Extension and Rural Development, 7(1), 16-27, DOI: 10.5897/JAERD2014.0595.

Sato, Y. (2005). Questionnaire Design for Survey Research: Employing Weighting Method, Proceedings of the Eighth International Symposium on the Analytic Hierarchy Process, ISSN 1556-830X.

Sayed, Y. & Soudien, C. (2003). (Re)Framing education exclusion and inclusion discourses: Limits and possibilities. In R. Subramanian, Y. Sayed, S. Balagopalan, & C. Soudien (eds.) Education inclusion and exclusion: Indian and South African perspectives. IDS Bulletin, 34(1), January, University of Sussex.

Schlenker, W. & Roberts, M.J. (2009). Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change. Proceedings of the National Academy of Sciences, 106:15594-15598, doi: 10.1073/pnas.0906865106.

Schmidhuber, J. & Tubiello, F. N. (2007). Global food security under climate change. Proceedings of the National Academy of Science (PNAS), 104(50): 19703-19708.

Schulze, R. (2012). A 2011 perspective on climate change and the South African water sector, WRC Report TT 518/12, Gezina, South Africa.

Schulze, R., Meigh, J. & Horan, M. (2001). Present and potential future vulnerability of eastern and southern Africa’s hydrology and water resources. South African Journal of Science , 97: 150–160.

Schulze, R.E., Kiker, G.A. & Kunz, R.P. (1993). Global climate change and agricultural productivity in southern Africa. Global Environmental Change, 3(4): 330–349.

Schulze, R.E., Lumsden, T., Horan, M., Warburton, M. & Maharaj, M. (2005). An Assessment of Impacts of Climate Change on Agrohydrological Responses over

South Africa. In: Schulze, RE (Ed). 2005. Climate Change and Water Resources in Southern Africa: Studies on Scenarios, Impacts, Vulnerabilities and Adaptation. Water Research Commission. WRC Report 1430/1/05. Pretoria, RSA.

Scoones, I. (1998). Sustainable Rural Livelihoods: A framework for analysis. IDS, Working Paper 72, IDS, Brighton, UK, June 1998.

SEAR (Ngqushwa Final Strategic Environmental Assessment Report). (2005). Ngqushwa Local Municipality. Ngqushwa Local Municipality. Eastern Cape November 2005.Available on http://drupal6dev15.econsultant.co.za/sites/psdp.ecprov.gov.za/files/Ngqushwa%20SEA %20Nov05.pdf

Sen, A. (1981). Poverty and Famines: An Essay on Entitlement and Deprivation. Oxford: Clarendon Press, 257pp.

Shackleton C.M., Netshiluvhi, T.R., Shackleton S.E., Geach B.S., Balance A. & Fairbanks D.F.K. (1999). Direct Use Values of Woodland Resources From Three Rural Villages. Report compiled by the Division of Water, Environment and Forestry Technology, CSIR, Pretoria.

Shackleton, C.M. & Shackleton, S.E. (2000). Direct Use Values Of Secondary Resources Harvested From Communal Savannas In The Bushbuckridge Lowveld, South Africa, Journal Of Trop. Forest Products, 6: 28-47.

Shackleton, C.M., Shackleton, S.E., & Cousins, B. (2001). The role of land-based strategies in rural livelihoods: The contribution of arable production, animal husbandry and natural resource harvesting in communal areas in South Africa. Development Southern Africa, 18: 581-603.

Shackleton, S. E., Shackleton, C. & Cousins, B. (2000). The economic value of land and natural resources to rural livelihoods: Case studies from South Africa. In Cousins, B. (ed.), At the crossroads: Land and agrarian reform in South Africa into the 21st century. Bellville and Johannesburg: Programme for Land and Agrarian Studies (PLAAS) and NLC.

Shongwe, P., Masuku, M.B. &. Manyatsi, A.M. (2014). Factors Influencing the Choice of Climate Change Adaptation Strategies by Households: A Case of Mpolonjeni Area Development Programme (ADP) in Swaziland. Journal of Agricultural Studies, 2(1): 86-98.

Sibanda, A. (2004). Who gets to drop out of school in South Africa? The role of individual and household attributes. African Population Studies, 19(1): 99–117.

Silwana, T. (2000) The Performance ofMaize/Bean andMaize/Pumpkin Intercrops under Different Planting Combinations and Weeding in Transkei, South Africa. M.Sc. Dissertation, University of Fort Hare, Alice. 122 pp.

Singh, M. (1995). Inaugural Address delivered at 54th Conference of the Indian Society of Agricultural Economics. Indian Journal of Agricultural Economics, 50(1): 1- 11.

Smit, B. & Pilifosova, O. (2001) Adaptation to climate change in the context of sustainable development and equity. In Climate Change 2001: Impacts, Adaptation, and Vulnerability McCarthy et al. (eds), Cambridge University Press, Cambridge.

Smit, W. (1998). The rural linkages of urban households in Durban, South Africa. Environment and Urbanization, 10: 77–87.

Smith, C. (2013). Massmart caves in to Shoprite for now. Fin24. http://www.fin24.com/Companies/Retail/Massmart-Shoprite-wins-but-consumers-lose-20131022

Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., McCarl, B., Ogle, S., O'Mara, F., Rice, C., Scholes,M.McAllister,B.T,., Pan,SirotenkoG., Romanenkov, V., Schneider, U., Towprayoon, S., Wattenbach, M., Smith, J. (2008). Greenhouse gas mitigation in agriculture. Philosophical Transactions of the Royal Society B, 363: 789–813.

Smith, P., Martino, D., Zucong C, Gwary, D., Janzen, H., Kumar, P., et al. (2008). Greenhouse gas mitigation in agriculture. Philosophical Transactions of the Royal Society B, 363 (1492): 789-813.

Solesbury, W. (2003). Sustainable Livelihoods: A Case Study of the Evolution of DFID Policy. Working Paper 217 Overseas Development Institute. London.

South Africa, CEEPA DP28.South African Social Security Agency (SASSA) (2009). You and Your Grants 2009/10–information Brochure. Pretoria, South African Social Security Agency.

South African Social Security Agency (SASSA). (2009). You and Your Grants 2009/10– information Brochure. Pretoria, South African Social Security Agency.

Stafford, T. (2011). Pick ‟n Pay - No Appetite: Labour love lost, Financial Mail, http://www.fm.co.za/Article.aspx?id=148893 21 July 2011.

Stats SA (Statistics South Africa). (2010). Millennium Development Goal Country Report. Stats SA: Pretoria.

Stats SA. (2011). Ngqushwa: Key Statistics. Statistics South Africa. http://beta2.statssa.gov.za/?page_id=993&id=ngqushwa-municipality.

Sterman, J.D. & Sweeney, L.B. (2007). Understanding public complacency about climate change: Adults' mental models of climate change violate conservation of matter. Climatic Change, 80(3): 213-238.

Stern, N. (2007). The economics of climate change. Cambridge, UK: Cambridge University Press.

Steyn, G.J. (1988). A farming systems study of two rural areas in the Peddie District of Ciskei. D.Sc. (Agric.) Thesis, University of Fort Hare, Alice. 531 pp.

Steyn, N.P., Abercrombie, R. & Labadarios, D. (2001). Food security – an update for health professionals. South African Journal of Clinical Nutrition, 14: 98-102.

Stooksbury, D. E. & Michaels, P. J. (1994): Climate change and large-area corn yield in the Southeastern United States. Agronomy Journal, 86(3): 564-569.

Strauss, A. & Corbin, J. (1990). Basics of qualitative research: Grounded theory procedures and techniques. Newbury Park, CA: Sage.

Sumner, J. (2011). Serving Social Justice: The Role of the Commons in Sustainable Food Systems. Studies in Social Justice, 5 (1): 63-75.

Sundkvist, A., Milestad, R. & Jansson, A. M. (2005). On the importance of tightening feedback loops for sustainable development of food systems. Food Policy, 30(2): 224-239. http://dx.doi.org/10.1016/j.foodpol.2005.02.003.

Swindale, A. & Bilinsky, P. (2005). Household Dietary diversity Score (HDDS) for Measurement of Household food Access: Indicator Guide, Food and Nutrition Technical Assistance. The Journal of Nutrition, 138(12): 2448-2453.

Switzer, L. (1993). Power and Resistance in an African Society: The Ciskei Xhosa and the Making of South Africa, University of Natal Press, Pietermaritzburg.

Tackett, C. (2013). How climate change helped spark Syrian Revolution, Arab Spring. Treehugger. http://www.treehugger.com/climate-change/how-climate-change-spark-syrian-revolution-Arab-Spring.html

Tanner, T. & Mitchell, T. (2008). Entrenchment or Enhancement: Could Climate Change Adaptation Help to Reduce Chronic Poverty? Institute of Development Studies Bulletin, 39:6-15.

Taub, D.R., Miller, B., & Allen, H. (2008). Effects of elevated CO_2 on the protein concentration of food crops: a meta-analysis. Global Change Biology, 14: 565–575.

Terry, G. (2009). No Climate Justice Without Gender Justice: An overview of the Issues. Gender & Development, 17(1): 5 -18.

Tesfaye, K. & Walker, S. (2004). Matching of crop and environment for optimal water use: the case of Ethiopia. Physics and Chemistry of the Earth, 29: 1061-1067.

Teshager, M., Adgo, E. & Tilahun, T. (2014). Investigating the Determinants of Adaptation Strategies to Climate Change: A Case of Batti District, Amhara Region, Ethiopia. International Journal of Agricultural Research, 9: 169-186.

The Economist. (2012). Riots in Mozambique. The angry poor. Why Mozambicans took to the streets. The Economist, Sep 9th 2010. http://www.economist.com/node/16996835

The Official Website of The British Monarch (2009). The Royal Household © Copyright 2008/09.

Thomas, D.S.G., Twyman, C., Osbahr, H. & Hewitson, B. (2007). Adaptation to climate change and variability: farmer responses to intra-seasonal precipitation trends in South Africa. Climatic Change, 83: 301–322.

Thomas, S. (2012). Billion rand man. The Shoprite empire. Financial Mail. December, 20. http://www.financialmail.co.za/business/2012/12/20/the-shoprite-empire.

Thornton, A. (2009). Pastures of plenty? Land rights and community-based agriculture in Peddie, a former homeland town in South Africa. Applied Geography, 29 (1): 12–20.

Thornton, A.C. & Nel, E. (2007). The significance of urban and peri-urban agriculture in Peddie, in the Eastern Cape Province, South Africa. Africanus. Journal of Development Studies, 37(1): 13-20.

Thornton, A.C. (2006). Urban land use policy in Peddie: A former homeland town in Eastern Cape province, South Africa. Urban Agriculture Magazine, 16: 58-59.

Tirado, M.C., Cohen, M.J., Aberman, N., Meerman, J. & Thompson, B. (2010). Addressing the challenges of climate change and biofuel production for food and nutrition security. Food Research International, 43: 1729–1744.

Tiwari, K. R., Rayamajhi, S., Pokharel, R.K. & Balla, M.K. (2014). Determinants of the climate adaptation in Rural Farming in Nepal Himalaya. International Journal of Multidisciplinary and Current Research, 2: 234-240.

Tizale, C. Y. (2007). “The dynamics of soil degradation and incentives for optimal management in the Central Highlands of Ethiopia”. Ph.D. thesis. Faculty of Natural and Agricultural Sciences, University of Pretoria; Pretoria, South Africa.

Todorov, A.V. (1985). Sahel: the changing rainfall regime and the ‘‘Normals’’ used for its assessment. Journal of Climate and Applied Meteorology, 24 (2): 97–107.

Toenniessen, G., Adesina, A. & DeVries, J. (2008). Building an alliance for a green revolution in Africa. Annals of the New York Academy of Sciences, 1136: 233–242.

Tolsi, N. (2011). Alarm raised over decline in maize crop. Mail and Guardian, 03 June 2011. http://mg.co.za/article/2011-06-03-alarm-raised-over-decline-in-maize-crop

Tortora, B. (2010). Hunger Goal Still Out of Reach in South Africa. Gallup World June 23, 2010 http://www.gallup.com/poll/141005/hunger-goal-reach-south-africa.aspx

Traub, A. (2014). Food Stamps Don't Keep Walmart's Prices Low, They Keep Its Profits High. The Huffington Post. Geolibertarian: http://www.huffingtonpost.com/amy-traub/walmart-food-stamps_b_5087262.html

Trenberth, K.E., Jones, P.D., Ambenje, P.G., Bojariu, R., Easterling, D.R., Klein Tank, A.M.G., Parker, D.E., Renwick, J.A., Rahimzadeh, F., Rusticucci, ,M.M., Soden, B.J & Zhai, P.M. (2007): Observations: surface and atmospheric climate change. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis M., Averyt, K.B. , Tignor, M.& Miller, H.L, Eds., Cambridge University Press, Cambridge, 235-336 pp.

Trends in the Agricultural Sector. (2010). Department of Agriculture, Forestry and Fisheries. Republic of South Africa. https://www.senwes.co.za/Files/main_productsservices/agriservices/2011/Trends_in_the_Agricultural_Sector_2010.pdf

Trollip, A. (2014). Nkwinti flying a dangerous land reform 'kite'. Farmer's Weekly, 30 June 2014. http://www.farmersweekly.co.za/article.aspx?id=59680&h=Nkwintiflyingadangerouslandreform%27kite%27

Troup, A. J. (1965). The Southern Oscillation. Quarterly Journal of the Royal Meteorological Society, 91: 490 – 506.

Turpie J., Winkler H., Spalding-Flecher R., et al. (2002). Economic Impacts of Climate Change in South Africa: a Preliminary Analysis of Unmitigated Damage Costs. Southern Waters Ecological Research and Consulting and Energy Development Research Centre, University of Cape Town, South Africa.

Twomlow, S., Mugabe, F., Mwale, M., Delve , R., Nanja, D., Carberry, P. & Howden, M. (2008). Building adaptive capacity to cope with increasing vulnerability due to climatic change in Africa — a new approach. Physics and Chemistry of the Earth, 33 (8): 780–787.

Tyson, P.D. & Preston-Whyte, R.A. (2000). The weather and climate of southern Africa. Oxford University Press: Cape Town.

Tyson, P.D. (1986). Climatic change and variability over southern Africa. Oxford University Press: Cape Town.

Uddin, M.R. & Awal, M.A. (2013). Early warning on disastrous weather through cellphone. Journal of Computer Engineering, 11: 51–53.

UNCTAD. (2009). World Investment Report 2009: Transnational Corporations, Agricultural Production, and Development. New York and Geneva: United Nations.

UNDP (United Nations Development Programme). (2007). Human Development Report 2007/2008. Fighting climate change: Human solidarity in a divided world. UNDP: New York.

UNFCCC (1992) United Nations Framework Convention on Climate Change. New York, United Nations, http://www.unfccc.de/resource/conv/conv.htm..

United Nations Development Programme (UNDP) (2007). Human Development Report 2007/2008. Fighting climate change: Human solidarity in a divided world. UNDP: New York

United Nations. (2012). Special Rapporteur on the Right to Food. Background note: the right to food as a global goal. Available at: <http://www.ohchr.org/EN/HRBodies/SP/Pages/OpenLetterRio20.aspx>.

Van Heerden, J., Terblanche, D.E. & Schulze, G.C. (1988). The Southern Oscillation and South African summer rainfall. International Journal of Climatology, 8: 577-597.

Van Rooy, M.P. (1972). District rainfall for South Africa and the annual march of rainfall over southern Africa. Climate of South Africa. Part 10 (WB 35). SA Weather Bureau, Dept of Transport, Pretoria.

Vermeulen, S. J., Campbell, B. M. & Ingram, J. S. I. (2012). Climate change and food systems. Annual Review of Environment and Resources, 37: 195–222.

Vermeulen, S.J., Aggarwal, P.K., Ainslie, A., Angelone, C., Campbell, B.M., Challinor, A.J., Hansen, J.W., Ingram, J.S.I., Jarvis, A., Kristjanson, P., Lau, C., Nelson, G.C., Thornton, P.K.. Wollenberg, E. (2012). Options for support to agriculture and food security under climate change. Environmental Science & Policy, 15(1): 136-144.

Vermeulen, S.J., Campbell, B.M. & Ingram, J.S.I. (2012). Climate Change and Food Systems. Annual Review of Environment and Resources (37): 195-222.

Vincent, K., Cull, T., Archer, E. (2010). Gendered vulnerability to climate change in Limpopo province, South Africa, In: Gender and Climate Change: An Introdution[Dankelman, I (Ed.)]. Earthscan, London, UK and Washington,DC, USA, pp. 160 -167.

Virtanen, Y., Kurppa, S., Saarinen, M., Katajajuuri, J., Usva K., Mäenpää, I., Mäkelä, J., Grönroos, J. and Nissinen, A. (2011) Carbon footprint of food – approaches from national input-output statistics and a LCA of a food portion. Journal of Cleaner Production, 19: 1849-1856.

Von Braun, J. (2008). Rising Food Prices: What Should Be Done? IFPRI Policy Brief. April 2008. Washington D.C., USA, International Food Policy Research Institute

Waha, K, Müller, C. & Rolinski, S. (2013). Separate and combined effects of temperature and precipitation change on maize yields in Sub-Saharan Africa for mid- to late-21st century. Global and Planetary Change, 106: 1–12.

Waldkirch, A. (2010). The Effects of Foreign Direct Investment in Mexico since NAFTA. The World Economy, 33 (5): 710-745.

Wandiga, S. (2006). Climate Change Induced Vulnerability to Malaria and Cholera in the Lake Victoria Region. Final report submitted to the Assessments of Impacts and Adaptation to Climate Change (AIACC), Project No. AF 91.

Wandiga, S., Opondo, M., Olago, D., Githeko, A., Githui, F., Marshall, M., & Achola, P. (2010). Vulnerability to epidemic malaria in the highlands of Lake Victoria Basin: The role of climate change/variability, hydrology and socio-economic factors. Climate Change, 99: 473–497.

WCED (World Commission on Environment and Development). (1987). Our Common Future; Oxford University Press: New York, NY, USA.

Weber, E. U. (2010). What shapes perceptions of climate change? Wiley Interdisciplinary Reviews: Climate Change, 1 (3): 332-342. doi:10.1002/wcc.41, http://dx.doi.org/10.1002/wcc.41

Wenhold, F.A.M., Faber, M., Van Averbeke, W., Oelofse, A., Van Jaarsveld, P., Jansen van Rensburd, W.S., Van Heerden, I. & Slabbert, R. (2007). Linking smallholder agriculture and water to household food security and nutrition. Water SA, 33.

West, C. T., Roncoli, C. & Ouattara, F. (2008). Local perceptions and regional climate trends on the Central Plateau of Burkina Faso. Land Degradation & Development, 19 (3): 89–304.

White, J.M. (2013).The New Alliance for Food Security and Nutrition: Pushing the Frontier of Enlightened Capitalism. E- Book. German Marshall Fund of the United States. ISBN-10: 1621172066.

White, M. (2007). Food access and obesity. Obesity Reviews, 8(1): 99–107.

Wiid, N. & Ziervogel, G. (2012). Adapting to climate change in South Africa: commercial farmers' perception of and response to changing climate. South African Geographical Journal, 94 (2): 152-173.

Winkler, A. (2007). Corporate Personhood and the Rights of Corporate Speech, Seattle University Law Review, 30: 863-871.

Wilbanks, T.J. & Kates, R.K., (1999). Global change in local places: how scale matters. Climatic Change, 43: 601–628.

Winter, P., Muragi, R., Sadoulet, E. & De Janvry, A. (1996). Climate change, agriculture, and developing economies. Working paper No 785, Department of Agricultural and Resource economics, University of California at Berkley, California.

Wise, T. A. (2007). Policy Space for Mexican Maize: Protecting Agro-biodiversity by Promoting Rural Livelihoods. GDAE Working Paper, No. 07-01. Medford, MA: Tufts University, Global Development and Environment Institute.

World Development Movement. (2014). Food speculation: What is the problem? World Development Movement. http://www.wdm.org.uk/stop-bankers-betting-food/what-problem.

World Food Programme (WFP). (2014). What causes hunger? Hunger. http://www.wfp.org/hunger/causes

Wotshela, L. (2004). Territorial manipulation in apartheid South Africa: Resettlement, tribal politics and the making of the Northern Ciskei, 1975–1990. Journal of Southern African Studies, 30(2): 317–337.

WRI. World Resources Institute. (2005). Millenium Ecosystem Assessment, Ecosystems and Human Well-Being Washington, DC.

Wright, H., Kristjanson, P., & Bhatta, G. (2012). Understanding Adaptive Capacity: Sustainable Livelihoods and Food Security in Coastal Bangladesh. CCAFS Working Paper No. 32. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. Available online at: www.ccafs.cgiar.org.

Yengoh, G.T. (2010). Trends in agriculturally-relevant rainfall characteristics for small-scale agriculture in Northern Ghana. Journal of Agricultural Science, 2(3): 3–16.

Yohe, G. W. & Tol, R. S. J. (2002). Indicators for Social and Economic Coping Capacity—Moving Towards a Working Definition of Adaptive Capacity. Global Environmental Change, 12 (1): 25–40.

Zadra, J. R. & Clore, G. L. (2011). Emotion and perception: the role of affective information. Wiley Interdisciplinary Reviews: Cognitive Science, 2(6): 676–685.

Zengeni, R., Kakembo, V. & Nkongolo, N. (2014). Historical rainfall variability in selected rainfall stations in Eastern Cape, South Africa. South African Geographical Journal, 1-20. DOI: 10.1080/03736245.2014.977811.

Ziervogel, G. & Zermoglio, F. (2009). Climate change scenarios and the development of adaptation strategies in Africa: challenges and Opportunities. Climate Research, 40: 133–146.

Ziervogel, G., & Ericksen, P.J. (2010). Adapting to climate change to sustain food security. Wiley Interdisciplinary Reviews: Climate Change, 1: 1757–7799.

Ziervogel, G., Bharwani, S. & Downing, T.E., (2006). Adapting to climate variability: pumpkins, people and pumps. Natural Resource Forum, 30: 294–305.

Ziervogel, G., Bithell, M., Washington, R. & Downing, T. (2005). Agent-based social simulation: a method for assessing the impact of seasonal climate forecasts among smallholder farmers. Agricultural Systems, 83 (1): 1–26.

Ziervogel, G., New, M., Archer Van Garderen, E., Midgley, G., Taylor, A., Hamann, R. Stuart-hill, S., Myers, J. & Warburton, M. (2014). Climate change impacts and adaptation in South Africa. WIRES Climate Change, 5(5):605-620. doi:10.1002/wcc.295

Zurek, M.B. (2006). A Short Review of Global Scenarios for Food Systems Analysis. GECAFS Working Paper 1, March 2006.

APPENDICES

APPENDIX A

QUESTIONNAIRE ON HOUSEHOLD FOOD SECURITY, LIVELIHOOD DIVERSIFICATION, AGRICULTURE AND HOUSEHOLD PERCEPTIONS ON CLIMATE VARIABILITY AND CHANGE

Climate Variability and Change, Food Systems and Crop Production: An Exploration of Perceptions, Adaptive Capacity and Food Security in the Ngqushwa Local Municipality –South Africa

Preliminary studies and reports indicate that climate change impacts may have already made changes to people's lives. This study hopes to unearth the perceptions of the Ngqushwa Municipality about their own adaptation experiences to climate variability and change and its impacts on livelihoods, food security and agriculture. The study requires inputs from the local residents of Ngqushwa Municipality so that knowledge about their environmental issues will be, at best, accurately captured. All information provided by interviewee will be treated as STRICTLY CONFIDENTIAL for mutual benefit of both the researcher and the respondents.

Questionnaire number…………… Enumerator name………………..…
Date...………………………………Name of Village.…………………...
Name of respondent………….. Coordinates.…………………………

A. HOUSEHOLD DEMOGRAPHIC INFORMATION		
1. Head of household		
a. Sex	Male	Female

b. Marital status		Married	Single	Divorced	Widowed
c. Age		< 35	36-50	51-62	>62
d. Highest level of education of household head					
	No formal or informal education	Informal education	Grade 0-7	Grade 8-12	Tertiary education
e. Highest level of education of any household member					
	No formal or informal education	Informal education	Grade 0-7	Grade 8-12	Tertiary education
2. What is your principal occupation? Pensioner					

3. What is your religion	Christianity x	Traditional	Muslim	Other (specify)

4. What is the size of your household?		Adults (≥16)	Children (<16)
	Male		
	Female		

5. What are your sources of income? (Rank 1 as the most important source of income)

Source	Amount raised	Rank
Crops		
Livestock		
Salary/wages		
Pension/social security grants		
Trade (transport, resale of goods)		
Craftwork (mats, baskets, pots)		
Community projects		
Other (specify)		

B. HOUSEHOLD FOOD SECURITY STATUS
1. What are your sources of food? (Rank 1 as the most important source of food)

Own crop production	Purchase	Wild food collection	Food Grant
Barter (exchange one product for another)	Own livestock products (milk, meat)	Exchange for labour (food for work)	Steal
Food at work	Fishing	Hunting	Friends/relatives
Food at school			
Other sources of food (Specify):			

2. On average, how many meals do you have per day?		
3. Are you satisfied with the number of meals you have daily?	Yes	No

4. What types of foods does your household eat during the following times?

	Morning	**Afternoon**	**Evening**	**In-between main meals**

5. How do you rate your level of access to food today as compared to 5 years ago?

No change	Better	Fair	Worse off

6. If the situation is fair or worse off, what might have contributed? (Rank): 1 - 10

	Income not increasing at the rate of inflation	
	Poor harvest due to drought	
	Poor harvest due to high temperatures	
	Poor harvest due to low temperatures (snow)	
	Poor harvest due to pests and diseases	
	Lack of agricultural inputs	
	Poor salaries	

	Retirement	
	Retrenchment	
	Reduced government support	
	Increase in household size	
	Death of the main food provider	
	Other (specify)	

7. If yes to the following questions, How often did this happen?

1 = Rarely (once or twice in the past month) **2** = Sometimes (three to ten times in the past month) **3** = Often (more than ten times in the past month)

a. Did you worry that your household would not have enough food?	
b. Was your household not able to eat the kinds of foods you preferred because of a lack of resources?	
c. Did you or any household member have to eat a limited variety of foods due to a lack of resources?	
d. Did you or any household member have to eat some foods that you really did not want because of a lack of resources to obtain other types of food?	
e. Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	
f. Did you or any household member have to eat fewer meals in a day because there was not enough food?	
g. Was there ever no food to eat of any kind in your household because of lack of resources to get food?	
h. Did you or any household member go to sleep at night hungry because there was not enough food?	
i. Did you or any household member go a whole day and night without eating anything because there was not enough food?	

8. When do any of the above problems happen? (you may tick more than once)

Any time	Just before	Before	After	**Other times:**

of the year	month end	harvesting	drought	

9. What adjustments or possible solutions have you made to avoid food shortages if any or to improve your diet? (you may tick more than one option)	
Borrow food from shops for future payments	Relied on food grants
Borrow money from friends or relatives	Look for petty jobs
Dispose household goods or other assets	Petty trading
Use credit cards	Sale of livestock
Grow Crops	Get loans from money lenders, banks
Reduction in non-food household expenditure	Reduce the amount of food
Reduce the number of meals per day	Did not pay credits already owed
Resort to external relationships to secure food	Over-use of natural resources (e.g. excessive fishing and collection of firewood)
Changed area of residents (moved to a pace with more employment)	
Other adjustment mechanisms:	

10. On average, what percentage of your income did you spend on food?			
Last month end	Last year	Past five years	Past 10 years
What might have contributed to the changes			
Food price	Poor harvests	Low income	High income

increase			
If other causes, explain:			

C. AGRICULTURE			
1. What agricultural activities have you practiced over the past 10+ years?			
Livestock Farming	Field Crops	Fishing	None
2. Which agricultural activities are you no longer practicing now?			
Enterprise (tick)	**Reason**		
Livestock Farming			
Field Crops			
Poultry			
None			

3. Which crops did you grow last season? (Rank 1 as the most commonly grown crop/vegetable)

			Purpose of production	
Crop/vegetable	Rank	Area (ha)	Consumption	Sale
	1			
	2			
	3			
	4			
	5			

4. What do you consider to be the main problem in crop production?

(1. Weeds, **2.** Fences **3.** Input supply **4.** Mechanization. **5.** Climatic problems **6.** Theft **7.** Finance **8.** Land shortage. **9.** Pests **10.** Planting late **11.** Other specify)

Present	
Past	

5. If your crop productivity is affected by climate variability and change which aspects affecting it (Rank 1 to 5)

Low rainfall	
Late rainfall	
Floods	
High temperatures	
Low temperature	
Other (specify)	

6. What may be the solution to the possible aspects mentioned above?

Low rainfall	
Late rainfall	
Floods	
High temperatures	
Low temperature	

7. In your opinion, which of the following options do you think will help reduce the impact of these climatic changes?

	Tick	**Have you tried this?**		**Outcome:**		
Planting of crop with early rainfall		Yes	No	Positive	Negative	Neutral
Change of planting date		Yes	No	Positive	Negative	Neutral
Practice irrigation		Yes	No	Positive	Negative	Neutral
Use of drought-resistant varieties		Yes	No	Positive	Negative	Neutral
Listening to information about climate variability and		Yes	No	Positive	Negative	Neutral

change						
Reclamation of wetlands/ river valleys		Yes	No	Positive	Negative	Neutral
Changing the timing of land preparation		Yes	No	Positive	Negative	Neutral
Mixed farming practices		Yes	No	Positive	Negative	Neutral
Reducing access to eroded and erosion prone area		Yes	No	Positive	Negative	Neutral
What are your thoughts on all the above options?						

D. WATER ACCESS					
1. Where do you get your drinking water?					
Tap	Stream	Tank x	Delivery	Borehole	Spring

2. Is water enough for the following purposes?		
Purpose	*Yes*	*No*
Human use		
Animal consumption		
Gardening		
Field crop production (irrigation) Rephrase		
3. Is water clean enough for the following purposes?		
Purpose	*Yes*	*No*
Human use		
Animal consumption		
Gardening		
Field crop production (irrigation)		

4. In your observations, what is the physical condition of your water for human consumption?		
Good	Fair	Poor

5. Is your water source reliable, do you always get water?		
Purpose	**Yes**	**No**
Human use		
Animal consumption		
Gardening		
Field crop production (irrigation)		

6. If no, when is the right time to get water?			
Purpose	**Morning**	**Afternoon**	**Evening**
Human use			
Gardening			
Field crop production (irrigation)			

7. Do you share you water source with animals?	Yes	No

8. If yes, which animals do you share with?		
Wild	Domestic	Both

9. What else do you use the water source for?		
Drinking for animals	Irrigation	Laundry
Swimming	Fishing	Aquaculture

10. How long does it take for you to get to your water source?			
≤30 minutes	30 minutes to 1 hour	1 hour to 2 hours	More than 2 hours

11. How do you bring the water to the household?			
Head	Wheel Barrow	Animal Drawn	Other:

APPENDIX B

GENERAL PERCEPTIONS ABOUT CLIMATE VARIABILITY AND ITS CHANGES

Climate Variability and Change, Food Systems and Crop Production: An Exploration of Perceptions, Adaptive Capacity and Food Security in the Ngqushwa Local Municipality –South Africa

Preliminary studies and reports indicate that climate variability and change impacts may have already made changes to people's lives. This study hopes to unearth the perceptions of the Ngqushwa Municipality about their own adaptation experiences to climate variability and change and its impacts on livelihoods, food security and agriculture. The study requires inputs from the local residents of Ngqushwa Municipality so that knowledge about their environmental issues will be, at best, accurately captured. All information provided by interviewee will be treated as STRICTLY CONFIDENTIAL for mutual benefit of both the researcher and the respondents.

Questionnaire number…………… Enumerator name………………..…

Date...………………………………Name of Village…………………...

Name of respondent…………… Coordinates…………………………

Please indicate how much you agree or disagree with the following statements about climate variability and change by ticking one box on each row: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), Strongly Disagree (SD)

	SA	A	U	D	SD
1. There is no climate variability and change happening here in the village					
2. Climate variability and change is an act of God and the ancestors					
3. Climate variability and change causes our crops and livestock to suffer					
4. I am concerned about how climate variability and change might affect my village					
5. Different planting dates help our crops to adapt to climate variability and change					
6. Weather keeps changing from time to time and we are not sure about is going on					
8. Weather keeps changing every 5 /10 years, sometimes its too dry then wet but mostly dry					
9. It is just normal climate and weather cycles nothing to be concerned about					
10. Our vegetable gardens and small farm crops are negatively affected by these weather changes					

APPENDIX C

QUESTIONNAIRE ON ADAPTIVE CAPACITY

Climate Variability and Change, Food Systems and Crop Production: An Exploration of Perceptions, Adaptive Capacity and Food Security in the Ngqushwa Local Municipality –South Africa

Preliminary studies and reports indicate that climate variability and change impacts may have already made changes to people's lives. This study hopes to unearth the perceptions of the Ngqushwa Municipality about their ADAPTIVE CAPACITY to climate variability and change and its impacts on livelihoods, food security and agriculture. The study requires inputs from the local residents of Ngqushwa Municipality so that knowledge about their environmental issues will be, at best, accurately captured. All information provided by interviewee will be treated as STRICTLY CONFIDENTIAL for mutual benefit of both the researcher and the respondents.

Questionnaire number…………… Enumerator name………………..…

Date...……………………………… Name of Village.…………………...

Name of respondent…………… Coordinates…………………………

Please indicate how much you agree or disagree with the following statements about climate variability and change by ticking one box on each row: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), Strongly Disagree (SD)

Adaptation strategies for Climate Variability and Change

	SA	A	U	D	SD
1. Crop diversification is critical to adaptation to climate variability and change					
2. Different planting dates help our crops to adapt to climate variability and change					
3. Soil conservation and mulching is critical to our adaptive strategies					
4. Use of fertilizer chemicals is important because it helps our crops to grow and to adapt					
5. Drought resistant seeds help us to grow our food and to be resilient to climate variability and change					
6. Genetically modified seeds are good for adaptation					
7. Other Adaptation:					
a) Irrigation and RWH is helping us to adapt to climate variability					
b) We migrated to villages closer to dams and taps as our adaptation strategy					
c) We have changed from crop to livestock farming					
d) We engage more in out of town off-farm employment					
8. Food security co-operatives help to combat food insecurity and to help adapt to climate variability and change					
9. Extension services are sufficient for both our food security needs and climate adaptation strategies					
10. We are not adapting					

SUSTAINABLE LIVELIHOODS ASSETS

Please indicate how much you agree or disagree with the following statements about climate variability change by
ticking one box on each row: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), Strongly Disagree (SD)

Social Capital and Climate Variability & Change Adaptation	**SA**	**A**	**U**	**D**	**SD**
11. Stokvels are essential to securing food availability and access	☐	☐	☐	☐	☐
12. Households which are not members of co-operatives and stoklvels are vulnerable to the impact of CC	☐	☐	☐	☐	☐
Natural Capital and Climate Variability & Change Adaptation	**SA**	**A**	**U**	**D**	**SD**
13. The dam, river or water reservoir has been running drier than in previous years	☐	☐	☐	☐	☐
14. We have enough land to grow crops, keep livestock and road networks to access market opportunities	☐	☐	☐	☐	☐
Financial Capital and Climate variability & change Adaptation	**SA**	**A**	**U**	**D**	**SD**
15. We know about the available grants, loans and credit available for rural agricultural projects	☐	☐	☐	☐	☐
16. Pension money and social grant are sufficient to offset food insecurity and the impact of climate change	☐	☐	☐	☐	☐
17. We have enough credit and funding for our farming endeavours					
Physical Capital and Climate Variability & Change Adaptation	**SA**	**A**	**U**	**D**	**SD**
18. There is a sufficient number of tractors and	☐	☐	☐	☐	☐

essential mechanisation for crop farming					
19. The size of the land is too small and the quality of the soil is poor for farming					
Human Capital and Climate Climate Variability & Change Adaptation	**SA**	**A**	**U**	**D**	**SD**
20. We need more education to better understand and mitigate the impact of climate variability on food security					
21. We have enough capacity and skills to work our lands and the youth are also involved					
22. Women are the vast majority of our farming community					

APPENDIX D

PRELIMINARY QUESTIONNAIRE FOR FARMERS AT NGQUSHWA DEPARTMENT OF AGRICULTURE OFFICES

Climate Variability and Change, Food Systems and Crop Production: An Exploration of Perceptions, Adaptive Capacity and Food Security in the Ngqushwa Local Municipality –South Africa

This preliminary study study hopes to unearth the perceptions of the Ngqushwa Municipality about their own vulnerability and adaptation experiences to climate variability & change and its impacts on livelihoods, food security and agriculture. The study requires inputs from the local residents of Ngqushwa Municipality so that knowledge about their environmental issues will be, at best, accurately captured. All information provided by interviewee will be treated as STRICTLY CONFIDENTIAL for mutual benefit of both the researcher and the respondents.

Questionnaire number…………… Enumerator name………………..…
Date...………………………………Name of Village.…………………...
Name of respondent…………… Coordinates…………………………

Table 1: Farmer perception of environmental impacts and hazards	
1.	In the past 10 to 30 years, what changes in climate have you witnessed? (Look at each variable and tick)

	Variable	Time/frequency/level		Intensity
	Rain season	early	late	Normal/abnormal
	Overall rainfall	more	less	Normal/abnormal
	temperature	high	low	Normal/abnormal
2.	Have you seen changes in the following farming/social parameters during the same period?			
	Crop yield			
	Livestock			
	Water			
	Economic			
	Cultural			
	Political			

3.	Have you made plans to adapt to the changes you have observed in as far as the following factors are concerned?	Change cropping dates	
		Shift from crops to livestock	
		Change to more cash crops	
		Change to more crops to eat	
		Reduce amount of livestock	
		Grow low input crops	
		Grow crops that use less water	

		Leave some parts of the land cultivated and the other fallow	
		Leave all land fallow	

4.	In your opinion which factors are affected by the changes in weather and the environment, and how?		
	Crop loss and gain		
	Yields		
	Food availability AND Access		
	Indebtedness		
	Ability to settle loans		
	Food price		

5.	In your opinion who has been affected the most by the environmental/weather changes, and how?		
	Women		
	Men		

	Children		
	Elderly		
	Disabled		
	Every Village Household		

6. What do you think causes all these changes in the climate?

___

___

7. What has been done to cope and adapt to the changes in the climate?

___

___

8. Have you heard of climate variability/change? What is it?

___

___

APPENDIX E

GUIDING QUESTIONS FOR FOCUS GROUP DISCUSSIONS

Climate Variability and Change, Food Systems and Crop Production: An Exploration of Perceptions, Adaptive Capacity and Food Security in the Ngqushwa Local Municipality –South Africa

This preliminary study study hopes to unearth the perceptions of the Ngqushwa Municipality about their own vulnerability and adaptation experiences to climate variability & change and its impacts on livelihoods, food security and agriculture. The study requires inputs from the local residents of Ngqushwa Municipality so that knowledge about their environmental issues will be, at best, accurately captured. All information provided by discussants will be treated as STRICTLY CONFIDENTIAL for mutual benefit of both the researcher and the respondents.

Questionnaire number…………… Enumerator name………………..…

Date...………………………………Name of Village.…………………..

Name of respondent…………… Coordinates…………………………

<u>Focus Group Discussions Outline</u>

Purpose of focus group:

Explore climate variability & change impacts on food supply and security, as well as on potential hazards that threaten subsistence farmers in Ngqushwa Local Municipality. The focus groups should provide a "community level" perspective versus the more individual level perspective of household/farmer interviews.

Methodology:

- Hold a “focus group” of 5-8 individuals in each of the four villages during the second week of field research.
- Use provocative statements (e.g., based on initial findings in individual household/ subsistence farmer interviews) to encourage ongoing discussion on select “prompts”.

<u>Group Introductions</u>

Open with ice-breaker activity. A note taker will collect basic participant information as part of introductions

Details	
Municipality	
Village	
Introduction: Thank you for taking the time to talk to us. We are students from the University of Fort Hare and are working with the Risk and Vulnerability Assessment Center. We are here to learn about your work, challenges and accomplishments in the face of environmental change and how such environmental change (weather and natural disasters?) is affecting food security in your families in this village. We would like you to feel free to share your ideas and thoughts and to interact with us on this topic of great significance to a sustainable future. Although we will audiotape this session your identity will never be revealed or connected to your thoughts. While we may report quotes from this discussion your comments will never be linked to your name. You are also free to stop participating at any time.	

You may freely move around and introduce ourselves. Please sate your name, age, how many people live in your household, and how many may help farm.

Participant	**Name**	**Age**	**Number in household**	**Number of farm helpers**
Participant 1				
Participant 2				
Participant 3				
Participant 4				
Participant 5				
Participant 6				
Participant 7				
Participant 8				

Activity and Discussion Description

Possible Discussion Prompts

Item Tackled	*Yes/No*
Please tell us about weather patterns in the past 10 – 30 years	
Has weather been more predictable?	
Does the rainy season start earlier or later?	
Has the weather been more extreme?	
Is the rainfall more/less?	

Is expected temperature higher/lower?	
Are summers hotter now than they once were?	
Is climate variability & change causing it to rain more than it once did?	
Are droughts becoming less frequent?	
Is crop failure a sign of climate variability &change?	
Are crop growing seasons changing?	
Is rainfall decreasing as a result of climate variability & change?	
Is the weather more predictable now than it was 30 years ago?	
Have there been outbreaks of pests and diseases in your community. Have you experienced any unusual outbreaks in the past few years?	
What do you think are the causes?	
Have there been impacts on crop yield, income, livelihoods, lifestyle in your community. If yes, what are they?	
How is the community coping under these circumstances?	
Please share your experiences related to natural disasters (floods, drought, hurricanes, land changes, etc)	

- How has your community been affected? - Who is affected the most? - Have there been impacts on crop yield, income, livelihoods, lifestyle in your community as result of the above natural disasters? - How did the most affected people survive the situation? - Did you get any outside assistance? - What kind of assistance did you get? - Has your community fully recovered from these natural disasters? - What do you think are the causes of these natural disasters? - What have you done to reduce the impacts, assuming that the impacts are negative? - Are you familiar with the idea of “climate variability & change”	

Is the anything you would like to ask us?

Is the anything you would like to share with us which we may have overlooked?

Thank you for your participation and precious time

APPENDIX F

QUESTIONNAIRE FOR THE MANAGER: WARD EXTENSION OFFICERS ON PERCEPTIONS ON CLIMATE VARIABILITY & CHANGE AND FOOD SECURITY

Climate Variability and Change, Food Systems and Crop Production: An Exploration of Perceptions, Adaptive Capacity and Food Security in the Ngqushwa Local Municipality –South Africa

Preliminary studies and reports indicate that climate variability &change impacts may have already made changes to people's lives. This study hopes to unearth the perceptions of the Ngqushwa Municipality about their own adaptation experiences to climate variability & change and its impacts on livelihoods, food security and agriculture. The study requires inputs from THE MANAGER: WARD EXTENSION OFFICERS so that knowledge about their environmental issues will be, at best, accurately captured. All information provided by interviewee will be treated as STRICTLY CONFIDENTIAL for mutual benefit of both the researcher and the respondents.

Questionnaire number…………… Enumerator name………………..…

Date...………………………………Name of Village.…………………...

Name of respondent…………… Coordinates…………………………

1. What extension services do you provide to farmers?

Crops	**Extension services**
On Maize	1
	2

	3
	4
On Other Crops	1
	2
	3
	4

2. Why do you provide such services?

Crops	Reasons for providing the services
On Maize	1
	2
	3
	4
On Other Crops	1
	2
	3
	4

3. What has been your priorities when providing services on:

Crops	Reasons for providing the services
New Crops	
New Crop Varieties	
Drought Tolerant	
Pest Resistant	

Early Maturing	
High Yielding	
Irrigation	
Improved Fallow	
Conversation Tillage	

(Tick where appropriate. Indicate order of priorities)

4. How do you provide the services? (e.g. Visiting farmers' fields and advising them individually, advising farmers in group)

Crops	**Method of providing the services**
On Maize	1
	2
	3
	4
On Other Crops	1
	2
	3
	4

5. What crops and crop species have you been advising farmers to grow and why?

Crops	**Species**	**Reasons for advising farmers to grow**
Maize		
Other crops		
1		

2		
3		
4		
5		

6. Which languages are you using to disseminate information to farmers?

____

____

7. How much funding do you receive from the Government for extension work?

____

____

8. What problems do crop farmers experience in relation to climate in this municipality?

____

____

9. For how long have they been experiencing these problems?

____

____

10. How does production of different crops get affected by the changes in rainfall pattern?

Crops	**Effects on different crops**
On Maize	1
	2
	3
	4
On Other Crops	1
	2

	3
	4

11. How does the production of different crops get affected when too much rainfall is received?

Crops	**Effects on different crops**
On Maize	1
	2
	3
	4
On Other Crops	1
	2
	3
	4

12. How does the production of different crops get affected when too little rainfall is received?

Crops	**Effects on different crops**
On Maize	1
	2
	3
	4
On Other Crops	1
	2
	3
	4

13. Before farmers started experiencing climatic conditions: Which month did they used to start planting different crops?

Crops	Month the farmers started planting
Maize	
Other Crops	1
	2
	3
	4
	5
	6
	7

15. Which month did they used to start harvesting different crops?

Crops	Month the farmers started harvesting
Maize	
Other Crops	1
	2
	3
	4
	5
	6
	7

16. After farmers started experiencing these problems: Which month did they start planting different crops?

Crops	Month the farmers started planting
Maize	

Other Crops	1
	2
	3
	4
	5
	6
	7

17. What changes did you make in the way of proving the services?

Crops	**Species**	**Changes in the way of providing the services**
Maize		
Other crops		
1		
2		
3		
4		
5		

18. What changes did you make in the crops and crop species you started advising farmers to grow and why?

Crops	**Species**	**Changes**
Maize		
Other crops		
1		
2		

3		
4		
5		

19. Did you consider changing your priorities of services? Yes /No. If yes, explain.____

____

20. What government policies are you implementing at present with respect to climate variability & change and food security?

____

____

21. Which policies are difficult to implement?

____

____

22. How are you implementing the priorities of the National Development Plan and how far did the Massive Food Production Programme do in this Municipality?

____

____

Please share any success stories

____

____

23. Did the funding from the Government increase or decrease? By how much?

____

24. What other extension services did you start providing to farmers and why?

Other Extension Services	**Reasons for providing them**

On Maize Production	1	
	2	
	3	
	4	
On Other Crops	1	
	2	
	3	
	4	

25. Generally, what changes did you make in your program to promote food crop production?

____

____

26.. Now that you are fully aware the climatic problems farmers are experiencing: What changes are you planning to make in the way of proving the services to ensure that farmers are helped to have food?

____

____

27. What other extension services do you plan to start providing to farmers?

____

____

INFORMATION ON CLIMATE VARIABAILITY & CHANGE

1. What do you know about climate variability & change?

____

____

2. Which year did you start hearing of it?

____

3. How did you hear about it?

4. Do you think you are experiencing climate variability & change in this municipality? Yes/no

Why do you say so?

5. From where do you obtain information about expected effects of climate variability & change in your area of operation?

How much knowledge do farmers have about climate variability & change?

6. What are you doing to make the farmers gain full knowledge of the climate variability & change problem?

7. How are you disseminating information on climate variability & change to farmers? (e.g. through TV, News papers, etc)

8. Which languages are you using to disseminate information to farmers on climate variability & change?

9. Now that you are fully aware of the climatic problems:

a) What activities are you planning to include in your program to ensure that more and accurate information on climate variability & change reaches the farmers?

____

b) What other extension services do you plan to start providing to farmers?

____

c) What major benefits (or advantages) are you seeing with the change in climatic conditions?

____

d) What are the major costs (or disadvantages) are you seeing with the change in climatic conditions?

____

e) Which, in your opinion, is the major obstacle to implementing necessary measures to minimise (or benefit) climate impacts?

____

APPENDIX G

QUESTIONNAIRE FOR PROVINCIAL OFFICE (DEPARTMENT OF AGRICULTURE AND LAND AFFAIRS: FOOD SECURITY DIRECTORATE & DEPARTMENT OF ENVIRONMENTAL AFFAIRS, ECONOMIC DEVELEMENT AND TOURISM

Climate Variability and Change, Food Systems and Crop Production: An Exploration of Perceptions, Adaptive Capacity and Food Security in the Ngqushwa Local Municipality –South Africa

This study hopes to estimate the prevalence of food insecurity/security as well as about the impact of climatic changes on crop farming in the Ngqushwa Municipality. The study requires inputs from GOVRNMENT DEPARTMENT OFFICIALS so that knowledge about their food accessibility issues will be, at best, accurately captured. All information provided by interviewee will be treated as STRICTLY CONFIDENTIAL for mutual benefit of both the researcher and the respondents.

INTRODUCTION

What are your main objectives in the province and its municipalities?

1.____

2.____

3.____

4.____

INFORMATION ON CLIMATE

1. What do you know about climate variability & change?

   ____

   ____

2. Which year did you start hearing about climate variability & change?

   ____

   ____

3. How did you hear about it?

   ____

   ____

4. Do you think Ngqushwa Municipality is experiencing any climate variability and change?

Yes/no .

Why do you say so?

____

____

5. From where do you obtain information about expected effects of climate variability & change?

____

____

6. What other factors affect maize and crop production in this municipality?

____

____

What are the effects?

____

____

Factor	**Effects on maize and crop production**

7. What problems do farmers experience in relation to climate variability & change?

____

____

For how long have they been experiencing them?

____

____

8. Before farmers started experiencing climatic problems:

a) What loan facilities did the Government used to provide to farmers? Please tick:

Cash	
Fertilizer	
Seeds	
Othetr (specify)	

b) Why was the Government providing the loan?

____

____

c) At what percentage did you to give the subsidies for fertilizer and seeds?

____

____

d) What percentage of budget allocation did you receive from the Government?

____

____

e) What percentage (Of the total money received from the Government) did you use to allocate for different activities and why?

Activity	Percentage allocated	Reason
Research		
Extension		

f) What kinds of research were you supporting most?

____

____

____

g) What kinds of research were you supporting most specifically on maize production?

____

____

h) What kind of extension services were you supporting most?

____

____

i) Which activities did you used to do together with NGOs to encourage food crop production in the country?

____

____

9. After farmers started experiencing climatic problems:

a) What changes did you make to your objectives?

____

____

b) What changes did you make to your Agricultural and/or Environmental Policy? Whichever is applicable.

____

____

c) Did the budget allocation from the government increase? Yes/no
If yes, by what percent (%)?

____

____

d) Which crops did you start promoting most and why?

____

____

e) What changes did you make to the loans, inputs and subsidies given to farmers?

____

____

f) What changes did you make to the loan facilities given to crop farmers?

____

____

g) What have you been doing to promote the possibility of storing water for irrigation purposes?

____

____

h) What changes did you make to the budget allocation for production of different crops?

Crops	**Changes made**
Maize	

Other crops	**Changes made**

i) What other activities did you start doing together with NGOs?

____

____

j) What extra loan facilities did the Government start providing to farmers?

____

____

k) What changes did you make in budget allocation for different activities?

Activity	Changes made
Research	
Extension	

l) What other extension services did you start supporting most?

____

____

m) What kind of research did you start prioritizing? (e.g. new crops, new crop varieties, high yields, drought tolerance, pest resistance, early maturation, irrigation, etc)

Kind of Research	Tick
New Crops	
New Crop Variety	
High Yields	
Drought Tolerance	
Pest Tolerance	
Early Maturation	
Irrigation	

Other (Specify)

____

n) What kinds of research did you start supporting most specifically on maize production?

____

____

o) Which extra activities did you start doing together with NGOs to promote food crop production?

____

____

p) Generally, what adjustments did you make in your programs and activities to ensure that there is enough food for every citizen as the municipality/province is experiencing the problem of climate variability & change?

____

____

10. Now that you are aware of climate variability & change:

a) What further adjustments are you planning to make to your objectives?

____

____

b) What further adjustments are you planning to make to your Agricultural Policy or Climate Change Policy?

____

____

c) What crops are you planning to start promoting most and why?

____

____

d) How much are you planning to be allocating for production of different crops and why?

Crops	Amount to allocate	Reasons
Maize		
Other crops		
1.		
2.		
3.		
4.		
5.		

e) What activities are you planning to be doing together with NGOs so as to handle the problem of food insecurity in the municipality?

____

____

f) Supposing climate continues to change in a way that maize production will not be possible, what future plans do you have of feeding the citizens?

____

____

g) Which crops could be suitable to substitute maize when necessary?

____

____

11) What major benefits (or advantages) are you seeing with the change in climatic conditions?

____

____

12) What are the major costs (or disadvantages) associated with the change(s) in climatic conditions?

____

____

13) Which, in your opinion, is the major obstacle to implementing necessary measures to minimize (or benefit) from the effects of climate variability & change in your jurisdiction?

APPENDIX H

HOUSEHOLD DIETARY DIVERSITY SCORE TOOL

Climate Variability and Change, Food Systems and Crop Production: An Exploration of Perceptions, Adaptive Capacity and Food Security in the Ngqushwa Local Municipality –South Africa

This study hopes to estimate the prevalence of food insecurity/security in the Ngqushwa Municipality. The study requires inputs from the local residents of Ngqushwa Municipality so that knowledge about their food accessibility issues will be, at best, accurately captured. All information provided by interviewee will be treated as STRICTLY CONFIDENTIAL for mutual benefit of both the researcher and the respondents.

	QUESTIONS AND FILTERS	**CODING CATEGORIES**	**1 / 0**
	Now I would like to ask you about the types of foods that you or anyone else in your household ate yesterday during the day and at night. READ THE LIST OF FOODS. PLACE A ONE IN THE BOX IF ANYONE IN THE HOUSEHOLD ATE THE FOOD IN QUESTION, PLACE A ZERO IN THE BOX IF NO ONE IN THE HOUSEHOLD ATE THE FOOD.		
A	Bread, rice, biscuits, or any other foods made from millet,	A …………………………………	………

	sorghum, maize, rice, wheat		
B	Any potatoes, carrot, beetroot, sweet potato, onion or any other foods made from roots or tubers?	B……………………………………	………
C	Any vegetables?	C…………………………………..	………
D	Any fruits?	D…………………………………..	………
E	Any beef, pork, lamb, goat, rabbit wild game, chicken, duck, or other birds, liver, kidney, heart, or other organ meats?	E……………………………………	………
F	Any eggs?	F……………………………………	………
G	Any fresh or dried fish or shellfish?	G……………………………………	………
H	Any foods made from beans, peas, lentils, or nuts?	H……………………………………	………
I	Any cheese, yogurt, milk or other milk products?	I……………………………………	………
J	Any foods made with oil, fat, or butter?	J……………………………………	………
K	Any sugar or honey?	K……………………………………	………
L	Any other foods, such as condiments, coffee, tea?	L……………………………………	………

Source: (Swindale & Blinsky, 2005)

APPENDIX I

HOUSEHOLD FOOD INSECURITY ACCESS SCALE

Climate Variability and Change, Food Systems and Crop Production: An Exploration of Perceptions, Adaptive Capacity and Food Security in the Ngqushwa Local Municipality –South Africa

This study hopes to estimate the prevalence of food insecurity/security in the Ngqushwa Municipality. The study requires inputs from the local residents of Ngqushwa Municipality so that knowledge about their food accessibility issues will be, at best, accurately captured. All information provided by interviewee will be treated as STRICTLY CONFIDENTIAL for mutual benefit of both the researcher and the respondents.

Guide for Scoring

1. In the past four weeks, did you worry that your household would not have enough food? 0 = No (skip to Q2)

1= Yes

1a. How often did this happen?

1 = Rarely (once or twice in the past four weeks)

2 = Sometimes (three to ten times in the past four weeks)

3 = Often (more than ten times in the past four weeks)

No.	Occurrence Questions	
1.	In the past four weeks, did you worry that your household would not have enough food?	
2.	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	
4.	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	
6.	In the past four weeks, did you or any household member have to eat fewer meals in a day because there was not enough food?	
7.	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	
9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	

Source: (Coates et al., 2007)