Coping strategies and vulnerability to climate change of households in Mozambique

Working Paper No. 28

CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

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CLIMATE CHANGE AGRICULTURE AND FOOD SECURITY

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Abstract

The purpose of this transdisciplinary project was to cogenerate methods, information and solutions between local communities, local and international scientists and policy makers involved in climate change and adaptation programmes, for coping mechanisms and adapting strategies to climate change and variability in Africa. Herewith the overall goal is to increase the adaptive capacity of agropastoralists, who are among the most vulnerable groups in Africa to climate change and variability.

At a household level, a number of factors influence the nature and degree of people's vulnerability to climate change. We conducted household-level surveys in the agropastoral areas of Mozambique. Based on this, we developed a vulnerability index at the household level and validated the value of a variety of indicators often used in vulnerability assessments. This study gives us more certainty about some variables' influence on coping capacity; some of which are widely applicable. Income diversification, increasing access to infrastructure and saving, for example, are widely applicable and promoted adaptation options.

Keywords

Adaptive capacity; Africa; Climate change; Pastoral communities; Vulnerability factors

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Contents

Acronyms

AE	Adult Equivalent
ANOVA	Analysis of Variance
ASALs	Arid and Semi-Arid lands
FAO	Food and Agriculture Organization of the United Nations
GoM	Government of Mozambique
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
MTs	Meticais (currency of Mozambique)
NGOs	Non Government Organizations
TLU	Tropical Livestock Unit
UNDP	United Nations Development Program
UNWP	United Nations World Program
USAID	United States Agency for International Development
WHO	World Health Organization

Introduction

This report is one of the outputs of a German Federal Ministry for Economic Cooperation and Development (BMZ) funded project 'Supporting the vulnerable: Increasing the adaptive capacity of agropastoralists to climatic change in West and Southern Africa using a transdisciplinary research approach'.

The goal of this transdisciplinary project is to increase the adaptive capacity of agropastoralists, who are one of the most vulnerable groups in Africa to climate variability and the expected effects of future climate change.

The purpose of this project is to cogenerate methods, information and solutions between local communities, local and international scientists, policy makers and other actors involved in climate change and adaptation programs. The project develops coping mechanisms and adapting strategies to climate change and variability in West and Southern Africa, and more particularly in Mali and Mozambique.

The project aims to deliver five integrated outputs:

- Estimation and documentation of the effects of climate variability and change on the primary productivity of crops, rangelands and livestock, and associated livelihoods impacts.
- Inventory, documentation and dissemination of past, present and possible future agropastoralists coping mechanisms to deal with climate variability.
- Active learning mechanisms developed, and priority livestock-based technological adaptation options for improving food security, incomes and sustainability of agropastoralists co-identified with communities and other stakeholders and pilot tested.
- Policy entry points for supporting the implementation of priority livestock-based adaptation options in agropastoral systems identified and discussed with key stakeholders.
- Dissemination pathways identified and implemented at different levels, to increase awareness of the likely impacts of climate variability and change, and to provide information for making decisions in relation to adaptation options for different conditions.

Objectives of the study

Agropastoralists in Mozambique already face daunting challenges, which are now compounded by the expected climate change and increasing climate variability. The planning and implementation of successful adaptation strategies is critical if agricultural growth in the region is to occur. In order to achieve food security and enhance households' livelihoods, we need to understand how households can respond to climate change. This response includes coping strategies, and in the longer term, adaptation (Kelly and Adger 2000). The vulnerability approach can help to contextualize how climate variability and change affects livelihoods. It also helps to emphasize that successful adaptation depends not only upon exposure and sensitivity to climate change, but also on an enabling institutional and policy environment and the inherent adaptive capacity of the system (Adger 2006; Nelson et al. 2010a; O'Brien et al. 2009).

As Heltberg et al. (2009) point out; managing climate risk has traditionally been the responsibility of households, except in times of extreme weather events and natural disasters. At the same time, the uncertainty associated with climate change demands an approach that prepares people without relying on detailed climate projections. In this study, we therefore focus on the adaptive capacity of households.

We conducted a household-level survey in the agropastoral areas of Mozambique. Based on this, we developed a vulnerability index at the household level and validated the value of a variety of indicators often used in vulnerability assessments. We also investigated how these factors influence the choice of coping strategies. Our findings provide evidence confirming the likely efficacy of some common interventions for reducing vulnerability while questioning others.

Structure of the report

Chapter 1 describes the survey design and implementation. Chapter 2 then gives an overview of the main findings. This chapter is sub-divided in to two sections. The first section discusses the results of the descriptive characteristics of surveyed households. We describe their assets and main components of their farming systems. The second section discusses their vulnerability to climate change, and the factors influencing coping strategies and vulnerability. The report ends with a discussion and conclusions in Chapter 3.

Survey design and implementation

Description of the study

Mozambique has a total land surface area of 799,380 square kilometres (km^2) with about 36 million hectares (ha) considered suitable for agriculture. Only 10% of the arable land is currently being used for agriculture. Due to its geographical location and its climate, characterized by the El Niño–Southern Oscillation (ENSO) and within the tropical climate of the Indian Ocean, Mozambique is prone to a variety of hydro-meteorological hazards. The northern provinces generally have good soils and regular rainfall and usually produce enough crops to consume and to sell, while the dry south is not only prone to drought but is also a food deficit area.

The data was collected in Mabalane District of Gaza Province of Mozambique (see appendices A and B). Mabalane District is in the southern part of the country where the predominant activity is crop and livestock farming. The district is situated approximately 314 km north of Maputo, the capital city. The district occupies an area of 9,580 km^2 of which 75% is arid and semi-arid lands (ASALs) and has a total population of 32,040 inhabitants (Government of Mozambique 2007). Population density in the district is 3 persons per km^2, far below the national average of 25 people per km^2 (National Statistics Institute (INE), 2007).

Mabalane District receives low and variable rainfall averaging 623 mm annually and most of this rain falls between November and March (see appendix C). The district also experiences high evapo-transpiration (1413 mm per year) and frequent floods leading to high agricultural risk particularly in dry land farming areas. The area is generally flat to undulating and the soils consist of marine deposits overlain in some places by more recent colluvium and alluvial deposits. Soils close to the river are sandy and fertile, while the rest are sandy loam in texture. These latter areas are dissected by a large shallow depression of clay soils that forms watercourses for a few weeks in a year.

Traditionally, households' centre their livelihoods on livestock keeping and agriculture (USAID 2009). Livestock keeping has been of primary importance because of adequate pastures and large animal feed potential in the district. In the last 15 years, following the end of the civil war, the number of livestock in the district and in Gaza Province in general has

increased thanks to government interventions that have promoted livestock keeping (UNWP 2006).

Site selection and sampling

Due to the encompassing characteristics of the livelihood concept, research on rural livelihood must make difficult choices. This is because almost any aspect of the way people go about making a living is potentially legitimate to investigate and, as a result, a mix of qualitative and quantitative data collection methods has been gaining credence in recent literature on development research methods (Ellis and Freeman 2004). For this report a quantitative household survey was carried out to assess assets, activities and incomes at the household level. By 'household' we mean all individuals who live in the same residential unit, which may or may not be synonymous with family. Also the factors influencing a household vulnerability to the effects of climate change and the coping strategies used as adaptation measures were assessed.

The data used in this report came from a detailed household survey carried out in 2009 in 12 villages of Mabalane District in Gaza Province of Mozambique. The 12 villages comprised: Chipswane, Combumuni Rio, Kokwe, Jasse, Mabomo, Makarale, Tindzaweni, Madjatimbute, Mavumbuque, Mungazi, Mabuya Passe and Mamanzela. A village is the smallest unit in the administrative structure of Mozambique. Selection of the district and the villages was made based on the twin criteria of, first, representation of rural livelihood patterns in a broad sense and, second, ability to capture the effect of livelihood 'gradients' of various kinds. The key livelihood gradients that determined village selection were distance to the market (how far from the market versus closeness to the market) and proximity to the river (how close to the river versus how far from the river) as shown in Table 1 below.

Table 1 2 x 2 design for the village section

		Distance to market	
		Close	Far
Distance to water	Close	Cluster A (Chipswane, Combumuni Rio and Kokwe)	Cluster C (Tindzaweni, Madjatimbuti, and Mavumbuque)
	Far	Cluster B (Jasse, Mabomo and Makarale)	Cluster D (Mungazi, Mabuya Passe and Mamanzela)

These criteria facilitated in identifying factors that influence the livelihood strategy of agropastoralists in coping with climatic variability. In each cluster, 3 villages were chosen to increase variability that could be captured in the households sampling. The villages were selected in a way that excluded influence by other factors, for instance differences in population pressure, or activities of other projects that could have an effect on the livelihoods of the households.

The survey collected a wide variety of variables that comprised: agricultural production at the plot level, household level data on livestock holdings and management, off-farm income activities and earning, household characteristics, household vulnerability context and the coping strategy used as an adaptation measure to climate change.

The national census, 2007 data that specified the names of districts and villages was utilized to randomly select the 12 villages. Based on sample size calculation (WHO 2005) at a 95% confidence interval, 14 to 16 households were selected randomly from each of these 12 villages, yielding a sample total of 184 households. A systematic random sampling was used to ensure that selected households were evenly spread in the sampled villages. Every n^{th} household was sampled, after randomly choosing a starting unit of less than the sampling interval *n*. 'n' was calculated by dividing the total number of households in the sampling frame by the sample size required. For example, if the total number of household in the village was 60, every fourth household name was sampled. Thus, overall 184 households were sampled and household survey instruments administered.

A comprehensive dataset that comprised household demographic, household's livelihood, livestock ownership and other standard cattle-related activities were collected through a structured questionnaire. The questionnaire was divided into sections covering household composition, livelihood strategies, and livestock assets; household livestock ownership, herd dynamics and species; livestock feeding techniques, management, products and markets; welfare outcome (income, food consumption and health); and vulnerability context (main concerns facing the households). The questionnaires with coding sheets are presented in the appendices section.

Data collection

The questionnaires were completed through interviews with the household head or in his or her absence, the senior member available or the household member responsible for the management of farm and livestock. The interviews were carried out in Portuguese between 10 March and 12 April 2009 by enumerators selected from among supervisory extension staff of District Directorate of Economic Services of Chókwe and Mabalane. The selected enumerators were also those who had been regularly hired to work in the National Agricultural Census.

Data reliability and validity

In order to control data reliability, validity, measurement and sampling errors, a dozen questionnaires were field-tested among the agropastoralists households of Kokwe village in Mabalane District by a team comprising the researcher and eight extension staff. The extension staff involved had adequate knowledge of the study area (they had grown up in the region and spoke the local language, Portuguese and a bit of English) and had field experience in data collection (as enumerators, translators, interviewers, facilitators, and field workers) in the district of Mabalane or other districts within Gaza Province.

During the field pre-test, each completed questionnaire was thoroughly checked by the enumerator and researcher immediately after the interview. Any errors noticed were immediately discussed with the enumerators in an attempt to improve the accuracy of subsequent interviews, and to ensure that, where necessary, the enumerator returned to the household to correct errors. To increase accuracy and quality of the survey data, further supervision of field staff during the actual survey was done every day throughout the data collection period.

The data from the questionnaire was then entered into an access database and checked for both data entry and coding errors. Data cleaning was done in Microsoft Excel. Supervision and on the spot assistance during data cleaning was ensured throughout the process. Descriptive statistical analyses were carried out using STATA (release 10.0/SE) software.

Results

Description of the farming system in the study area

This study was carried out in Mabalane District of Gaza Province, which is situated in the southern part of Mozambique. The district falls in the ASALs, which cover approximately 40% of the total land mass (FAO 2005). Consequently, the majority of the households are agropastoralists. Agropastoralism is a system of farming whereby about 50% of household gross revenue[1] is derived from crop farming while the other 50% is derived from pastoralism[2] (Swift 1986). Livestock in the district comprises cattle, sheep, goats, pigs and chicken. Off-farm income generating activities include non-agricultural (salary and wage labour), remittances (values of items received in kinds such as gift and groceries), income from other sources (fishing, hunting and gathering) and trading of forest products such as charcoal.

Approximately 86% of the households raise cattle extensively. While grazing is the main form of livestock feeding, sometimes, the cattle are fed on crop residues particularly following the harvesting season when the animals are allowed to go into the cropping areas as depicted in Table 2. The major crops grown include cereals (maize, millet and sorghum), pulses (beans and cowpeas), vegetables (cabbages, pumpkins, tomatoes and onions), fruits (watermelon) and tubers (cassava and sweet potatoes). The main land tenure systems are own land inherited from ancestors (90%), farm owned with lease agreement (8%) and communal and rental land from individuals (2%). Households cultivate their own small arable plots, producing subsistence food crops.

Table 2 Utilization of crop residues among households immediately after harvest

Uses of crop residues	Households (%)
For cattle grazing	67
As a mulch to conserve moisture	30
For grazing goats and sheep	2
Cut and carry for cattle	1

Source: Author survey (2009)

[1] Gross revenue refers to the total value of marketed and consumed production by the household

[2]Pastoralism is a production systems in which more than 15% of household food energy consumption consists of milk or milk products produced by the household (Swift, 1986)

Socioeconomic characteristics of households

Table 3 presents socio-economic characteristics of households studied. On average the household size was 8 members in adult equivalent (SD=3; range 2–16). The average age of the household head was 52 years. The average farm size was 4 ha and the head of the household was recognized as the overall farm manager. Three major sources of household annual income were identified in each household; they comprised crop, livestock and off-farm income.

Table 4 shows that the average age for male and female household heads was 53 and 51 years respectively. The female-headed households in the context of this report comprise women whose husbands are dead, or whose husband lives elsewhere. However, it is not known whether household structure where some husbands may live and work in other districts is a particular characteristic of the Mabalane District. The highest level of education attained by the head of households was primary education.

As indicated, the women were less educated than men and a relatively high proportion (65%) did not receive formal education at all. This may affect not only their ability to manage crop and livestock production, but also their level of access to public services and hence their vulnerability to, and ability to cope with, climate change. The results also indicate that males dominate as household heads by (80%) compared to 20% female-headed households. This does not compare well with the sex ratio of male to female in Mabalane District, which is 60% to 40% respectively (National Statistics Institute 2007).

Table 3 Summary of household's socio-economic characteristics

Parameter	Average	Standard deviation	Minimum	Maximum
Household age head (Years)	52	15	21	97
Household size (in Adult equivalent)	8	3	2	16
Farm size (Ha)	5	3	1	27
Off-farm income (MTs)	6,315	10,989	3,000	75,000
Crop income (MTs)	124,843	322,761	20,000	3,097,938
Livestock income (MTs)	3,603	6,323	2,000	14,000
Household income (MTs)	1,432,124	324,306	15,000	3,114,828

Source: Author' survey (2009)

Where:

MTs stands for Mozambique Meticais (legal currency in Mozambique); 1 USD = 27 MTs at the time of survey (March, 2009)

For Adult equivalent the factors used are 1 if >15 years of age, 0.5 if between 6 and 14 years, 0.25 if <5 years

Ha stand for Hectares;

n stands for sample size (n=184).

Table 4 Sex of household head[3], age and years spent on education.

Parameter	**Male**	**Female**
Sex (Percentage)	80	20
Average age (Years)	53	51
Education level		
No formal education (percentage)	55	65
Primary education (percentage)	45	35

Source: Authors survey (2009)

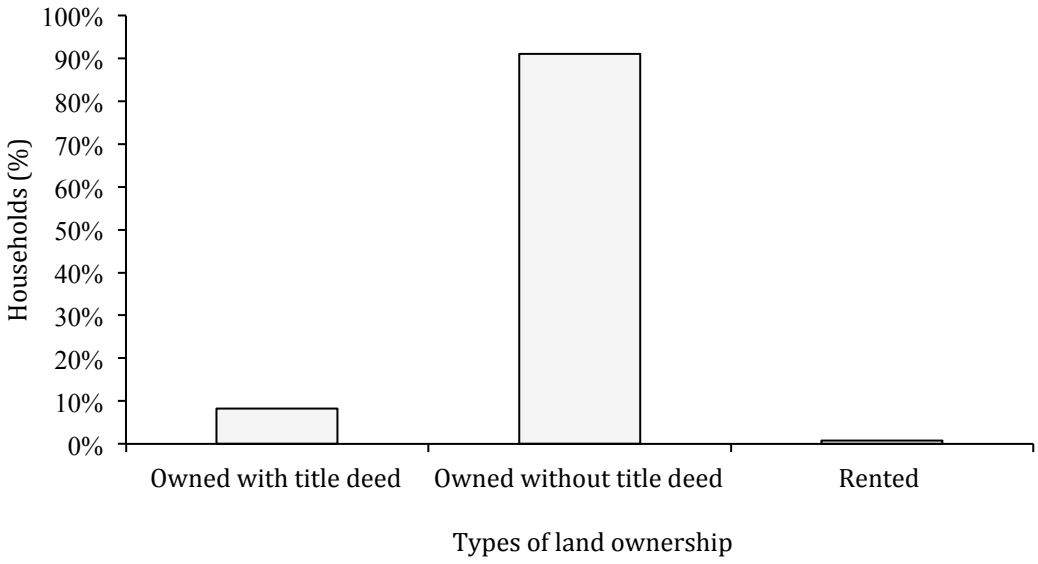
Land Tenure, land improvement and farm sizes

The main land tenure system was freehold (90%) and less than 10% of farmers possessed lease agreement (rights land use) as shown in Figure 1. Only a few households rented plots through cash payment. None of the households reported sharecropping as a form of land renting.

[3] Household head in the context of this thesis is defined as the senior most member of the household, who makes key decision and whose authority is recognized among all household members (Ouma et al. 2004).

However, the type of land tenure system did not seem to have any influence on the type of land improvement made on the farms. This was because out of the 60 households who had lease agreement rights of land usage, only 3 of them had improved land through fencing. On the other hand, out of 121 households who owned land from ancestor without lease agreement, 113 of them showed some form of land improvement such as fencing, and the remaining 8 households reported to have applied a large amount of cattle manure as a form of land improvement. Nevertheless, none of the households (with or without land lease agreement) depicted any long-term form of land improvement, such as tree planting.

Figure 1 Types of land ownership



The mean farm sizes varied considerably among households (see Figure 2). Majority of the households (70%) had farms whose size ranged between 0–2 ha while less than 1% had farm sizes equal to, or greater than 9 ha. The mean farm sizes also varied across households by clusters (see Figure 3). The largest farms were those in villages that were close to the water (in cluster A and C) with the mean of 2.36 ha. Villages far from the water (in cluster B and D) had smaller farms. However, as expected villages far from both the water and the market were slightly larger than those far from the water but closer to the market. This observation agrees with the theory of intensification, stipulates that population density is inversely related to distance to main market. That is, as we get closer to the main market the population density

increases. High population, in turn creates a rise in demand land which for the purpose of settlement. The rise in demand for land, often lead to sub-division of land to tiny pieces on which effective food production cannot be sustained leading to failure in food supply system (Binswanger and McIntire 1987).

Figure 2 Distribution of farm sizes (ha)

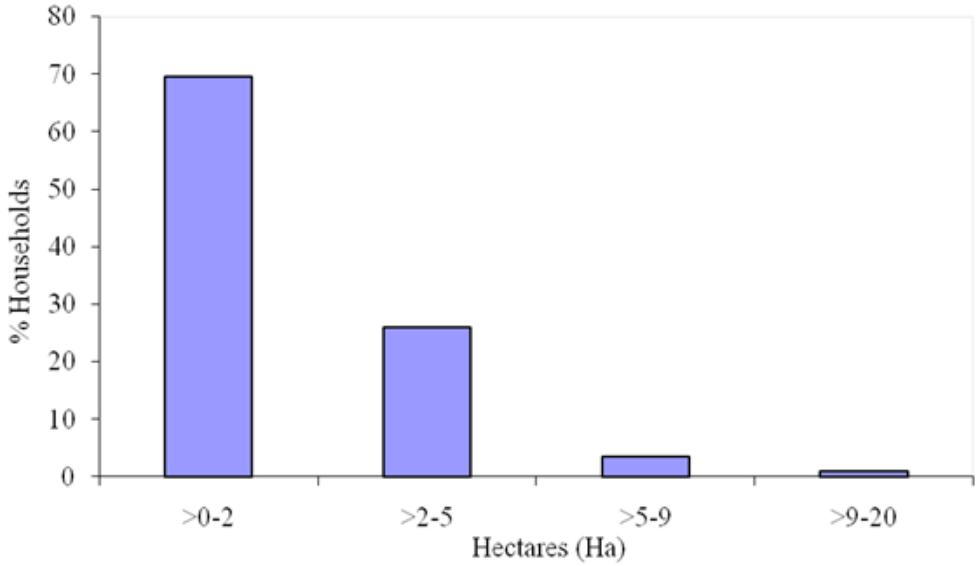
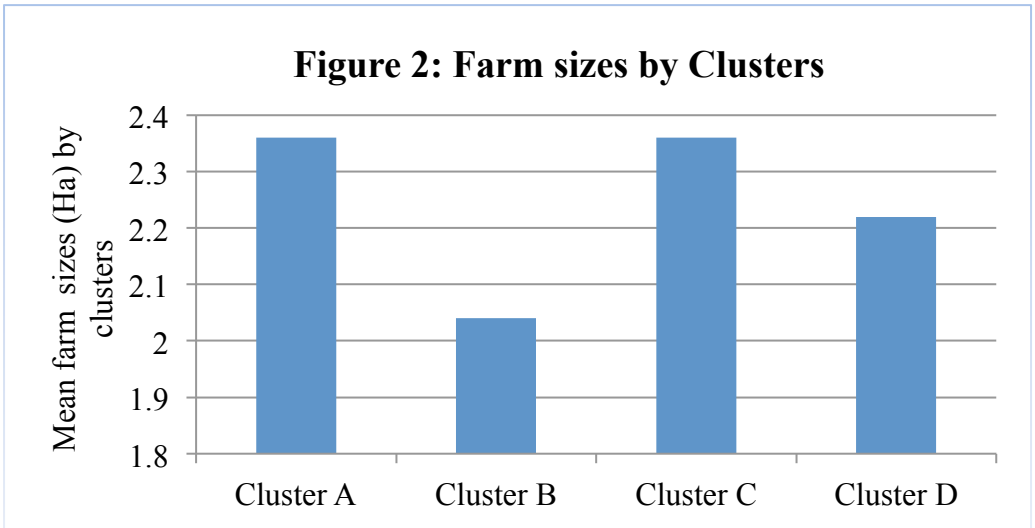


Figure 3 Distribution of farm sizes by cluster



Farms infrastructure and transport

Table 5 shows the variation among households in terms of access to public infrastructure. In general, although the distance to potable water seems shorter, the results show that some households walked for long distances in search of water as indicated by the standard

deviation. The result also indicates that most of the infrastructure (i.e. clinic, public telephone, electricity, livestock and urban markets) was far away for the majority of the households.

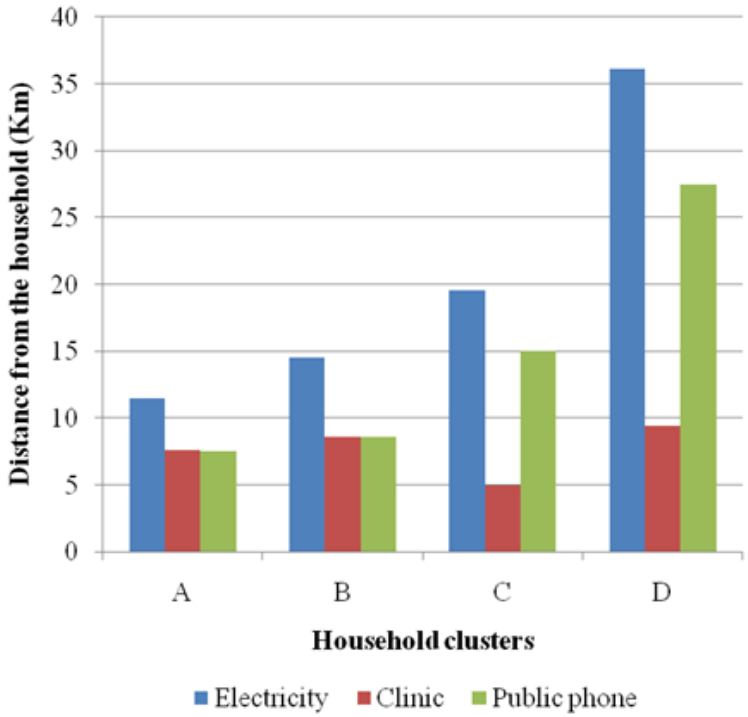
In order to understand how the households differed in terms of access to the major public infrastructure, the four clusters indicated in Table 2 were used as basis for comparison. Figure 4 shows that cluster villages close to the water sources were also close to the clinic, while villages far from the water sources were also far from the clinic. On the other hand, villages with less influence of market and water were furthest from the electricity as well as public phones.

Table 5 Households access to public infrastructure and services

Distances in Km from the household to:	Mean	Std. Dev.	Min	Max
Urban market	30.7	28.2	5.0	265.0
Livestock market	32.9	24.3	0.3	102.0
Potable water	6.7	39.6	0.0	525.0
Nearest electricity	32.8	26.8	0.2	180.0
Nearest clinic	21.5	20.9	0.0	180.0
Nearest public telephone	27.9	23.0	0.5	180.0

Source: Authors survey (2009), (n = 184)

Figure 4 Accessibility to public infrastructure



Household annual food security

All households studied were agro-pastoralist, practicing some crop farming alongside livestock keeping. Major crops in the study area were cereals (maize, millet and sorghum), pulses (beans and cowpeas), vegetables (cabbages, pumpkins, tomatoes and onions), fruits (watermelon) and tubers (cassava and sweet potatoes). Livestock comprised cattle, sheep, goats, pigs and chicken.

Figure 5 and 6 provide information on the sources of metabolism energy for the households under study. All the studied households meet their energy and protein, as per World Health Organization (WHO) requirements. However notable differences exist in the contribution of different types of commodities to household food security. In the study area, for example, cereals (maize, rice, sorghum and millet) contributed significantly to the dietary energy and protein by 49% and 51% respectively. Other significant sources of energy were edible oils (17%), meat (15%) and pulses (10%). As expected meat and pulses was reported as important sources of protein that contributed approximately 27% and 17% respectively to household protein needs.

Figure 5 Average energy (Mega Joules) consumed per household

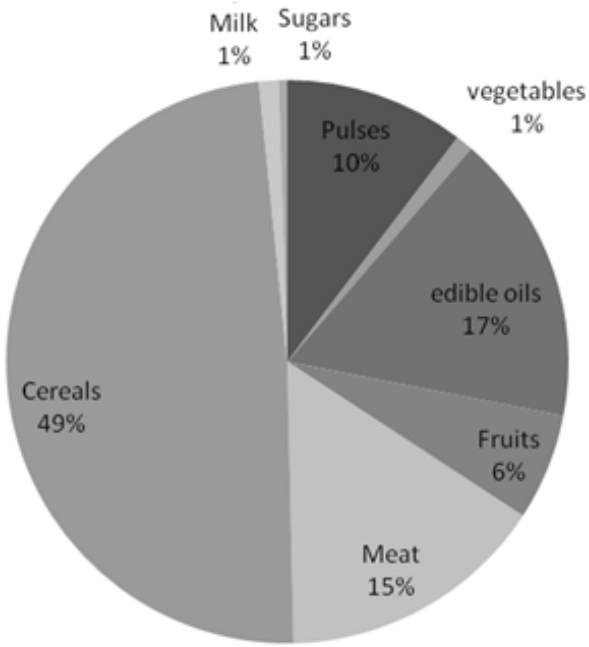
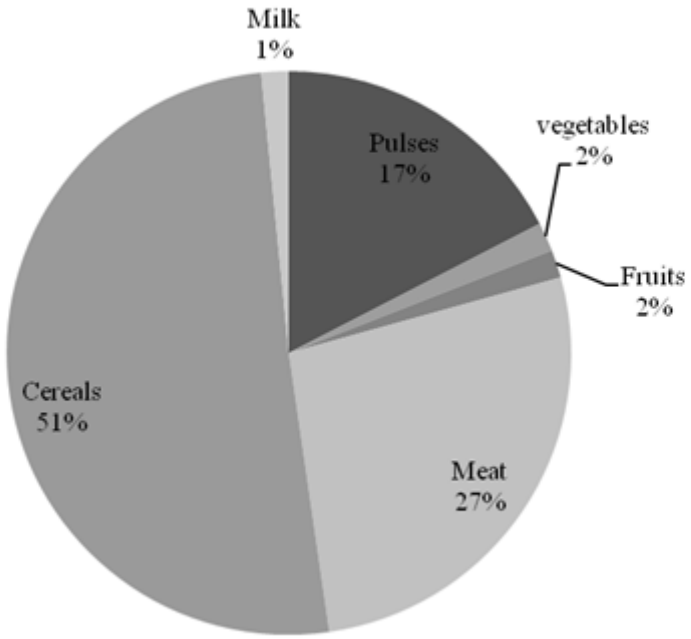


Figure 6 Average proteins (grams) consumed per household



Apart from the use of wild fruits across households, purchased cereals and protein also played a role in meeting household energy and protein requirement across surveyed households. Figure 5 shows that despite the use of own production and purchased food (approximately 50% of all cereals and meat); households still experienced some energy and protein deficits that were met through the use of forest products such as fruits. This revealed the level of subsistence versus commercial orientation of the system, and which can be taken to indicate that households probability of falling into food insecurity and external food dependency were high. Before falling into food insecurity situation, however, farmers in Mabalane District could probably provide a buffer for themselves against increases in prices of purchased food products by reducing the effects of factors affecting their crop yield, thereby reducing the negative effect of drought. This is important considering that 86% of the households reported to have experienced inadequacy in food supply over the past 12 months.

However, the severest period in terms of access to food for consumption was the period between March and July as reported by 80% of the households. This four-month period coincides with the time when majority of the farmers deplete their crop harvest from the previous year. This is also the time they begin to plant for the long rains season. The severity in access to food therefore could imply several things: 1) that majority of the households have

limited supply and are therefore motivated to keep what they may have in store, 2) The inadequacies in food supply also indicate that the quantity harvested by majority of the farmers is insufficient for consumption by the household till the next harvest season, and 3) that needs such as medicine and clothing could be a triggering factor for households to sell some of the produce immediately following the harvest rather than due to surplus harvest.

Household health

Illnesses are major risks to people's livelihoods in resource poor settings, particularly where there are rising levels of chronic illness. The impact of illness is even more pronounced when the decision-making or labour-providing persons in a household are affected. This is because productivity is likely to be affected in both the short- and long-term, implying that household resilience and coping strategies could be easily compromised (Goudge et al. 2009). Thus because of the frequent flooding in the two southern provinces (Gaza and Maputo) of Mozambique, which creates suitable breeding conditions for mosquitoes, we assessed the prevalence for malaria among sampled households.

As expected, it was observed that majority of the households had dealt with malaria related illness in the last 12 months. Seventeen percent of the households reported to have had at least one person sick with malaria for an average period of 117 days (SD = 133 days; range 14–365 days). In contrast, short-term malaria illness lasting for an average of 5 days (SD = 2.37 days; range 1–14 days) was reported among 32% of the households. Moreover, since access to treatment continues to be a key form of social protection for vulnerable households and central to the achievement of the millennium development goals (Goudge et al. 2009), we assessed whether households seek medical advice and the kind of treatment obtained. The results showed that out of the 49% (90 households) infected by malaria, 72% and 18% sought for medical advice from professional doctors and traditional healers respectively.

Those who sought the help of professional doctors and were chronically ill were hospitalized for some days, while those not chronically ill were given medicine in form of tablets or oral suspension. The rest, comprising 18% of the households, sought treatment from traditional healers' and were advised to uproot some herbs, then boil the root and ingest the resulting soup. Some of the herbs/shrubs that households were referred to take include 'matimba' *(Nynphaea nochali),* 'tilhampswa', 'macuacua' *(Strychosmadagacascarensis)* and 'tintoma' *(Ekebergia capensis).*

Nevertheless, depending on the nature and extent of illness, the households were required to pay some medication fees. For example, for oral suspension and tablets received from professional doctors the price ranged from 4–5 MTs (equivalent to 0.14–0.19 USD) while those in need of hospitalization had to pay 4–50 MTs (equivalent to 0.14–1.85 USD). The amount paid was largely determined by the number of days that the patient spent in hospital. Households who sought the advice of a traditional healer were required to pay higher fees ranging from 15–50 MTs (equivalent to 0.55–1.85 USD).

Household labour information

Labour resources comprised mainly the available household or family members and all the studied households depended solely on family labour. The dependence on family labour was particularly useful in activities associated with crop production such as land preparation, planting, weeding, harvesting, winnowing, transporting of inputs and outputs and livestock production activities such as herding. Even in cases of peak labour demand such as when planting, harvesting and transporting harvested crop products from the farm, members from the extended family were called upon. Family members working off-farm sometimes reduced the labour resources available for farming and herding activities. However, among the sampled households, the overall number of active adults (15–65 years) working off-farm was only 4 and had thus no effect on family labour availability.

Cattle production system characteristics

Table 6 summarizes cattle characteristics based on the survey results. The predominant cattle breeds across the surveyed households were indigenous; they were reared in 95% of households, while exotic and crossbreeds were reared only in 5% of the households. The dominance of the indigenous cattle type could be because of the influence of the region's agroclimate on the cattle breeds reared. Generally, the indigenous cattle types are more adapted to harsh climatic conditions than exotic and crossbred animals.

Some differences were observed between households rearing crossbreeds and those rearing indigenous cattle breeds. The level of education of the household head was higher in household heads rearing exotic and crossbreeds (3.8 years) compared to 1.85 years of education on average for the overall sample; these household heads also had a lower average age (47 years) compared to the overall mean age (52 years) of household heads in the sample. Also, in these households the crop residues were used exclusively for cattle grazing either

directly or through cut and carry, and the cattle herd sizes ranged between 3 – 5 Tropical Livestock Unit (TLU) as compared to an average of 14 TLU for indigenous cattle breeds.

Table 6 Characteristics of livestock in Mabalane District

Breeds	Mean	Std. Dev.	Min	Max
Cattle				
Indigenous breed (TLU[4]) (n=175)	14.0	13.4	1.4	92.5
Exotic breed (TLU) (n=13)	5.0	7.5	1.4	28.0
Cross breed (TLU) (n=6)	2.9	2.8	0.8	8.4
Goats				
Indigenous breed (TLU) (n=101)	2.5	2.9	0.15	24.8
Exotic breed (TLU) (n=14)	1.8	1.72	0.15	6.0
Cross breed (TLU) (n=1)	0.60	-	0.60	0.60
Sheep				
Indigenous breed (TLU) (n=22)	2.7	2.3	0.30	9.2
Exotic breed (TLU) (n=3)	1.5	1.0	0.90	2.7
Pigs				
Indigenous breed (TLU) (n=32)	**4.62**	**3.77**	**0.65**	**16.9**
Exotic breed (TLU) (n=3)	**1.30**	**0.00**	**1.30**	**1.3**
Cross breed (TLU) (n=1)	**1.9**	**0.00**	**1.9**	**1.9**
Poultry				
Indigenous breed (TLU) (n=101)	**0.11**	**0.14**	**0.01**	**1.4**
Exotic breed (TLU) (n=9)	**0.08**	**0.07**	**0.01**	**0.20**
Cross breed (TLU) (n=1)	**0.0**	**0.0**	**0.0**	**0.0**

Source: Authors' survey (2009)

The analysis of variance (ANOVA) result indicated that the average herd size of an indigenous breed was significantly different than the exotic and cross breeds cattle herd sizes (at $p<0.01$). This implies that as farmers intensify, they tend to reduce the herd size thus allowing them to use more of the planted crop residues as livestock feed in order to achieve a higher productivity per cattle. A similar finding from Kenya showed the average herd size for a high-intensive systems household is 1.8 TLUs compared to 3.2 TLUs for low-intensive systems (Bebe et al. 2002).

The general composition of livestock comprised cattle, sheep, goats and pigs. Although cattle, goats and poultry were present in varying numbers, in all households interviewed only 11%

[4] TLU refer to Tropical Livestock Unit (1 TLU =250 kilograms)

of the households reported to rear sheep. This could be because sheep do well in high altitude areas, which Mabalane District (which falls in ASALs) lacks.

The management of sheep, goats and poultry was mainly the responsibility of women, while men managed cattle. On the other hand, in male-headed households, although women's role in managing small stock in terms of feeding, breeding and disease control was absolute, they had to consult the head of the household before selling shoats and pigs. However, in cases where the women were the household heads, they were responsible for all decisions relating to livestock management including sales and consumption.

Table 7 shows cattle, their products and uses. The results show that less than 10 % of all households keep cattle for milk production and the milk produced was consumed in the households. Milk therefore does not play a significant role in the provision of household food security and income to majority of the households in the region. Low milk production in this region can be attributed to: 1) the system of cattle keeping i.e. extensive system, and 2) the genotype of the cows kept in most of the households. This is because the indigenous breeds commonly found in extensive systems of production have a low milk production potential compared to upgraded breeds, commonly found in the semi-zero and zero-grazing systems of production. In addition, the region does not have a tradition of drinking milk as is the case in Eastern Africa.

Table 7 Characteristics of cattle production per breed type in Mabalane District

Production parameter	**Cattle breed types**		
	Indigenous (n=175)	Exotic breed (n=13)	Cross breed (n=6)
Households using milk for consumption (%)	9	7	30
Household selling milk (%)	0	0	6
Households using cattle draught (%)	58	23	17
Household using cattle for insurance, financing and saving (%)	100	100	100

Source: Authors survey (2009)

Utilization of cattle for draught power is common. Respectively 58%, 23% and 17% of the surveyed households report the use indigenous, exotic and crossbred cattle breeds for draught power. The main tasks in which draught power is utilized include land preparation for

planting, transporting farm produce during harvest and transporting commodities to and from markets. On average, the draught cattle work three hours per day for 156 days a year. Breeding bulls/oxen and/or castrates are the animals mostly utilized for draught power. Two animals are yoked together to form a work span (locally referred to as a 'junta'). One junta may be comprised of cattle from the same owner or different owners. Household without cattle hired draught animals at an average fee of MTs 250 (equivalent to 9.2 USD) per junta for every 2 hours of work. The use of draught power is very common across Mabalane District and Gaza Province in contrast to the rest of the country where its use is limited.

Feeding resources

Owing to the nature of livestock production in agropastoralist settings, the entire sample of households reported herding/grazing as the most important avenue through which their livestock obtain feed. Differential feeding management for different animal types and categories was non-existent. However, households reported that supplementation of livestock feed with crop residues was a common phenomenon, particularly following the harvesting season. Table 8 shows the crop residues that are utilized across the livestock-keeping households. The majority of the households (67%) use crop residues to supplement their cattle feed (either through direct grazing or by feeding them through cut and carry) while 30% of the households leave the crop residues on the farm to decay or apply them as a mulch to conserve moisture. Only 2% of the household supplement goats feed using crop residues.

Table 8 The use of crop residues among livestock keeping households

Use of crop residues	Frequency	Per cent	Cumulative
Leave on the farm	112	29.4	29.4
For cattle grazing	254	66.7	96.1
For goats and sheep grazing	6	1.6	96.3
Cut and carry for cattle	2	0.5	97.9
Used for conservation agriculture	5	1.3	98.4
Others	1	0.26	99.7

Source: Authors survey (2009)

In terms of feed scarcity and availability, 75% of the households reported the unavailability of feed between May–August and September–December as moderate and severe respectively. However, sufficient feed for livestock grazing was reported from January to April.

Feed resources and disease presence or absence in the last 10 years

Feed resources in the past 10 years

As a result of the civil war that ended approximately 15 years ago, livestock numbers in the district were reduced. The farmers could not recall the feed resources that were present 10 years ago, which were absent now or why such feeds could have disappeared or appeared. Consequently, changes in feed availability or their components during the last 10 years could not be identified.

Livestock diseases: past, present and constraints to treatment

Changes in livestock diseases during the last 10 years and constraints to treatment were identified based on what farmers or households recalled. Because of the civil war, majority of farmers in Mabalane lost much of their livestock. Despite restocking activities by government and NGOs, current livestock numbers are still below those kept before the war. As such, 75% of the households could not tell which diseases were present 10 years ago, and which were absent today. However, 25% of the households reported that heartwater (*cowdriosis)* and lumpy-skin diseases as the only diseases present a decade ago, but absent today.

Nevertheless, household knowledge on the diseases present today but absent a decade ago was demonstrated by the ease with which they were listed. Figure 7 shows present livestock diseases plotted against the number of households that had noted the presence of disease in their livestock. In addition, households noted some diseases that existed 10 years ago were still present as indicated in Figure 8. Farmers reported that incidences of occurrence of some diseases such as diarrhoea, limb paralysis and foot and mouth disease (FMD) have been decreasing since a decade ago. However, lumpy-skin disease and heartwater incidences had increased.

Figure 7: Disease present today but absent 10 years ago

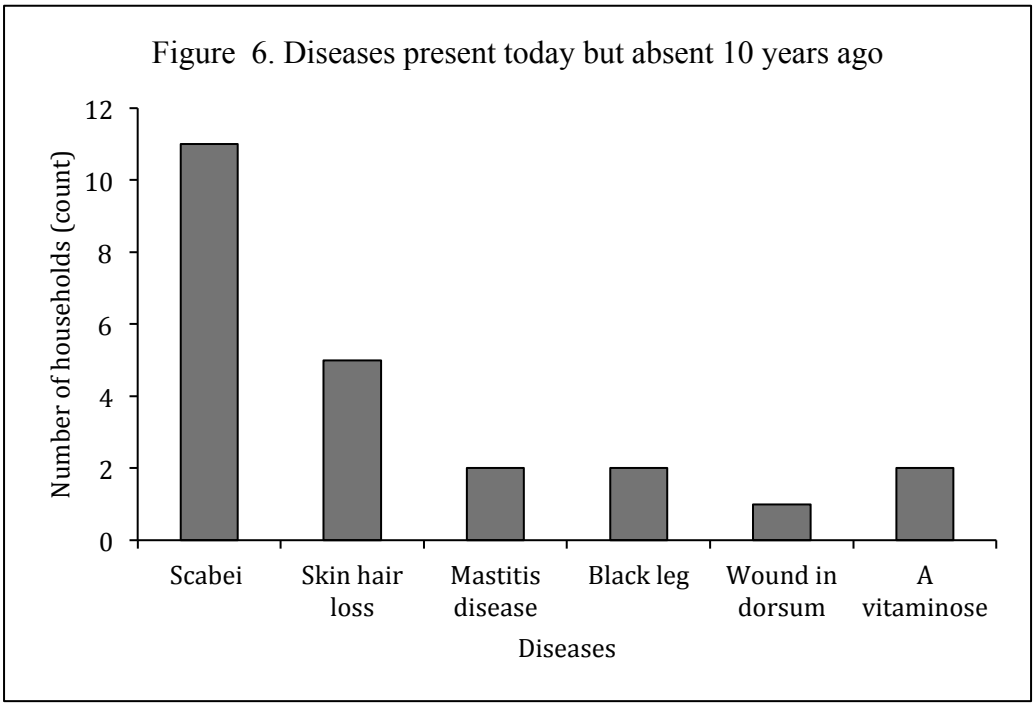
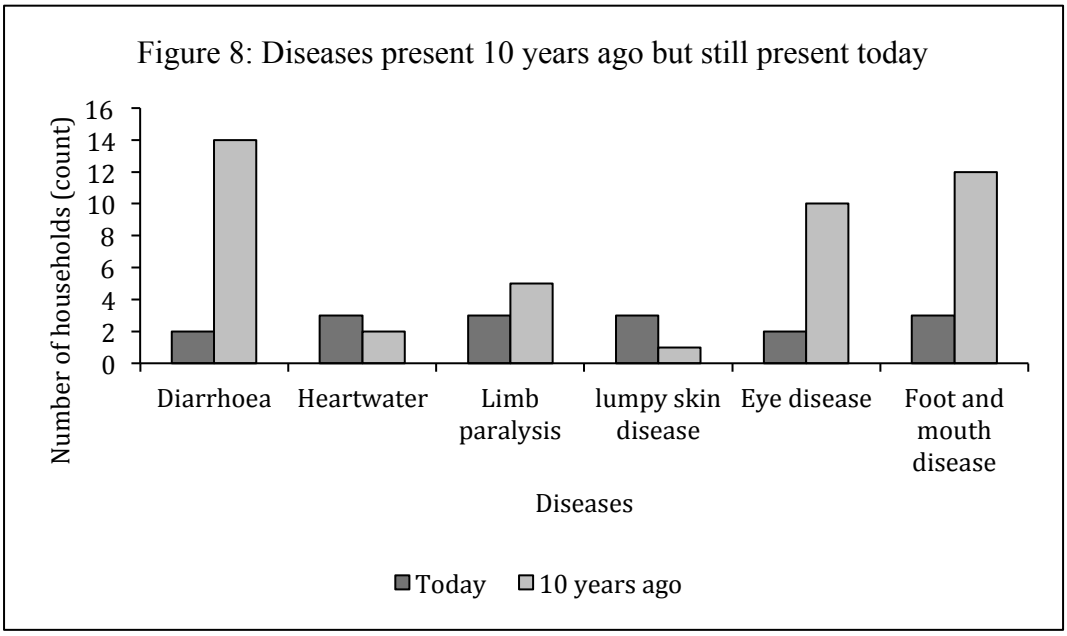


Figure 1: Diseases present 10 years ago but still present today



Two perceived reasons for the disappearance and reappearance of diseases reported by 42% and 23% of the households was change in climate and prolonged drought respectively. However, 35% of the households were not able to identify a specific reason why some diseases reappeared or disappeared. The seasonality of diseases may have been influenced by

budgetary constraints, which forced the government to withdraw subsidies for veterinary services, which affected especially the smallholder producers.

In the event of livestock diseases, 75% of the households reported conventional treatment (veterinary medicines and drugs) as their preferred option, while the other 25% said they utilize a combination of both non-conventional methods (such as washing powder, petrol, burned motor oil) and traditional treatment using herbs, roots and animal fat. However, households who utilize the conventional treatment methods reported lack of knowledge on controlling and treating most of the diseases as their major hindrance. In addition, even where they successfully identified the mode of treatment for their livestock diseases the inputs were inaccessible or unaffordable.

Vulnerability and coping strategies

Conceptual framework

Vulnerability is one of the key terms in the climate change literature and there is a wide variety of definitions and frameworks to assess climate change vulnerability of households and ecosystems (see Alwang et al. 2001; Heitzmann et al. 2002; Turner et al. 2003; Lim and Spanger-Siegfried 2004; Thornton et al. 2006; Adger 2006; O'Brien et al. 2004; Brooks 2003; Cutter 1996; TzPPA 2002/2003; Intergovernmental Panel on Climate Change (IPCC) 2001). A number of authors have reviewed the various definitions and approaches to vulnerability in relation to climate change (Cutter 1996; Adger,1999; United Nations Education Program (UNEP) 2001; Brooks 2003; IPCC 2001). Generally, the definitions and frameworks combine hazard factors with social factors, that is, they holistically merge external stressors with internal system capacity to resist and/or recover from these stressors. It is precisely the interaction between these two factors that defines how vulnerable communities are (e.g. Dilley et al. 2005, Lim et al. 2004, Thornton et al. 2006, Alwang et al. 2001). These components can be applied in various ways, depending on the stressors and the systems looked at, the level of uncertainty of the stressors, whether the focus is broad or specific and on the direction and emphasis of the approach used (Notenbaert et al. 2010). Even though the semantics remain confusing, with many authors referring to what we call vulnerability as risk to what we call risk as hazards, there seems to be a growing agreement that the vulnerability

of any system is a function of three main components. For the purpose of this paper, we will refer to (i) exposure to climate change impacts, (ii) sensitivity to those impacts and (iii) the capacity to cope with those impacts as the components of vulnerability.

Vulnerability is comprised of risks (or a chain of risky events) that people confront in pursuit of their livelihoods, the sensitivity of the livelihood to these risks, the risk response or the options that people have for managing these risks and finally the outcomes that describe the loss in well-being (Turner et al. 2003). The risk response or available options is determined by livelihood assets, strategies, policy and institutional environments. Vulnerability, therefore, rests largely within the condition and dynamics of a coupled human–environment system exposed to climate variability and change. Vulnerability is thus conceptualized as the starting point of the analysis (Eriksen and Kelly 2007), in which vulnerability depends not so exclusively on the precise nature of the hazard, but also on the latent characteristics of human–environment systems that enable them to cope with change in their current form, or undergo more transformative adaptation to maintain important functions (Folke et al. 2005; Nelson et al. 2007).

This definition of vulnerability is a useful concept for assessing climate change and adaptation. It is a dynamic and forward-looking concept that inherently deals with uncertainty and probabilities. The concept can be applied in many different and nested scales. Most importantly, vulnerability as a function of exposure and coping capacity explicitly links ecosystems with human welfare. This view, which this study adopts, puts people and their dependency on the natural and socio-economic environment at the centre of the analysis and offers direct entry points for interventions on the resource, management and policy level.

The study starts by taking a look at the main concerns and associated coping mechanisms of the surveyed households and investigates the factors influencing these concerns and coping strategies. Households' coping strategies can potentially reduce damage associated with climate change by making tactical responses to these changes. Analysing factors influencing coping strategies adopted by households is therefore important for finding ways to help farmers in similar situations across Africa. It will also enhance our understanding of what factors are essential for designing incentives that could enhance the adaptive capacity of local farmers through appropriate coping strategies.

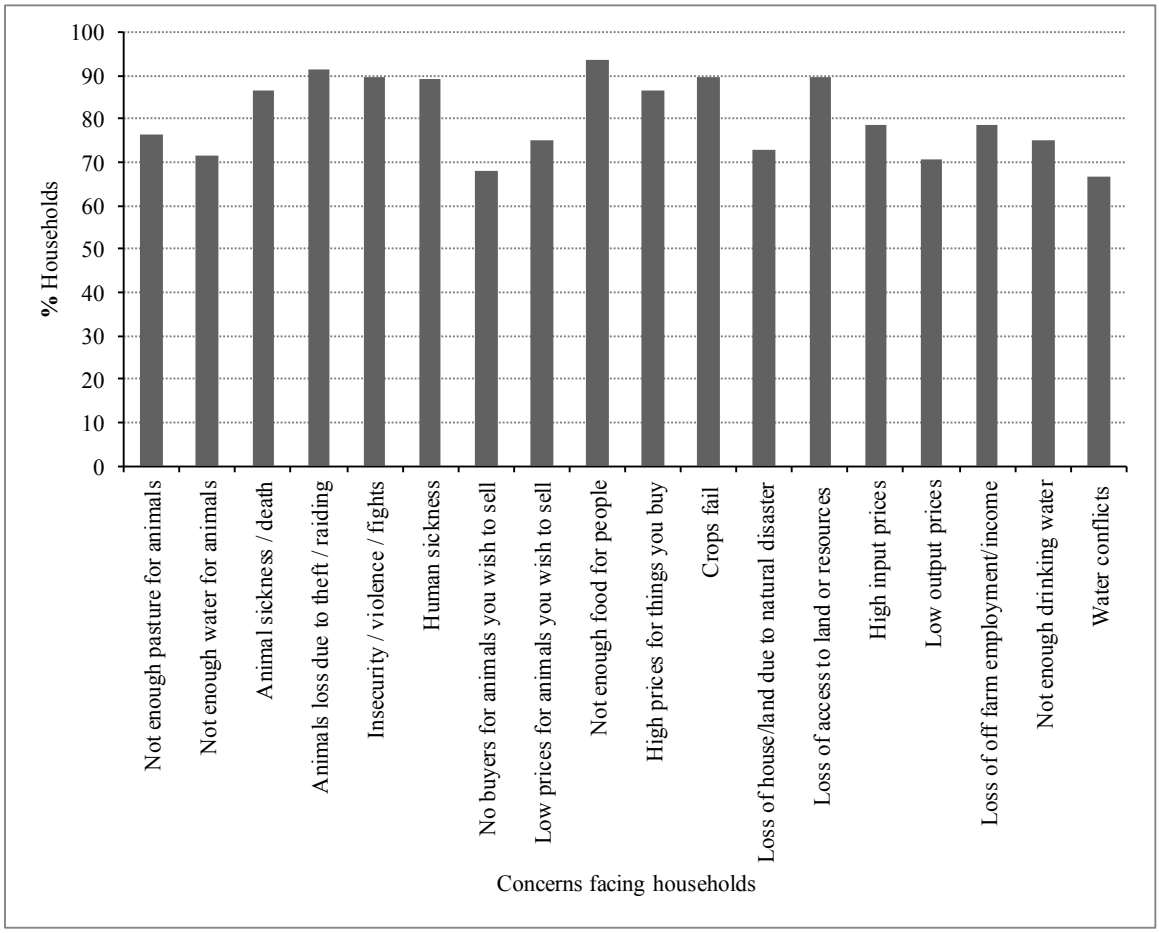
We end the chapter by assessing the households' vulnerability and the determinants of this vulnerability.

Coping mechanisms and factors influencing them

Main concerns and associated coping strategies

Households were asked to state and rank their biggest fears, which were likely to occur in the next one (1) year. Figure 9 indicates that approximately 90% of the households reported animal loss due to theft, insecurity/violence/fighting, lack of adequate food, crop failure and loss of access to land as their five most important concerns. Four other concerns were lack of buyers for animals that households wished to sell; loss of house due to natural disaster, high input prices and conflict over water.

Figure 2 Concerns facing households



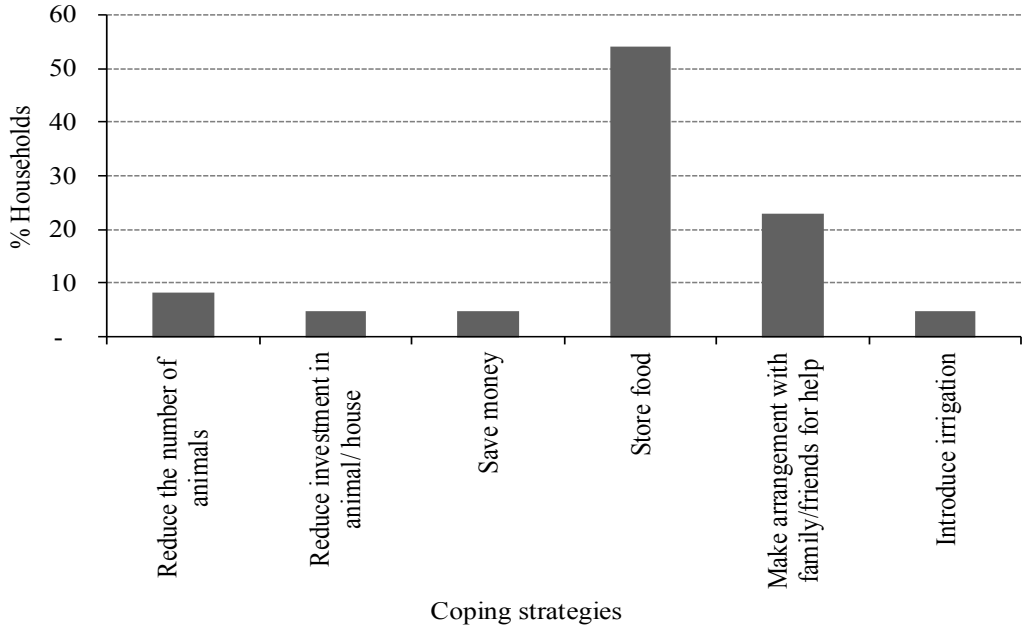
To reduce their vulnerability, households mentioned various measures they put in place as adaptation mechanisms or coping strategies. Coping strategies help households achieve their food security, income and livelihood security objectives in the face of climate variability and

change. The coping strategies farmers perceive as appropriate include reducing the number of livestock, preventive health care for livestock, preventive health care for people, reduced mobility or avoiding certain areas, reducing investments, saving, storing foods, making arrangement with family members or friends, introduction of irrigation and increasing water storage facilities.

Some coping strategies that serve as an important form of insurance against rainfall variability are increasing diversification by growing a variety of crops on the same plot or on different plots of land and taking full advantage of available water, thus reducing the risk of complete crop failure since different crops are affected differently by climate events. The coping strategies can also be used to modify the length of growing season, for instance by using additional water from irrigation and water conservation techniques.

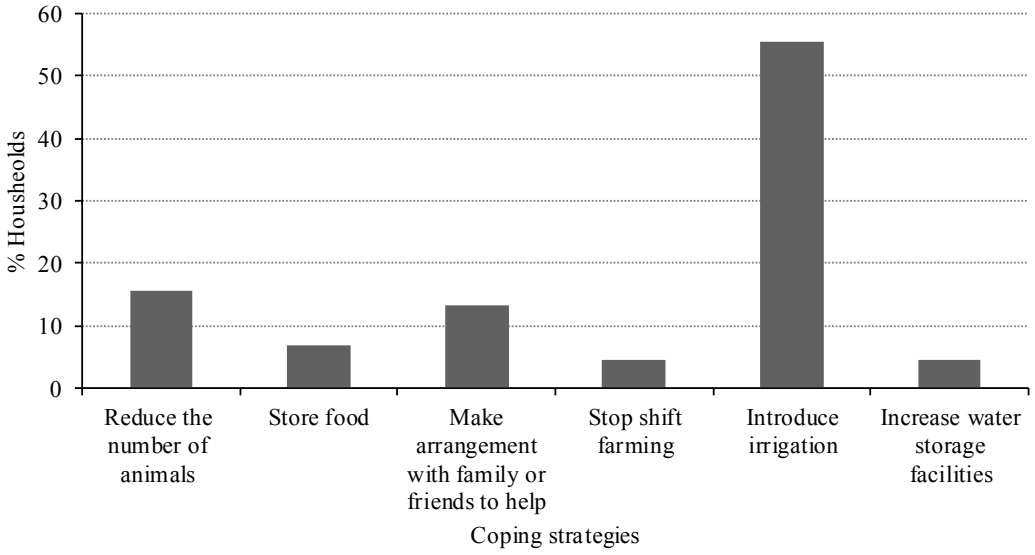
Some of these coping strategies were specific to a particular concern while others were measures for a variety of concerns to which the households were most vulnerable. Figure 10 shows some of the most important coping strategies taken by the households to lower vulnerability associated with lack of food. As expected, over 50% of the households who reported lack of food as a major concern said food storage was an important strategy that could reduce vulnerability.

Figure 3 Coping strategies to curb lack of food (survey results, 2009)



To reduce household vulnerability as catalysed by crop failure, 56% of the households reported introduction of irrigation as an important coping strategy (Figure 11). Since crop failure often results in food shortages, making arrangement with family and friends at such times was being utilized by 13% of households as an important strategy to curb lack of food. The practice of making arrangements with family or friends for help has also been noted elsewhere. Mworia and Kinyamario (2007) report support from family and friends as an important strategy through which the Maasai community in Kenya and Tanzania are able to cope with lack of food during drought. Other important coping strategies to reduce vulnerability posed by shortage of food supply were: reduction of the number of animals, storing food, reduction of shifting cultivation, reducing investment in animals and houses, saving money and increasing water storage capacities.

Figure 4 Coping strategies against lack of food (survey results, 2009)



To cope with lack of water, the majority of the farmers utilize the following strategies: increasing the water storage capacity, reducing investment in animals, reducing the number of animals and introducing irrigation as illustrated in Figure 12. When asked how reducing the number of animals helped reduce vulnerability associated with lack of water, the households argued that animals consume large quantities of water, which is a problem to households especially during periods of drought when the little water conserved whenever it rains is consumed by animals. Thus, by reducing their animals, the households are able to conserve that water.

The households noted that although increasing water conservation could be successful in reducing vulnerability particularly during the dry season, it could be made more successful if government agencies and non-government organizations provided funding and necessary inputs for the construction of water storage facilities. Approximately 10% of the farmers cited reduction on animal investment as a way through which resources to increase water storage facilities can be mobilized.

Figure 5 Coping strategies to curb lack of water (survey results, 2009)

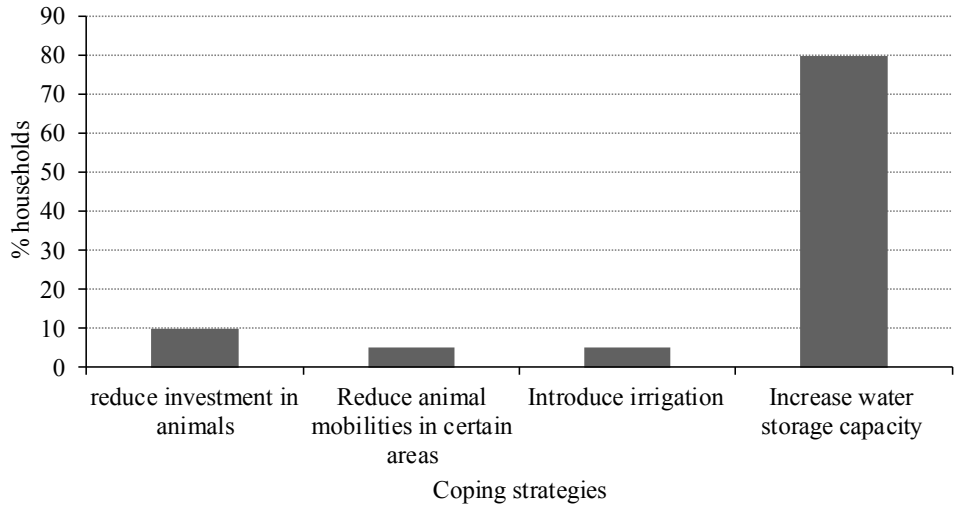
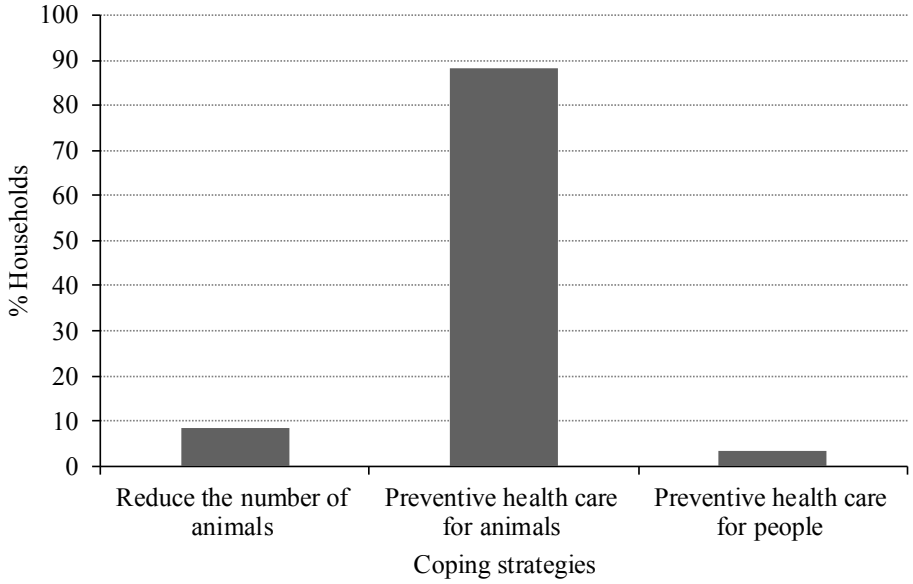


Figure 13 indicates that in households that stated animal sickness and sudden death as a concern; 88% reported preventive health care as an important coping strategy. Reducing the numbers of animals and preventive healthcare for humans was mentioned by 9% and 3% of households respectively.

This latter 3% of the farmers argued that if the preventive healthcare for humans was well instituted, there would be fewer cases of sickness and sudden death of the animals. This means that in some cases the management of diseases in animals is related to or caused by human beings; for example, improper cleaning of the udder of a cow during milking could easily result in mastitis disease. The households utilizing the reduction of the animal numbers as a coping strategy argued that it is easier to provide good care to a smaller number of animals compared to a large herd.

Figure 6 Coping strategies to curb sicknesses and sudden death (survey results, 2009)



Mozambique is very prone to natural disasters such as floods and cyclones. As such, loss of houses or land due to natural disasters were reported as important concerns with more than 90% of the households afraid that this could make them vulnerable in the next 12 months. To reduce these risks and the vulnerability they posed to the household, saving money, reduction of investment in land or houses and reduction in animal mobility or avoiding certain areas while grazing were the three most important coping strategies reported by 25%, 20% and 10% of households respectively.

Factors influencing adoption of coping mechanisms

Adaptation measures help farmers guard against losses associated with climate change. The following analysis identifies some of the factors influencing coping strategies utilized by surveyed households. These findings can guide policy formulation by showing which factors to target and how, so that farmers are encouraged to increase their use of different adaptation measures.

The analytical approach that is commonly used in the investigation of factors influencing an adoption or the utilization of a specific coping strategy among farmers is logit regression. The computation burden of the logit regression is made easier by the likelihood function, which is globally concave (Hausman and McFadden 1984). Logit analysis also produces statistically

sound results. By allowing the transformation of a dichotomous dependent variable to a continuous variable ranging from -∞ to + ∞ the problem of out of range estimates is avoided. Moreover, the logit regression provides results, which can be easily interpreted; the method is simple and gives parameter estimates, which are asymptotically consistent, efficient and normal, so that the analogue of the regression t-test can be applied.

The logit model for the factors influencing the coping strategies among agropastoralist households in Mabalane District of Mozambique is as presented below:

$$Logit\ (y_1 = 1)\ = f(\beta_0 + \beta_1 X_1 + \ \beta_2 X_2 + \beta_3 X_3, + \beta_4\, X + \ \beta_5 X_5 + \cdots . + \beta_{32} X_{32} + \ \beta_{33} X_{33})$$

$$With: f = \frac{e^x}{1+e^x}$$

$Where, X_1, X_2 \ldots X_{33}$ stands for the variables described in Table 9.

To assess the factors influencing a specific coping strategy, the respondents that utilized this coping strategy were given the value of 1 and 0 otherwise. The analysis was done with 33 independent variables comprising geographical, demographic and socio-economic variables. The coping strategies or dependent variables (Y) in the model comprised storing of food, saving money, preventive health care for animals, preventive health care for humans, introduction of irrigation, and increasing water storage capacities. They were given a binary value of 1 or 0. Each of these dependent variables was regressed against the 33 independent variables.

Resource limitation coupled with household characteristics and poor infrastructure limit the ability of most farmers to adopt certain coping strategies amidst changing climate (Kandlinkar and Risbey 2000). Table 9 summarizes the explanatory variables used for empirical estimation.

Table 9 Summary of the explanatory variables used in the regression model

Variable	Variable definition	Measures
dist~nmarket	Distance to the urban market	Km
distanceto~d	Distance to the paved road	Km
dist~lmarket	Distance to the local market	Km
dist~kmarket	Distance to the livestock market	Km
distanceto~r	Distance to potable water	Km
distanceto~y	Distance to the nearest electricity	Km
disttothen~r	Distance to the nearest health centres	Km
disttothen~e	Distance to the nearest public telephone	Km
dailyavail~r	Daily potable water availability	1=yes and 0 =no
hhgenderd~0f	Household gender	1=Male and 0 =Female
yrsspenton~n	Years spent on education by HH head	Years
hhage	Age of the household head	Years
farmsize	Farm size (ha)	Hectare (Ha)
incomefrom~k	Proportion of income from livestock	Percentage (%)
cropvaluep~a	Crop value per hectare	Mts (1US$ =27Mts)
numberofna~e	Number of natural resources accessed	Count
accesstora~r	Access to rangeland	1=yes and 0 =no
accesstofo~s	Access to forest	1=yes and 0 =no
accesstow~10	Access to water resources	1=yes and 0 =no
freepaidra~s	Free/paid ratio to access resources	Ratio
incomedive~s	Income diversification indices	Index
livestockd~s	Livestock diversification indices	Index
cropdivers~s	Crop diversification indices	Index
orgcommuni~e	Membership to organization	1=yes and 0 =no
grouppatic~r	Membership to a group	1=yes and 0 =no
numberofco~d	Number of constrains listed	Count
savingsdum~e	Saving undertaken in the last 1 year	1=yes and 0 =no
emergencyd~e	Emergency needed in the last 1 year	1=yes and 0 =no
hhsizeadul~t	Herd size	TLU
hhsizeadul~t	Household size (AE)	Adult equivalent (AE)
lengthofil~s	Length of illness	Months
hhdepenenc~o	Household dependent Ratio	Ratio
	Maximum temperature	0C
	Minimum temperature	0C
	Annual rainfall	Mm
	Rainfall variability	Index
	NDVI	Index

NB: The expected sign could not be assigned because of the large number of coping strategies in consideration

Seasonal climate variables: Seasonal temperature and precipitation influence households' choice of coping strategies. Empirical studies on economic impact of climate change on

agriculture in Africa have shown that climate attributes (temperature and precipitation) significantly affect the net farm revenue and such impact can be significantly reduced through coping strategies (Seo and Nhemachena 2006; Benhin 2006). Kurukulasuriya and Mendelsohn (2006b) have also shown that household choice of crop and livestock species is sensitive to seasonal climate variables. These studies show the importance of seasonal climate variables in influencing the choice of coping strategies adopted by households. It is our hypothesis that drier and warmer climates favour livestock production and irrigation and are a contributor to crop failure.

Socio-economic attributes: In adoption literature 'household size' has been shown to have mixed influences on adoption of technologies related to agriculture (Birungi 2007). Large households might be forced to divert part of their labour force into non-farm activities, in order for example to generate more income (Tizale 2007). Nevertheless, opportunity cost of labour might be low amongst most households. For other households coping strategies such as irrigation might be labor intensive thereby not adopting them. Consequently, we hypothesize household size to have a positive influence on the adoption of such coping strategies.

Also, the influence of 'household head age' has been mixed in literature. For example Nyangena (2007) and Anley et al. (2007), found that age is significantly and negatively related to a farmer's decision to adopt coping strategies related to water. On the other hand, Bayard et al. (2007) found age to be positively related to coping strategies associated with conservation measures. The 'gender of the household head' has been found as an important variable affecting adoption decisions. For example, Bayard et al. (2007) found female households to be more likely to adopt coping strategies related to natural resources management and conservation practices. Accordingly, Clay et al. (1998) found that 'education' was a significant determinant of coping strategies adopted while Gould et al. (1989) found that education was negatively correlated with such decisions. We expect that households with more education have some information about climate change and coping strategies that they can use in response.

Farm asset and wealth factors: Empirical studies have found mixed effects of 'farm size' on adoption of coping strategies. For example, a study in South Africa showed that farm size was not a significant adoption factor (Anim 1999) while in Nigeria it was farmers with large farms

that were found to allocate more land for constructing bunds (Anleyet al. 2007). In this study it is hypothesized that farmers with small farms would adopt coping strategies that require small areas of land, such as diversification.

Several studies have shown that 'access to emergency loan/cash aid' is an important factor influencing the adoption of various technologies (Kandlinkar and Risbey 2000; Tizale 2007). With more financial and other resources at their disposal, farmers are able to make use of all the available information to change their management practices in response to changing climatic and other conditions. For instance, with financial resources and access to markets, farmers are able to buy new crop varieties, new irrigation technologies and other important inputs they may need to change their practices to suit the forecasted climate changes.

Market access is another important factor influencing coping strategies (Feder et al. 1985). Input markets allow farmers to acquire the inputs they need such as different seed varieties, fertilizers and irrigation equipment. At the other end, access to output markets provides farmers with positive incentives to produce cash crops that can help improve their resource base and hence their ability to respond to changes in climate (Mano et al. 2003).

Maddison (2006) observed that long distances to markets decreased the probability of farm coping ability in Africa and that markets provide an important platform for farmers to gather and share information. Access to 'electricity' was found to be an important factor explaining crop choice (Kurukulasuriya and Mendelsohn 2006b) and livestock choice (Seo and Mendelsohn 2006a). Household access to electricity may reflect either higher levels of market access or both. Farmers with better access to public infrastructure therefore are expected to be able to take up coping strategies measures that enable them to cope better.

Econometric analysis with cross sectional data is normally associated with problems of heteroscedasticity and multicollinearity. Multicollinearity among explanatory variables can lead to imprecise parameter estimates. To explore the potential multicollinearity among explanatory variables, we calculated the correlation between continuous independent variables (see Appendix E).

The results of the correlation analysis indicated that distances to the nearest electricity, nearest public telephone and health centre were highly correlated and we had to combine the three distances to public facilities. For dummy variables we used the chi-square test for

independence to determine the dependencies between variables. The variance inflation factor of all included variables was less than 10, which indicate that multicollinearity is not a serious problem in the reduced model (see Appendix 5).

To address the possibilities of heteroscedasticity in the model, we estimated a robust model that computes variance estimator based on a variable list of equation-level scores and a covariance matrix (StataCorp 2005a). Table 10 presents the estimated effect of different variables to the coping strategies utilized by households. The results show that most of the explanatory variables are statistically significant at 10 or lower and the signs on most variables were as expected except for a few. The chi-square results show likelihood ratio statistics were highly significant (P<0001) suggesting the models had a strong explanatory power.

Table 10 Results logistic regression

Log Likelihood	=-47.58	LR Chi2(33)	112.41
No of observation	180	Prob>Chi2	0.0001
		Pseudo R2	0.4573

	Store food	Save money	Preventive animal	Preventive human	Introduce	Increase water
Geographic factors						
Dist~nmarket	0.072**	-0.014	0.000	-0.004	-0.034	0.065**
Distanceto~d	0.129	-1.370**	1.113**	0.007	0.136	-0.348
dist~lmarket	0.034	0.031	-0.011	-0.052**	0.064**	0.065**
Dist~kmarket	0.124**	0.088**	0.057**	0.110***	0.079**	0.108***
Distanceto~r	-0.001	-0.018	-0.014	0.005	0.000	0.033
Dailyavail~r	-0.453	-1.590*	-0.972**	-0.828**	-0.248	0.339
Distanceto~y	0.005	-0.059**	-0.014	-0.021	-0.058**	0.036
Disttothen~r	-0.048	-0.016	0.008	0.016	-0.020	-0.005
Disttothen~e	0.023	-0.033	-0.019	0.000	0.023	-0.056
Demograhic factors						
Hhgenderd~0f	0.488	0.136	-0.204	-0.499	0.208	0.442
Yrsspenton~n	0.213	0.150	0.140	0.212**	0.038	0.090
Hhage	0.040**	-0.011	-0.013	-0.008	0.054**	0.012
Hhsizeadul~t	0.054	-0.053	0.036	-0.020	0.289**	-0.151
Hhdepenenc~	-0.390	-1.525	0.707	1.309*	1.097	-0.094
Socioeconomic factors						
Farmsize	0.028	0.158	0.005	0.005	0.065	-0.131
Incomefrom~	-	-1.515	-0.962	0.561	-0.843	-0.516
Cropvaluep~a	0.000	0.001*	0.000	0.001*	0.001**	0.001**
Numberofna~	-	0.035	0.490**	0.424	-1.946**	-0.854**
Accesstora~r	-	-	-23.071	-37.885***	-	-
Accesstofo~s	11.337	-16.661	23.308	-41.844	-17.094	-13.556
Freepaidra~s	-10.415	15.119**	21.128***	39.653***	19.083***	14.510**
Incomedive~s	-3.958	4.706*	3.843*	-2.332	-0.172	-5.596
Cropdivers~s	-0.803	-1.404	-0.629	-2.381	-4.897**	1.681
Livestockd~s	1.277	-0.768	-0.872	0.009	-1.271	-0.970
Orgcommuni~	0.177	0.854	1.065	0.199**	1.515*	2.229**
Grouppatic~r	0.865	-1.382	1.797	2.837**	2.527**	2.626**
Numberofco~	0.415*	0.430	0.503**	0.179*	0.102	0.568
Savingsdum~e	-0.013	3.024**	1.397*	1.569**	-0.840	-3.099
Emergencyd~	-0.931	-1.515**	-0.183	0.204	-0.730	0.341
Hhfoodaidn~e	-1.019	0.108	0.176	-0.148	1.301	2.034**
Incomepera~t	0.000	0.000	0.001*	0.000	0.000	0.000
Herdsizein~u	-0.044	-0.011	0.074**	0.033	0.010	0.035
Lengthofil~s	0.034	0.070	0.012	0.047	0.069	0.007
_cons	-5.618	0.806	-4.700	-0.180	-2.295	-11.006

*Significant at 10%, ** significant at 5%, and*** significant at 1%.

The result suggests that a long distance to the market promotes storage of food and increases the water storage as a coping strategy. The distance to the paved road had, as expected, a negative and positive influence (at 5% level of significance) on the use of saving and preventive health care for animals respectively. This implies that, when distances to banking facilities are far from farmers, it becomes costly those farmers who are already resource constrained to access such services and preventive animal health care is more likely to be adopted.

As expected, households were less likely to adopt the preventive healthcare for humans if the distance to the local market (used as a proxy for health clinic) was far. However, households had the tendency to adopt irrigation and increasing water storage coping strategies as the distance from the households to the local market increased. This positive relationship could be due to households' inability to travel for long distances to buy food and fetch water, during the periods when food and water are in shortage (such as during drought period). The positive relationship with fetched water in particular was because during drought boreholes (which were mainly situated close to the local markets) were the main sources of water for household consumption.

The distance to the livestock market was important in that it influenced storage of food, saving money, preventive health care for animals and human beings, introduction of irrigation and increasing of water storage. Although livestock markets were an important avenue for generating income, and thus key in determining farmers coping ability, households situated away from the livestock market were prompted by the need to survive and hence inclined to use preventive health care for human and livestock, adopt irrigation to ensure adequate food supply and water storage to save on the time spent to go and fetch water from the boreholes. Daily water availability is very important to household livelihoods. Consequently, lack of daily water availability had a negative influence on saving money and preventive healthcare for animals and human beings as more time was spent fetching water for human consumption, and thus less time on farming and/or other income generating activities.

In their study, Kurukulasuriya and Mendelssohn (2006b) found that access to electricity was an important factor explaining households' access to markets and technology. Similarly, in this study lack of access to electricity had a negative influence on the ability to save money and introduce irrigation as coping strategies. As expected, technology associated with the

banking sector in many places functions well where electricity is present. However, in Mabalane District, as is most other rural areas of Mozambique, lack of such technology is a major drawback to provision of banking services. Lack of banking services in Mabalane could therefore explain why access to electricity had a negative influence on money saving as a coping strategy.

Several studies have shown that improving education and knowledge dissemination is an important policy measure for stimulating local participation in adoption decisions (Dolisca et al. 2006; Anley et al. 2007). This study found that the number of years spent in education had a positive influence on the adoption of preventive health care for household members, implying that farmers try to prevent diseases, such as by sleeping under bed net for malaria, when they are more educated. Although, being educated does not necessary imply that households have a lot of understanding on climate change, the preventive healthcare measure that they were willing to undertake contribute positively to their ability to cope with impacts of climate change. This is because resources that could otherwise be diverted to treating of malaria can, for example, be used in purchasing food.

Similarly, aged household heads have a lot of farming experience and are able to perceive when changes in production start to occur, and as such are able to adopt such practices as storing food for the households as well as introducing irrigation as adaptation measures. This was indicated by the positive relationship between age of the household head and the two coping strategies (such as storing of food and introduction of irrigation). This concurs with similar observations made in Bayard et al. (2007) that age was positively related to the adoption of conservation measures.

As hypothesized, large households are expected to take up labour intensive adaptation measures. In this study it was found that a large household size in adults' equivalent had a positive influence on the use of irrigation as a coping strategy against effects related to climate variability and change.

A high proportion of income from livestock was found to have a negative influence of storing food as a coping strategy. This observation was as expected because more than 50% of the studied households revealed that they use livestock as a form of saving and sell them only when financial needs arise. Thus the possession of livestock provided households with a fall back position in hard times. This could also explain why households with livestock such as

cattle, sheep and goat, were not keen on storing food. However, higher crop value per hectare was found to be important in influencing the adoption of the following four coping strategies: saving of money, preventive health care for humans, introduction of irrigation and increasing water storage.

When the crop value per hectare rises, farmers dispose most of the produce in favour of savings. Since higher crop value per hectare is positively related to disposable income, the households with higher crop value seemed to be more inclined to seek preventive health care (acquiring mosquito nets) than others. Similarly, with more disposable income, the household easily acquires irrigation technology and water storage facilities (for example water tanks), which could have been unaffordable if the crop value per hectare was low.

The quantity of natural resources accessible to households was found to exert a negative influence on three coping strategies. These were the household ability to store food, introduction of irrigation money and increasing water storage. However, it exerted a positive influence on preventive healthcare for animals. This could be explained by the fact that more than 60% of the households studied reported that they gather forest fruits for use as food thereby lowering the motivation for storage of food as a coping strategy.

Access to rangelands also had a negative influence on all coping strategies, except the use of preventive health care for animals because free access to rangelands implied that the cost related to livestock production was low. Keeping large herds reduced the motivation to store food as a coping strategy among households. On the other hand, the majority of households view livestock as a form of saving. This lowers their motivation for the introduction of irrigation, increase of water storage and preventive health care for humans. Consequently, animals are sold only when a need arises, thus leaving the households with less disposable income.

The results also suggest that the low cost of accessing resources (such as rangeland, forests and water) have a positive influence on the adoption of coping strategies such as: saving money, preventive health care for animals and humans, introduction of irrigation and increasing the water storage capacities. This implies that by the virtue of resources that the household access being free, a large portion of disposable income becomes available for saving (in form of building up their livestock herd), acquiring new technology to facilitate

irrigation and water storage facilities as well as disposable income for providing preventive healthcare to the animals and household members as well, hence the positive influence.

The free access to a large number of natural resources, some of which are major sources of livelihoods (for example commercial burning and selling of charcoal as well as a source of food) implies that they act as a platform for household income diversification. Access to a large number of free natural resources (for example fruits) which are free food, have the tendency to reduce crop diversification on the farm. Consequently, the crop diversity index has a negative influence on introduction of irrigation as a coping strategy.

Awareness of the problems and potential benefits of taking action is an important factor in influencing farmers' coping capacity to climate change. However, the effects of this awareness become pronounced when spread widely through social networks among households and communities (Birungi 2007). The results suggest that in Mabalane District, social networks through such forms as membership tin community organizations or group membership positively influenced the household in the use of preventive healthcare among household members, introduction of irrigation and increase of the water storage capacities positively. This implies that social networks are an asset that has the potential of making farmers in a group influence each other in creating awareness and implementing appropriate coping mechanisms.

As expected the ability to save among households had a positive influence on the saving, preventive health care for animal and preventive health care for humans. This suggested that the ability to mobilize savings among households had the potential of enabling farmers to cope well to the effects of climate change. This observation concurs with past studies that have shown that more financial resources at the farmers disposal enables them to use all available information to change their management practice in response to changing climatic conditions (Tizale 2007; Kandlinkar and Risbey 2000). Nevertheless, good access to credit or emergency loan whenever a need arises had a negative influence to the saving of money, implying that easy access to credit reduces the motivation to save money.

Large herd sizes and high income per adult equivalent have a positive influence on the use of preventive health care for animals. This is because, as was noted earlier, cattle are used as a form of saving, and thus the larger the herds size the more savings a household has.

Consequently, the value attached to cattle is a motivation among farmers to adopt preventive health care for animals as an insurance against risks such as disease outbreaks.

Determinants of the households' vulnerability

The households were not only asked to list and rank their concerns and associated coping mechanisms but also to compare with other households (in the same village) the extent to which they have been coping. For each of the concerns faced, they were asked if they had been coping either better than, worse than or similar to other households in their village. This information allowed us to come up with a household-level vulnerability index, assessing the degree of a households' vulnerability to climate change and variability in relation to other households in the same village.

For each of the concerns a household listed, an impact factor (I_i) was established. This impact factor takes the value of +1 if the household considered itself coping less well than the other households, -1 if it was doing better and 0 if they assessed themselves similar to the other households in the village. The rationale was that households that are coping less than others are more vulnerable, while the ones that are doing better than other households have a lower vulnerability. The concerns listed are not all of equal importance. To correct, we established a weight for each of the concerns based on the rank they were assigned across all the sampled households. If a household reported '$\boldsymbol{n}$' concerns, the vulnerability of a household was then calculated using the following formula:

$$V = \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} w_i \, I_i$$

$$\boldsymbol{n} = Number\ of\ concerns$$

$$w_i = Weight\ of\ concerns$$

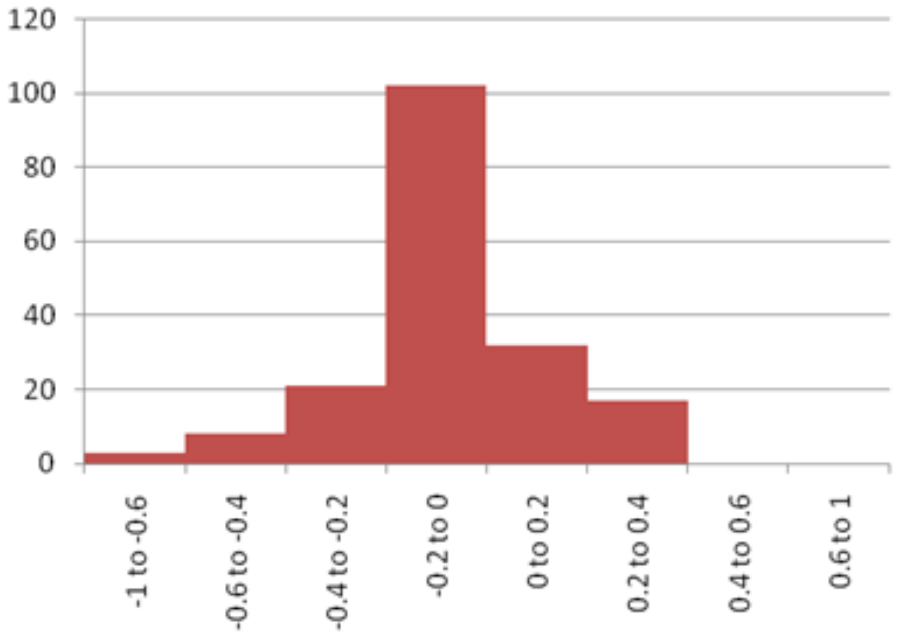
$$I_i = Impact\ (+1: worse\ than/\ 0: same/\ -1: better)$$

As households compare their vulnerability to households in the same villages, the exposure to climate change and variability can be assumed to be equal. The vulnerability assessment the households make therefore reflects the internal capacity only, i.e. differences in sensitivity and coping capacity. This capacity is profoundly influenced by external policy and institutional context. As with the exposure, we assume these are equal for all households in the same village.

This vulnerability index provides a directly observable proxy for vulnerability and enables us to determine which factors influence households' vulnerability to climate change. To this end, correlation and regression analysis was used to determine the factors influencing the household's vulnerability based on the vulnerability index developed.

The frequency histogram of the vulnerability index is somehow shifted to the left (Figure 14). This indicates the general tendency of the households to perceive the problems they face as worse, or their own coping capacity as lower, than their neighbours'. This is in accordance with the social psychology literature on the worse-than-average effect (Kruger 1999; Moore and Small 2005), which describes the human tendency to underestimate one's achievements and capabilities in relation to others, especially in difficult situations or when the chances of success are perceived to be low.

Figure 7 Frequency histogram of the vulnerability index



The computed final vulnerability index was correlated with the factors hypothesized to influence the vulnerability using the spearman correlation analysis. These included a combination of demographic, socioeconomic and geographic factors, including the numbers of coping mechanisms practiced by each of the households. In addition, analysis was done using STATA for windows, version 10 SE to help determine the combined effect of the different hypothesized factors on households' vulnerability regression. Both the correlation and regression analysis used a 0.01 to 0.05 level of significance.

Table 11 presents the significant factors associated with household vulnerability based on spearman correlation analysis considering the vulnerability index developed by the authors. Several demographic, socioeconomic and geographic factors were found to have considerable correlation with vulnerability. They include farm distance to the market, farm distance to clinic and public telephone, proportion of household income derived from livestock, crop value per hectare, number of natural resources accessible to households, crop diversification index, household ability to save, access to emergency cash loan and food aid over the last one (1) year. In the case of farm distance to the market, clinic and public telephone, households had a tendency to be less vulnerable when closer compared to those who were far away and hence they were less vulnerable to the climate change disorders.

The proportion of income from livestock and crop value per hectare are negatively correlated with vulnerability. This implies that households are more vulnerable to effects related to climate change if the proportion of household income derived from livestock is low and also if the crop value per hectare is low. Considering that households attempt to diversify for various purposes, the more dependent on crop diversification they are, as was indicated by the variable crop diversification, the more vulnerable they are to climate change related disorders.

The result also shows that household saving is negatively correlated with vulnerability. This means that households who save less, presumably because they have limited financial resources, are likely to be more vulnerable to adverse climate conditions. Finally, access to several free natural resources is positively correlated with vulnerability, although the degree related with it is quite weak. This implies that the more dependent households are on the natural resources, the more vulnerable they are to climate change related disorders.

Table 11 Pair-wise correlation of factors postulated to influence household vulnerability to climate change

Postulated factors	Vulnerability coefficients	Level of significance
Distance to urban market (Km)	0.07	
Distance to paved road (Km)	-0.08	
Distance to local market	-0.07	
Distance to livestock market	-0.18	0.05
Distance to potable water	-0.02	
Daily water availability (1=Yes, 0 Otherwise)	-0.03	
Distance to electricity (Km)	0.06	
Distance to clinic (Km)	-0.20	0.05
Distance to public telephone (Km)	-0.18	0.01
Household gender (1=Male, 0, Otherwise)	-0.01	
Years of education	-0.01	
Household age (Years)	-0.02	
Farm size (Ha)	0.04	
% Livestock income	-0.13	0.05
Crop value (MT's)	-0.22	0.05
Access to more than 1 natural resources	0.11	0.05
Access to rangeland (1=Yes, 0 Otherwise)	0.05	
Access to forest (1=Yes, 0 Otherwise)	0.08	
Access to water (1=Yes, 0 Otherwise)	0.02	
Free/paid ratio to resources	0.18	
Income diversification index	0.11	
Crop diversity index	-0.18	0.01
Livestock diversity index	-0.04	
Community membership (1=Yes, 0 Otherwise)	-0.09	
Group participation (1=Yes, 0 Otherwise)	-0.03	
Savings (1=Yes, 0 Otherwise)	-0.12	0.05
Emergency loan (1=Yes, 0 Otherwise)	0.06	
Food aid needed (1=Yes, 0 Otherwise)	-0.18	0.05
Seek cash (1=Yes, 0 Otherwise)	0.05	
Income per adult equivalent (MT's)	0.02	
Herd size in TLU	0.09	
Household size in adult equivalent	0.01	
Household dependency ratio	0.05	
Length of illness	0.06	

NB: The yellow highlights imply that the degree of association is significant at 0.01, 0.05 level of confidence interval and highly significant at 0.01 levels.

To identify and evaluate the combination of factors that significantly influence household vulnerability, the vulnerability index was regressed with the different predictor variables. Out of the 30 postulated predictor variables, eleven variables were found to be significantly related with households' vulnerability (Table 12). These were geographic (distances to: the livestock market, potable water, nearest clinic and public telephone), demographic (gender of the household head, age of the household head) and socioeconomic factors (crop value per hectare, number of natural resources accessed, access to the forest, income diversification index and ability to save).

In terms of demographic factors, households headed by women were found to be more vulnerable compared to male-headed households. This may be attributed not only to women's limited physical capacity but also to their overwhelming family burdens. Family issues such as caring for sick children or extreme events like crop failure may impel women to borrow money to survive. They must cope with these events, in addition to already burdensome daily household chores. On the other hand, the vulnerability due to the household head being aged may be related to the limited physical working capacity. Hence, they are unable to better prepare or develop appropriate adaptation strategies to cushion against the adverse impacts of variable and changing climate.

For the predicted socioeconomic variables, the number of natural resources accessible by households, accessibility to forests and household income diversification were important factors influencing household vulnerability to the effects associated with climate change. They significantly reduced the household vulnerability to about 10%, implying that more savings have the potential to help farmers meet shortfalls for example in provision of food following crop failure due to drought. In Mabalane, more than 90% of the households reported to depend on the forest for income generation, such as through burning and selling of charcoal. This explains the significant influence in reducing vulnerability facing households, which although unsustainable in the long run, could make households more prone to the adverse effect of climate change in the future because depletion of resources like forests through felling trees and burning charcoal could impact negatively on water sources such as rivers.

Similarly, income diversification among households and access to more than one natural resource had a negative and significant influence (at 5%) on household vulnerability meaning that households who had good access to a variety of resources were less vulnerable. This could be explained by the fact that resources such as rangelands, water and forest are major sources of household livelihoods, for example pasture for cattle grazing, sources of firewood, construction materials and income. Involvement in several sources of incomes in the study district had the potential to reduce household vulnerability and is thus important.

However, income diversification does not necessarily accrue to the reduction of household's vulnerability but may in fact in the long term exacerbate it. For example, access to natural resources, such as forests, enable the household to diversify income sources, through felling of trees and selling firewood or charcoal, an economic activity that in the long run might exacerbate the effect of climate change rendering the households to be even more vulnerable.

Meanwhile, households who have to pay to access resources and those who have less access to emergency cash loan/aid are likely to be more vulnerable, since access to emergency loans in times of need are important assets for the households' livelihoods. On the other hand, households become more constrained if they have to pay accessibility fees.

In terms of geographical consideration, distances to potable water, health clinics and public telephone were positively and significantly related to vulnerability at 1% level of significance. Households located far from the livestock market also were more vulnerable at 5% as compared to those who were closer. This affirms the significant relationship between these two variables using correlation analysis. On the basis of the computed coefficient of determination, about 36% of the total variations in vulnerability are explained by the above variables. There is thus the need to look for other factors that may explain household vulnerability aside from those identified in the regression model.

Table 11 Factors influencing the household's vulnerability

Postulated factors	Coefficient	Std. Err.	t	P>t
Geographic factor				
dist~nmarket	0.000	0.001	-0.640	0.521
distanceto~d	-0.001	0.011	-0.100	0.919
dist~lmarket	0.000	0.001	-0.440	0.662
dist~kmarket	0.002**	0.001	-1.950	0.053
distanceto~r	0.002***	0.000	-4.240	0.000
dailyavail~r	0.014	0.012	1.140	0.258
distanceto~y	0.000	0.001	0.330	0.741
disttothen~r	0.004***	0.001	3.030	0.003
disttothen~e	0.003**	0.001	-2.540	0.012
Demographic factors				
Hhgenderd~0f	-0.060**	0.038	-1.570	0.018
Yrsspenton~n	0.002	0.007	0.340	0.738
Hhage	0.002**	0.001	1.930	0.056
Hhsizeadul~t	0.003	0.006	0.570	0.572
Hhdepenenc~o	-0.013	0.035	-0.360	0.717
Socioeconomic factors				
Farmsize	0.002	0.005	0.340	0.735
Incomefrom~k	-0.007	0.054	-0.140	0.891
Cropvaluep~a	0.000	0.000	0.910	0.362
Numberofna~e	-0.036**	0.016	2.320	0.021
Accesstora~r	0.184	0.119	1.540	0.125
Accesstofo~s	-0.231*	0.135	1.710	0.089
Accesstow~10	0.043	0.134	0.320	0.750
Freepaidra~s	-0.202**	0.134	-1.500	0.035
Incomedive~s	-0.265**	0.128	-2.070	0.040
Cropdivers~s	0.084	0.089	0.950	0.344
livestockd~s	0.047	0.065	0.730	0.469
orgcommuni~e	-0.029	0.037	-0.780	0.438
grouppatic~r	0.065	0.063	1.030	0.307
numberofco~d	-0.001	0.004	-0.200	0.838
savingsdum~e	-0.082*	0.048	1.700	0.091
emergencyd~e	-0.040	0.032	-1.250	0.213
hhfoodaidn~e	-0.007	0.042	-0.170	0.864
seekcashlo~e	-0.042	0.040	-1.050	0.294
incomepera~t	0.000	0.000	0.280	0.777
herdsizein~u	-0.002	0.001	-1.650	0.100
lengthofil~s	0.003	0.006	0.460	0.650
constant	-0.042	0.117	-0.360	0.719

Note: ***, ** and * stand for significance level at 1, 5 and 10% respectively.

Conclusion and recommendations

This study analysed actual coping strategies used by agropastoralists based on a household survey of approximately 184 households in Mabalane District of Mozambique. The main

coping strategies adopted by agropastoralist households to circumvent the effects related to climate change were: storing food, saving money, preventive health care for animals, preventive health care for humans, use of irrigation and increasing water storage capacity. The results show that a variety of geographic, demographic and socioeconomic factors have a positive or negative influence on the specific coping strategies used by the households.

This study demonstrates the importance of government policies and strategic investment plans that support improved access to climate forecast awareness, research into the development of and information about appropriate farm-level climate coping strategies, access to credit, farmer education, market development and access to public infrastructures.

A lot has been written about the uncertainty of the impacts of climate change (for example Moss and Schneider 2000, Jones 2000). There is a great deal of uncertainty about when, where and how much predicted climate changes will happen and even less is known about the actual impacts of these changes (Kabubo-Mariara 2009). It is therefore crucial to keep the design and development of adaptation options very flexible, enabling smallholders to adjust to the local context and unknown future climate variability. This directly implies increasing the capacity of the households themselves to cope and adapt and warrants the study of adaptive capacity at the household level. The range of uncertainty associated with this coping capacity could well have equal or even larger ranges to that of exposure. According to Adger and Vincent (2005) one of the main challenges is how to characterize adaptive capacity in a meaningful sense and to find generic determinants of adaptive capacity at various scales to build predictive models of its evolution into the future. They say “there is an increasing need to develop indicators of both vulnerability and adaptive capacity both to determine the robustness of response strategies over time and to understand better the underlying processes”.

There is, however, relatively little understanding about the determinants of vulnerability and coping capacity. Extensive literature concentrates on entitlements and command over resources and shows the positive relationship between access to natural, physical, human, financial, political and social capital and the capacity to cope and adapt (Adger 1996; Brooks and Adger 2005; Brouwer et al. 2007; Downing et al. 1995; Eakin and Lemos 2006; Ford et al. 2008; Reid et al. 2007; Smit and Pilifosova 2003; Tompkins and Adger 2004; Wisner et al. 2004; Yohe and Tol 2002). Other studies suggest that cognitive factors such as risk

perception, information management and behaviour, play an important role in determining people's actions and adaptive capacity (Davidson et al. 2003; Grothmann and Patt 2005; IPCC 2001; Tobin and Montz 1997; Peacock et al. 2005).

Following these insights, vulnerability assessments typically follow a 'composite index' approach. For each of the perceived determinants of vulnerability, an indicator is selected and subsequently aggregated into one composite index, measuring the overall potential to cope (for example Cutter et al. 2003; Deressa et al. 2008; Eakin and Bojorquez 2008; Ellis 2000; Esty et al. 2005; Hahn et al. 2009; Nelson et al. 2010b; Notenbaert et al. 2010; O'Brien et al. 2004; Thornton et al. 2006; Vincent 2004).

The determinants hypothesized to be important are often extracted from anecdotal information about case studies or expert opinion. They are usually based on hypothesized links, but often the direction of change and causality in many of the key functional variables are contested (Adger and Vincent 2005). In fact, the choice of indicators often remains subjective, and the relative strength of the various determinants unclear. Methodologically the most advanced in trying to address these uncertainties are the application of a fuzzy set theory by Alcamo et al. (2008). While some other studies have gone some way in empirically justifying the selection of determinants of vulnerability (for example Yohe and Tol 2002, Brooks et al. 2005), to our knowledge, this is the first study looking at determinants of vulnerability from a household perspective and based on primary data collection, from the vulnerable households themselves.

Our assessment studied vulnerability and coping capacity as related to the current conditions of variability. Due to climate change, these conditions are expected to change drastically, possibly far beyond any of the existing experiences. Several authors suggest that assisting households to better manage current climate variability would be a first step in preparing for expected increases in future volatility (Heltberg et al. 2008; Cooper et al. 2008; Nelson et al. 2010a; Tompkins and Adger 2004; Adger et al. 2003). Some say that understanding the present-day effects and response to climate variability at all levels of social organization is a prerequisite for studying the effects and responses to future climate change and for identifying the key determinants of successful adaptation in the future (Adger et al. 2003). The best strategy to assess coping capacity might, therefore, be to look at strategies aiming at dealing with current variability.

Although an enabling institutional and policy environment are essential for promoting development and adaptation, much adaptation will be autonomous and facilitated by the farmers' own social capital and resources. Adaptation should, therefore, be homegrown as far as possible, centred on local knowledge and local innovation. We believe that our focus on the household level complements the multitude of vulnerability assessments done at the community, district or national level. While these are useful for prioritizing and geographical targeting, this household level vulnerability assessment brings back the focus to the main actors in coping and adaptation. The findings have practical local implications, providing easy entry points for household and community level interventions. The identification of sources of adaptive capacity will enable the design of local adaptation options through reinforcing, modifying or offsetting trends in the factors that limit or enhance vulnerability.

Vulnerability as well as the feasibility and efficiency of coping strategies, however, depend very much on the context and the type of exposure. The factors that reduce or increase social vulnerability of an agro-pastoral community facing climate variability and drought are clearly different from those influencing the coping capacity of urban dwellers in the face of flooding or cyclones. Still, certain factors are likely to influence vulnerability in a wide range of socio-economic circumstances and geographical contexts.

This study gave us more certainty about some variables' influence on coping capacity; some of which are widely applicable. Income diversification, increasing access to infrastructure and saving, for example, are widely applicable and promoted adaptation options. Lowering the distance to the livestock market, on the other hand, only makes sense in settings where livestock provide a significant proportion of income to households. Still, our findings suggest that many pastoral and agropastoral regions can benefit from interventions increasing the access to livestock markets. Our results do, on the other hand, question the merits of long-term emergency aid and cash-transfer programs, as they seem to decrease the adoption of saving.

Our significant variables account for only 36% of the variation in vulnerability. It seems that we are far from understanding vulnerability and its underlying processes. More in-depth studies into the coping capacity of households are certainly warranted. Bottom-up assessment of coping capacity and use of household-level primary data does not suffer from the

limitations of secondary data-driven methods, namely the consequences of combining data collected at different temporal and/or spatial scales and for different purposes.

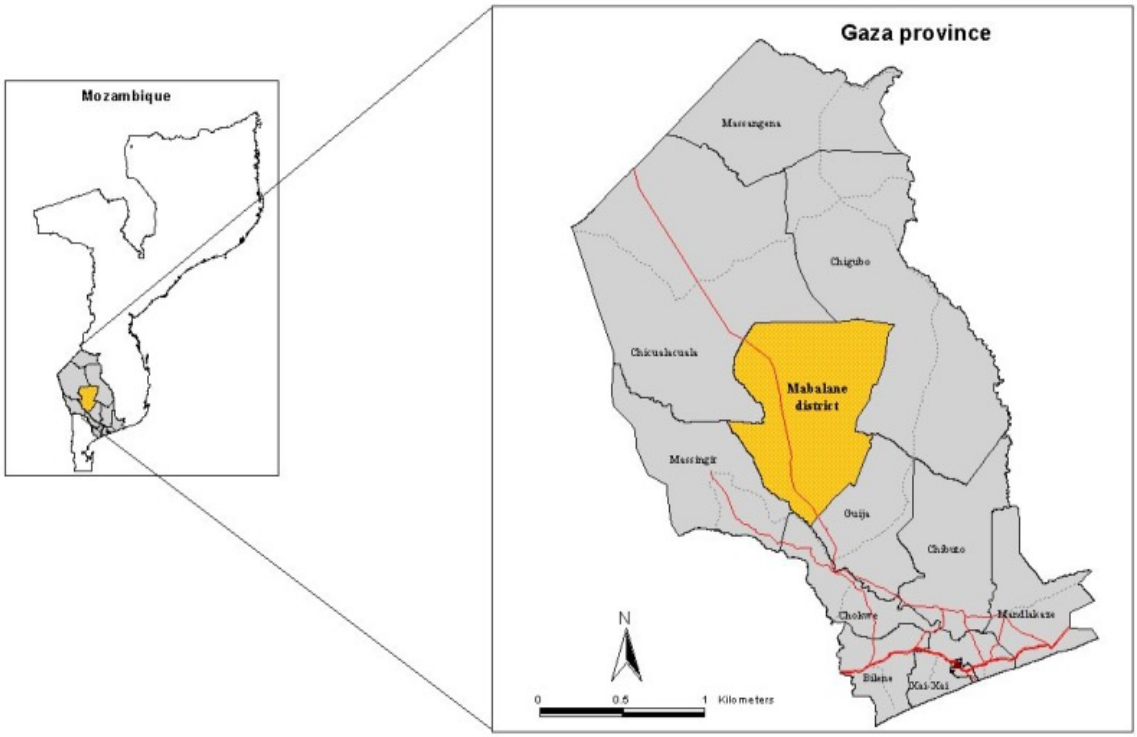
The methodology presented in this paper is easily replicable and provides entry points for local action. If applied to longitudinal data from a variety of regions and contexts, the described methodology might yield useful insights about vulnerability and adaptation. Common determinants will emerge, trends and dynamics appear and differences between regions and communities become clear. When applied in a multitude of local contexts, analogue situations can be encountered, in a different location or even at a future point in time. Lessons learned in similar situations can provide useful insights, coping strategies can be adapted to suit the particular context and necessary conditions (influencing factors) improved or provided for.

The most successful adaptation is likely to be local in response to the localized manifestations of climate variability and change. As the future risk might be far beyond what we are currently experiencing, they could well overwhelm local adaptive capacity and the wider global community will have to support local adaptation (Heltberg et al. 2008). There are various geographic scales and social agents involved in adaptation. A great deal of adaptation is supported by NGOs, community based organizations and governments. Government policies and individual adaptations are not independent of each other – they are embedded in governance processes that reflect the relationship between individuals, their capabilities and social capital and the government (Adger and Vincent 2005). Efforts by households need to be supported by higher-level actions, institutions and policies on regional, national and international levels. The identification of effective adaptation options as well as supporting policy making depend critically on successful engagement with a wide range of stakeholders. A clearer understanding of the determinants of vulnerability and adaptive capacity is only one small piece of a much bigger puzzle.

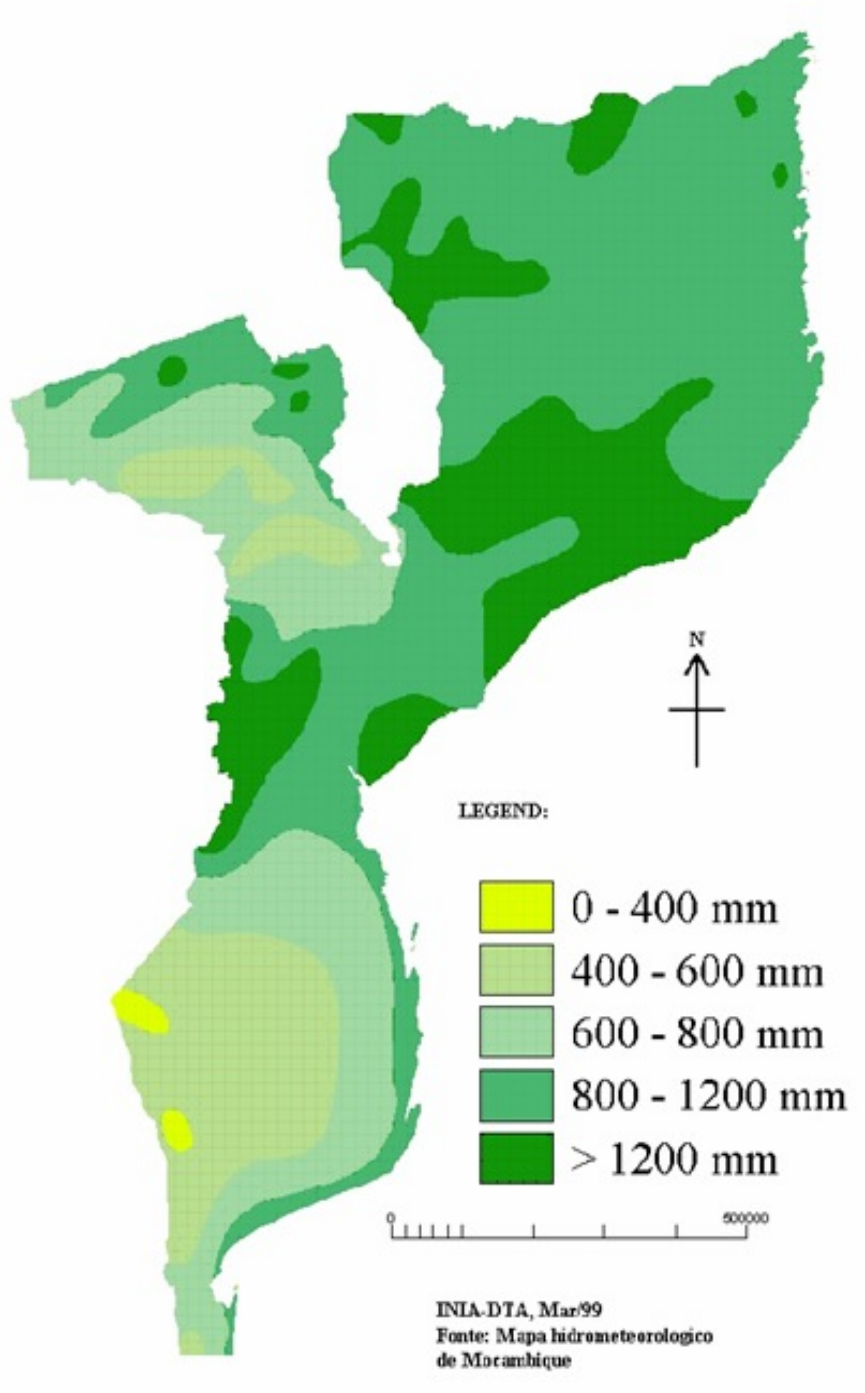
Appendices

Appendix A Map showing the 10 provinces of Mozambique and the neighbouring countries

Appendix B: Map of Mabalane District (area of study), in Gaza Province



Appendix C Map of Mozambique showing the average annual rainfall per year (symbolized by colours) received in different parts of the country



Appendix D Household questionnaire

BMZ-CC HOUSEHOLD SURVEY –MODULE 1
HOUSEHOLD COMPOSITION, LIVELIHOOD STRATEGIES, AND NON-LIVESTOCK ASSETS

Name of household head_____

Gender of household head? Code [_____]

1 =Male	2 =Female	3 = Male Child	4=Female child	5 = Other (specify)

Is the household head polygamous? Code [_____] .

1 = Yes	2 = No

What part of the polygamous household is being interviewed? [_____] (use codes below)

1 = Entire homestead (husband and all co-wives)
2 = Only the "household" (property and activities) of one co-wife, who is wife number [___]

What is his/her relationship to the household head? [_____]
Relationship to household head

1 = Household head	6 = Son
2 = 1st wife to household head	7 = Daughter
3 = 2nd wife to household head	8 = Hired manager
4 = Husband	9 = Other (specify) _____
5 = Co – wife	

REVIEWED BY: 1. _____ 2._____

SECTION 1: GENERAL HOUSEHOLD INFORMATION

1.1 Respondent's name (s) _____
1.2 GPS Coordinates of house: Latitude [_____] (N/S) Longitude [_____](E/W). Altitude [_____]masl
1.3 Distance to paved road _____ (Kms)
1.4 Distance to motorable road _____ (Kms)
1.5 Distance to; a) the nearest local market _____ (Kms) b) the nearest Urban market _____(Kms)
1.6 Distance to nearest livestock market ___ kms
1.7 (a) Distance to portable water ___ kms
1.7 (b) is this water available every day? 1=yes, 2=no
1.8 Distance to nearest electricity _____ Kms
1.9 Distance to nearest health clinic _____ Kms
1.10 Distance to nearest public telephone ____ Kms
1.11 Marital status of household head Code [_____]

1 = Married	4 = Living together
2 = single	5 = Widow/Widower
3 = Divorced/Separated	6 = Other specify

1.12 Number of years household head has lived in this village [_____]
1.13 What is the religion of the household Code [ ]

1 = Christian	2 = Muslim	3 = Other

1.14 Tribal affiliation or ethnic group? Code [ ]

1 =	2 =	3 =	4 =	5 =

1.15. Give details of household members (including HH head) living permanently at home or mostly away from home but contributing to or demanding significantly from the household resources (eg son in South Africa sending cash, boarding pupil)

ID	Relationship to HH head (please write the code plus name)	Gender (1=male; 2=female)	Age (years)	level of education	Primary activity (code)	Home occupancy (1=permanent; 2=mostly away)
1	HH head = 1					
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						

RELATIONSHIP TO HEAD	level of education	Primary activity
1 = Household head 2 = 1st wife 3 = 2nd wife 4 = Husband 5 = co-wife 6 = Son 7 = Daughter 8 = Daughter in law 9 = Son in law 10 = Grandchild 11 = Niece/nephew 12 = Housemaid 13 = Grandparent 14 = Sister 15 = Brother 16= Cousin 17=orphan	0=No formal education 1= Nursery school 2= Sub A Grade 1 3= Sub B Grade 2 4= Standard 1 Grade 3 5= Standard 2 Grade 4 6= Standard 3 Grade 5 7= Standard 4 Grade 6 8= Standard 5 Grade 7 9= Secondary/high school 10=Post secondary school 11=Technical college 12=University 13= others (specify)	1 = Infant (<6years) 2 = Student 3 = Farmer (on this farm) 4 = labourer on-farm) 5 = Labourer off- farm 6 = Civil servant 7 = Private sector employee 8 =Self employed (non-farm) 9 = Migrant 10= Not working/unemployed 11=old or disabled 12=Retired with pension 13=Retired without pension 14 =Other (specify)

1.16.1 Are there any children less than 18 years old from other families living in your house because one or both of their parents has died? 1=yes, 2=no

1.16.2 If yes in 1.16.1 above, please fill the table below

ID	Gender (1=male; 2=female)	Age (years)	level of education	Primary activity (code)	Home occupancy (1=permanent; 2=mostly away)

1.17 For each household member listed in 1.16 who is mostly away from home, please provide the following information

ID (obtain from 1.16)	Number of years away	Current place of residence (town, country)	If working, how was job obtained? (code)	If working, has been obtained jobs for others in same place (Code)?	Sent money home last 1yr? (1=yes; 2=no)	Number of times last 1yr	Sent groceries home last 1 yr (1=yes; 2=no)	Number of times last 1yr

HOW OBTAINED JOB?	Found jobs for others?	Primary activity
1 = Alone 2 = Through family contact 3 = Through contact of relative 3 = Through non-relative contact 4 = Other (specify)	1= No 2= Yes, family 3= Yes, other relative 4= Yes, non-relative	1 = Infant (<6years) 2 = Student 3 = Farmer (on this farm) 4 = labourer on-farm) 5 = Labourer off- farm 6 = Civil servant 7 = Private sector employee 8 =Self employed (non-farm) 9 = Migrant 10= Not working/unemployed 11=old or disabled 12=Retired with pension 13=Retired without pension 14 =Other (specify)

SECTION 2: LIVELIHOOD ASSETS AND ACTIVITIES

1.18 Please provide information on access to land and land use.

Plot ID	Plot Size (ha)	Land ownership (code)	Current land use (for land used by household) (code)	Owned by whom? (code)	Cultivated/Managed by whom?	Land improvements made (use hh codes)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

LAND OWNERSHIP	LAND USE	OWNED BY WHOM	CULTIVATED/MANAGED BY WHOM?	LAND IMPROVEMENTS
1 = Owned with title deed 2 = Owned with no title deed 3 = Rented (cash payment 4 = Rented (sharecropped) 5 = Borrowed (no payment) 6 = Other (specify)	0 = Idle; fallow 1 = Crop cultivation 2 = Livestock grazing 3= pastures/fodder trees 3= Fruit Trees 4=Rented out 5 = Other (specify)	1=Neighbour 2=Government 3=Community 4=HH head 5=Spouse/wife	Use HH ID number if by family member; or hired if otherwise	0=none 1=soil or stone bunds 2=terraces 3=drainages ditches 4=fences 5=trees 6=manure application 7= other (specify)

1.19 For each parcel that is owned or cultivated by women, state under whose control the plot and the output from the plots is.

Plot ID	Plot controlled by whom? (HH ID)	Output controlled by who? (HH ID)	Income (if any) from sale of output controlled by? (HH ID)

1.20 Crop cultivation: Please provide information on crops grown, amount harvested and sold in the last 1 year

Crop grown (see codes below)	Plot ID	Area planted (Ha)	Purchase input used (fert & seeds)	Price per Kg	Commodity harvested	Quantity harvested (Kgs)	Quantity for home use (Kgs)	Quantity sold (Kgs)	Price per kg	Use of crop residue (code) Multiple responses possible

CROPS GROWN		**LAND SIZE UNITS**	**USE OF CROP RESIDUES**
1=Maize	12=Cabbage/rape	1= ha	0=None ,
2=Sorghum	13=Irish potato	2=tree	1=For grazing cattle,
3=Millet	14=Sweet potato	3=Other (specify)	2=For grazing shoats
4=Beans	15=Cassava		3=Cut and carry for cattle,
5=Groundnuts	16=Yam		4=Cut and carry for shoats,
6=Cashew nuts	17=Arrow root		5= Treated for cattle,
7=Cowpeas	18=Grass		6=Treated for shoats,
8=Tomato	19=Dual-purpose		7=Used for conservation
9=Pumpkins/melons	cereals		agriculture,
10=Watermelons	20=Legume		8=Other (specify)
11=Onion	shrubs		
	21=Legume trees		
	22= Other		

1.22. In addition to the plots you own, are there other natural resources you own? 1= yes 2 = No.
If yes please fill the table below?

Resource	Who owns this?	Do you need permission to access these resources? (0=no; 1=yes)	Do you pay for access? (0=no; 1=yes)	Are there rules for use? (0=no; 1=yes)	For what do you use this resource For?	Who is the primary user? (HH ID code)	How often does the person use the resource?	What is the quality of the resource?
Rangeland								
Forest								
River/lake								
Other water source								

RESOURCE OWNERSHIP	ACTIVITIES CODE	FREQUENCY	RESOURCE QUALITY
1=Private/individual 2=community 3=government 4=other (specify)	1=graze animals 2=collect firewood 3= hunt/fish 4=collect other products 5=other	1=Daily 2=weekly 3=monthly 4=seasonally 5=other	1=very good 2=good 3=degraded 4=Very degraded

1.23 Please provide information on asset ownership by your household

Assets Type	Asset	Number owned now	Value if sold now (Currency?)
Info/communication	Radio		
	Television		
	Phone (land or cell)		
Transportation	Vehicle		
	Motorcycle		
	Bicycle		
Farm tools	Tractor		
	Hoe		
	Scotch cart		
	Harrow		
	Shovel		
	Axe		
	Bush knife (Panga)		

	Plough		
	Wheel barrow		
	Trough/bucket		
	Others (Specify)		
House	Refrigerator		
	Cooking pots		
	Jerry can		
	Bed (wooden, metal)		
	Table		
	Chairs		
	Lantern / torch		
	Clock / watch		
	Sewing Machine		
Other	Shop		
	House or plot in town		
	Other		

1.23 Is your house rented or owned? [_____]

1 = rented
2 = owned
3 = owned by friend or relative

1.24 Evaluate the housing standard for this household – (by enumerator's estimation)

Mostly used roofing material (code)	Mostly used wall material (code)	Total number of units/rooms (count)

Roofing material	Wall material	
1=Thatch grass	1=Pole and mud	5=Stone
2= Iron / asbestos sheet	2=Burned brick and mud	6=Other (Specify)
3=Tiles	3=Unburned brick and mud	
4=Other(Specify)	4=Brick plastered with cement	

SECTION 3 – PARTICIPATION, SAVINGS AND CREDIT

1.25 Is anyone in your household a member of a community organization?

HH ID number	Org type1(codes)	Years in position	Elected or appointed

ORGANIZATION TYPE 1=Village council, 2=school board,3= water supply board, 4=Agricultural producers association, 5= others……

1.26 Do any members of your household participate in groups of specific activities? _____

1.26.1 If yes to 1.26, which member(s) and group(s)?

HH ID number	Group type (code)	Holds leadership position? 0=no, 1=yes	Does the group include members from outside community? 0=no, 1=yes

GROUPS TYPE
1=Marketing, 3=self help (i.e. merry go round), 4=credit and savings, 5=religious, 6=burial, 7= crops producers association, 8=livestock producers association, 9=other (specify)

1.27 For members of credit/saving schemes, what type of saving and credit scheme is it? Fill the table below.

Household member (from previous question) (code)	Type of saving or credit scheme? (code)

Type of credit scheme
1=Formal institution (e.g bank)
2=Merry-go round
3= Family and friends
4=Funeral society
5= Others (specify)

1.28 In the past 5 years have you ever undertaken some form of savings in order to offset any planned needs or expenditures? Code [_____]

1 = Yes	= No

1.28.1 If yes, complete the table below;

Year	Planned need	How much in total was the planned need worth (MT)	Form of saving undertaken	How much money was used to buy animals (as a form of saving)	Which animals
2004					
2005					
2006					
2007					
2008					

Future planned need	Form of savings
1 = School fees payment 2 = Building a house 3 = Land purchase 4 = Dairy unit 5 = Poultry unit 6 = Start up business 7 = Buying other assets specify 8 = Dowry payment 9 = Others (Specify) _____	1 = Bank savings 2 = Farmer group savings (rotating and non-rotating) 3 = Cooperative Savings and Credit Society (SACCOs) 4 = Buying of animals), specify type 5 Buying of land for crop farming 6 = Buying of cattle for milk production 7 = Buying of land for development 8 = Other (specify) _____

1.29 In the past five years have you had to deal with an emergency (unplanned, unforeseen) situation requiring you to meet unexpected expenditures? code [____]

1 = Yes	= No

1.29.1 If yes, please complete the table below.

Year	Emergency situation	How much in total was the emergency worth (MT)	How did you offset it?	How many animals did you sell?	What type of animals
2004					
2005					
2006					
2007					
2008					

Emergency situation	How offset unexpected expenditures
1 = Sickness (Hospital bills) 2 = Death/Burial 3 = Drought 4 = Other (Specify) _____	1 = Formal credit (Banks) 2 = Semi-formal credit (AFC, Cooperatives and 3 = Informal credit (Farmer group (Group credit)) 4 = Sale of animal, specify type _____ 5 = Sale of crop plot 6 = Sale of other assets, specify _____

7 = Off-farm income (Salaries) 8 = Withdrawal of bank savings 9 = Fundraising 10 = Borrowing from friends and /or relatives 11 = Other (Specify) _____

1.30 Did you seek a cash loan in the last 12 months? Code [_____] If no, skip to 1.30.4

1 = Yes	0 = No

1.30.1 Did you obtain it? Code [_____]

1 = Yes	0 = No

1.30.2 If yes, where did you get it from? Code [_____]

1 = Bank	2 = Family member	3 = Friends	4 = farmers group	5 = Others (specify)

1.30.3 What did you use the cash loan for? Code [_____]

1 = Food 2 = Pay School fees	3 = Health 4 = Housing	5 = Clothing 6 = Buy farm inputs	7 = Buy livestock 8 = Other (specify)

1.30.4 If you did not obtain it, why? ____ (code)

1 = no money available 2 = no collateral 3 = existing loans

1.31 If you did not seek a loan, why? Code [_____]

1 = Didn't need one 2 = Credit not available 3 = Credit was too costly 4 = Lack of collateral 5 = Fear of being unable to pay 6 = Other

1.32 Did your household need food aid in the last 1 year? [_____]

1 = Yes	2 = No

1.32.1 If YES, for which months did you need food aid? (Please tick)

Months	Jan 08	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Food aid needed												

1.33 Did you lend any money to relatives or friends in the last 12 months? [_____]

1 = Yes	2 = No

BMZ CC HOUSEHOLD SURVEY—MODULE 2
LIVESTOCK OWNERSHIP, HERD DYNAMICS AND SPECIES

2.1 Household livestock ownership

This section relates to **livestock that household currently owns and manages**

Fill in the table giving the **number owned**. Calculate the total number of animals in the final column.

	Hh-head	[Spouses]	[child (Male]	[Child Female]	Other Relative]	Total: fill all, use 0 if needed
Breeding Bulls						
All other cattle						
Sheep						
Goats						
Poultry						
Camels						

Pigs (#)						
Other (#) Specify……..						

2.2 Main reasons for livestock ownership

This section relates to **reasons/objectives for livestock ownership, whether livestock are managed by the household or not**. Fill in the table by ranking three most important reasons for owning livestock.

(the interviewer will ask an open question then tick three most important reason)

livestock keeping reasons	Bulls	All other cattle	Sheep	Goats	Poultry	Horses	Donkeys	Pigs (#)	Other (#)……
Milk for food									
Milk for Sale (income)									
Meat for food									
Meat for Sale									
Calves									
Draft power(traction)									
Insurance[5], Financing[6], and Saving[7]									
Dowry payment									
Manure									
Prestige (social status)									
Hides/skins									
Breeding									
Transportation									
Other reasons (specify)									

2.3 Livestock Management

This table relates to management (care) of the animals listed in the household herd or flock table. Give the ID for household members that manage livestock, or code if a non-household members manages the livestock. Strike out the row if the household does not manage a livestock type.

Please indicate who perform different activities for different animals, If HH member (Indicate relation to household head) but if hired please indicate how they are paid and how much.

Activity code	Who? (use codes below)	How paid?	How much per Week/Month/year?
Cattle			

5 Insurance defined as financing of unplanned expenditures
6 Financing defined as funding of expected planned
7 Saving defined as a store of wealth

Goats			
Sheep			
Camels			

Codes

Activity: 1 = watering, 2 = herding/grazing 3 = treatment 4 = milking 5 = sale of livestock products 6 = housing 7 = breeding, 8= other (specify)

How paid: 1=Cash, 2=In kind, 3= Combination of cash and in kind, 4=others (specify)….

Relationship to HH: 1=Household head, 2= 1st wife, 3= 2nd wife, 4 = Husband, 5 = Co-wife, 6= Son, 7=Daughter, 8=Daughter in law, 9=Son in law, 10= Grandchild, 11=Niece/Nephew, 12=Grandparent, 13= Sister, 14=Brother, 15=Cousin

2.4 Control of livestock products

The first column of the table below shows decision relating to animal product and services, while the first row consists of household members... For each decision type of household member (column,) please tick ([_√__]) the product or services (appearing in rows) that they control.

Hh member / Who decides the following?	HH head	Wife	Others (specify)
Oxen be used for draft power	[___]	[___]	[___]
All other cattle			
sale of milk	[___]	[___]	[___]
Milk for consumption	[___]	[___]	[___]
Slaughter	[___]	[___]	[___]
Whole animal sales	[___]	[___]	[___]
Sheep			
Sale of milk	[___]	[___]	[___]
Milk for consumption			

Slaughter	[___]	[___]	[___]
Whole animal sales	[___]	[___]	[___]
Goats			
Sale of milk	[___]	[___]	[___]
Milk for consumption			
Slaughter	[___]	[___]	[___]
Whole animal sales	[___]	[___]	[___]
Camels			
Sale of milk	[___]	[___]	[___]
Milk for consumption	[___]	[___]	[___]
Slaughter	[___]	[___]	[___]
Whole animal sales	[___]	[___]	[___]
Pigs			
Slaughter	[___]	[___]	[___]
Whole animal sales	[___]	[___]	[___]
Chicken			
Sale of egg	[___]	[___]	[___]
Chicken slaughter	[___]	[___]	[___]
Whole chicken sales	[___]	[___]	[___]
Other (specify…)	[___]	[___]	[___]

2.5 Herd structures

Fill the below table. Strike out a column if the household does not keep that species.

	Cattle	Sheep	Goats	Camels
Does the household have animals they own but do not manage?	[___]=yes [___]=no	[___]=yes [___]=no	[___]=yes [___]=no	[___]=yes [___]=no
If yes, give main reason why (use code)				
Complete the following for households that manage livestock they don't own				
For how many households do you manage animals (number)				
What is the total number of breeding females (number)				
What is the total number of breeding males (number)				

Codes
1=Herder – contracted directly by livestock owner(s) 2=Herder – contracted by 'head herder' 3= Head herder – who contracts other herders for day to day animal care 4=Other (specify below & indicate whether this applies to cattle, sheep or goat)

Why do you have animals that you *own but do not manage*? Code [___]

Codes
1=Culture / heritage 2=Involved in other enterprises 3=Grazing area is away from household 4=Unable to manage own animals due to health / age 5=Other (specify below & indicate whether this applies to cattle, sheep or goat)

Why do you have animals that you *manage but do not own?* Code [___]

1=Animals on adjustments for fattening 2=Main occupation is as a herder 3=Belong to friend / neighbour / relative who is away 4=As a Keeper I use manure from the animals 5=As a Keeper I use the milk 6=As a keeper, I get the Calves 7= As a keeper, the animal generate income for me through draft power 8=Other (specify below & indicate whether this applies to cattle, sheep or goat

Are your animals free to breed with animals from other households? Yes ( ) No ( )

If yes– why?

2.6 inventory of animals owned and managed by the household

List in the first row the different **livestock species** that the household currently **owns AND manages**. Then indicate the number of animals the household currently owns and manages by type. Strike out the table if the household does not own and manage cattle.

Species(codes)											
Breeding Males	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]
Breeding female (number)	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]
Young females (number)	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]
Male intact (number)	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]
Male castrated (number)	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]
Calve (<9 months) (number)	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]
Lamb/kid (>1yr)	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]
Total (number)	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]	[__]

Species and breeds
1 = Exogenous cattle (i.e. Friesian, Guernsey, Jersey e.t.c) 2 = Indigenous cattle (i.e. Zebu, N'dama e.t.c) 3 = Cross-bred cattle (i.e. (exotic **x** Exogenous) 4 = Exogenous goat breed 5 = Indigenous goat breed 6 = Cross-bred goat breed 6 = Exogenous sheep breed 7 = Exogenous goat breed

8 = Cross-bred sheep 9 = Camel

2.6.2 Then indicate the number of livestock the household currently owns and manages by type. Strike out the table if the household does not own and manage livestock by type.

Species	….	….		
Breeding female (number)	[___]	[___]	[___]	[___]
Young females (number)	[___]	[___]	[___]	[___]
Male intact (number)	[___]	[___]	[___]	[___]
Male castrated (number)	[___]	[___]	[___]	[___]
Calve (<9 months) (number)	[___]	[___]	[___]	[___]
Total (number)	[___]	[___]	[___]	[___]

2.7 Animals that have entered herd over the last 12 months (only cattle, sheep, goat and camels)

Fill in the table below in relation to **animals that your household owns** and have entered the herd over the last 12 months. This should include entries of animals that were acquired and thereafter removed, but not short-term entry-exits (e.g. ploughing contracts for less than one month). Use one row per animal. Strike out table if no rows are filled.

	Category	Animal type	Means of acquisition	For what purpose/reason	Average price: State currency	Point of acquisition
1	[__ __]	[___]	[___]	[___]	[___]	
2	[__ __]	[___]	[___]	[___]	[___]	
3	[__ __]	[___]	[___]	[___]	[___]	
4	[__ __]	[___]	[___]	[___]	[___]	
5	[__ __]	[___]	[___]	[___]	[___]	
6	[__ __]	[___]	[___]	[___]	[___]	
7	[__ __]	[___]	[___]	[___]	[___]	
8	[__ __]	[___]	[___]	[___]	[___]	
9	[__ __]	[___]	[___]	[___]	[___]	
10	[__ __]	[___]	[___]	[___]	[___]	
11	[__ __]	[___]	[___]	[___]	[___]	
12	[__ __]	[___]	[___]	[___]	[___]	
13	[__ __]	[___]	[___]	[___]	[___]	
14	[__ __]	[___]	[___]	[___]	[___]	
15	[__ __]	[___]	[___]	[___]	[___]	
16	[__ __]	[___]	[___]	[___]	[___]	
17	[__ __]	[___]	[___]	[___]	[___]	
18	[__ __]	[___]	[___]	[___]	[___]	
19	[__ __]	[___]	[___]	[___]	[___]	
20	[__ __]	[___]	[___]	[___]	[___]	

Animal Category	**Point of acquisition**
1 = Indigenous breed	1 = Market
2 = Exotic breed	2 = Middleman/Trader
3 = Cross-bred (Exotic* Indigenous)	3 = Farm gate
4 = other (specify)	4 = Neighbour

	5 = Other (specify) _____

Animal type		Reasons for purchase	Means of acquisition
1 = Bulls (>3 yrs or used for service)	11= Doe/Nanny	1 = Security (finance future unexpected expenditures)	1=cash purchases
2 = Castrated male cattle (>3 yrs)	12= Bucca/buck	2 = Store of wealth (savings)	2=Barter
3 = Immature male cattle (< 3 yrs)	13= Ewe	3 = Financing future expected	3=gift
4 = lactating cows	14 =Camel cow	4 = Increase social prestige (status	4=credit
5 = Heifers	15 = Camel bull	5 = Replacing old stock	5=others
6 = Pre – weaning male calves	16 = Male camel calf	6 = Obtain more manure	
7 = Pre – weaning females calves	17 =Female camel calf	7 = Increase milk production	
8 = Sheep lamb		8 = For animal draft	
9 = Goat kid		9 = Replace animal that died	
10 = Ram		10 = Others (Specify)	

2.8 Animals that have exited herd over the last 12 months

Fill in the table below in relation to **animals that** have exited the herd over the last 12 months. This should include exits of animals that arrived into the herd in the last 12 months, but not short-term exits (e.g. for ploughing contracts). Use one row per animal. Strike out table if no rows are filled.

	Animal category	Animal type	means of sale	point of sale	Reason for selling	Transport expense: (State currency)	Price per animal: State currency……
1	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
2	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
3	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
4	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
5	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
6	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
7	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
8	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
9	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
10	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
11	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
12	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
13	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
14	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
15	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
16	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
17	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
18	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
19	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]
20	[__ __]	[___]	[___]	[___]	[___]	[___]	[___]

Animal type	Reasons for selling	Animal Category	Point of sale	Means of sale
1 = Bulls (>3 yrs or used for service)	1 = Security (finance future unexpected	1 = Indigenous breed	1 = Market	1 = cash sale
2 = Castrated male cattle (>3	2 = Store of wealth	2 = Exotic breed	2 = Middleman	2=Barter
3 = Immature male cattle (< 3 yrs)	3 = Financing future expected expenditures	3 = Cross-bred (Exotic*	3 = Farm gate	3 = gift
4 = lactating cows	4 = Increase social	4 = other (specify)	4 = Neighbour	4 =credit
5 = Heifers	5 = Replacing old stock		5 = Other (specify)	5=others

6 = Pre – weaning male	6 = Obtain more			
7 = Pre – weaning females	7 = Increase milk			
8 = Sheep lamb	8 = For animal draft			
9 = Goat kid	9 = Replace animal that			
10 = Ram	10 = Others (Specify)			
11= Doe/Nanny				
12= Bucca /buck				
13= Ewe				
14 =Camel cow				
15 = Camel bull				
16 = Male camel calf				
17 =Female camel calf				
18 = others specify------				

2.9 Herd dynamics over the last 10 years

Fill the table below. Strike out column if the household does not keep a species.

Species of animals	Cattle			Sheep			Goats			Camels
Animal category										
How has the number of animals you own changed in the last 10 years? (tick(√))										
If increased, why? (code)										
If decreased, why? (code)										
If no change above, why? (code- rank)										
Has the number of exotic animals that you own changed in the last 10 years? (tick)										

Codes

Changes in the herd/flock	**Animal categories**
1=Increased	1 = Indigenous breed
2=Decreased	2 = Exotic breed
3= No change	3 = Cross-bred (Exotic* Indigenous)

.

Any ideas on why your animal numbers *increased* in the last 10 years
1= increase in feed availability 2= improved disease prevention programme 3= 4= 5= 6=

Any ideas on why your numbers *decreased* in the last 10 years
1=decrease in feed availability 2= loss of grazing land

3=
4=
5=
6=

Any ideas on why your animal numbers did *not changed* in the last 10 years
1=
2=
3=
4=
5=
6=

2.10 Planned future changes

Fill the table below. Strike out column if the household does not keep a species.

Species of animals	Cattle			Sheep			Goats			Camels
Animal category										
Does your household plan to change the number of animals it owns in next 12 months? (use codes)										
If increase, for what purpose (code										
If increase, how do you plan to increase your animals (code)										
If decrease, why? (code)										
If no change, why? (code)										
Under what conditions would you increase your offtake (code: rank)										

Code

Changes in the herd/flock	**Animal categories**
1=Increased	1 = Indigenous breed
2=Decreased	2 = Exotic breed
3= No change	3 = Cross-bred (Exotic* Indigenous)

If increase, how do you plan to increase your animals
1=Improve fertility of own animals by better management of health and feed 2=Improve fertility of own animals by breeding from the highly fertile animals from own stock 3=Improve fertility of own animals by purchase of highly fertile breeding stock 4=Purchase more animals 5=Reduce mortality 6=acquire more animals by through exchange with crop produce 7=Through an upcoming project 9=Other (specify below & indicate whether this applies to cattle, sheep or goat):

If increase, for what purpose
1=Sale of animals 2=Milk for sale 3=Food security (milk or meat for home consumption) 4=Draught power 5=Breeding 6=As a way to save money (saving) 7=Insurance in case of emergency 8=Restocking 9=Financing (to finance planned expenditure) 10=manure 11=Other (specify below & indicate whether this applies to cattle, sheep or goat):

If decrease or no change, why
1=Animals have poor health 2=Not enough feed available 3=Not enough labour available 4=No services available (veterinary etc.) 5=Cannot sell animals 6=The price is too low 7=Other more profitable enterprises 8=No money to buy animals 9=No animals available for purchase 10= Other (specify below & indicate whether this applies to cattle, sheep or goat):

Under what conditions would you increase your offtake
1=Increase in herd size allowing sale of more animals 2=Market prices are high 3=Market access is good 4=Imminent drought 5=Moving to other enterprises 6=Labour shortage 7=Other (specify below & indicate whether this applies to cattle, sheep or goat):

BMZ CC HOUSEHOLD SURVEY- MODULE 3
LIVESTOCK FEEDING TECHNIQUES, MANAGEMENT, PRODUCTS, AND MARKETS

Feed improvement techniques and Management

3.1. Do you apply different feeding management for different animal categories? 1 =Yes, 2= No
3.1.1. If yes in 3.1 above, what feed or fodder resources do you use the different categories of your cattle, goats, sheep and camels? Allocate the codes of main resources per season; multiple resources per season are possible

		Early dry season	Hot dry season	Rainy season	Late rainy season
Species	Animal category	Duration: Start: End:	Duration: Start: End:	Duration: Start: End:	Duration: Start: End:
		RANGELANDS: 1=rangeland (short distance), 2=rangelands long distance, 3=crop lands (specify which crop), 4=forest areas, 5=others (SPECIFY!)			
Cattle					

Sheep					
Goat					
CROP RESIDUES: Specify					
Cattle					
Sheep					
Goat					
Camels					

	SUPPLEMENTS: 1=grain concentrates, 2=crop by-products (brans, cakes, etc)-SPECIFY, 3=salt, 4=roadside weeds (opportunistic feeds), 5=cut and carry fodders-SPECIFY, 6=hays, 7=others-SPECIFY				
Cattle					
Sheep					
Goat					
Camels					

	In which month(s) do you experience shortages of feed? For each month, ***note level of severity*** 1= none 2-moderate 3 = severe												
		Jan	Feb	Mar	Apr	May	Jun	Juy	Aug	Sep	Oct	Nov	Dec
Cattle													
sheep													
Goat													
Camels													

CODES FOR ANIMAL CATEGORIES

CATTLE	GOAT	SHEEP	CAMELS
1=lactating cow 2=Heifer 3=Breeding Bull 4=Young bull <3yrs 5=female calf 6= Male calf 7=Other (specify)	1=lactating doe 2=Kid 3=Breeding buck 4=Breeding doe 5=All 6=Other (specify)	1=lactating ewe 2=lamb 3=Breeding ram 4=Breeding ewe 5=All 6=Other (specify	1=lactating cow 2=Breeding Bull 3=Young bull <3yrs 4=young female 5=Other (specify

3.2.1 Which feed resources were present 10years ago but which are absent today?

1. 5
2 6
3 7
4 8

3.2.2 Which feed resources are present today but were absent 10 years ago?

1. 5
2 6
3 7
4 8

3.2.2. What do you think are the reasons that have caused the feed resources to appear or disappear?

3.3 Rank three most common diseases and/or parasites that affect your animals in the dry season and in the rainy season (Code).

	Cattle	Goats	Sheep
Early dry season	1 2 3	1 2 3	1 2 3
Late dry season	1 2 3	1 2 3	1 2 3
Early rainy season	1 2 3	1 2 3	1 2 3
Late rainy season	1 2 3	1 2 3	1 2 3

1=Gall sickness 2=Eye problem 3=Pulpy kidney 4=Helminthes (which) 5=Foot rot 6=Trypanosomosis 7=Tick-borne disease	8=East Coast Fever (ECF) 9=Orf/Mouth sores 10=Rabies 11=Malignant Catarrhal fever (MCF) 12= Management	13= Diarrhea 14=Round worms 15=Screw worm 16=Heart water 17=Anthrax 18=Foot and mouth (FMD) 19=Sudden	21=Tetanus 22= CBPP 24= Red water 25=Other(specify)

(which)	Diseases	death 20=Liver flukes	

3.4 What methods did you use to prevent diseases in the last 12 months (rank)?

		Diseases	Modes of prevention (code)	Treatment drugs purchased 1=yes, 2=no	Sources of inputs (code)	Cost of input (state currency)	Modes of payment (code)	Major constraints (code)
Cattle	1							
	2							
	3							
Goats	1							
	2							
	3							
Sheep	1							
	2							
	3							

MODES OF PREVENTION	SOURCES OF INPUTS	MODES OF PAYMENT	MAJOR CONSTRAINTS
0=None 1=Dipping, 2=Vaccination, 3=Deworming 4=Traditional 5=others (specify!)	0=None, 1= Veterinary Department, 2=local farmers, 3=Livestock traders, 4=Local authorities, 5=Farmer organization /association, 6=NGO/research, 7=Drug dealers, 8=Local shops, 9=Town shops, 10=Weekly markets, 11= Others (specify)	0=None 1=Cash 2=Kind/ exchange (specify)	1=Lack of knowledge, 2=Difficult to access the inputs, 3=Inputs not affordable, 4=Others (specify)

3.5 What methods did you use to treat diseases in the last 12 months (rank)?

		Diseases	Modes of treatment (code)	Purchased inputs 1=Yes, 2=No	Sources of inputs (code)	Cost of input (MT)	Modes of payment (code)	Major constraints (code)
Cattle	1							
	2							
	3							
Goats	1							
	2							
	3							
Sheep	1							
	2							
	3							

MODES OF TREATMENT	SOURCES OF INPUTS	MODES OF PAYMENT	MAJOR CONSTRAINTS
0=None 1=Conventional medicine 2=Non-conventional (coke, alcohol, petrol, washing powder) 3=Traditional (ashes, herbs..)	0=None, 1= Veterinary Department, 2=local farmers, 3=Livestock traders, 4=Local authorities, 5=Farmer organization /association, 6=NGO/research, 7=Drug dealers, 8=Local shops, 9=Town shops, 10=Weekly markets, 11= Others (specify)	0=None 1=Cash 2=Kind/ exchange (specify)	1=Lack of knowledge, 2=Difficult to access the inputs, 3=Inputs not affordable, 4=Others (specify)

3.6 Which diseases were present 10years ago but which are absent today?

1. 5
2 6
3 7

4 8

3.7 Which diseases are present today that were absent 10 years ago?

1. 5
2 6
3 7
4 8

3.8 What do you think are the reasons that have caused the diseases to appear or disappear?

3.9 What water sources did you use for your cattle, goats, sheep and camels last year? Rank

		Cattle				Goat				Sheep			
Season code (1-4)													
Water source (code)	1	…..											
	2												
	3												….
Distance to water point (Km)	1												
	2												
	3												
To whom does the water source belong	1												
	2												
	3												
What do you give to use this water source?	1												
	2												
	3												
Watering frequency (nb of times/week)	1												
	2												
	3												
Are you still using this water source 1=yes, 0=no													
If the answer is no, why	1												
	2												
	3												

WATER SOURCES	CODES FOR GIVE TO USE	WATER SOURCE OWNERSHIP CODES	REASON FOR STOPPING TO USE THE WATER SOURCE	SEASON CODES
1=Borehole 2=Dam 3=Well 4=River 5=Spring 6=Stream 7=Natural occasions 8=Constructed water points 9=Rainwater harvesting 10=Other (specify)	1=nothing 2=cash 3=animals 4=labor 5=other	1=household 2=other household 3=community 4=Other	1=asked to leave 2=water finished 3=pasture finished 4=disease 5=insecurity 6=rains fell 7=other	1= Early dry season 2= Hot dry season 3= Early rainy season 4= Late rainy season

3.10. Rank most important sources of information on livestock marketing and management in the last 12 months *(max 3)*

Sources	**Cattle**						**Goats**					
	Weather	Feeding Practices	Breeding	Market	Animal health	Other	Weather	Feeding Practices	Breeding	Market	Animal health	Other
1												
2												
3												
Sources	**Sheep**						**Camels**					

	Weather	Feeding Practices	Breeding	Market	Animal health	Other	Weather	Feeding Practices	Breeding	Market	Animal health	Other
1												
2												
3												

Information source		
0=None	6=NGO/research	12=Television
1=Veterinary department	7=Radio	13=Markets
2=Agricultural extension	8=Newspaper/magazine	14=Posters at shop
3=Local farmers	9=Local authorities	15= School
4=Livestock traders	10=Input sellers	16= Church
5=Farmer organization/association	11=Own experiment	

3.11. Identify management components in which you would invest to increase the productivity of your animals?

		Feeding	Animal health	Water	Breeding	other
Cattle	Would you invest? (√)					
	If yes, level of importance (code)					
Goats	Would you invest? (√)					
	If yes, level of importance (code)					
Sheep	Would you invest? (√)					
	If yes, level of importance (code)					
Camels	Would you invest? (√)					
	If yes, level of importance (code)					

Level of importance

1= Highly important	2=Important	3= not very important

3.12 Please fill out the following table for the livestock products (and services) produced by household last year

Product	Average quantity produced per animal	Number animals producing	Total quantity obtain per day	Qty sold (Kgs)	Qty consumed (Kgs)	Qty given away (Kgs)	Duration of prodn (Months in a yr)
Cattle							
Fresh milk							
Hide/pelt							
Manure							
Animal traction							
Insurance and Financing							
Goats							
Fresh milk							
Other milk products							
Hide/pelt							
Other							
Sheep							
Fresh milk							
Other milk							

products							
Wool							
Camels							
Fresh milk							
Other milk products							
Meat							
Hides							
Other							

3.13 For products/services sold in previous section, please fill in the following table

Product	Where sold? (use code below)	Price per kg/litre?	Transport expenses	Taxes	Form of payment (use code below)
Cattle					
Fresh milk					
Other milk products					
Hide/pelt					
manure					
Animal traction					
Other					
Goats					
Fresh milk					
Other milk products					
Hide/pelt					
Other					
Sheep					
Fresh milk					
Other milk products					
Wool					
Other					
Camels					
Fresh milk					
Other milk products					
Meat					
hides					
Other					

Where sold	**Form of payment**
1=Middleman/Trader 2= Market 3= Farm gate 4= Neighbour 5= Others specify	1= Cash 2= Credit 3= Barter 4= In kind 5= Others specify

3.14 Producer associations

	Cattle	Goat	Sheep
Are you member of a goat/sheep/cattle producer association? (√)			
If Yes, what activities is the association involved in (code)			
If No, do you see a need for establishing such			

association? (√)			
If Yes, for what purpose would you form an association? (code)			

Activities of the association	Purpose for forming a new association
1= Marketing 2=Animal health 3= Feeding 4=Breeding 5=Input purchase 6= Pass on schemes 7= Others (specify)	1= Marketing 2=Animal health 3= Feeding 4=Breeding 5=Input purchase 6= Rebuilding herds, mutual assistance in restocking 7= General management 8= Water construction 9= Housing 10= Sharing of draft animals 11= Others (specify)

BMZ CC HOUSEHOLD SURVEY- MODULE 4

Welfare outcomes: Income, Food Consumption and Health

4.1 Please provide information on what people in this household do for a living (in addition to what has been previously listed) (enumerator checks livelihood activities mentioned by household in Module 1)

Activity	livelihood activities in the last 1 year (√)	How much income generated (estimate please)	Who undertook the livelihood activities? (hh id)	Did you engage in this activity 5 years ago? (ask for all, even if not doing it now)
Rearing livestock (all species				
Cattle				
Sheep				
Goat				
Chicken				
Livestock products (meat, milk, eggs)				
Trading livestock (buying and selling)				
Renting out livestock (draft power, insemination)				
Food crop production				
Feed and fodder production				
Gardening/vegetable production				
Farm land rent or sharecropping				
Producing or gathering natural products (eg charcoal, firewood, water, thatching grass)				
Craft, carpentry, weaving, basket making, pottery, etc				

Bricks, construction				
Foods and drinks				
Transport				
Barber/hairdresser				
Musician				
Traditional healer				
Petty trade, buying and selling (except livestock)				
Cross border trade				
Formal employment				
Working on other farms				
Pensions, cash aid				
Hunting and fishing				
Other (specify)				

4.2 Income summary (based on answers given in the previous question and earlier modules)

	Amt/year ($)	Rank importance (codes: 1 very important, 2= not very important, 3= more or less important, 4= least important	Rank 5 years ago
Other resource based income like hunting, fishing, gathering			
Non Ag income (salary, wage labor)			
Remittances			
Estimated value of items received in kind (eg gifts, groceries)			
Other			

FOOD CONSUMPTION

4.3 What livestock or livestock products do you consume now, that you used not to consume 10 years ago? And why?

Product type (code)	Most important reason for change in consumption (code)

Product type		**Reason for change**	
1 = Beef	5 =bush meat	1=Higher income	5=Awareness
2 = Goat meat	6 – milk	2=Easier availability	6=Proximity to market or source point
3 = Chicken/poultry	7 = eggs	3=Lower price	
4 = pig	8= Other (specify)	4=Improved quality and safety	7=New species/products
			8=Other (specify)

4.4 Indicate which livestock or livestock products you do not consume now, that you used to consume 10 years ago? Why?

Product type (code- same as 4.1)	Most important reason for change in consumption (code)

Reason for change		
1=Cannot afford	3=Point of purchase too far away	5=Too expensive
2=Not available at purchase point	4=Bad quality	6=Others (specify)

4.5/. Is there any seasonality in the consumption of livestock products? Code [_____]

1 = Yes	0 = No

4.5.1 If yes, compare consumption of livestock products by months and the reasons

Month of the year that meat product are consumed the most			Month of the year meat products are consumed the least/none		
Meat product (code)	Month (code)	Reason for high consumption (code)	Meat product (code)	Month (code)	Reason for not consuming (code)

Product type	**Month**	**Reason for high consumption**	**Reason for low consumption**
1 = Beef 2 = Goat meat 3 = Chicken/poultry 4 = pig 5 =bush meat 6 – milk 7 = eggs 8= All 9= Other (specify)	1=Jan, 2= Feb, 3= Mar, 4= Apr, 5= May, 6= Jun, 7=Jul, 8= Aug, 9= Sep, 10= Oct, 11=Nov, 12= Dec 13= other months	1 = Festival 2 = Increased household income 3 = Lower prices 4 = Doctor's recommendation 5 = Increase in herd size 6= Increase in household size 7=Other (specify)	1 = Unaffordable 2 = Low household income 3 = Decrease in herd size 4= Decrease in household size 5 = Other (specify)

4.5.2 Where does the household get most of its food? 1=own farm, 2=own livestock,3= purchases

	Own production		Purchase / remittances			
	Quantity last 30 days	Unit	Quantity last purchased/ Received in the last 1 month	Unit	How many times per month?	Price per (kg) (0 for remittances /gifts)
Beef						
Goat meat						
Poultry						
Other meat						
Milk						
Eggs						
Rice						
Maize						
Maize flour						
Other cereals and staples						
Edible oils						
Sugar						
Salt						
Tea						
Beans, pulses,						
Roots, tubers						
Vegetables						
Fruits						
Other (specify)…..						
Other (specify)…..						

4.6. Consumption of food items in the last 30 days (We may want more detailed information for certain hh members, eg women and children < 5 years)

4.6.1 Does your family have adequate food the whole year 1=Yes, 2=No

4.6.2 How many months a year does your family have trouble getting enough food? [_____] months

HEALTH

4.7 Over the last 12 months, were any household members so sick that they could not do their daily activities?

HHID	Nature of illness (codes)	Number of days sick	Medical advise sought? (0,1=doctor, 2=traditional medicine)	Treatment obtained?	Cost of treatment?

4.8 Which month of the year was malaria particularly bad? [_____]

4.9 How many mosquito nets do you have? [_____]

BMZ CC HOUSEHOLD SURVEY - MODULE 5 - VULNERABILITY CONTEXT

5.1 Main concerns facing household

We know that households in this area are concerned about problems that could happen to them. We have made a list of concerns people commonly tell us about. I am going to read to you this list of concerns, and I would like you to tell me which of these you are afraid could affect your household in the next 1 year. If you are concerned about one that is not on the list, please tell us what it is. Once concerns have been identified, please rank them and note whether any precautionary action has been taken to prevent the problem from affecting the household.

(Enumerator, get to know what is listed in the list, then ask as an open question and tick, and afterwards rank the ones that have been mentioned. If a concern not on the list is mentioned, write it in the space after "other" in row 17

Concern	Is your household worried about this (yes, no)	Ranking	Prevention taken? (code)
Not enough pasture for animals			
Not enough water for animals			
Animal sickness / death			
Animals loss due to theft / raiding			
Insecurity / violence / fights			
Human sickness			
No buyers for animals you wish to sell			
Low prices for animals you wish to sell			
Not enough food for people			
High prices for things you buy			

Crops fail			
Loss of house/land due to natural disaster			
Loss of access to land or resources			
High input prices			
Low output prices			
Loss of off farm employment/income			
Not enough drinking water			
Water conflicts			
Others… specify			

Preventative action codes
1=reduce number of animals 2=preventive health care for animals 3 preventive health care for people 4 reduced mobility or avoiding certain areas 5= reduce investment in animals/land/house 6=save money 7 = store food 8 = make arrangements with family or friends to help 9=stop shift farming, planting more pastures, 10 = introducing irrigation, 11=increase water storage facilities

5.2 Past response to problems

For the following question, I am going to read again the list of problems faced by people in this area. But this time I would like to **ask about how these problems affected your household in the past**. During the past 10 years- , when each of these problems happened in your area, did you do **better than most** other households in this area, **worse than most** households in this area, or the **same as** other households in this area in dealing with this problem?

(Enumerator: check below the response for each type of problem)

No	Concern	Better than most	Worse than most	Same as most
1	Not enough pasture for animals			
2	Not enough water for animals			
3	Animal sickness / death			
4	Animals loss due to theft / raiding			
5	Insecurity / violence / fights			
6	Human sickness			
7	No buyers for animals you wish to sell			
8	Low prices for animals you wish to sell			
9	Not enough food for people			
10	High prices for things you buy			
11	Crops fail			
12	Loss of house/land due to natural disaster			
13	Loss of access to land or resources			
14	High input prices			
15	Low output prices			
16	Loss of off farm employment/income			
17	Not enough drinking water			
18	Water conflicts			

5.2.1 If the respondent answered **better than most** for any of the items listed in the table in question 5.2 just above, write the number of that item in the Problem Number column in the table below. Then ask the respondent **question i**).

i) You answered **better than most** when you answered the question above Can you help us understand why most other households did worse then your household in dealing with these problems?

Problem Number	**Why?**

5.2.2 If the respondent answered **worse than most** for any of the items listed in the table in question 5.2 just above, write the number of that item in the Problem Number column in the table below. Then ask the respondent **question ii**).

ii) You listed the following problems as worse than most when you answered the question above. Can you help us understand why most other households did better then your household did in dealing with these problems?

Problem Number	**Why?**

5.3. In the past 10 years did you face extreme climatic events like droughts or floods?

5.3.1 If yes, please list the events and impacts they had on your household

Event	year	Not enough feed for animals (yes/no)	Response (code)	Not enough food for people (yes/no)	Response (code)	Loss of productive asset (code)

Response to lack of feed	**Response to lack of food**	**Productive assets lost**
1=slaughter of animal	1=food from relatives or friends	1=animals
2=sell animals	2=food aid	2=land
3=death of animals	3=migration	3=agric.inputs
4=decreased productivity of animals	4=other, specify	4=other, specify
5=buy feed resources		
6=other, specify		

Appendix E: Correlation analysis of continuous explanatory variables included in the analysis of factor influencing vulnerability index

	vulner"x	d"urba"t	distan"d	d"ocal"t	d"ives"t	distan"r	distan"y	yrsspe"n	hhage	farmsize	income"k	cropva"a	number"e	income"s	cropdi"s	livest"s	number"d	income"t	herdsi"u	hhsize"t	length"s
vulnerabil"x	1																				
dist"nmarket	0.07	1																			
distanceto"d	-0.09	-0.15	1																		
dist"lmarket	-0.07	0.41	-0.04	1																	
dist"kmarket	0.02	0.44	-0.09	0.59	1																
distanceto"r	-0.08	-0.08	-0.03	-0.04	-0.03	1															
distanceto"y	0.07	0.51	-0.15	0.38	0.46	-0.08	1														
yrsspenton"n	-0.01	-0.02	0.01	0.03	0.03	0.04	-0.04	1													
hhage	-0.02	-0.05	0.01	-0.17	-0.11	-0.02	-0.03	-0.22	1												
farmsize	0.05	0.00	-0.06	0.01	0.04	-0.02	0.04	0.15	0.07	1											
incomefrom"k	-0.13	0.05	0.11	0.10	0.03	0.09	-0.02	-0.01	0.01	-0.10	1										
cropvaluep"a	-0.22	-0.16	0.36	0.00	0.03	-0.01	-0.08	0.08	-0.02	0.18	0.10	1									
numberofna"e	0.12	0.00	-0.03	-0.09	0.19	-0.09	0.03	0.01	0.05	-0.03	0.12	-0.23	1								
incomedive"s	0.12	-0.02	-0.09	-0.11	0.09	-0.11	0.06	-0.10	0.10	-0.07	-0.25	-0.29	0.53	1							
cropdivers"s	-0.18	0.05	0.11	0.40	0.14	0.10	0.01	0.09	-0.14	0.10	0.27	0.13	0.10	-0.12	1						
livestockd"s	-0.04	-0.02	0.05	0.04	0.03	0.07	0.03	0.02	0.15	0.13	0.09	0.13	0.02	0.05	0.07	1					
numberofco"d	-0.02	0.01	0.02	0.16	-0.05	-0.02	-0.08	0.03	0.03	0.04	0.18	0.09	-0.19	-0.02	0.18	0.20	1				
incomepera"t	0.03	-0.05	-0.05	-0.04	-0.02	-0.02	-0.06	0.05	-0.07	0.07	0.06	-0.08	0.19	0.14	0.10	-0.03	0.06	1			
herdsizein"u	0.10	-0.06	0.02	0.04	-0.08	-0.05	-0.06	0.08	0.18	0.13	0.08	-0.01	-0.09	-0.10	-0.03	0.20	0.13	0.06	1		
hhsizeadul"t	0.02	0.08	-0.09	-0.01	-0.11	-0.08	0.02	0.07	0.20	0.15	-0.05	-0.08	-0.07	0.00	-0.01	0.12	0.00	-0.08	0.16	1	
lengthofil"s	0.07	-0.05	-0.05	-0.03	-0.03	-0.03	0.02	0.01	-0.02	0.00	-0.04	-0.03	-0.03	0.00	-0.03	-0.07	0.07	-0.04	0.09	0.14	1

Appendix F: Variance Inflation Factor (VIF) test for multicollinearity among variables included in the analysis of factor influencing the coping strategies

Variable	VIF	1/VIF		Variable	VIF	1/VIF
dist~lmarket	2.84	0.35		Hhage	1.40	0.71
numberofna~e	2.29	0.44		hhsizeadul~t	1.39	0.72
dist~kmarket	2.29	0.44		hhfoodaidn~e	1.35	0.74
incomedive~s	2.09	0.48		yrsspenton~n	1.32	0.76
distanceto~y	1.90	0.53		livestockd~s	1.31	0.77
dist~nmarket	1.76	0.57		accesstora~r	1.30	0.77
cropdivers~s	1.69	0.59		herdsizein~u	1.29	0.78
dailyavail~r	1.59	0.63		hhdepenenc~o	1.28	0.78
cropvaluep~a	1.58	0.63		hhgenderd~0f	1.24	0.81
orgcommuni~e	1.50	0.67		Farmsize	1.20	0.83
distanceto~d	1.49	0.67		emergencyd~e	1.18	0.84
savingsdum~e	1.46	0.68		incomepera~t	1.17	0.85
seekcashlo~e	1.45	0.69		grouppatic~r	1.15	0.87
accesstow~10	1.45	0.69		distanceto~r	1.11	0.90
incomefrom~k	1.44	0.70		lengthofil~s	1.10	0.91
numberofco~d	1.41	0.71		Mean VIF	1.52	

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