Planning and costing agricultural adaptation to climate change in the small-scale maize production system of Malawi

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Acronyms and abbreviations

ADC	Area development committee
ADD	Agricultural Development Division
ADMARC	Agricultural Development and Marketing Corporation
ASWAp	Agriculture Sector Wide Approach
CAADP	Comprehensive African Agricultural Development Programme
CABS	Common approach to budgetary support
CADECOM	Catholic Development Commission in Malawi
CGIAR	Consultative Group on International Agricultural Research
DADO	District agricultural development officer
DCCMS	Department of Climate Change and Meteorological Services
DDP	District development plan
DFID	Department for International Development, UK
DoDMA	Department of Disaster Management Affairs
DRR	Disaster risk reduction
EAD	Environmental Affairs Department
EAM	Evangelical Association of Malawi
EDO	Environmental development officer
EIP	Environmental Investment Programme
ELDS	Evangelical Lutheran Development Service
EMA	The *Environmental Management Act* (1996)
EPA	Extension planning area
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
FGD	Focus group discussion
FISP	Farm Input Subsidy Programme
GBI	Green Belt Initiative
GCAP	Global Call to Action Against Poverty
GCM	Global circulation model
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gas
GoM	Government of Malawi
ICRAF	International Centre for Research in Agroforestry
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IFAD	International Fund for Agricultural Development
IIED	International Institute for Environment and Development, UK
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency

LDF	Local development fund
MASAF	Malawi Social Action Fund
MDG	Millennium Development Goals
MDPC	Ministry of Development Planning and Cooperation
MGDS	*Malawi Growth and Development Strategy* (2006)
MoAFS	Ministry of Agriculture and Food Security
MoNREE	Ministry of Natural Resources, Energy and Environment
MPRS	Malawi Poverty Reduction Strategy
MPRSP	*Malawi Poverty Reduction Strategy Paper* (2002)
MTEF	Medium Term Expenditure Framework
NAMAs	Nationally appropriate mitigation actions
NAPA	*Malawi National Adaptation Programmes for Action (NAPA)* (2006)
NAPF	National *Agricultural Policy Framework* (2006)
NASFAM	National Smallholder Farmers Association of Malawi
NCE	National Council on the Environment
NDPRC	National Disaster Preparedness and Relief Committee
NEAP	The *National Environmental Action Plan* (1994)
NEP	The *National Environmental Policy* (1996)
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organisation
NORAD	Norwegian Agency for Development Cooperation
NPO	Not-for-profit organisation
NSA	Non-state actors
NSO	National Statistics Office
ODA	Overseas development assistance
PRSP	Poverty reduction strategy paper
RDP	Rural Development Programme
SEI	Stockholm Environment Institute
SEP	Socioeconomic profile
SOMD	Self Organising Map-based Downscaling
TCE	Technical Committee on the Environment
UN/ISDR	UN International Strategy for Disaster Reduction Secretariat
UNCED	United Nations Conference on Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations International Children's Fund
USAID	United States Agency for International Development
VDC	Village development committee
WB	World Bank

Executive summary

Malawi has recently experienced an increased incidence of climate change-related hazards. More droughts and floods have occurred in the last decade (2000 - 2010) than in the past three decades before (1970 - 2000). Agriculture is one of the most vulnerable sectors and consequently has suffered from the negative impacts of climate change. As a result, communities, NGOs and the government of Malawi are adapting (adjusting to continue deriving benefits) to the changing conditions in order for Malawian farmers and their families to survive, since their livelihoods are dependent on agriculture.

This adaptation is inevitable and will add a cost to the national economy and households. To successfully calculate this there is a need for proper planning and costing of adaptation strategies at household, community and national level. Currently, the exact costs of adaptation are not yet known hence this study was undertaken to investigate what adaptation measures are currently available in the maize subsector in Chikhwawa District in the Lower Shire Valley of Malawi and how much it will cost at household, community and national level to continue to carry out such activities. The calculation is based on climate projections that are likely to happen in Chikhwawa in the next 50 years.

The study revealed that communities are already coping with climate change through a number of strategies including: use of early and drought-resistant varieties, irrigation systems, selling of assets, winter cropping and diversification. Regarding climate projections, it is expected that the temperatures in Chikhwawa will increase by 3^{o}C by 2065, which will translate into having more days in a month with a mean temperature of above 32^{0}C. It is also expected that drier conditions will prevail in the future (2046 - 2065).

In terms of costs, Chikhwawa will require about US$55,034,932 (over five years) in the maize subsector to adapt to climate change. The results of the study suggest that communities and government should start planning for the subsector bearing in mind the likely scenarios. The study recommends that research into drought-resistant varieties, investment in extension and training, as well as investment in irrigation should be undertaken.

1. Introduction

Due to climate change and extreme weather, Malawi is exposed to various types of natural hazards, which have occurred with increasing frequency in the recent past and sometimes have resulted in serious disasters leading to severe food insecurity, and loss of lives and property. In developing countries like Malawi, risks are higher in agriculture, fisheries and other components that constitute the livelihoods of rural populations (Adger *et al.* 2003). An IPCC report puts the increase in global temperature at 0.13 degrees per decade on average from 1906 - 2005 (IPCC 2007). This increase in temperature has been most rapid in the summer, leading to a late onset of rains and dry spells during the rainy season. This has affected agricultural productivity as frequent droughts have led to crop failure and hence food insecurity and loss of income. On the other hand it has been observed in Malawi that the intensity of rains has increased, mainly in February and March, leading to floods and damage to established crop fields. Such hazards have induced responsive measures undertaken by the farmers, government, and NGOs in order to reduce the negative consequences of food insecurity and loss of income. However, to implement such responsive measures, extra costs on top of the normal practices are incurred and planning for this at both local and nation level is urgently required.

Photograph 1: Maize field under irrigation in Chikhwawa (photo taken by George Matiya).

To estimate these costs and plans for adaptation to climate change, evidence-based research was carried out in Malawi, specifically looking at maize-based agricultural systems. This study, which is part of a wider project led by the International Institute for Environment and Development (IIED), was conducted by Bunda College of Agriculture of the University of Malawi. Similar studies were undertaken in Tanzania, Rwanda, Nepal and Bangladesh. In Malawi the study was conducted to assess the cost and how to plan for adaptation to climate change in maize-based farming systems in Malawi. Chikhwawa District was used as an illustration of this type of agriculture system. This study revealed a number of coping strategies already being implemented at the local household level that were initiated by the climate change hazards of drought and floods. It also projected the rainfall and temperature patterns for the years 2046 - 2065.

2. Background

2.1 Climate change and agriculture

In Malawi, agriculture plays a significant role in the social and economic development of the country. It contributes about 39 per cent to the gross domestic product (GDP) while up to 90 per cent of the labour force is employed in agriculture and related sectors (GoM 2009). Besides, global food production needs to increase to meet the food requirements of an increasing population, which is estimated to rise to about nine billion people by 2050. Agriculture is directly affected by climate change and also contributes significantly to greenhouse gas emissions. Food security is at stake, especially in the developing world where economies and livelihoods are directly linked to agriculture. Different global and national policy processes and funding mechanisms are being pursued to develop strategies for ensuring a sustainable agricultural production in the face of climate change. The Department for International Development (DFID) research programme on climate change, agriculture and food security will provide the knowledge to guide decisions effectively for making agriculture a significant part of the post-2012 climate change agreements. It will also provide guidance on how to align and integrate agricultural mitigation and adaptation measures into national plans to ensure the cost effectiveness of implementing agricultural development and mitigation programmes.

In order to increase food production for an increasing global population, new agricultural development and adaptation measures need to be explored. Agricultural development is also often cited by Malawi's national development plans and poverty reduction strategies as a key strategy for delivering their development visions and goals. The risks posed by climate change have to be taken into account in these strategies through adaptation. At the same time, following a low carbon development path contributes to both the global goal of climate change mitigation as well as developing countries' avoidance of being locked in carbon-intensive technologies. A significant potential for well-designed agricultural programmes to deliver both adaptation and mitigation benefits has also been recognized. While each of these goals (adaptation, mitigation and agricultural development in general) has to be addressed, the exact terms and costs of implementing them are unknown and have not been quantified yet.

National sectoral plans, such as the *Malawi Poverty Reduction Strategy Paper* (MPRSP), the national development plans – which used to be called the *Statement of Development Policies* (DEVPOL) – and the Agriculture Sector Wide Approach programme (ASWAp), have been some of the frameworks supporting agricultural development and the routes through which investments from overseas development assistance (ODA) have been channelled into the sector. Adaptation and mitigation policies for agriculture in developing countries are being pursued through different channels, such as the *Malawi National Adaptation Programmes for Action (NAPA)* (EAD 2006) and nationally appropriate mitigation actions (NAMAs).

If agriculture becomes part of the climate change framework, implementation and funding frameworks need to be developed both at the national and local level to address critical issues both at policy and community level. However, the risk of disconnection between the different frameworks that address agricultural development at the global and national policy and programming levels may emerge. In Malawi, climate change has not been mainstreamed in the national budget and existing programmes related to climate change are not well coordinated. The climate change debate especially is not well connected to the agricultural policy debate. A post-2012 climate change agreement that addresses agriculture effectively needs to consider the potential synergies and trade-offs between them.

This specific research project on costing and planning agriculture's adaptation to climate change will provide guidance on the best options for developing countries to adapt their agricultural systems to climate change. It will contribute to the overall goal of providing guidance on how developing countries can best adapt their agricultural systems to climate change by focussing on the following areas:

1. The real costs of agricultural adaptation in developing countries.
2. The potential of adaptation options and their costs.
3. The options for implementing and financing adaptation, mitigation and agricultural development plans given their current separation.

The key issues that emerge from these questions include:

- The potential for generating win-win outcomes with respect to adaptation and mitigation through synergising funding from various sources.
- The cost-effective and efficient development of the agricultural sector in developing countries.
- A global climate change agreement that recognises and fosters a mainstreamed approach to agricultural adaptation in developing countries.

This country case study was part of a wider project in which the International Institute for Environment and Development (IIED) is leading a consortium of organisations and researchers to address these issues through evidence-based research on agricultural development, adaptation policy and practice. This research is underpinned by case study research that illustrates the practical realities of these issues in five selected developing countries. These countries are Bangladesh, Tanzania, Malawi, Nepal, and Rwanda. Each country case study will provide a unique agricultural system analysis that forms the basis for understanding the nature of agricultural development and climate change adaptation from an economics perspective. The case studies will jointly contribute to a better understanding of agricultural adaptation that can inform national and global policy processes. By focusing on a single agricultural system in each country, we are assuming that the diverse agricultural systems persisting in developing countries are represented by a blanket approach.

3. Objectives and methodology of the study

To facilitate country case study research, researchers in the case study countries spearheaded local research that fed into the global project. The main objective was to undertake a country-specific analysis of agricultural development and climate change adaptation at the national level and in specific sites for a selected agricultural system. For Malawi the case study was undertaken for the maize subsector in Chikhwawa District.

3.1 Methodology

The study in Malawi is part of a larger global study that includes different cases and also takes into account multiple governance levels. At the country level, Chikwawa district was selected as a case to be studied because of the fact that it is one of the districts that experiences both droughts and floods. Although Chikwawa is a dry area that frequently experiences droughts and/or dry spells, it also experiences floods because of the Shire River, which passes through the district and swells during the rainy season because of heavy rains that fall in the highlands. The Thyolo Mountains on the east bank of the river have been heavily deforested, which has left parts of Chikwawa district, such as the Livunzu Extension Planning Area (EPA), prone to flash floods along the many small rivers that run from the Thyolo Mountains feeding into the Shire River and then also the subsequent swelling of the Shire River. Details on the climate for Chikwawa are further discussed in Chapter 6.

3.1.1 Data collection

The study used both primary and secondary data. The secondary data collection involved desk research, reviewing and analysing the country's agricultural sector policies, climate change-related policies and national development planning policies, and examining their strengths and weaknesses as far as the agricultural sector's planning and costing for adaptation to climate change were concerned. The review also included the sources and levels of available financial support for the agricultural sector.

Primary data was collected through focus group discussions (FGDs) and individual interviews. The FGDs were conducted in four villages, with both male and female farmers. A checklist, comprising pertinent study issues, was used to guide the researchers in their communication with the farmers. The discussions were open-ended and farmers were free to express themselves in a participatory manner. The researchers were mainly guided by the farmers to come to an understanding of their farming calendar, the problems they face in production, and the stakeholders that they interact with in their livelihoods. The farmers were also given the opportunity to discuss the adaptation options that they would take when faced with climate change impacts.

A sample of 250 farmers was also involved in the study through individually conducted household questionnaires. The questionnaire asked what the livelihoods activities of the farmers and their adaptation options in the face of climate change are. The questionnaire also addressed issues of how much it would cost them to adopt a particular action in response to climate change in their agricultural activities and their livelihoods in general.

3.1.2 Data analysis

The data collected from FGDs were largely qualitative, and were analysed based on the themes that were coming out in relation to the objectives of the study. The data from the questionnaires were largely quantitative and were analysed following the methodology that was developed by the project partners in consultation with country researchers:

- Adaptation pathways.
- Key stakeholders.
- Costing of adaptation and the roles and inputs of various stakeholders.
- Assessing potential mitigation co-benefits from adaptation.

3.2 Role of agriculture in Malawi

Agriculture is not only the backbone of Malawi's economy but also an essential part of its social fabric. Agriculture is synonymous to livelihood security in Malawi. The sector contributes about 39 per cent to GDP, 87 per cent to total employment, supplies more than 65 per cent of the manufacturing sector's raw materials, and provides 64 per cent of the total income of rural people and more than 90 per cent of foreign exchange earnings.

It is therefore very apparent that good performance of the economy is directly linked to the performance of the agricultural sector. Agricultural growth accelerated from around four per cent in 2004/05 to around 14 per cent in 2006/07, and to around 13 per cent in 2008/09. Within the same period the economy grew by 8.6 per cent in 2007, 9.7 per cent in 2008 and 7.6 per cent in 2009. The availability of food crops from increased agricultural production has contributed to the inflation drop from 22 per cent in 2006 to 7.6 per cent in 2009/10.

Over 85 per cent of Malawi's 13.4 million people live in rural areas and derive their livelihood from agriculture. Agriculture activities currently occupy about 56 per cent of the land area, covering 5.3 million hectares of the country's 9.4 million hectares (DAES 2000). This further demonstrates that agriculture plays a significant role in contributing to food security and income.

Agriculture is one of the six sectors for pro-poor growth in the Malawi Poverty Reduction Strategy (MPRS). Since the economy of Malawi is agro-based, a lot of emphasis has been placed on agriculture as the engine for development. The Ministry of Agriculture and Food Security was created to oversee the development of the agricultural sector in Malawi. The ministry has offices in all districts of Malawi.

3.3 Climate change adaptation initiatives

The *Malawi National Adaptation Programmes for Action (NAPA)* (EAD 2006) was developed in 2006 and launched in 2008. The threat posed by extreme climate change events to food security, health, water and energy has been the major driving force behind the development of the country's NAPA, which serves as a simplified and direct communication channel for information relating to urgent and immediate adaptation needs in Malawi.

The following areas were identified as climate-related hazards specific to agriculture: flooding, droughts, low flows, windstorms, intense rainfall, dry/cold spells, heatwaves, thunderstorms, hailstorms and mudslides. The main human vulnerabilities and livelihood impacts are:

- Reduced agricultural production.
- Water shortage and/or groundwater depletion.
- Increased disease and/or other health problems.
- Food insecurity.
- Water pollution.
- Displacement of people.

Thirty-one adaptation options were identified from eight different areas (agriculture, water, health, energy, fisheries, wildlife, forestry and gender). Of these, 15 prioritised adaptation options were selected. Five areas requiring immediate actions include:

1. Improving community resilience to climate change through the development of sustainable rural livelihoods.
2. Restoring forests in the upper and lower Shire River to reduce siltation and associated water flow problems that affect hydro-power generation.
3. Improving agricultural production under erratic rains and changing climatic conditions.
4. Improving Malawi's preparedness to cope with droughts and floods.
5. Improving climate monitoring to enhance Malawi's early warning capability and decision making.

In order to implement the NAPA, US$22.43 million will be required. Apart from the funds, relevant skills in research, drought control, weather forecasting and effective extension system would be required.

Currently a number of projects are being implemented to address climate change issues. The UNDP, DFID, Irish Aid, the FAO and the EU are among the donor partners that are supporting projects in climate change adaptation and mitigation. Action Aid, Church Aid, Concern Universal, Oxfam, Goal Malawi, CURE and World Vision Malawi are some of the NGOs that are implementing development programmes that address climate change issues.

4. The agricultural system in Malawi

4.1 Agricultural sector development

The agricultural sector of Malawi is dualistic, consisting of small-scale farmers and estate subsectors. The subsectors have been historically distinguished on the basis of legal and constitutional rules regulating land tenure; type of crops; and marketing arrangements. The smallholder subsector contributes more than 70 per cent to agricultural GDP (GoM 2005), is based on the customary land tenure system, and is primarily subsistence. The estate subsector comprises 14,700 estates occupying 850,000 hectares of leased land. Over 70 per cent of the cultivated area in Malawi is under the customary land tenure system and is utilised by 1.2 million smallholder farming families, with land holdings ranging from 0.5 to 2.5 hectares (DARS 1995). Rural livelihoods in Malawi, for all wealth groups ranging from the poorest of the poor to the richest, depend to a significant degree on production and direct consumption of crops and livestock. Many households, including the poor, also derive incomes from growing and selling of cash and food crops. Poor rural households in Malawi obtain 30 - 40 per cent of their income from 'off own farm' activities (Kydd *et al.* 2004).

Small-scale farmers make up the majority of agricultural producers in Malawi. Their production is a vital aspect for ensuring food security in a region where the formal sector and formal markets only provide for a certain proportion of the population. Although smallholders produce for their own consumption and for local markets, most remain poor and vulnerable to food insecurity. Most of the agricultural development initiatives have emphasised enabling small producers in southern Africa to increase their productivity in order to supply food to local markets and on 'removing barriers' to market access, primarily through providing information about marketing opportunities. This shift in policy focus coincides with widespread international recognition that investment in agriculture, specifically small-scale farming, is an important and much-neglected development strategy (World Bank 2008).

The aggregate agricultural growth during the period 1970 - 2005 was 4.35 per cent per annum. Much lower growth rates were registered in the 1980s and in the 2000 - 2005 periods (Table 1), though. Recent figures show that agricultural output grew by just 2.16 per cent per year between 2000 and 2005, much lower than in the 1970s when the average annual growth rate was 5.35 per cent.[1] The growth rates in GDP per capita and agricultural GDP per capita were generally negative during the 1980s and early 1990s, with some improvements in the late 1990s. The late 1990s actually registered higher growth rates in GDP per capita and agricultural GDP per capita than during the 1970s. The high growth rate in agricultural GDP in the 1995 - 1999 period is probably an anomaly and can be partly attributed to a reported but probably overstated estimate of the increase in production of root crops for home consumption such as cassava and sweet potatoes.

[1] The impressive growth rates in the 1970s were achieved through a very narrowly-based policy environment. The lower growth rates today reflect the drag inflicted on the economy by the increasing poverty consequent upon those earlier policies.

Table 1: Trends growth (%) in the agricultural sector output, 1970 - 2009 (Source: Chirwa *et al*. 2009, updated using data from Annual Economic reports, IMF, and ReSAKSS-SA).

Indicator	1970-79	1980-84	1985-89	1990-94	1995-99	2000-05	2006-09
Gross domestic product	5.9	1	3.03	0.61	6.4	1.55	7.28
Agricultural GDP	5.35	0.36	1.28	2.15	15.06	2.16	3.63
GDP per capita	2.4	-2.08	-0.2	-2.66	3.17	-0.28	13.63
Agricultural GDP per capita	1.9	-2.7	-1.89	-1.19	11.55	0.36	4.99

The smallholder agricultural sector had poorer growth rates compared to the estate sector, with a decline of 1.8 per cent per annum between 2000 and 2005 – these were the years when financial support for farm inputs was withdrawn. From 2006 - 2009, Malawi has experienced positive agricultural growth (9.23 per cent per annum) largely due to the successful implementation of the Farm Input Subsidy Programme (FISP) and favourable weather patterns in the period.

The renewed emphasis on agriculture has transformed Malawi from a net importer to a net exporter of maize and allowed the majority of households to attain food security since 2005/06. It has also led to low and stable maize prices – very important in a country where the majority of households are net consumers and where food accounts for over 60 per cent of household income.

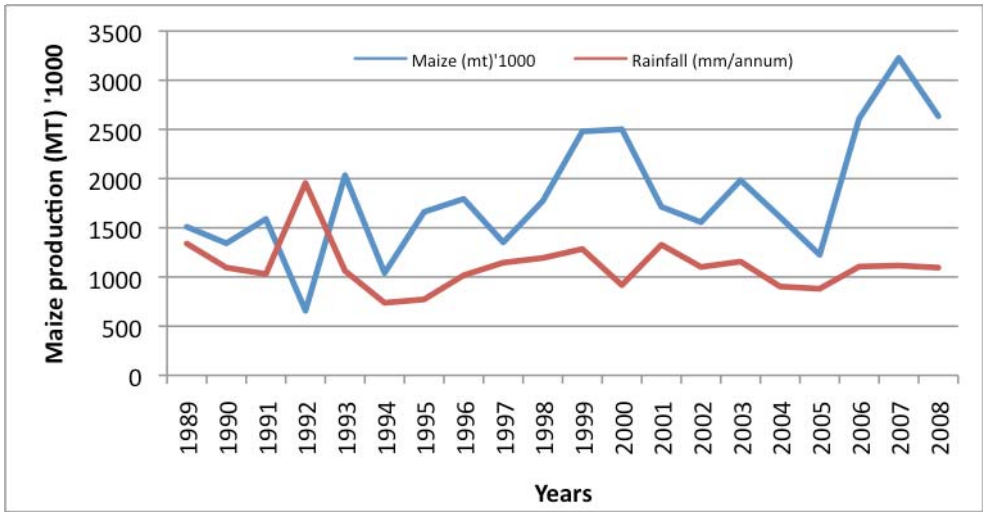
The estate sector primarily produces cash crops such as barley, tobacco, sugar, coffee, tea and tree nuts (e.g., macadamia and cashew). The three main cash crops – tobacco, sugar and tea account for about 80 per cent of total exports. Tobacco alone contributes as much as 70 per cent to Malawi's foreign exchange.

4.2 The maize subsector

Maize, as the staple food, is the most important crop to the Malawian population and occupies about 68 per cent of the total land for crops (Chirwa 2006). The subsistence maize production is characterised by small land holding sizes (0.5 - 0.8ha), continuous cultivation of maize on the same land without fertilizing inputs, low productivity (which will get worse with the effects of climate change), high dependence on rainfall, and poor backward linkages in terms of uncoordinated input supply and limited access to technologies, extension services and credit.

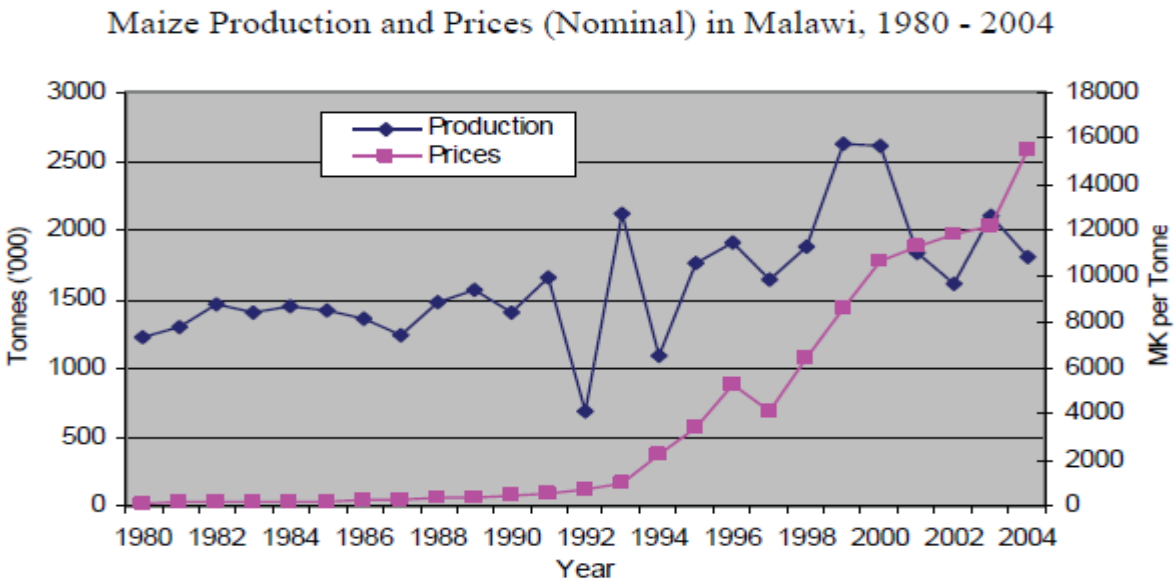
In Malawi, the production of maize is around 3 million MT, most of which is produced by smallholder farmers (Figure 1).

Figure 1: Maize production 1989 - 2008 (Source: FAOSTAT data).



In terms of prices, it can be noted that maize prices increased over the years while production has been fluctuating (Figure 2).

Figure 2: Maize production and prices (Source: Chirwa 2006).

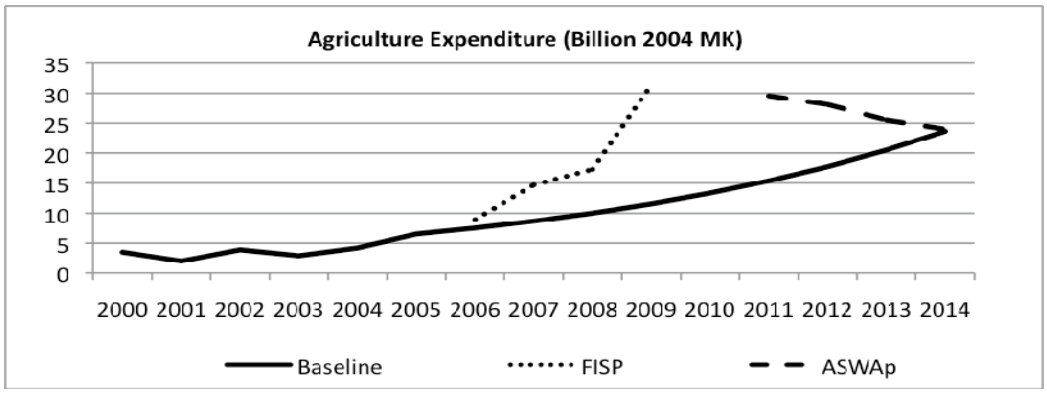


Subsistence is the main objective of the subsystem while production surplus is sold. Being a staple food for Malawi, maize is grown in all districts. The subsystem is prone to adverse impacts of climate change because it depends mainly on rainfed agriculture. Intercropping as a way of spreading risk is practised by many farmers.

4.3 Agriculture expenditures (values, growth rate, and shares)

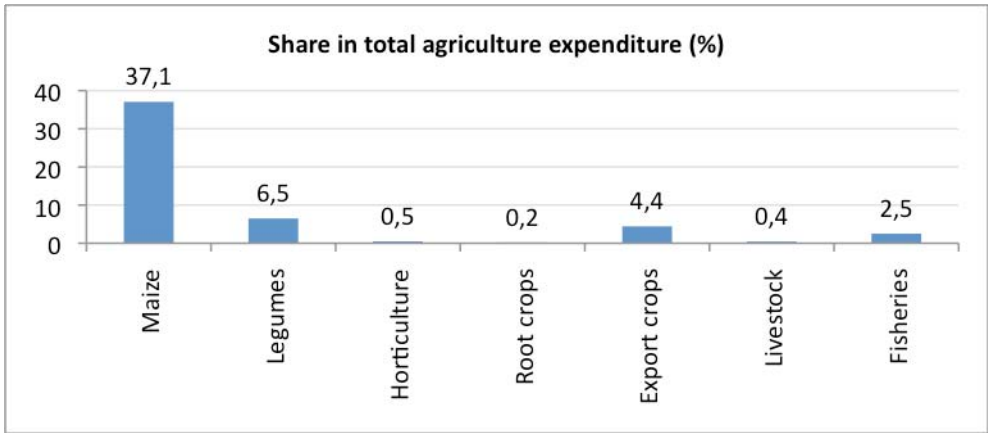
In terms of expenditure in agriculture (according to ASWAp) it can be noted that FISP, which mainly targets maize, accounts for more than 30 per cent of the budget (Figure 3).

Figure 3: Agricultural expenditure from 2000 - 2014 (Source: GoM 2010).



Within the agricultural sector, 37.1 per cent of the total expenditure is allocated to the maize subsector representing the largest proportion for one subsector (Figure 4). This demonstrates the importance the government is placing on maize production.

Figure 4: Share of maize in total agricultural expenditure (Chirwa *et al.* 2009)



It must be noted that apart from the export crops, maize is the highest agricultural GDP contributor with 25.1 per cent (Chirwa 2006). This is because over the last seven years maize productivity has increased due to the provision of inputs and favourable weather conditions (Table 2).

Table 2: Maize production in Malawi 2004 - 2007 (Masanganise 2009)

Year	Production (MT)	% change from 2004/05	Yield (MT/ha)
2004/05	1,225,234.00		0.81
2005/06	2,611,486.00	113%	1.61
2006/07	3,226,418.00	163%	2.65
2007/08	2,777,438.00	127%	1.69

5. Development policies related to agriculture and climate change

Malawi has pursued an agriculture-led development strategy since its independence in 1964. This strategy was based on the promotion of a dual agricultural system comprising estate (large-scale) production mainly for cash (export) crops and smallholder agricultural production – mainly to support the population's food security (Chirwa 2004). In the early years of independence, government policy was biased towards estate-led agricultural development. Nonetheless, smallholder agriculture remained an important source of livelihoods for a majority of the rural population (World Bank 2003). Various policies in the 1960s and 1970s were implemented to support smallholder agricultural development including guaranteed product prices through the state marketing agency, government administered agricultural input credit, promotion of technologies, and subsidies for key agricultural inputs.

The development planning that followed until 1996 was conducted in 10-year cycles, with the last one being the *Statement of Development Policies 1987 – 1996* (GoM 1987). This development policy document outlined the policies and strategies that will be pursued by the government in all sectors including agriculture. It allocated the roles that will be played by the state in terms of service provision (such as agricultural extension) and also the role of the Agricultural Development and Marketing Corporation (ADMARC) – in terms of purchasing products from farmers. For other crops like coffee and tobacco, the services of extension and marketing were provided by the private sector; however the smallholder sector was serviced by governmental agents. The document did not address climate change because it was not yet on the country's agenda at that time.

More recently, there are new developmental instruments such as the *Vision 2020* document, the 2002 *Malawi Poverty Reduction Strategy Paper* (MPRSP), and the 2006 *Malawi Growth and Development Strategy* (MGDS), among others, that have been developed to guide the nation in its development agenda. There have also been several policies that were developed to specifically address agriculture-related issues, as well as policies and frameworks developed to deal with climate change-related issues. Additionally, attempts were undertaken by the government and other stakeholders to incorporate issues of climate change in various sectoral policies.

This chapter will analyse the instruments in terms of how national development, agricultural development, and climate change adaptation issues are addressed. For this purpose, the various roles played by the interested actors were identified as well as how they complement, or could complement, each other. The policies have been grouped into three areas: national planning and development, agricultural planning and development, as well as climate change mitigation and adaptation.

5.1 National planning and development

5.1.1 The Malawi *Vision 2020* document (2000)

The *Vision 2020* document sets up the roadmap to move Malawi towards becoming a middle-income country by the year 2020. All the current development policies and agendas for Malawi revolve around the *Vision 2020* document. *Vision 2020* represents a move from the ten-year national development planning cycle to a 20-year cycle. The vision states that:

> 'By the year 2020, Malawi as a God-fearing nation, will be secure, democratically mature, environmentally sustainable, self-reliant with equal opportunities for and active participation by all, having social services, vibrant cultural and religious values and a technologically driven middle-income country.'

Vision 2020 addresses agricultural development as one way for ensuring sustainable economic growth and development, as well as food security and nutrition. To achieve this, agricultural finance through the provision of credit, as well as technology development and transfer, have to be extended.

Vision 2020 also addresses climate change under a section on natural resource and environmental management, albeit considering the problem of climate change as 'a very small concern in Malawi' at that time. Because it was therefore mostly neglected, *Vision 2020* does not contain climate change details or long-term approaches to climate change adaptation and mitigation. The section referring to disaster management does not link climate change to these events. The *Vision 2020* document identified the need for a disaster management plan, which Malawi did not have at that time.

5.1.2 The *Malawi Poverty Reduction Strategy Paper* (2002)

In Malawi, the Poverty Reduction Strategy Paper (PRSP) process was embraced as an instrument for participatory policy making and integrating poverty issues into national development plans (Jenkins and Tsoka 2003). The philosophy of the Malawi Poverty Reduction Strategy (MPRS) was: 'Sustainable poverty reduction through socio-economic and political empowerment of the poor.'

The MPRS moves away from seeing the poor as helpless victims of poverty in need of hand-outs and as passive recipients of trickle-down growth. Instead, the poor are regarded as masters of their own destinies. Government's and development partners' role is to create the conditions whereby the poor can reduce their own poverty (MEPD 2002*).* Through the major goal of promoting good governance, the MPRS connects issues of participation, decentralisation and empowerment by stating that decentralisation focuses on the empowerment of people for effective popular participation and decision making in the development process in their respective areas, and it includes activities that are aimed at developing institutional capacities for local governance, transferring functions to local governments, and revising institutional frameworks across government to ensure consistency with decentralisation (MEPD 2002). The *Malawi Poverty Reduction Strategy Paper* (MPRSP) was to be implemented in the context of decentralisation whereby functions and responsibilities would be devolved to the districts, as evidence of the fundamental change in the way the state would relate to its citizens. Through the MPRS, local governments would be more active than central government, whose role will be reduced to that of policy making, setting standards and regulations, and co-ordination (MEPD 2002).

The agricultural sector was singled out in the MPRSP as the most important sector that can deliver pro-poor growth (Chirwa 2004). The MPRS became the overarching medium-term strategy of the government for reducing poverty in the country and was built around four strategic pillars, namely: sustainable pro-poor growth; human capital development; improving the quality of life of the most vulnerable; and governance. In addition, it had four key cross-cutting issues – HIV/AIDs, gender, the environment, and science/technology. The implementation period for the MPRS was three years and it came to an end in the fiscal year 2004/05.

In the second half of 2005, the MPRS was reviewed to draw lessons from its implementation. These lessons were summarised in a report and its findings informed the strategic direction of the 2006 *Malawi Growth and Development* strategy (MGDS) document. The achievement of the MPRS was the decline in poverty levels from 54.1 per cent to 52.4 per cent. Also important was the fact that ministries and departments tried to implement their activities in line with the MPRS framework. However, there were some short falls that hampered the implementation process. These included failures by ministries and

departments to translate the activities into the budget and Medium Term Expenditure Framework (MTEF), slow implementation of the devolution process, and that funding was not based on the pillars.

5.1.3 The *Malawi Growth and Development* strategy document (2006)

The *Malawi Growth and Development* strategy (MGDS) document is the government's current overarching medium-term strategy (2006/07 - 2010/2011) to attain the nation's *Vision 2020* objectives. The overall objective of the MGDS is to reduce poverty through sustained economic growth and infrastructure development. This is expected to transform the country from being a predominantly importing and consuming economy to a primarily producing and exporting economy. The MGDS is, in effect, the country's version of the Millennium Development Goals (MDGs).
The MGDS represents a policy shift from social consumption to sustainable economic growth and infrastructure development and outlines five broad themes: sustainable economic growth; social protection; social development; infrastructure development; and improving governance. From these broad themes, six key priority areas have been identified as follows: a) agriculture and food security; b) irrigation and water development; c) transport infrastructure development; d) energy generation and supply; e) integrated rural development; and f) prevention and management of nutrition disorders and HIV/AIDs. These six key priority areas are expected to accelerate the attainment of the MDGs in the areas of health, education, gender, the environment, and governance.

The emphasis in agriculture is on increasing the contribution of the agricultural sector to economic growth through production of food crops and value-added agricultural products for domestic and export markets. The MGDS aims at increasing agricultural productivity and food varieties by:

1. Increasing value addition to agricultural products by smallholder farmers and orienting smallholder farmers to greater commercialisation.
2. Strengthening the linkages of farmers to markets through infrastructure development.
3. Enhancing irrigation and water development.

It is evident that food production and income generation from agricultural activities are key in achieving food security through own production and/or incomes realized from sales of agricultural outputs. Such agricultural activities need to ensure that natural resources are used in a sustainable manner.

Through the MGDS, the Malawi government resumed using input price policies to stimulate maize and tobacco production for food and income, respectively. At the start of the 2005 - 06 agricultural seasons, Malawi reintroduced large-scale input subsidies for maize and tobacco via the FISP. The provision of input subsidies to farmers had been halted in the late 1980s in response to the IMF/WB recommendations for reduced state interventions and budgetary stabilisation.

Though the MGDS does not specifically refer to climate change issues, theme two relates to social protection and thus disaster risk management, and it outlines the government's response to protecting vulnerable groups from negative impacts as well as disasters. It is recognised that Malawi is increasingly affected by natural disasters but officially they are not yet linked to climate change, hence climate issues are not prioritised in this development plan.

5.2 Agricultural planning and development

Over the years, Malawi has developed several policies and frameworks specifically related to agricultural development. By focusing on its economic importance the national development policies discussed above do not go into the details of agricultural development but the agricultural sector policies do so instead. In developing its agricultural policies, the government is aware of its international obligations and has made the effort to harmonise its agricultural policies and programmes with the Comprehensive African Agricultural Development Programme (CAADP) of 2010, which is part of the New Partnership for Africa's Development (NEPAD) programme. The CAADP is a strategy to put African agriculture on the path of strong and sustained growth. The principles of CAADP include achieving an agricultural growth rate of six per cent and allocating at least ten per cent of budgetary resources to the agricultural sector. Therefore, the policy documents and strategies that are currently in use do reflect this obligation by aligning regional and international requirements.

5.2.1 The national *Agricultural Policy Framework* (2006)

By the year 2006, the government had more than ten policies and frameworks in the agricultural sector alone. These dealt, *inter alia,* with issues of extension provision (2000), seeds (2003), crops and livestock (2004), and economic development and food security (in, for instance, the *New Era in Agricultural Policy* document of 2005). All these separate policy documents were supposed to guide Malawi's agricultural development. In 2006, the government reviewed then the various existing national and agricultural development strategies, as well as agriculture-related legislation documents, and synergised them into the national *Agricultural Policy Framework* (NAPF), as the new comprehensive agricultural policy document. The NAPF, as a synthesis, summarises the objectives of agricultural development, strategies and policies that will be pursued to achieve both stated and commonly-perceived agricultural objectives (MoAFS 2006). The purpose of NAPF is to ensure food security and sustainable agricultural growth and development. This is envisaged to be attained through increased production of food and cash crops, horticulture, livestock, fisheries and agro-forestry. However, the framework does also not specifically include climate change issues.

5.2.2 The Agriculture Sector Wide Approach (ASWAp) document (2010)

The 2010 ASWAp document (*The Agriculture Sector Wide Approach (ASWAp): Malawi's prioritised and harmonised agricultural development Agenda*) is the current policy framework in the Ministry of Agriculture and Food Security. It was formulated as an approach to facilitate agricultural development aiming at increasing agricultural productivity, contributing to six per cent annual growth in the agricultural sector, improving food security, diversifying food production to improve nutrition at the household level, and increasing agricultural incomes of the rural people. It is a priority investment programme for the agricultural sector, being based on the agricultural elements as outlined in the MGDS. The ASWAp has three focus areas:

1. Food security and risk management.
2. Agri-business and market development.
3. Sustainable land and water management.

The two key support services include technology generation and dissemination, as well as institutional strengthening and capacity building. There are two cross-cutting issues that are identified in the ASWAp: the HIV/AIDs pandemic, and gender disparities.

In the ASWAp document, a distinct awareness of the relationship between agricultural development, food security and climate change issues is expressed. To this end, it is clearly stated that land and water, as the critical resource inputs into crop production, should be managed sustainably to avoid land degradation, soil erosion, deforestation, diminishing water resources, and declining biodiversity. In the context of increased weather variability and climate change, there is a need to increase water-use efficiency and strengthen irrigation potential through the Green Belt Initiative (see below).

Floods and droughts are recognised as having negative impacts on agricultural production and several interventions to mitigate climate change are incorporated into the ASWAp's focus areas including, *inter alia*, improving early warning systems; introducing weather insurance; using drought-resistant varieties; and ensuring watershed protection by community-based afforestation.

5.2.3 The *National Irrigation Policy and Development Strategy* (2000)

The irrigation sector is currently supervised by the Ministry of Irrigation and Water Development, whereas it previously used to be a discrete department within the former Ministry of Agriculture and Irrigation. Its functions are closely related to agricultural services since Malawi depends on rainfed agriculture and there is a need to move away from this in order to increase productivity. The broad policy objectives of the irrigation sector are to contribute to poverty alleviation by targeting resource-poor smallholder farmers for irrigation development to enhance farm income, and supplementing the recommended strategies for rainfed agriculture outlined in the then Ministry of Agriculture and Livestock Development's 1995 *Agricultural and Livestock Development Strategy and Action Plan*. The other objective is to increase agricultural production and enhance food security through irrigation (which will ensure some production during droughts and the dry season) as well as to supplement rainfed agriculture.

5.2.4 The Green Belt Initiative (GBI)

The Malawi government developed the Green Belt Initiative (GBI) in 2010 in order to make use of the country's vast water resources. The programme targets a coverage of about one million hectares of land compared to 90,000ha currently under irrigation. The GBI was initially implemented in four pilot sites: Shire Valley in the southern region districts of Chikhwawa and Nsanje; Lake Malombe in the eastern region district of Mangochi; Mnema in the central region district of Salima; and Nthola-Ilora-Ngosi in the northern region district of Karonga (OPC 2011). The focus of the programme will now be Lake Malawi and Lake Malombe; the Shire and other perennial rivers from Chitipa to the Shire Valley already have connections to existing irrigation schemes. The specific target is to have a coverage of 20 kilometres along the water banks under irrigation.

It can be noted from the policies and strategies guiding agricultural development in Malawi that there is a lack of awareness of climate change as a constraint to agricultural (and consequently economic) development. Although Malawi signed and ratified the United Nations Framework Convention on Climate Change (UNFCCC) in June 1992 and April 1994, respectively, it wasn't until November 2003 that Malawi submitted its first national communication to the UNFCCC. In line with the UNFCCC, Malawi developed its *Malawi National Adaptation Programmes for Action (NAPA)* in 2006 (Chadza and Banda 2008). Climate change issues were not high on the government's agenda before 2006, as became evident from this study's analysis of the national development policies and agricultural policies, above. Therefore most of the activity on climate change from the government's and donors' point of view – apart from the NAPA – has been to integrate or mainstream climate change issues into already existing policies and frameworks.

To properly follow the development of climate change issues within the Malawian context, it is important to revisit the way environmental issues were framed and debated within these policies and other frameworks. To this end, the following subsection will review the *National Environmental Action Plan* (1994), the *National Environmental Policy* (1996), and the *Environmental Management Act* (1996), followed by the NAPA and other attendant frameworks that clearly spell out climate change issues.

5.2.5 The *National Environmental Action Plan* (1994)

The *National Environmental Action Plan* (NEAP) can be traced back to Malawi's participation in the United Nations Conference on Environment and Development (UNCED) and the country becoming a signatory to Agenda 21. Malawi began to show a greater commitment to environmental protection for sustainable development by creating the NEAP. The NEAP is a government undertaking to provide the framework for integrating the environment into the overall socioeconomic development of the country through broad public participation. The NEAP describes the existing environmental conditions in Malawi and recommends a set of actions that should be taken in order to redress the extensive environmental degradation and facilitate sustainable utilisation and management of natural resources. Its specific objectives are:

1. To document and analyse the major issues of environmental destruction and measures to alleviate them.
2. To promote sustainable use of natural resources in Malawi.
3. To develop an environmental protection management plan.

The NEAP also provides specific guidelines for:

- Actions to be taken by local communities, with or without government/non-governmental assistance.
- Actions to be taken by the government and additional agencies.
- Modifying existing programmes and projects to adequately cover environmental concerns.
- Selecting projects for the Environmental Investment Programme (EIP).

Climate change is recognised in the NEAP as one of the environmental issues that requires significant consideration. Climate variety and change impact on the environment and society in the following manner:

1. Environment:
    - The shift in precipitation patterns and soil moisture results in altered hydrological systems.
    - The transformation of vegetation zones and species leads to reduced biological diversity and changing ecosystems.
2. Society:
    - The increased occurrence of floods and droughts negatively impacts on water resources.
    - The changes to growing seasons, yields, pest distribution, cultivated land, forestry and fisheries heavily influence agricultural production and thus food security

3. Changing energy requirements impinge on issues of transport and industry (i.e., on economic activity).
4. Human settlement and health – altering disease patterns will impact on the existing infrastructure,

Although climate variations and change are recognized, the NEAP concludes by emphasising the difficult issue of uncertainty that does not only apply to Malawi but is a global problem. Although recent climate abnormalities such as droughts and floods indicate climate change, the topic is not included in the environmental issues identified for closer consideration.

5.2.6 The *National Environmental Policy* (1996)

The government of Malawi adopted a *National Environmental Policy* (NEP) in 1996 to provide guidance and set standards for the development of sector policies related to the environment and natural resources. It provided an overall framework against which relevant sectoral environmental policies were revised and adopted to ensure that these are consistent with the principles of sustainable development.

The overall policy goal of the NEP is the promotion of sustainable social and economic development through the sound management of the environment and natural resources. More specifically the NEP sought to:

1. Promote the efficient utilisation and management of the country's natural resources.
2. Facilitate the rehabilitation and management of essential ecosystems and ecological processes.
3. Enhance public awareness of the importance of sound environmental management.
4. Promote cooperation between government, local communities, women's groups, NGOs and the private sector in the management and sustainable utilisation of natural resources and the environment.

The NEP was developed within the ambit of sustainable environmental management; however, because it was based on the conclusions of the NEAP, it does not recognise issues of climate change. It addresses environmental issues in general with the perception that some agricultural and developmental activities are detrimental to the environment.

5.2.7 The *Environmental Management Act* (1996)

This Act intends 'to make provision for the protection and management of the environment and the conservation and sustainable utilisation of natural resources and for matters connected therewith and Incidental thereto' (GoM 1996). It provides the legal support for the implementation of the NEP and establishes various offices for environmental management such as the Director of Environmental Affairs, the National Council on the Environment (NCE) and the Technical Committee on the Environment (TCE). The Act also provides for environmental planning and environmental impact assessments and audits, as well as environmental quality standards and management.

The Act does not specifically tackle issues of climate change because the documents it provides legal support for do not address issues of climate change themselves.

5.2.8 The *Malawi National Adaptation Programmes of Action (NAPA)* (2006)

The threat posed by extreme climatic events to food, health, water and energy has been the driving force behind the preparation of *Malawi's National Adaptation Programmes of Action (NAPA)* (EAD 2006). This document was prepared with the primary objective of identifying and promoting activities that address urgent and immediate needs among rural communities in vulnerable areas of the country for adapting to the adverse impacts of climate change. (This will initially focus on adaptation needs in the agriculture, water, energy, fisheries, land-use change, forestry, wildlife, human health and gender sectors.) Specifically the document aimed at:

1. Identifying a list of priority activities.
2. Formulating priority adaptation options.
3. Building capacity for adapting to long-term climate change and variability.
4. Raising public awareness on the urgency to adapt to the adverse effects of extreme weather events.

The NAPA was the first comprehensive document prepared by the government of Malawi to directly address issues of climate change impacts, mitigation and adaptation. The programme aimed at identifying priorities then implementing five priority activities that had been developed into project profiles, highlighting the rationale or justification, objectives, inputs, short-term outputs, potential long-term outcomes, institutional arrangements, risks and barriers, and monitoring and evaluation requirements, as well as a proposed budget. A summary of the projects identified under the programme and their budgets is presented in the table below.

Table 3: Costed projects identified under the *Malawi's National Adaptation Programmes of Action (NAPA)* (Source: EAD 2006).

Project title	Time	Budget (US$)
Improving community resilience to climate change through the development of sustainable rural livelihoods	3 years	4.5 million
Restoring forests in the Shire River Basin to reduce siltation and the associated water flow problems	3 years	2.0 million
Improving agricultural production under erratic rains and changing climatic conditions	3 years	3.0 million
Improving Malawi's preparedness to cope with droughts and floods	3 years	8.0 million
Improving climate monitoring to enhance Malawi's early warning capability, decision making, and sustainable utilisation of Lake Malawi and lakeshore area resources	3 years	5.43 million

Thus the NAPA has been costed and only waits funding, which is to come from government and other stakeholders including donor agencies and other non-state actors. It represents the first attempt at planning and costing climate change adaptation measures.

From the analysis above, it is clear that climate change is a 'new' phenomenon in Malawi because most of the policies and frameworks developed within the past decade do not reflect the attention that the issue is enjoying at present. Several programmes and activities previously carried out by different stakeholders do address agricultural development and environmental and natural resource management issues that can also be included in climate

change adaptation actions. Food security receives high priority in agriculture and even in terms of climate change adaptation; ensuring that the vulnerable are well adapted to climate change impacts is tantamount to ensuring that they are food secure.

The International Food Policy Research Institute (IFPRI) Consultative Group on International Agricultural Research (CGIAR) noted that it is important that organisations work towards ensuring that agricultural and food systems adapt to a changing climate, while managing trade-offs between food security, livelihoods and environmental goals (IFPRI 2009).

In the next subsections, we will analyse the roles played by various actors, including government ministries and departments, donors, and other non-state actors (NSAs) that are involved in issues of climate change adaptation and mitigation.

5.2.9 The government of Malawi

The government of Malawi (GoM) implements climate change and adaptation programmes through several ministries and departments. These are:

- The Office of the President and Cabinet (OPC) in the Department of Disaster Management Affairs (DoDMA).
- The Ministry of Development Planning and Cooperation.
- The Ministry of Natural Resources, Energy and Environment (Environmental Affairs Department, Department of Forestry, Department of Energy and Mines, Department of Climate Change and Meteorological Services).
- The Ministry of Agriculture and Food Security (Land Resources Conservation Department, Crops Department, Department of Agricultural Research Services, Department of Agricultural Extension Services).
- The Ministry of Irrigation and Water Development.
- The Ministry of Local Government and Rural Development

The Department of Disaster Management Affairs (DoDMA) was created through the *Disaster Preparedness and Relief Act* (1991) as the entity responsible for coordinating and directing the implementation of disaster risk reduction (DRR) programmes in Malawi. DoDMA works with district assemblies in the implementation of DRR activities that are conducted at community level. The same Act establishes the National Disaster Preparedness and Relief Committee (NDPRC) that comprises all Permanent Secretaries, the Malawi Red Cross and three NGOs. However, the NDPRC is not considered a national platform since it has a weak representation from civil society and largely consists of government officials (UN/ISDR 2010). The legal framework also provides for disaster management, which is primarily related to relief and response actions rather than mitigation of climate change impacts and planned adaptation.

The Ministry of Natural Resources, Energy and Environment (MoNREE) hosts seven departments (Energy Affairs; Environmental Affairs; Forestry; Geological Surveys; Mines; Climate Change; and Meteorological Services). Of these departments, Environmental Affairs, Forestry, Climate Change and Meteorological Services are the ones that are more involved in climate change and adaptation issues.

The Environmental Affairs Department (EAD) is also concerned with environmental and climate change issues as evidenced by the fact that in the development of the NAPA, the EAD took the coordinating and leading role. The implementation of the NAPA has not yet taken off however since funding has not materialised so the planned implementation is constrained. Due to these funding difficulties, the EAD does not take the leading role anymore.

The Department of Forestry is involved in issues of climate change mitigation and adaptation due to the fact that forests play a crucial role in both mitigation and adaptation aspects of rural communities' livelihoods. Malawi has experienced a lot of deforestation so there exists a strong need for afforestation and rehabilitation of the environment. The Department of Forestry implements several afforestation projects at community level towards this end. The department is also responsible for the management of forest reserves, which are gazetted under the *Forest Act* of 1997. These forest reserves are concerned with the protection of wildlife habitats as well as catchment areas. The department is also involved in carbon trading projects for facilitating climate change mitigation.

Another department in the Ministry of Natural Resources, Energy and Environment that is involved in climate change issues is the Department of Climate Change and Meteorological Services (DCCMS). The department's mission is to provide reliable, responsive and high quality weather and climate services to meet national, regional and international obligations through timely dissemination of accurate and up-to-date data and information for socioeconomic development. The specific objectives of the department are as follows (DCCMS 2011):

- To monitor, analyse and predict weather and climate patterns. The thrust of this objective is to ensure that the weather forecast is based on improved early warning procedures. This information is vital for natural disaster advisory bodies.
- To provide weather and climate data and information for various socioeconomic sectors such as aviation, agriculture, water, marine, construction industry, insurance, tourism, health, sports and recreation.
- To carry out research and development that would improve the quality of weather and climate data as well as the information provided to the general public. The main focus is to carry out research on all aspects of meteorology.
- To establish and maintain a well-equipped network of 'Met stations'. This objective intends to ensure that meteorological data and information is reliable, timely and up to date.

The other ministries and department involved in climate change planning and adaptation depend on information from the DCCMS for up-to-date information that can be used for planning purposes.

The Ministry of Development Planning and Cooperation (MDPC) is the one that has taken a leading role in most of the major projects that are being implemented on climate change adaptation. This is because this ministry is responsible for coordinating donor funds as well as providing overall guidance on the direction of development planning through the production of overarching development strategies and policies such as the MGDS. As it is, the government does not allocate substantial amounts to climate change but donors do, hence the MDPC is the lead ministry there.

5.2.10 Bilateral and multinational donors

In Malawi, donors work under the umbrella of the Common Approach to Budgetary Support (CABS). Currently, most donors in Malawi are not yet giving aid specifically for climate change adaptation. According to a study by Malcomb (2010), of the 6,300 projects in Malawi, only eight projects use 'climate adaptation' in their description. However, this is not to say that donors are not implementing adaptation projects; most of them argue that their projects have always been adaptation orientated. The same study observed that many donors' sentiments were that 'climate change is here and adaptation is all about food security.' Thus, when donors assist in agriculture and food security projects, they also feel that they have contributed to climate change adaptation. The table below shows the donors and the respective amount of fundings that they provided to Malawi in FY2009/10.

Table 4: Donor support to Malawi in FY2009/10. (Source: Malcomb 2010).

Donor	Amount (US$)	No of projects
EU Commission	79,926,887	19 projects in 48 locations
World Bank, FAO, IFAD or GEF	28,903,970	4 projects in 13 locations
NORAD (Norway)	26,863,817	8 projects in 24 locations
African Development Bank	15,491,565	3 projects in 35 locations
DFID (UK)	13,769,255	2 projects in 5 locations
USAID	5,830,267	4 projects in 13 locations
Irish Aid	4, 769,212	6 projects in 13 locations
JICA	2,064,587	3 projects in 6 locations

The government of Malawi received US$90,437,836 of the aid in the table above in direct agriculture budget support from donors in the FY2009/10.

In addition to the general aid indicated above, some donors have contributed to climate change adaptation through bilateral agreements. These include DFID, Irish Aid and USAID.

A. Department for International Development (DFID), UK

DFID is a key player in supporting the ASWAp, which aims at agricultural development and also addresses issues of climate change. It also supports the MGDS through the following focus areas: growth and resilience (including agriculture); water and sanitation; access to finance; energy efficiency; and private sector development. DFID provided £18.4 million towards the MoAFS's logistics unit and weather insurance programme.

DFID, in collaboration with the Norwegian Embassy and Irish Aid, has provided funding for NGOs and not-for-profit organisations (NPOs) or consortiums looking to expand and scale-up community-based disaster risk management or climate change adaptation programmes. It has provided £14 million for five years (2011 - 2016).

DFID's bilateral work focuses on local adaptation and energy efficiency; it also financially assisted the World Bank to work on carbon finance mechanisms. The financial contribution for the Climate Change Programme, which is aims at supporting the government of Malawi in planning for climate change action, is as follows:

Table 5: DFID's contribution towards climate change-related issues (Source: DFID 2009).

Recipient	Amount (£)
Government of Malawi Climate Change Programme	990,000
UNDP	250,000
British Council	50,000
World Bank (for Department of Forestry)	64,000
Within DFID	50,000

B. Irish Aid

Irish Aid has a country programme in place that runs from 2010 to 2014. Its goal is to ensure that households are better nourished, more food secure, and less vulnerable to poverty. Irish Aid supports the Agricultural Inputs Subsidy Programme to boost agricultural production. It also supports NGOs such as Concern Universal, the National Smallholder Farmers Association of Malawi (NASFAM), the International Potato Center (known by its Spanish acronym, CIP), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and the International Centre for Research in Agroforestry (ICRAF).

Irish Aid also works in collaboration with the Norwegian Embassy, DFID and the government of Malawi on a comprehensive disaster risk reduction programme to protect poorer households from the risks of climate change and environmental degradation. For the above mentioned projects, the Irish Aid funding has been as follows:

Table 6: Irish Aid support to Malawi (2008 -2009) (Source: Irish Aid 2010).

Year	Amount (million Euros)
2008	9.947
2009	10.8
2010	10.5

C. The United Nations Development Programme (UNDP)

The UNDP has been deeply involved in implementation as well as providing funding for climate change activities. One of its projects is the Building Capacity for Integrated Comprehensive Approaches to Climate Change Adaptation in Malawi project, which runs from January 2010 to December 2011 and is budgeted at US$3,881,575. The objective of this project is to enhance Malawi's existing climate initiatives by strengthening capacities for long-term investments into climate-resilient sustainable development. The implementation partners for this project include the Ministry of Development Planning and Cooperation and the World Food Programme.

UNDP has also signed an agreement with the Ministry of Natural Resources, Energy and Environment in 2010 to prepare an annual workplan on environment and energy for pro-poor growth. The outcome of this project was 'enhanced conservation of the natural resource base by 2011'. The output expected from this is 'the integration of environmental provisions of the MGDS into national strategies, policies and action plans' (MDPC 2009). The programme also includes incorporating climate change into the curriculum at the Malawi College of Forestry. Moreover, a high number of ministries and departments participate in the project, among others the Ministry of Lands; Department of Energy; Department of Forestry; Ministry of Tourism, National Parks and Wildlife; and the Ministry of Women, Child Development and Community Services.

D. United States Agency for International Development (USAID)

USAID also contributes to agriculture and disaster programmes. A large bulk of this aid goes into the social sectors of health and education.

Table 7: USAID state foreign assistance appropriation (FY2008-11) – US$ (millions) (Source: USAID 2010).

Item	Amount US$ (millions)
Peace and security	0.300
Investing in people (e.g., health, education)	135.748
Governing justly and democratically	3.000
Economic growth (agriculture, environment, etc.)	39.769
Humanitarian assistance (disaster readiness)	0.170

E. Non-state actors (NSAs) or non-governmental organisations (NGOs)

Several NSAs or NGOs are involved in both agricultural development and climate change adaptation in Malawi:

Christian Aid co-funded a DFID project, which was implemented by the Evangelical Lutheran Development Service (ELDS). The project improved the food security of 100 poor families in Phalombe District by channelling mountain spring water for irrigation and also provided improved access to drinking water. Phalombe is one of the districts in Malawi that experiences droughts and erratic rainfall. The project enabled the irrigation of approximately 10 hectares of land. In implementing this project, ELDS collaborated with the district assembly and the Ministry of Irrigation and Water Development.

Cordaid has provided funding for disaster risk management projects in Malawi and this funding was channelled through other NSAs. The Catholic Development Commission in Malawi (CADECOM) organisation and the ECM are the beneficiaries from the funding of Cordaid as follows:

Table 8: Cordaid support to other NGOs (Source: Cosgrave 2010).

Year	Recipient and project	Amount (US$)
2004	CADECOM (risk management project)	251,631
2008	ECM (disaster risk management programme)	500,000
2006	CADECOM (disaster risk management)	121,798

The **Evangelical Association of Malawi (EAM)** works in collaboration with the DoDMA and Christian Aid to improve local communities' ability to respond to disasters and adapt to climate change. The EAM gets funding from donors such as Irish Aid and the EU. The EAM and partners are currently implementing three projects.

Table 9: Climate change projects funded by EAM and partners in the Lower Shire Valley (Source: Evangelical Association of Malawi 2010).

Project title	Amount* (Euros)
Community-based Disaster Risk Management	112,567
ECHO	302,353
DIPECHO	202,701

**Amounts exclude salaries for staff.*

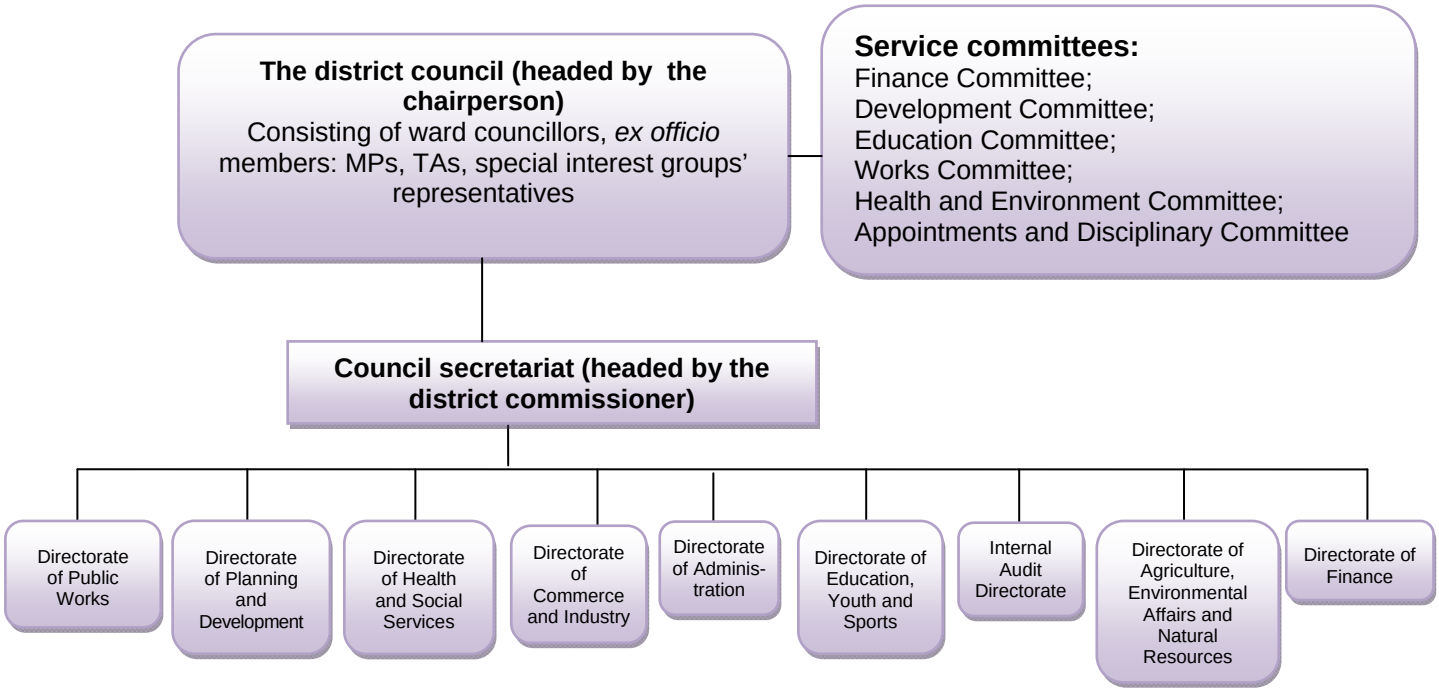
5.3 Synergies and contradictions among actors

The relationships between the various actors involved in the planning and implementation of agricultural activities and climate change-related activities are mapped out in Figure 5 below. From the analysis above, it has already become clear that various actors have their own capabilities and differing interests. But actions would better benefit the targeted communities if there were enhanced joint implementation instead of the existing fragmented approach, since a large number of projects initiated by various donors address the same issues.

Moreover, the NAPA is not yet funded since the emphasis has been on providing funds to NSAs rather than to governmental actors, while lacking balanced and effective coordination. Malawi as a country is small and resource-constrained. The government on its own is not capable of managing the NAPA, thus its departments are simply waiting for donors to pick projects that they are willing to support. However, the involvement of multiple actors without proper coordination leads to overlaps at the local level. For example, in Chikhwawa District, where the case study was conducted, different NGO projects that targeted the same populations clashed with each other. To better understand the activities of these actors, particularly in relation to their interactions with communities, it is important to understand the functioning of the district- and community-level structures in relation to the national-level structures under decentralisation policies.

In Malawi, decentralisation was embraced as the overall guiding approach for programme implementation and governmental service delivery. With the adoption of the *National Decentralisation Policy* (1998) and the *Local Government Act* (1998), the state initiated the process of devolving functions to the district assemblies. Decentralisation aimed at abolishing the dualistic development planning and implementation structure that existed back then by merging the sectoral structures at district level into one body, namely the ‘district assembly’ (currently known as the district council), as well as removing the complex regional structures, to create a single mechanism connecting the line ministries and the district assemblies (MLGRD 2004). The former district councils were merged with the offices of the district commissioner, removing the district development committee, resulting in a new structure as shown in Figure 5 below. The second aim of decentralisation was to improve the coordination at district level since different line ministries had established their own structures there, which led to a duplication of functions.

Figure 5: Decentralised district council structure (Source: GTZ 2005).



The third reason for decentralisation was to promote popular participation against the backdrop of the new Constitution of 1995 (which provided for good governance and development as citizens' rights) and ensure that local authorities would be better able to represent local communities. The district councils are therefore expected to carry out a number of functions and responsibilities which include, among others, the collection of ceded revenue and coordination of development activities at the district level.

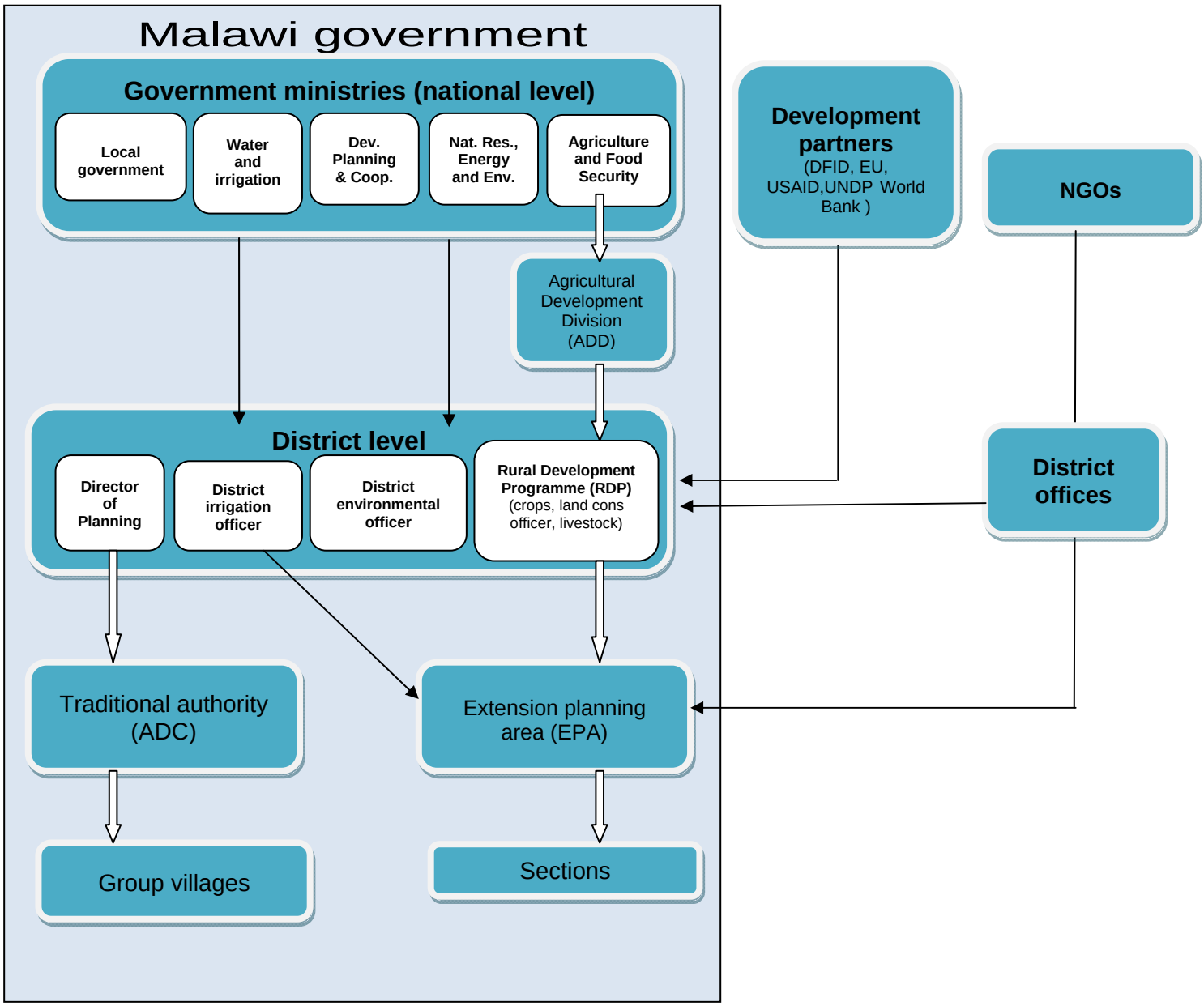
The actual process of decentralisation has faced many challenges, particularly when one considers the political nature of devolution. Despite preparation via sector devolution plans, the corresponding functions were not fully devolved to the district councils, nor were the mergers of their offices within the district council structure facilitated. Despite a phased plan towards devolution of functions, some sectors appear to be slower in implementing this process than others. The reasons for not decentralising are various – for example a lack of capacities and funds for carrying out the devolved functions.

Consequently, the district sector heads, e.g., the district agricultural development officer (DADO) and the environmental development officer (EDO), have not yet taken up their positions in the Directorate of Agriculture, Environment and Natural Resources. They are still operating in a vertical manner with their line ministries and only meet the other section heads at DEC meetings, as illustrated in Figure 6 below. They still receive donor funding through their line ministries and implement projects as they did before the decentralisation process began. Local and international NGOs are supposed to channel their support through the district councils; however, there are certain projects that are implemented in direct contact with the local communities without passing through the councils. This creates the risk of duplication of effort, particularly considering the fact that the district councils prepare socioeconomic profiles (SEPs) and district development plans (DDPs) that are based on the local communities' priorities fed to the district councils through the village development committees (VDCs) and the area development committees (ADCs).

While the local development fund (LDF) provides funding only according to the priorities expressed in the DDPs, the other actors – by sidelining the district councils – weaken this structure even further. For example, in some communities, the only functional committees are related to projects instead of being coordinated by the VDC or ADC as part of all development activities, including agricultural and climate change issues.

The decentralised system requires that the district councils should be recognized as important primary stakeholders by project implementers, in order that they can play a substantial coordinating role (rather than simply going along with what has already been decided).

Figure 6: Agriculture and climate change stakeholders' relationships.



6. Case study findings

6.1 The case study baseline

6.1.1 Characterisation of the agricultural system

Farmers sampled in this study tended to produce a variety of crops and owned more than one plot of land. Land in this area of Chikhwawa is acquired through three major of ways: inheritance, rent and purchase. Land is the main resource that the households in these communities own. It supports their livelihoods in terms of providing food and income through selling crops. Therefore these communities can be said to be agriculture-based.

Their cropping calendar reveals that they have two growing seasons, one during the rainy season from November to April and the other using residual moisture and irrigation from May to October. This pattern was observed in both lowland and upland communities. In colder periods, upland communities travel more than 20km to fertile wet areas along the Shire River and camp there for a number of weeks while cultivating their winter gardens. These farmers acquire the land plots mainly through renting from the people who own them and who live close to the river. This practice of land rental markets has emerged due to the dry spells and droughts encountered in these areas and the resulting higher demand for fertile wet land. The modes of rental payments are different, ranging from a fixed rental payment to shared cropping systems. Shared cropping is common when the tenant has no upfront money to pay, whereas a fixed rent is usually chosen when the tenant is able to pay this. Consequently, both resource-poor and resource-rich farmers were able to access the fertile wet lands during the dry spell and drought seasons.

Besides maize as the main subsistence crop, other crops grown in the villages include cotton, sorghum, millet, sweet potato, beans, tomatoes, okra and rice. Farmers in upland areas indicated that they also cultivate oriental tobacco. Cotton is the main cash crop in the area and requires less water than other crops and can survive well in hot conditions. Another drought-resistant crop is sweet potatoes, which have been used during the dry season as a source of cash for purchasing maize. It is interesting to note that these communities used to have sorghum and millet as their main staple food before the 19th century, but changed to maize soon after British colonisation. The British encouraged the cultivation of maize to meet their starch demand; white maize was preferred and promoted throughout their colonies.

In terms of crop production, farmers exhibited the ability to adapt to climatic shocks through growing various crops in different periods of the year. From the seasonal calendar, it is evident that their cultural practice is to grow them not only during the rainy season, but also during the winter and dry months. They grow millet and sorghum, which have shorter growing periods and require less rain than maize, indicating a deliberate climate-coping strategy. In addition, their major cash crop is cotton which also does well in hot areas. Other crops like sweet potato and okra also assist them in times when maize production has declined. By consuming – and especially selling – these crops, lean periods are balanced out. Additionally, maize production is carried out twice or three times a year: in the rainy season, in the winter season (with residual moisture), and using irrigation in the dry season (mainly in the marshes).

Table 10: Example of a seasonal calendar (Source: FDG during the study).

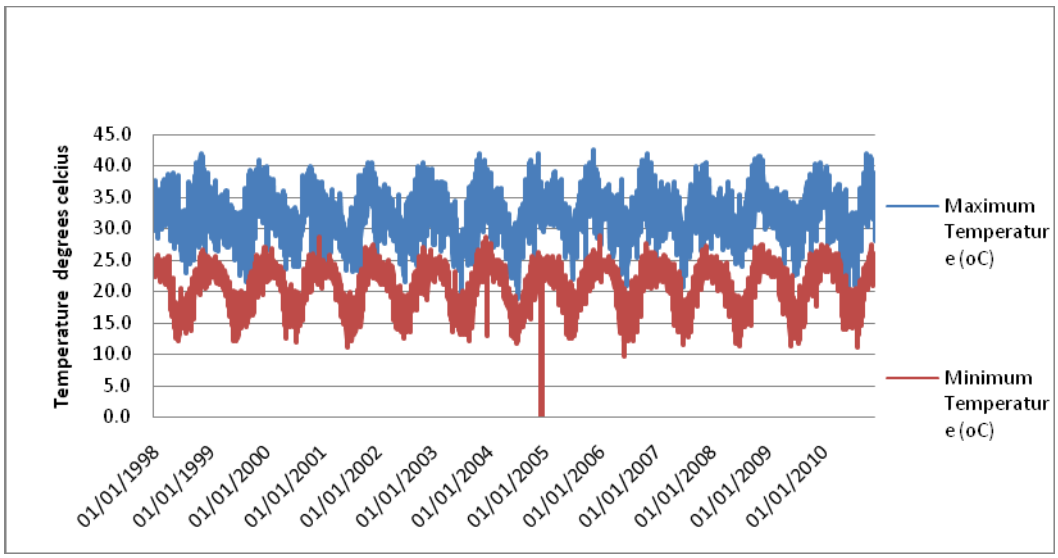
Crop	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
Maize	Land clearing and ridging (upland) Harvest from the dimba*	Land clearing and ridging (upland) Digging holes and applying manure	Making box ridges Applying manure Making canals Digging holes	Planting Supplying Weeding Applying fertiliser	Planting Supplying Weeding Applying fertiliser	2nd weeding 2nd fertiliser application	2nd weeding 2nd fertiliser application Harvesting green maize	Harvesting green maize Harvesting early maturing maize	Harvesting Removing stalks Land clearing (dimba) Burning cleared bushes (dimba)	Dimba: digging holes Planting Weeding Fertiliser application	Dimba: weeding	
Cotton	Uprooting and burning stalks Land clearing and ridging (upland)	Land clearing and ridging (upland) Digging holes and applying manure	Making box ridges Digging holes	Planting Weeding Thinning Spraying	Weeding Spraying	Picking	Baling and selling					
Millet and sorghum	Clearing land, ridging, applying manure	Planting	Weeding	Thinning	Harvesting fresh millet and sorghum	Harvesting dry millet and sorghum						

** A 'dimba' is a small garden.*

6.1.2 Observed climate trends, including local-level climate envelopes

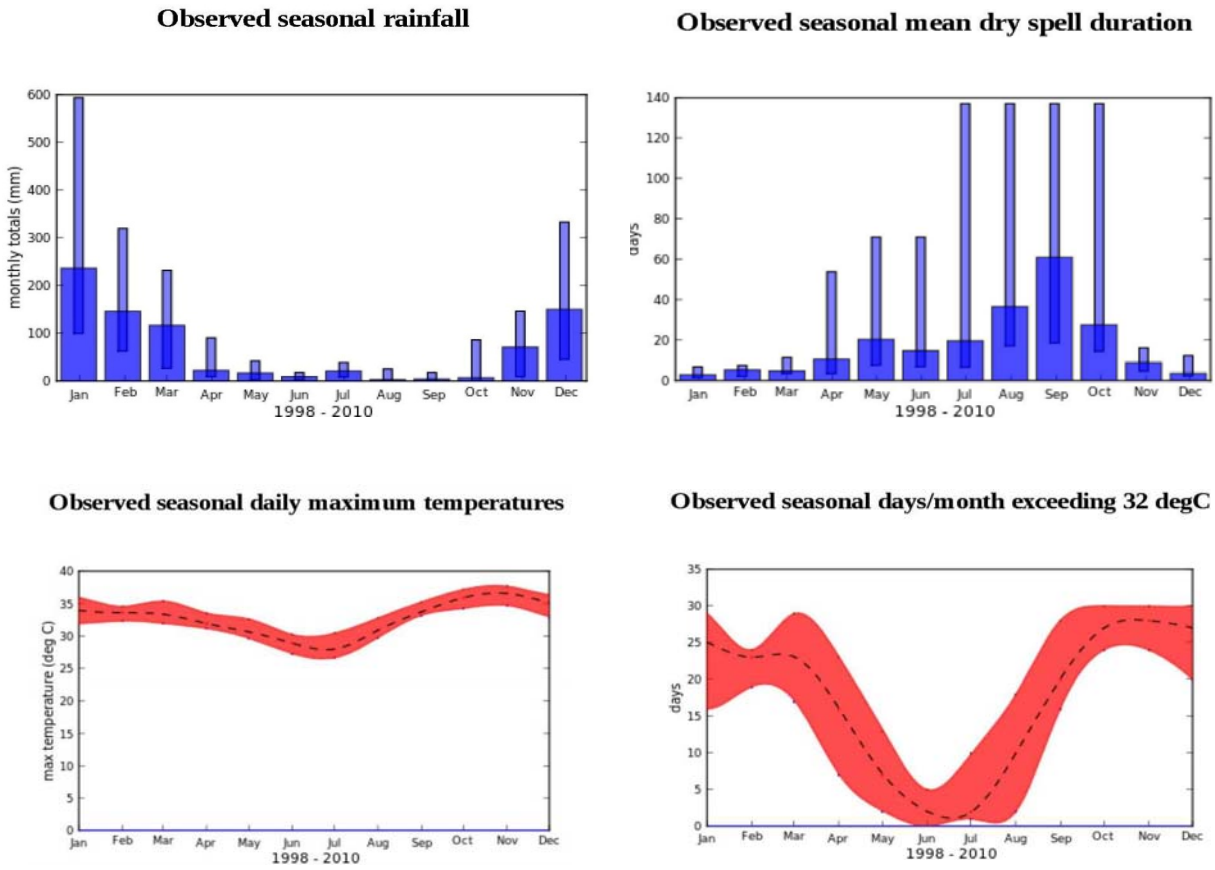
Chikhwawa District lies in the Lower Shire Valley, between 30 and 500 metres above sea level. The district experiences a tropical climate with wet and dry seasons. The wet season starts in November/December and ends in April/May, while the dry season occurs from May to October/November. The temperatures are generally high, with a maximum above 40^{o}C in November and a minimum of 27.6^{o}C in July, while the mean temperatures are usually above 20^{o}C. The area experiences strong rainfall patterns in summer; January has historically been the wettest season. The inter-annual variability of monthly rainfall is high and varied (for instance for January between 100mm and 600mm) for all but the wettest ten per cent and driest ten per cent of years. The impact of this variability is potentially serious for agriculture in the region. It is especially significant in the context of climate change projections as current variability could be significantly higher than future changes. Currently, it has been observed that highest temperatures of above 40^{0}c appear common, which is detrimental for agricultural production. Recent research has indicated that maize yields decline with each day that the crops are exposed to temperatures above 32^{o}C. Therefore the current trend of temperature increase has negative effects on production outcomes. The graph below shows that the maximum temperature of 40^{o}C was more frequently exceeded after 2004. This rise in temperature is also correlated with the increasing incidences of droughts and dry spells during the rainy season.

Figure 7: Observed temperatures for Chikhwawa from 1998 – 2010 (Source of data: Illovo Sugar company meteorological station).



Dry spells, especially when they happened during the critical time of plant maturing, have negatively affected crop production by leading to partial and complete crop failures that have been observed in the past decade in Chikhwawa. Dry spells are most critical during the start of the wet season when dependence on regular rainfall is highest in the agricultural sector. Their durations are clearly longest during the dry periods and reduce markedly during the start of the wet season in November. Being a summer rainfall region, highest temperatures are experienced during the months of October to March. However, the highest temperatures are experienced before the wettest month, which would be in this case November or December. The number of days in a month that exceed the 32^{o}C temperature threshold is a simple but useful proxy for heat stress. Clearly this index will be higher during the warm months and is especially sensitive to changes in temperature under a warming climate, as will be seen in the projections in a later subsection.

Figure 8: Observed climate trends (Source: University of Cape Town data).



6.1.3 Climate risks and hazards

Local climate change knowledge is largely defined by the currently experienced situation, but many development organisations conduct their activities in order to sensitise local people more about climate change and its effects. This was revealed when farmers assumed that our discussions were premised on the 'fact' that the climate has changed, rather than evaluating whether the climate has indeed changed or not.

The participants identified droughts and floods, which are directly attributed to climate change, as the most common climatic hazards. They noted that historically, in the 1940s and 1950s, the period between two droughts would have been at least a decade. Currently, it takes only two to three years for a drought or serious flood to happen.

In the years 1949, 1975, 1982, 1987, 1991, 1992, 2001, 2002, 2004, 2005 and 2010, serious droughts were experienced. Droughts are better remembered than floods because they affect crop production and food security more significantly than floods. During a drought, crops fail and livestock dies and the overall access to food becomes constrained, which also includes nearby neighbourhoods. For example, participants from Gangu village called 1987 'the year of Jalawaza', which is the name of a distant region where they were compelled to purchase food when it was unavailable in neighbouring villages. Farmers from Mfunde village remembered 2005 as the year when, even with sufficient purchasing power, they could not buy food in their vicinity.

On the other hand, floods also have an immediate devastating impact through the loss of lives, livestock and crops. Nevertheless after the flood, the residual moisture is used to grow more crops, so flood survivors sometimes even benefit from these events since they produce more than they would have done in a year without this climatic hazard.

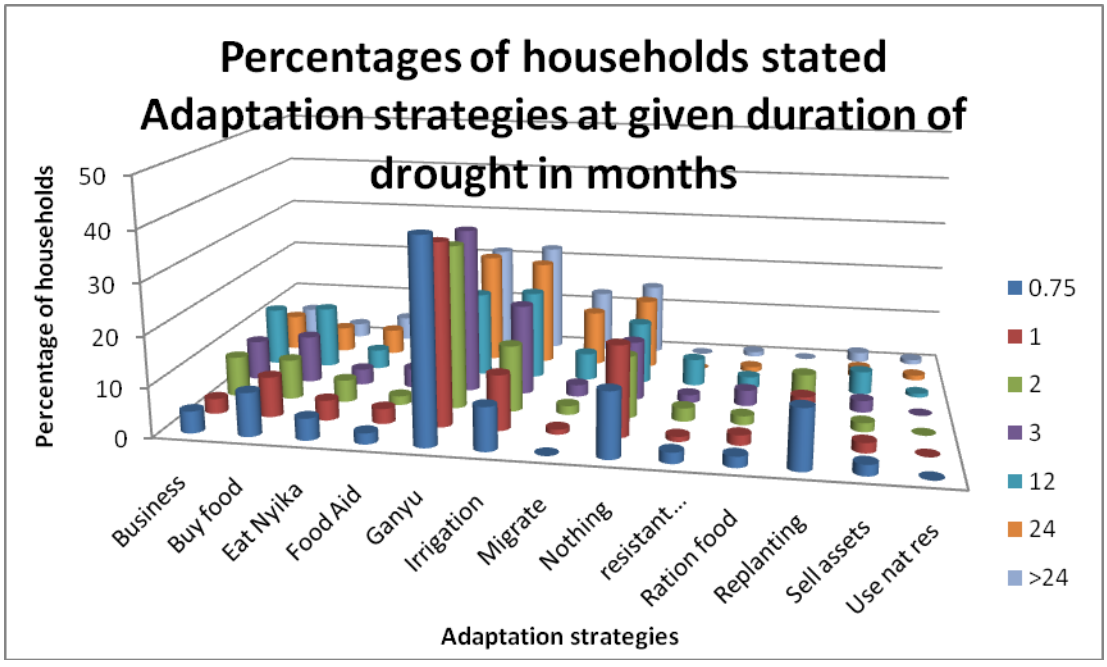
6.1.4 Vulnerability to climate variability and change, and existing coping strategies

The communities in Chikhwawa have already experienced adverse climate variability and change, and have since implemented a number of coping strategies. During the survey, households in the study sites were asked to indicate when they had experienced the effects of droughts and floods of different magnitude. The magnitude was measured in the duration of the hazards and this ranged from three weeks of either drought or flood to more than twelve months. Various existing coping strategies were detected at the household level, which ranged from eating the Shire River's wild tubers (*nyika*) to temporarily migrating out of the area to seek food and water. Another common strategy was casual labour (*ganyu*), which provides some income for buying food; this strategy appeared regardless of the duration of the hazards.

During short drought incidences, households resorted to replanting their maize crops. In longer drought incidences, however, farmers resorted to other strategies, e.g., irrigation and migration, the former being common for communities along the Shire River.

Moreover, the trend of increasingly taking advantage of land rentals along the river has emerged. This enables winter or residual cropping for those communities located far away from the river. In one visited community that was about 20km away from the river, the households indicated that it has become common for them to travel this distance and camp along the river for growing maize during the winter season. The use of natural resources (selling of charcoal, eating and selling wild fruits) was also a strategy during longer drought spells. The graph below presents the existing coping strategies and their percentage of practice by farmers for the past ten years.

Figure 9: Adaptation strategies.



In times of droughts and floods, farmers usually get assistance from external government and non-governmental organisations (NGOs). The assistance that they get varies according to the organisation's mandate. Some organisations offer food relief whereas others provide agricultural inputs.

6.1.5 Factors affecting the decision to undertake a climate change adaptation strategy

The decision to undertake the above strategies at household level is dependent on a number of factors, which may be related to climate change or other socioeconomic reasons. A multinomial logit model was used to assess the several factors that could affect farmers' adaptation choices, for which a comprehensive analysis is provided in Annex 1. The table below also presents some of the results. It is revealed that the drought duration is the key factor for households conducting some of the strategies, for instance selling assets and eating *nyika*. This simultaneously reinforced the fact that climate change indeed affects households and how they adapt their livelihoods to the changing weather patterns.

Regarding the adoption of drought-resistant crops, households that had more interchanges with extension workers exhibited a higher probability for adopting these new varieties. This strategy should be encouraged by the government to ensure that drought-resistant crops are increasingly adopted for ensuring harvests in the face of climate change.

Table 11: Regression results of factors affecting adaptation strategies.

	Adaptation strategies			
	Sell assets	**Eat *nyika***	**Buy food**	**Plant drought-resistant crops**
Duration of drought	0.265**	0.580*	0.171**	0.133
	(0.11)	(0.31)	(0.07)	(0.09)
Household size	0.323*	-0.112	0.184	-0.236
	(0.19)	(0.72)	(0.15)	(0.25)
Household head sex	-0.983	-2.525	-0.520	-1.827*
	(1.22)	(2.07)	(0.80)	(0.97)
Age	0.063**	0.174*	-0.002	-0.014
	(0.03)	(0.09)	(0.02)	(0.03)
Livestock assets	0.000	-0.002	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Months without food	0.253*	0.502*	-0.088	-0.029
	(0.14)	(0.30)	(0.08)	(0.11)
Number of extension visits	-0.467	-0.153	0.053	0.260*
	(0.42)	(0.52)	(0.13)	(0.14)

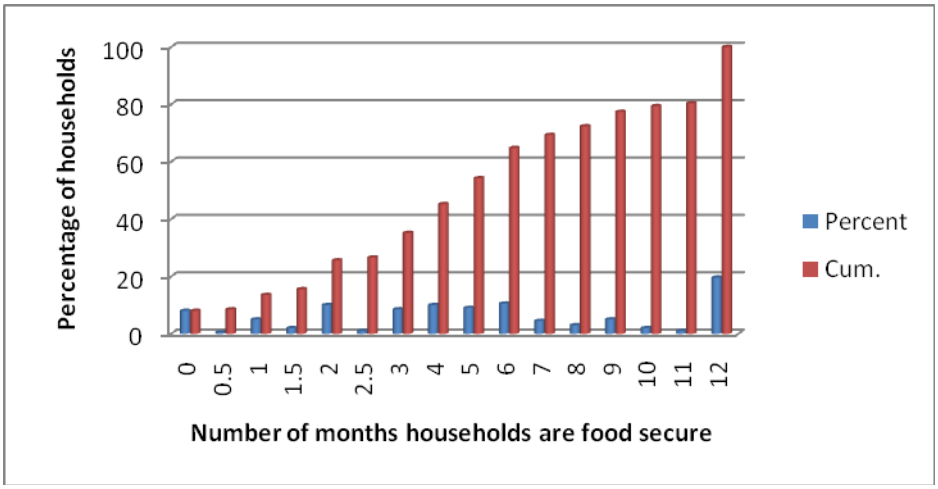
Figures in parenthesis are standard deviations.

*Significance levels: * = 10%; ** = 5%; *** = 1%; **** = 0.1%.*

6.1.6 Food security status

The community of Chikhwawa is generally food insecure. From the households interviewed in the study, only 20 per cent indicated that they have enough food from one growing season to the other. The remaining households stated that they lack food for at least one month, and 50 per cent have no food for more than half of the year (see Figure 10) – food in this respect predominantly refers to maize.

Figure 10: Food secure months.



6.1.7 Adaptive assets

Livelihoods in the study area are mainly agriculture-based, so study participants were involved in farming throughout the year. They also engaged in other livelihood activities, e.g., in Thonje village, farmers earned additional income from selling charcoal, firewood, burnt bricks, mats, grass and local beer.

The participants are differently endowed with productive assets through owning land (partially), livestock (goats and chicken), radios and mobile phones. Ownership of assets affects their ability to respond to vulnerabilities such as climatic shocks. They are, in fact, an indication of how easily one can bounce back from losses of farm production.

Households also depend on so-called *ganyu*, which is casual labour undertaken on other farms in order to earn additional incomes. The challenge related to this, though, is that the period when households need the labour on their own farms is also the point in time when they run short of food and need the extra income generated from *ganyu*. Thus, husbands and wives have to agree on which of them will leave for additional employment and who will stay on the family farm. Lastly, livestock sales have also become an important source of income for paying school fees, purchasing medicine and paying traditional healers.

The study participants often also belong to several clubs and social networks that enable them to access resources such as farm inputs, food aid and information. These clubs are promoted either by government or NGO frontline workers. The map and table below presents a list of NGOs operating in the district, their locations and respective activities.

Figure 11: NGOs operating in Chikhwawa District.

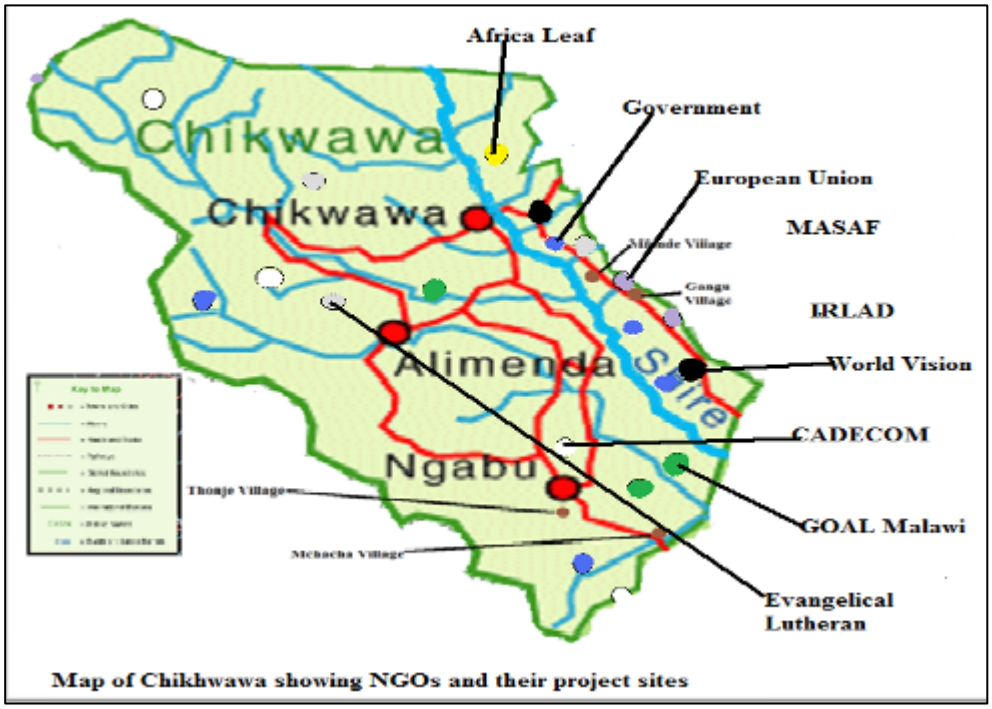


Table 12: Organisations and their activities.

Organisation	Assistance/support
Catholic Development Commission in Malawi (CADECOM)	Agricultural inputs, goats (pass on programme)[2]
IRLAD	Agricultural inputs (fertiliser, seed, sprayers), irrigation scheme, forestry)
World Vision Malawi	Food: maize, soya flour
Malawi Social Action Fund (MASAF)	Income through public works programme
European Union	Irrigation, agricultural inputs, equipment
GOAL Malawi	Goats (pass on programme)
Nyasa Leaf	Oriental tobacco
Evangelical Lutheran Development Service	Goats (pass on programme)
Government	Food, agricultural inputs

These organisations get in contact with farmers mostly through the official extension planning area (EPA) offices. Some NGOs, however, recruit their own frontline staff to implement their activities. The frequency and amount of visits that organisations have conducted is shown in Table 13. It can be seen that the government is the most crucial extension provider indicated by the comparatively high percentage of household visits; on the other hand, NGOs conducted their visits more frequently. The main challenge faced by government extension workers is the limited resources available to them for implementing their activities effectively. Most of the time, the activities supported by government resources

[2] This is a programme whereby a she-goat is given to a household and the first kid from the goat is passed on to another household, which later passes its first kid on to yet another household, hence the term 'pass on'.

only operate smoothly due to the assistance provided by NGO or donor partners working through the EPAs. A regression analysis (see Annex 1) was conducted to assess the determinants of the adaptation strategies and it shows that more extension visits significantly contributed to the higher acceptance of drought-resistant varieties. Other strategies, for instance irrigation extension services, are positive but not significant.

Table 13: Extension organisation and the number of visits per year.

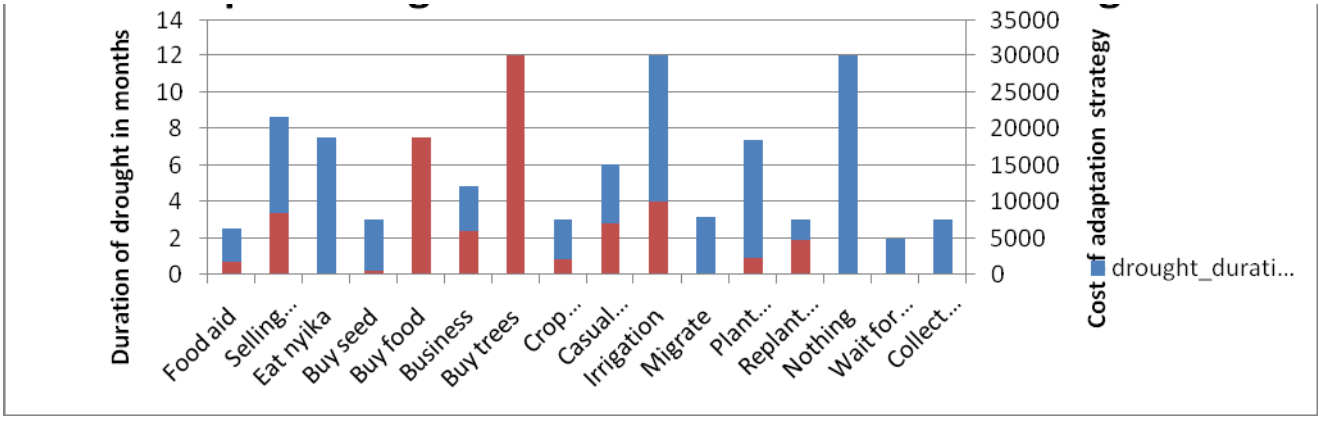
Extension organisation	% of households visited	Mean number of times visited per year	Max. number of times visited per year
None	51.18	0	0
Government	41.23	3.4	12
Government projects	1.90	1.5	2
NGOs	5.69	4.7	12

6.2 Current adaptation signatures

Currently, a number of adaptation strategies have been employed by the farmers and below is a graph showing the strategies and the cost on the y axis, and duration of drought on the x axis. Food aid (1) is already provided during very short drought incidences and was rated the cheapest form of adaptation. This mainly refers to government- and NGO-led disaster relief measures. Migration (6), on the other hand, is often the most expensive strategy and is applied in long drought periods. Irrigation (8) has already been employed during short-term hazard occurrences and also constitutes one of the more expensive options due to the equipment costs related to pumps and the general establishment of schemes, which used to be mainly financed by the government or NGOs.

Households resort to selling assets (2) only during severe drought conditions. Replanting (11), although very cost-intensive due to repurchasing of seeds and labour, is commonly used during dry spells – mostly at the beginning of the growing season.

Figure 12: Adaptation signatures based on observed strategies.



6.3 Looking to the future

6.3.1 Climate projections

Global circulation Models (GCMs) are the foundation of climate change projections. These models attempt to simulate the global climate system by integrating known atmospheric physical processes through time. The models simulate effects of the heating effect of the sun; the heat and moisture fluxes from the oceans; and the effect of the land surface and vegetation, as well as greenhouse gases (GHGs), on the atmospheric temperature profile. Nevertheless, many processes occur at scales that cannot be resolved by the GCM numerics. These processes are approximated through parameterisations. Parameterised processes included cloud radiative effects; convection and precipitation; boundary layer mixing; and diverse aspects of surface heat and moisture fluxes. The many differences between GCMs are a result of the different approaches to these parameterisations, particularly cloud radiative effects and precipitation processes. Another consequence of importance is that the capacity of a GCM to simulate a particular region varies among regions

6.3.2 Multi-model selection

Just picking the GCM that best represents the climate of a respective region of interest is not a valid approach because when generating climate change projections, changes in GHG concentrations also need be taken into consideration. But a GCM that accurately simulates climate patterns does not necessarily accurately respond to changes in GHGs. Since we do not know what an accurate response in this respect may be, all models represent an equally probable response. This is the basis for the development of climate projection envelopes that are composed of a range of responses produced by the GCMs.

6.3.3 Model bias

It is acknowledged that each GCM has a particular bias for a particular variable in a particular region. This bias can be significant in the case of precipitation. When developing future projections it is therefore important not to look at the raw GCM output fields only, but also to look at the anomalies between the past and the future GCM simulations. These anomalies are calculated for each GCM and represent the GCM response or delta given the GHG forcing. In the figures that follow, both the absolute downscaled GCM projection envelopes and the anomaly envelopes are presented. The absolute values are still useful in order to show the GCM seasonality as well as the conformity between GCMs.

6.3.4 Downscaling

The resolving scale of GCMs has improved significantly in the last ten years, with many state-of-the-art GCMs able to resolve at a scale of around 100km. The CMIP3 archive GCMs are typically of lower resolution than 100km, with resolution ranging between 200km and 400km. However, while the native resolution of GCM may be 200km, the skill of the model at this resolution is typically low due to the GCM's simplified topography and representation of regional processes. GCM skill is much higher when aggregated up to large scales, such 500km to 1000km.

The problem is that these scales are far too coarse for most users who are dealing with regional issues such as water management and agriculture. Society and ecosystems typically operate at much finer scales. Downscaling is the concept based on the observation that local climate is largely a function of the large-scale climate, modified by some local conditions such as topography. There are two main types of downscaling: dynamical and empirical.

- Dynamical downscaling utilises a higher resolution, limited domain, and a model that follows the same principles as a GCM but is able to be run at much higher spatial resolutions with moderate computation costs.
- Dynamical downscaling offers a physically-based regional response to the large-scale forcing. However, dynamical modelling is complicated by similar problems to those of GCMs, namely bias and error.

Empirical downscaling utilises various statistical methods to approximate the regional-scale response to the large-scale forcing. Various methods have been developed. The method used in this report is called SOMD (Self Organising Map-based Downscaling) developed at the University of Cape Town. The method recognises that the regional response is both stochastic as well as a function of the large-scale synoptics. As such, it generates a statistical distribution of observed responses to past large-scale observed synoptic states. These distributions are then sampled based on the GCM-generated synoptics in order to produce a time series of GCM downscaled daily values for the variable in question (typically temperature and rainfall). An advantage of this method is that the relatively unskilled grid scale GCM precipitation and surface temperature fields are not used by the downscaling but the relatively highly-skilled large-scale circulation (pressure, wind and humidity) fields are used.

1. The change in monthly total rainfall in millimetres (mm) for Chikhwawa - Illovo-Alumenda station is presented in Figure 13. Grey bars represent the 10th to 90th percentile range of the control period multi-model climatologies (1961 - 2000). Red bars represent the same but for the future multi-model projections (2046 - 2065). Anomaly plot wide bars represent 10th to 90th percentile ranges of the future – control anomalies with the median change marked as a solid black line.

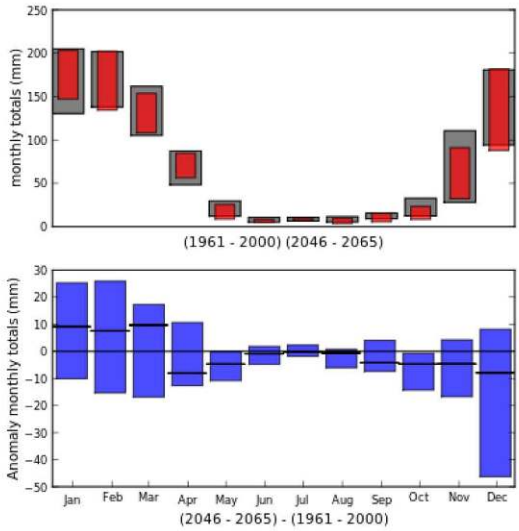
2. In respect of the change in monthly mean maximum daily temperature for Chikwawa Illovo-Alumenda station, the grey envelope represents the 10th to 90th percentile range of the control period multi-model climatologies (1961 - 2000). The red envelope represents the same but for the future multi-model projections (2046 - 2065). The anomaly plot envelope represents the 10th to 90th percentile range of anomalies with the median anomaly as a dashed line.

3. The change in monthly days exceeding 32°C for Chikwawa – Illovo - Alumenda station is also presented in the graphs. The grey envelope represents the 10th to 90th percentile range of the control period multi-model climatologies (1961 - 2000). The red envelope represents the same but for the future period multi-model projections (2046 - 2065). The anomaly plot envelope represents the 10th to 90th percentile range of anomalies with the median anomaly as a dashed line.

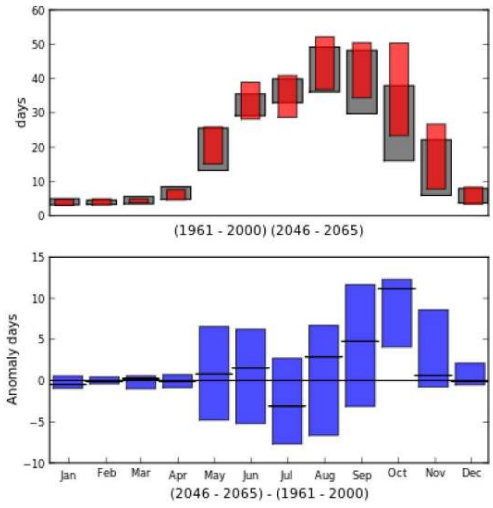
4. The projected changes in overall monthly rainfall show a possible drying of the early wet season and a corresponding wetting of the later season, indicating a shift of wet periods in the future. While the width of the multi-model envelopes is high there is a fairly strong agreement regarding the change for most months.

Figure 13: Climatic prediction (temperature and precipitation 2046 - 2065).

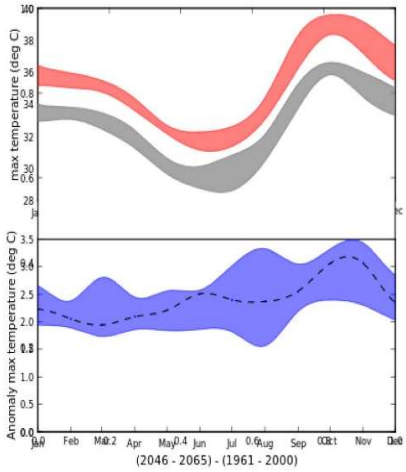
Monthly total precipitation change (SRES A2 Scenario)



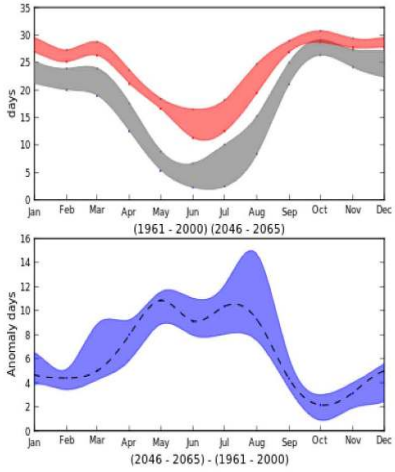
Monthly dry spell duration change (SRES A2 Scenario)



Monthly mean maximum daily temperature change (SRES A2 Scenario)



Monthly mean change in days exceeding 32 degC (SRES A2 Scenario)



5. The drying of the early wet season is represented more clearly when observing the projected changes in dry spell durations. Here we see a very strong shift towards drier conditions towards the end of the dry season and the start of the wet season. The analysis is too limited to allow an exact exploration, thus a more detailed analysis should be considered.

6. The projected changes in temperature largely align with the general regional increases of around 2°C to 2.5°C. However, corresponding to the drier end of the dry season and the increased dry spell durations in September and October is an enhanced warming during the end of the year, with the multi-model median changes exceeding 3°C.

7. It is important to note the interaction between rainfall and temperature. The projections presented suggest a drier hotter end of the year approaching the rainy season. The combination of dry conditions and high temperatures may have considerable consequences for a number of sectors, including water management and agriculture. The agreement between models is good, which suggests that these projections are reasonably robust.

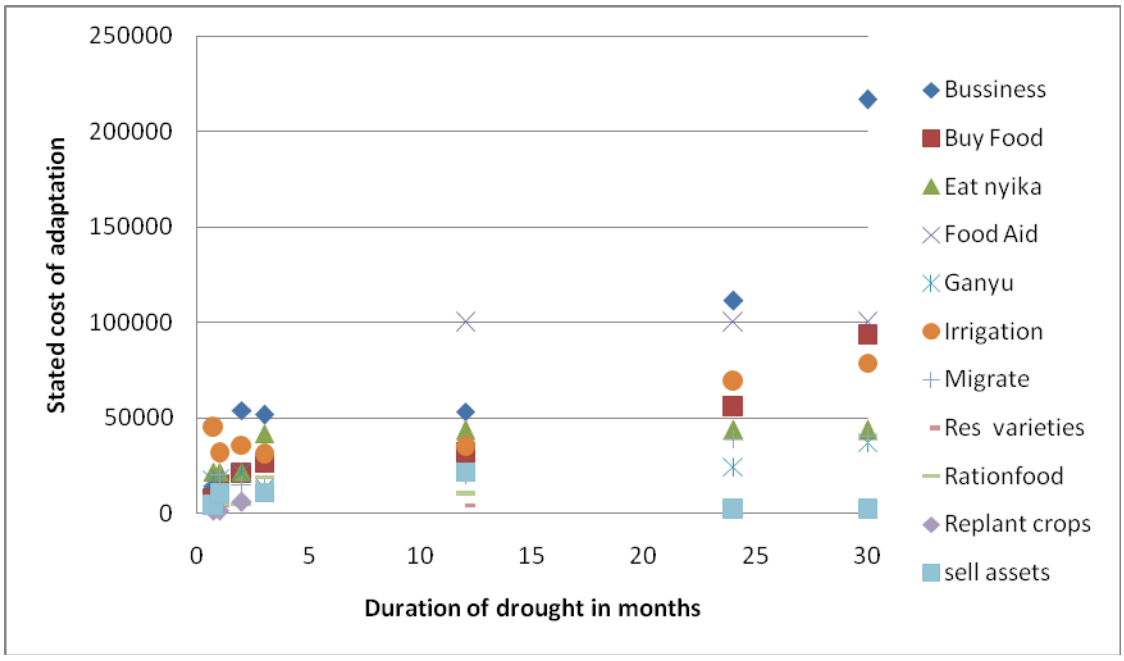
8. Projections of days per month exceeding 32°C show the greatest projected change during the cooler part of the year, which is to be expected. These changes could have considerable impact on energy requirements for cooling during a period of the year where currently significant cooling may not be required. Impacts on water resource management, both in supply and demand, may also be significant.

6.4 Communities' perceptions of future climate changes

The communities visited in the study envisage continuing climate change, especially in terms of temperature rise. Previously, people used to cover themselves with blankets at night in the winter month of June but nowadays they do not feel that cold anymore. The rain patterns also do not appear as they used to. Historically, rainfall was concentrated in September/October, resulting in early plantings so that by December people usually started harvesting and were provided with food. But due to the irregular rains nowadays, food is often lacking in January and February. Additionally, from their experience with the occurrence of droughts, farmers think that the frequency will continue to increase and it will keep on getting hotter.

With the predicted increase in temperature, and irregularity and unpredictability of precipitation, it will be difficult to continue farming as usual; assistance that can be provided should therefore be geared towards off-farm livelihoods. However, households were able to indicate what they would do if changes in climate occur. These strategies were based on what they have experienced and envisage as being more realistic and affordable, according to their resource endowments. Irrigation and venturing into non-agricultural activities featured high on their list of future adaptation strategies. Migration, use of natural resource (selling wild fruits and making charcoal), and food aid were options for longer drought periods or severe adverse conditions.

Figure 14: Stated adaptation strategies and average cost.

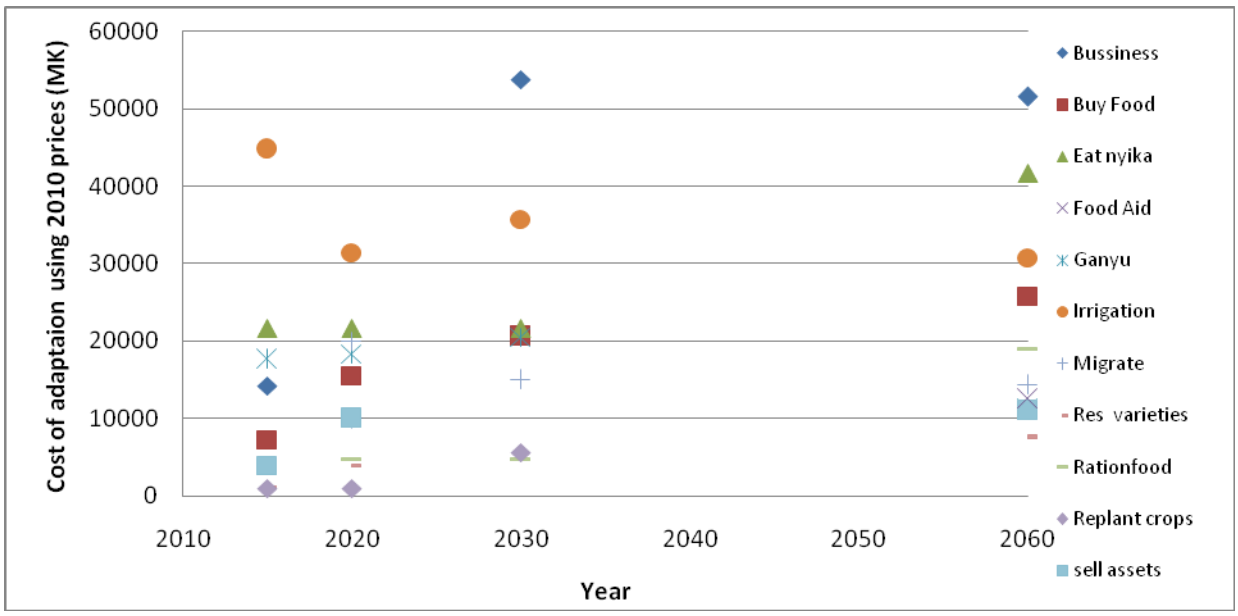


From the climate change projections, it is predicted that the adverse effects of climate change will occur as an increase in dry spells. It has been projected that dry spells may increase in length to become up to two months long in 2046 and beyond. Using this

information and including the strategies that are used in these adverse dry conditions by the communities visited, a graph (see Figure 15) has been plotted combining the two, i.e., two to three months dry spells and farmers' adaptation measures and costs. The costs are based on 2010 prices.

- In the short term (between 2010 and 2020), cheaper strategies would be replanting and selling assets.
- Irrigation is the most expensive strategy in the short term as it requires buying irrigation pumps and other equipment and the renting of land for those living far away from irrigable sites.
- Venturing into non-farm business activities is a better strategy during the adverse drought situations that are predicted to occur after 2030.
- Planting resistant varieties is a relatively cheap strategy in the short- and long-term. Households have planted drought-resistant crops such as sweet potatoes, millet and sorghum and have thereby been successful in harvesting enough food.
- Buying of food is rated as cheaper now as it can be financed by assets owned. However not all households have enough assets, such as livestock, to hedge against severe drought conditions.

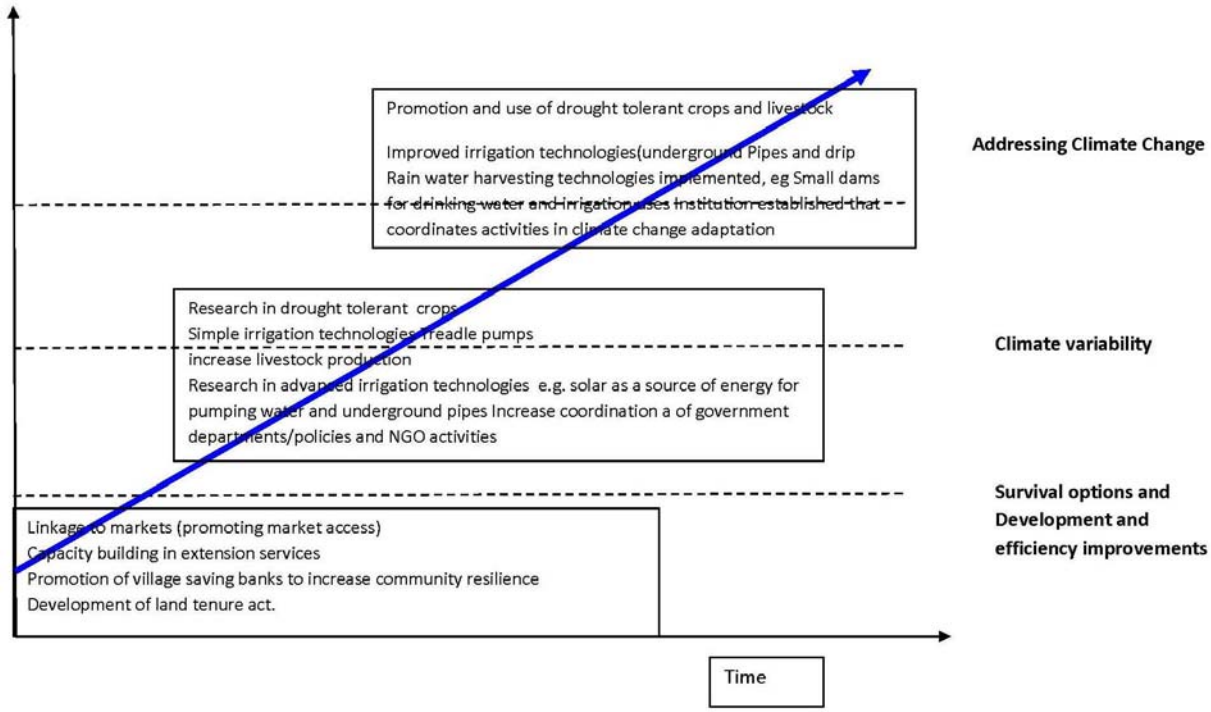
Figure 15: Stated adaptation strategies and climate change predictions.



7. The adaptation pathway

To adapt to climate change, a pathway of three levels is proposed. These stages build on each other and the first precedes the second and third. It is assumed that we may be in the second stage of climate change variability. However, any of the strategies in this stage cannot be sustainably effective if the strategies in the first stage are not satisfied. Details of each stage are given below.

Figure 16: Climate change pathway (assuming that the major effect of climate change is an increase in dry spells and drought).



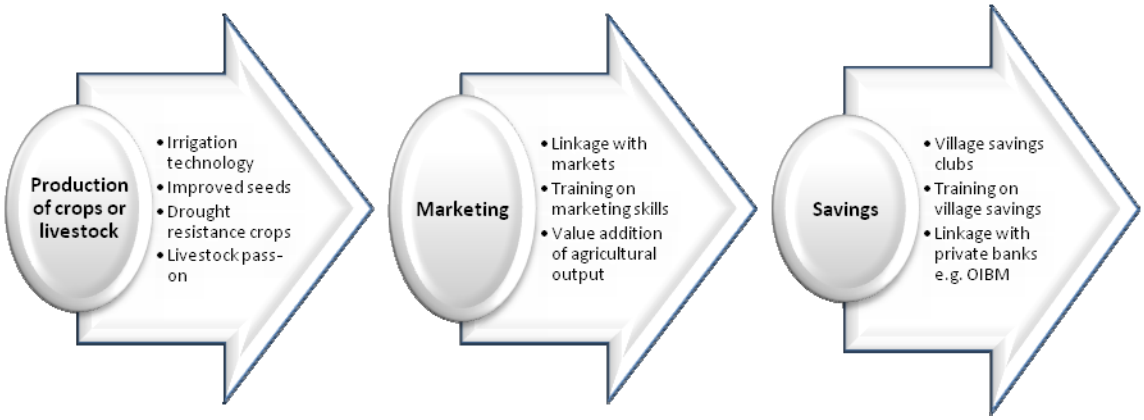
7.1 Building resilience in the community

Most livelihood activity projects have centred on production: using improved crops in drought-prone areas or improving soil productivity by introducing organic manure; agro-forestry; or conservation agriculture. Such interventions, however, have proven unsustainable as soon as the project phases out. A number of constraints have been identified including: the inability of rural famers to pay for the energy cost of irrigation systems; low pricing of agricultural output from irrigation; poor storage facilities resulting in produce that needs to be sold at low prices to prevent high storage losses; and finally poor road networks that make products inaccessible to potential buyers.

To address these issues, energy sources have to be sustainable and cheap. Solar energy has been proven to fulfil both requirements for rural farmers when the Churches Alliance for Rural Development (CARD) and the Red Cross have provided solar panels to communities in Chikhwawa and Salima respectively. Learning from these successful projects can help extend these technologies and hence sustain the projects. In other areas, the increase in production and the resulting supply of agricultural products has flooded the market and therefore reduced prices. Consequently, farmers were unable to finance the interventions necessary after the termination of the project.

Incorporating marketing and village savings clubs ensures that farmers are able to secure good markets and are also able to save their earnings for future investments. The Catholic Development Commission in Malawi (CADECOM), operating in Chikhwawa in collaboration with CARE Malawi, has piloted this model and has shown that farmers could save up to half a million Malawian kwacha in a year or two. Such savings can be linked to private banks and then provide farmers with further credit opportunities.

Figure 17: Complete model of intervention for livelihood improvement.



**OIBM = Opportunity International Bank Malawi Ltd.*

7.2 Climate change adaptation

In the second stage, having built resistance the community will have the ability to cope with changes in climate patterns. However, certain measures need to be implemented to establish an environment conducive to adaptation.

- Research in advanced irrigation and drought-resistant crops and livestock; establishment of well-coordinated institutions; and training and expanding extension services are regarded as sustainable and effective efforts.
- The need to improve water harvesting technologies, for instance through small dams that retain the water for use during droughts or dry spells, has also been identified .
- Similarly the requirement to enhance extension capacity in order to help farmers getting involved in new technologies has to be fulfilled as well.

The third stage is basically about implementing the climate change adaptation strategies, e.g., drought-resistant varieties and livestock, advanced irrigation technologies, and establishing a corresponding institutional environment.

8. Costing climate change adaptation

A costing of climate change adaptation technologies was conducted at three different levels: household, district and national. A list of activities that the costs are based on is presented in Table 14. A total of US$55,034,932 is required to prepare and adapt the maize-based system to climate change in the district of Chikhwawa. This estimate aggregates all costs from stakeholders, the government, private sector NGOs and local farmers and was calculated for five years.

8.1 Farmer level

Costs at this level were calculated according to farmers' past experiences when similar strategies had been implemented. These costs were then adjusted to 2010 prices and are costs the household has to pay, for example to buy improved seeds or get access to markets for selling products. Costs are presented on a 'per household' basis. The major contribution by households is labour – the major resource owned by rural peasants. Based on their experience during past droughts and projected strategies, it has been estimated that a total of US$600,000 may be required in the form of labour for the construction of water-harvesting technologies (e.g., earth dams and the establishment of irrigation schemes both at the community- and household-level). The other major cost to be met by the rural community is accessing input and output markets. This will involve transport costs and buying of seeds and other equipment, which was estimated to amount to US$100,000 for a period of five years.

8.2 District level

District-level costs were taken from projects and plans at the district assembly and NGO district office. These were adjusted to the number of households that each of the activities benefited, or are planned to benefit. (The budget at district level is presented as part of the national government budget, which is discussed under subsection 8.3, below). The private sector is envisaged as taking a leading role in linking the farmers to both the output and input markets. The establishment of village savings banks and credit facilities, as well as the entire marketing investment, is envisaged to cost about US$30,000,000 in the next five years. This is very important as it will reduce the burden on the government and at the same time create employment and enhance the resilience of both the farmers and the economy as a whole.

8.3 National level

The government has developed a sector-wide approach programme in which it has proposed a number of activities. These are activities to be carried out in the next five years according to detailed budgets that also include activities for climate change adaptation. These are presented (and used) as national figures. However, they also represent how much it will cost per unit of each activity, therefore they can be applied to any level

A total of US$21,334,932 is estimated as cost to be incurred by the government, mainly through providing subsidies for advanced irrigation equipment; research; promotion of drought-resistant crops and irrigation technologies; promotion of soil and water conservation; and other technologies. For the most part, these will be channelled through the Ministry of Agriculture and Food Security in extension services and research.

Table 14: Mapping of action and actors for climate change adaptation for Malawi.

Action	Actors/level	Now (relevant actions)	Later (relevant actions)
Linkage to markets (promoting market access)	*Community*	Provide what is demanded product: quality: quantity)	Establish stable supply units
	Private sector	Provide information on what is demanded	
	NGOs	Establish farmer groups/associations Facilitate contracts between farmers and private sector	
Capacity building in extension services	*National*	Train more extension workers	
Promotion of village saving banks to increase community resilience	*Community*	Development of village savings banks	Link with private banks
	District	Facilitating formation of village saving banks	Link village saving banks to private sector
Development of *Land Tenure Act.*	*National*	Enacting bill	
Research in drought-resistant crops	*National*	Trials in research stations Participatory plant breeding	Developing drought-resistant crops
Simple irrigation technologies such as treadle pumps	*Community*	Purchase pumps	
	District	Distribute pumps	
	Private sector	Provide pumps and spare parts at district level	
Increased livestock production	*National*	Establish breeding programmes	
	District	Distribute improved livestock breeds	
	Community	Implement pass-on programme	
Research in advanced irrigation technologies e.g., solar as a source of energy for pumping water, and underground pipes	*National*	Establish linkages with NGOs and University on research	
	District	Work with NGOs	
Increase coordination of government departments/policies and NGO activities	*National*	Establish coordination unit	Elevate into a government department
Promotion and use of drought-resistant crops and livestock	*District*	Provide more resources to extension services	
	Community	Adoption of drought-resistant crops	
Improved irrigation technologies (underground pipes and drip kits)	*District*	Linkage with private sector provider	
	Community		
Rainwater harvesting technologies implemented, e.g., small dams for drinking water and irrigation uses	*District*	Studies on possible dam sites	Construct dams
	Community		Provide labour in dam construction
Institution established that coordinates activities in climate change adaptation	*National*	Source funds for construction of small dams	Construct dams

Table 15: Summary of adaptation costs.

	Government	Private sector	NGO	Farmers	TOTAL
	US$	***US$***	***US$***	***US$***	***US$***
Linkage to markets (promoting market access) (10,000 households)	1,576,885	30,000,000	1,000,000	100,000	32,676,885
Development multiplication and promotion of improved drought-resistant varieties	32,714				32,714
Drip kit for 0.2 ha of land for one household US$1000/household (10,000 households)	10,000,000				10,000,000
Labour contribution to construction of tanks US$2000/tank (1000 tanks)				600,000	600,000
Cost of one underground tank materials US$2000/tank (1000 tanks)			2,000,000		2,000,000
Cost of one earth dam = US$10,000/dam (assuming 200 earth dams across the whole country)	2,000,000				2,000,000
Institution established that coordinates activities in climate change adaptation	21,000				21,000
Research in advanced irrigation technologies, e.g., solar as a source of energy for pumping water, and underground pipes	1,254,333				1,254,333
Increased livestock production	1,450,000				1,450,000
Promote conservation farming/agriculture (all technologies that maintain soil fertility and water management) US$500/household X 10,000 households	5,000,000				5,000,000
Total	**21,334,932**	**30,000,000**	**3,000,000**	**700,000**	**55,034,932**

9. Conclusions

The increased frequency of droughts and floods in Malawi can be linked to climate change and has negative impacts on agriculture. Maize-based systems, like the one used in Chikhwawa District, are vulnerable to changing weather patterns, which consequently adversely affects people's livelihoods.

This study has revealed that a number of adaptation strategies are already being implemented at the local and household level. Selling of assets, diversification of crops and livestock, migration, and collecting wild plants (*nyika*) for food were identified as some local adaptation strategies.

NGOs and the government, through the Ministry of Agriculture and Food Security, have embarked on a number of activities – mainly increasing water availability through different types of irrigation.

Climate projections reveal that temperature in Chikhwawa District will increase by about 3^{o}C by 2065, and the number of days with temperatures above 32^{o}C will also increase. Consequently, the area will get drier as the amount of rain declines there. A number of strategies need to be put in place to make communities more resilient to climate change and prepare them for the drier and hotter seasons.

Proper planning and strategising on how to reduce the impacts of such temperature changes have been evaluated in this study. The study proposes strategies such as research into drought-resistant crops, advanced irrigation, and building community resilience to be able to adapt to the projected climate change. Using the current strategies already employed by the community and NGOs, and projecting other important strategies that need to be planned, it is estimated that around US$55,000,000 will be required to adapt to climate change in the district over five years. This will include local activities (e.g., irrigation systems) and national programmes (such as research into drought-resistance).

The study recommends the following;

1. Investing in research, extension, and training to identify drought-resistant varieties and impart knowledge on climate change to the farmers.

2. Investing in irrigation infrastructure to enable farmers to grow maize, even during droughts.

3. Building resilience in the communities by diversifying their livelihoods.

References

Adger, W.N., Huq, S., Brown, K., Conway, D. and Hulme, M. 2003. Adaptation to climate change in the developing world. In: *Progress in Development Studies* 3(3): 179-195. Available to download at: http://www.uea.ac.uk/env/people/adgerwn/ProgDevStudies2003.pdf

Chadza and Banda. 2008. Climate Change Initiatives in Malawi. Paper presented at the UNFCCC Conference of the Parties (COP15), Copenhagen, Denmark, 7 - 19 December, 2009.

Chirwa, W. 2004. *Access to Land, Growth and Poverty Reduction in Malawi.* Project Report funded by the North-South Institute (NSI), Ottawa, Canada.

Chirwa. W. 2006. *Commercialisation of Food Crops in Rural Malawi.* Working Paper No. 2006/04, Chancellor College, University of Malawi.

Chirwa, E.W., Kumwenda, I., Chilonda, P. and Jumbe, C. 2009. *Agricultural Growth and Poverty Reduction in Malawi: Past Performance and Emerging Trends*. Regional Strategic Analysis and Knowledge Support Systems, Southern Africa (ReSAKSS-SA) Working Paper No.8.

Cosgrave, J. 2010. *Programme evaluation of disaster risk reduction*. Available to download at: http://www.preventionweb.net/english/professional/publications/v.php?id=12764

Department of Agricultural Extension Services (DAES). 2000. *Agricultural extension in the new millennium: towards pluralistic and demand-driven extension services in Malawi*. Agriculture and Livestock Development, Lilongwe, Malawi.

Department of Agricultural Research Services (DARS). 1995. *Agricultural Research Master Plan*. Agriculture and Livestock Development, Lilongwe, Malawi.

Department of Climate Change and Meteorological Services (DCCMS). 2011. *Towards More Reliable, Responsive and High Quality Weather and Climate Services in Malawi*: *About Us*. Available to download from: http:www.metmalawi.com/climate/climate.php

Environmental Affairs Department (EAD). 2006. *Malawi's National Adaptation Programmes of Action (NAPA).* Government Press, Zomba, Malawi. Available to download from: http://www.preventionweb.net/english/policies/v.php?id=8536&cid=104

Environmental Affairs Department. 2008. *Malawi's Second National Communication to the UNFCCC*. Government Press, Zomba, Malawi

Evangelical Association of Malawi. 2010. *Annual Report for 2010*. Lilongwe Malawi.

Government of Malawi (GoM). 1987. *Statement of Development Policies 1987 - 1996.* Government Printer, Zomba, Malawi.

Government of Malawi (GoM). 1991. *Disaster Preparedness and Relief Act No. 27 of 1991.* Lilongwe, Malawi.

Government of Malawi (GoM). 1994. *National Environmental Action Plan*. Lilongwe, Malawi.

Government of Malawi (GoM). 1996. *National Environmental Policy*. Lilongwe, Malawi.

Government of Malawi (GoM). 1996. *Environmental Management Act No. 23 of 1996*. Lilongwe, Malawi.

Government of Malawi (GoM). 1997. *Forest Act No. 11 of 1997*. Lilongwe, Malawi.

Government of Malawi (GoM). 1998. *National Decentralisation Policy*. Available to download at: http://www.mlgrd.gov.mw/030107.htm

Government of Malawi (GoM). 1998. *Local Government Act No. 42 of 1997*. Lilongwe, Malawi.

Government of Malawi (GoM). 2000. *Vision 2020: The national long-term development perspective for Malawi.* Lilongwe, Malawi.

Government of Malawi. 2000. *National Irrigation Policy and Development Strategy*. Ministry of Agriculture and Irrigation. Lilongwe, Malawi.

Government of Malawi (GoM). 2003. *HIV/AIDS in the Agriculture Sector Policy and Strategy, 2003-2008*, Lilongwe, Malawi.

Government of Malawi (GoM). 2005. *Food and Nutrition Security Policy*. Lilongwe, Malawi.

Government of Malawi. (GoM). 2005. *A New Era in Agricultural Policy: A Strategic Agenda for Addressing Economic Development and Food Insecurity in Malawi.* Ministry of Agriculture, Lilongwe, Malawi.

Government of Malawi (GoM). 2009, *Annual Economic Report*, Ministry of Economic Planning and Development, Lilongwe, Lilongwe.

Government of Malawi (GoM). 2010. *The Agriculture Sector Wide Approach (ASWAp): Malawi's prioritised and harmonised agricultural development.* Ministry of Agriculture and Food Security, Lilongwe, Malawi.

GTZ. 2005. *Guide Book on Decentralization and Local Government in Malawi*. Malawi-Germany Programme for Democracy and Decentralization, Lilongwe, Malawi.

Intergovernmental Panel on Climate Change (IPCC). 2007. *Synthesis Report.* See: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

International Food Policy Research Institute (IFPRI). 2009. *The impacts of agricultural input subsidies in Malawi*. Policy Note No. 5. Lilongwe, Malawi

Irish Aid. 2010. *Malawi Country Strategy Paper 2010-2014*. Lilongwe, Malawi. See: http://www.irishaid.gov.ie/Uploads/Malawi_mini_CSP.pdf

Jenkins, R. and Tsoka, M. 2003. *Malawi, Fighting Poverty in Africa: Are PRSPS Making a Difference?* Overseas Development Institute, London, UK.

Kydd, J.G., Dorward, A.R, Morrison, J.A. and Cadisch, G. 2004. Agricultural Development and Pro Poor Economic Growth in Sub Saharan Africa: Potential and Policy. *Oxford Development Studies* 32 (1): 37-57.

Malcomb, D. 2010. *Geo-coding Aid Projects in Malawi: New strategies in aid transparency in Malawi.* University of Texas-Austen, USA.

Masanganise, P. 2009. *The Maize Success Story in Malawi: Agricultural Input Subsidy Programme.* Khanya-aicdd (African Institute for Community-driven Development). PowerPoint presentation can be downloaded from: http://www.uneca.org/search.htm

Ministry of Agriculture and Food Security (MoAFS). 2006. *Ministry of Agriculture and Food Security Strategic Plan*. Lilongwe, Malawi.

Ministry of Agriculture and Food Security (MoAFS). 2006. *Agricultural Policy Framework*, Lilongwe, Malawi.

Ministry of Agriculture and Food Security (MoAFS). 2010. *The Agriculture Sector Wide Approach (ASWAp): Malawi's prioritised and harmonised agricultural development Agenda*. Lilongwe, Malawi:

Ministry of Agriculture and Irrigation (MoAI). 2000*. National Irrigation Policy and Development Strategy.* Lilongwe, Malawi:

Ministry of Agriculture and Livestock Development (MoALD).1995. *The Agricultural and Livestock Development Strategy and Action Plan*. Lilongwe, Malawi.

Ministry of Development Planning and Cooperation (MDPC). 2009. *Poverty-Environment Initiative. See:* http://www.unpei.org/what-we-do/pei-countries/malawi.html

Ministry of Economic Planning and Development (MEPD). 2002. *Malawi Poverty Reduction Strategy Paper*. Lilongwe, Malawi.

Ministry of Economic Planning and Development (MEPD). 2006. *Malawi Growth and Development.* Lilongwe, Malawi.

Ministry of Local Government and Rural Development (MLGRD). 2004. *National Decentralisation Programme*. Lilongwe, Malawi.

Ministry of Women and Child Development (MoWCD). 2005. *National Plan of Action for Orphans and Other Vulnerable Children*. Lilongwe, Malawi.

Ministry of Women and Child Development (MoWCD). 2006. *National Policy on Early Childhood Development.* Lilongwe, Malawi.

National Statistics Office. 2005. *Malawi Demographic and Health Survey 2004*. NSO and ORC Macro, Calverton, Maryland.

National Statistics Office. 2005. *Integrated Household Survey: 2004-2005, Volume I*. Government of Malawi, Lilongwe, Malawi.

Office of the President and Cabinet (OPC). 2011. *The Green Belt Initiative: Scope and Current Status.* Government of Malawi, Lilongwe, Malawi.

World Bank. 2003. *Land Policies for Growth and Poverty Reduction*. World Bank, Washington, D.C., USA.

World Bank. 2008. *Malawi Agricultural Development. Report No.: AC3254*. World Bank Lilongwe, Malawi.

UN International Strategy for Disaster Reduction Secretariat (UN/ISDR). 2010. *Integrating disaster risk reduction and climate adaptation into the fight against poverty. Annual Report 2010.* Washington, D.C., USA.

USAID. 2010. Fact Sheet USAID state foreign assistance appropriation (FY2008-11). See: http://www.usaid.gov/locations/sub-saharan_africa/countries/malawi/malawi_fs.pdf

Annexure 1: Multinomial logit of adaptation strategies

	Food aid	Sell assets	Eat *nyika*	Buy food	Business	Casual labour (*ganyu*)	Irrigation	Migrate	Plant drought-resistant crops	Replant
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
Duration of drought	-0.134	0.265**	0.580*	0.171**	0.075	0.108	-0.075	0.701	0.133	-0.094
	(0.20)	(0.11)	(0.31)	(0.07)	(0.11)	(0.07)	(0.11)	(0.73)	(0.09)	(0.10)
EPA close to river	-1.144	0.138	-16.913	-0.501	-0.678	-0.407	-0.623	-0.544	0.718	-0.215
	(1.09)	(1.02)	(576.11)	(0.63)	(1.01)	(0.58)	(0.78)	(1.96)	(1.04)	(0.71)
Household size	0.148	0.323*	-0.112	0.184	-0.229	0.083	0.229	0.055	-0.236	-0.055
	(0.26)	(0.19)	(0.72)	(0.15)	(0.30)	(0.14)	(0.18)	(0.60)	(0.25)	(0.16)
Household head sex	-0.112	-0.983	-2.525	-0.520	-0.264	-0.901	-0.542	18.962	-1.827*	-0.994
	(1.35)	(1.22)	(2.07)	(0.80)	(1.31)	(0.73)	(0.96)	(2372.24)	(0.97)	(0.83)
Age	0.014	0.063**	0.174*	-0.002	-0.018	-0.001	0.022	0.051	-0.014	0.024
	(0.03)	(0.03)	(0.09)	(0.02)	(0.03)	(0.02)	(0.02)	(0.06)	(0.03)	(0.02)
Livestock assets	-0.000	0.000	-0.002	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Plot size (ha)	0.108	-0.028	-0.327	-0.125	0.095	0.030	0.058	0.019	-0.221	0.087
	(0.17)	(0.19)	(1.00)	(0.21)	(0.17)	(0.13)	(0.15)	(0.29)	(0.50)	(0.15)
Value of assets	-0.000	-0.000	-0.000	0.000	0.000	0.000	-0.000	-0.000	0.000	0.000
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Months without food	0.040	0.253*	0.502*	-0.088	0.018	-0.040	-0.035	0.170	-0.029	0.065
	(0.15)	(0.14)	(0.30)	(0.08)	(0.13)	(0.07)	(0.11)	(0.25)	(0.11)	(0.09)
No. of extension visits	0.017	-0.467	-0.153	0.053	-0.202	0.086	0.139	0.008	0.260*	0.133
	(0.26)	(0.42)	(0.52)	(0.13)	(0.35)	(0.12)	(0.15)	(0.38)	(0.14)	(0.13)
Constant	-1.271	-6.523*	-9.911	0.513	1.032	1.918	-0.961	-48.597	2.617	0.527
	(3.19)	(3.36)	(7.41)	(1.88)	(3.23)	(1.72)	(2.26)	(4744.51)	(2.51)	(1.99)
									Prob > chi2	0.028
									Number of observations	175

Annexure 2: Detailed costs of adaptations

.

STAGE1: Building community resilience

Action	Actor(s)	Total units	Unit cost (US$)				Output indicator/qualitative factors/notes
			GoM	*Private sector*	*NGO*	*Farmers*	
Linkage to markets (promoting market access): provide what is demanded (product, quality, quantity)	*Farmers*					10	
Linkage to markets (promoting market access): provide information on what is demanded	*Private sector*			3,000			
Linkage to markets (promoting market access): - establish farmer groups/associations - facilitate contracts between farmers and private sector	*NGOs*				1,000		
Provide research, extension and marketing services for irrigation systems users	*DAES*	6,000	100				Number of farmer groups receiving advice on irrigation production and marketing of rice/horticulture
Promote group and individual small-scale agro-processing (e.g., horticultural produce, cassava, potato, pulses)	*DCP*	340	500				Number of cassava and sweet potato processing groups set up
		425	2,500				Number of cassava and sweet potato processing equipment distributed
		30,000	35				Number of farmers receiving information about transformation technologies for root crops
Develop and adapt agro-processing technologies	*DARS*	2	15,000				Number of root crop agro-processing technologies released
Increase knowledge and skills in agro-processing technologies	*DAES*	789	10,000				Number of extension staff trained in agro-processing technologies
		374	5,000				Number of farmer groups trained in agro-processing
		374	7,000				Facilitate procurement of agro-processing machinery
Expand market information system (MIS)	*DAPS*	198	750				Number of MIS bulletins

STAGE1: Building community resilience (*continued*)

Action	Actor(s)	Total units	Unit cost (US$)				Output indicator/qualitative factors/notes
			GoM	*Private sector*	*NGO*	*Farmers*	
Build or rehabilitate market infrastructure	*DAPS*	20	20,000				Number of new wholesale markets built
		100	1,000				Number of new collection points built
		40	10,000				Number of markets rehabilitated
Financial leverage systems for private agro-business enterprise development (matching grants, etc.)	*DAPS*	1	1,500,000				Number of systems developed and tested
Provide non-financial business services and capacity strengthening to small- and medium-scale agro-processors.	*DAPS*	34	5,000				Number of agro-processors trained

STAGE 2: Research in drought-resistant crops

Action	Actor(s)	Total units	Unit cost (US$)				Output indicator/qualitative factors/notes
			GoM	*Private sector*	*NGO*	*Farmers*	
Develop improved varieties	*DARS*	6	10,300				
Multiply breeder seed	*DARS*	26,000	10				Number of improved varieties released
Increase distribution of improved maize seed	*DARS*	70	5,000				Quantities of breeder seed multiplied (kg)
	DARS	7,000	50				Quantities of maize basic seed produced (metric tonnes)
	DARS	107,000	179				Quantities of commercial improved seed certified (metric tonnes)
	DCP	540	100				Quantities of improved maize seed sold (metric tonnes)
Multiply breeder and basic seed	*DCP*	168	500				Number of farmer groups involved in improved seed multiplication
Develop new pulse varieties	*DARS*	9	8,000				Number of community seed banks
Develop new pulse varieties	*DARS*	15	350				Number of new pulse varieties released
Multiply breeder and basic pulse seed	*DARS*	3,900	15				Quantities of breeder pulse seed produced (kg)
Multiply breeder and basic pulse seed							Number of community seed banks
Multiply breeder and basic pulse seed	*DARS*	39	5,000				Quantities of basic pulse seed produced (metric tonnes)
Multiply breeder and basic pulse seed	*DARS*	390	75				Quantities of basic pulse seed produced (metric tonnes)

STAGE 2: Research in drought-resistant crops (*continued*)

Action	Actor(s)	Total units	Unit cost (US$)				Output indicator/qualitative factors/notes
			GoM	*Private sector*	*NGO*	*Farmers*	
Increase distribution of improved pulse seed	*DPC*	100	100				Quantity of certified commercial pulse seed (metric tonnes)
Conduct pulse seed quality control	*DARS*	9,000	35				Number of farmer groups involved in pulse seed multiplication
Promote establishment of community seed banks for legumes	*DCP*	500	500				Number of hectares inspected
Popularise new crop varieties and improved farming technologies	*DCP/ DAES*	7,900	2,500				Number of community seed banks established

STAGE3: Climate change adaptation

Action	Actor(s)	Total units	Unit cost (US$)				Output indicator/qualitative factors/notes
			GoM	*Private sector*	*NGO*	*Farmers*	
Simple irrigation technologies such as treadle pumps	*Farmer*					125	
Research in advanced irrigation technologies, e.g., solar as a source of energy for pumping water, and underground pipes	*GoM*		1,254,333				
Increased livestock production	*GoM*	800	1,450				Number of farmer groups assisted with breeder goats
Increase coordination of government departments/policies and NGO activities	*GoM*	500	21,000				Number of technical meetings conducted
Promotion and use of drought-resistant crops and livestock	*Farmers*					15	Cost of using drought-resistant crops per household
	GoM		5,000				Increase distribution of improved maize seed
Promote conservation farming/agriculture (all technologies that maintain soil fertility and water management)	*GoM*	3,200	500				Number of groups receiving conservation agriculture advice and planting material
Improved irrigation technologies (underground pipes and drip kits)	*GoM*					1,000	Drip kit for 0.2 ha of land for one household
Rainwater harvesting technologies implemented, e.g., small dams for drinking water and irrigation uses	*Farmers*					300	Labour contribution to construction of tanks
	NGO				2,000		Cost of one underground tank materials
	GoM		10,000				Cost of one earth dam
Institution established that coordinates activities in climate change adaptation	*GoM*	16	500				Number of technical meetings conducted

Annexure 3: Percentage of farmers with their stated adaptation strategies

Adaptation strategies	0.75 month	1 month	2 months	3 months	12 months	24 months	>24 months
Business	4.35	3.03	8.04	8	11.81	7.22	5.88
Buy food	8.7	8.08	8.04	9.6	12.6	5.15	2.94
Eat *nyika* (water tuber)	4.35	4.04	4.46	3.2	3.94	5.15	4.9
Food aid	2.17	3.03	1.79	4	4.72	8.25	10.78
Ganyu (casual labour)	40.22	36.36	33.04	33.6	17.32	22.68	21.57
Irrigation	8.7	11.11	13.39	18.4	18.11	21.65	22.55
Migrate	0	1.01	1.79	2.4	5.51	11.34	12.75
Nothing	13.04	18.18	12.5	12	12.6	14.43	14.71
Planting resistant crops	2.17	1.01	2.68	1.6	5.51	0	0
Ration food	2.17	2.02	1.79	3.2	2.36	1.03	0.98
Replanting	11.96	10.1	10.71	1.6	0	0	0
Sell assets	2.17	2.02	1.79	2.4	4.72	2.06	1.96
Use natural resources	0	0	0	0	0.79	1.03	0.98