DISSEMINATION OF CLIMATE INFORMATION TO SMALL-HOLDER FARMERS: A CASE STUDY FOR MUJIKA AREA, ZAMBIA

by

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DECLARATION

I hereby declare that this thesis hereby submitted by me for the qualification Philosophiae Doctor in Agricultural Meteorology (Department Soil, Crop and Climate Sciences) at the University of the Free State is my own independent work and has not previously been submitted by me for a qualification at/in another University/faculty.

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Durton H. Nanja

ABSTRACT

DISSEMINATION OF CLIMATE INFORMATION TO SMALL-HOLDER FARMERS: A CASE STUDY FOR MUJIKA AREA, ZAMBIA

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Most scientists globally agree that human activities are causing global climate change resulting in pressures on Africa's agriculture systems and economies. Knowledge gaps still exist in coping with climate change and adaptation, regardless of the increasing country level research on the agricultural systems. With climatic information dissemination and appropriate policy development as major global themes, literature and knowledge on dissemination of climatic information is still limited in Zambia.

This study was undertaken in Mujika area of Monze district, southern province of Zambia from 2007 to 2010. Faced with climate change challenges, the Mujika community opted to investigate the possibility of developing an agrometeorological extension strategy. This strategy was to respond to community needs for routine dissemination of climatic information, serving as a warning as well as guide to improving the local agricultural decision making.

This study addressed the following specific objectives:

- To analyze long-term rainfall data for two stations as a basis for developing climate risk approaches for Mujika area;
- To establish the current status of climatic risk information and dissemination practices in Mujika area;
- To document the social/institutional aspects that enable farmers to adopt appropriate alternative interventions; and
- To operationalise the community agrometeorological participatory extension service (CAPES) so as to evaluate its effectiveness.

Data collection used both quantitative and qualitative methods. The quantitative approach analyzed long-term rainfall data while the qualitative approach used Participatory Rural Appraisal (PRA). Community members from three villages (Nkabika, Bulimo and Malomo) participated in PRA exercises by presenting spatial data (in community sketch maps, farm sketches and transect walks),

time related information (by historical time and trend lines) and social data (from household interviews, daily calendar according to gender and institutional analysis) throughout the study. They organized their problems and opportunities into a priority order at the village level, resulting in the creation of a community information dissemination plan (CIDP). The implementation of the CIDP included weekly local radio broadcasts of specially prepared programmes which were then recorded by local club representatives. The farmers organized themselves into five small radio listening clubs where they listened and discussed the re-recorded programmes. Their learning by doing was around the mother field trial managed by the other PhD student, Prospard Gondwe and baby field trials conducted by 16 local farmer volunteers in their own fields. Monitoring and evaluation was incorporated into the project by these volunteer farmers keeping records of most project activities. A community agrometeorological participatory extension service (CAPES) developed out of these interactions between stakeholders, including community members, agriculture extension officers, an agrometeorologist and agronomist during all these activities. CAPES is an agrometeorogical extension service including monitoring, developed together with a community to give tailor-made climatic information for improved agricultural decision making. Stories of five selected Mujika farmers were used to evaluate the effectiveness of CAPES in disseminating climatic information to smallholder farmers in Mujika. This assisted understanding the influence of CAPES on individuals across a range of different types of farmers that are present in Mujika, according to status, education and influence of authority.

The study findings led to the following conclusions:

- Although long-term rainfall data analysis was useful in understanding smallholder farmers' environment, it was also instrumental in characterising available annual and seasonal rainfall trends. Detailed intraseasonal information (start and end of rain, dry spell length) used together with seasonal forecasts helped improve agricultural decision making.
- Indigenous forecast knowledge plays a major role in smallholder farmers' agricultural decision making and planning of crop management options for every unfolding season when access to seasonal climate forecast information is limited.
- The fact that the community had a good knowledge of the natural resources enabled them to recognize that the use of climate information was a viable opportunity to improve crop productivity.
- The lack of credibility of researchers and Zambia Meteorological Department (ZMD) within the community to produce and disseminate seasonal climate forecasts had a negative influence on farmers' acceptance and usage of seasonal climate forecasts.

- A sustainable community agrometeorological participatory extension strategy depends on smallholder farmers' contributions during planning as users because farmers know what climatic information is required for addressing their problems and the best dissemination modes for effective information utilization.
- It is possible to develop an effective and appropriate community agrometeorological participatory extension service with a community when appropriate participatory approaches to community interactions are used.
- The stories of the identified farmers used in the qualitative approach provided the visible evidence of the influence of the CAPES on the farming systems in Mujika.
- All this information was combined into a practical handbook on CAPES to be used to train agrometeorological intermediaries.

Recommendations that follow from this thesis and that may also help as starting points for future research are:

- Participatory dissemination of climatic information should be based on a well researched community baseline so as to address actual community problems.
- The participatory multi-disciplinary climatic information dissemination plan should be develop together with farmers and other stakeholders for an effective information flow in the community.
- In order to improve smallholder farmers' agricultural decision making and crop management options in rainfed systems, an effective dissemination of seasonal climate forecast and a detailed long-term rainfall analysis for their respective area is required.
- The community agrometeorological extension strategy (CAPES) developed during the dissemination of climatic information to smallholder farmers in Mujika area is a model of success and is recommended for application to other areas.
- Use of stories about selected farmers in evaluating the effectiveness of community interactions is a useful approach and is recommended.
- The CAPES handbook, developed during this project, is a useful guide and is recommended for use by anyone intending to interact with communities for the dissemination of climatic risk information.
- The community agrometeorological participatory extension strategy should be evaluated in future in five or ten years after it establishment.

Key words: Climate change, climate variability, climatic information, dissemination, participatory, Agrometeorological service, Mujika, Zambia

TABLE OF CONTENTS

DECLARATION……...i
ACKNOWLEDGEMENTS……..….ii
ABSTRACT…….……..……..….iii
TABLE OF CONTENTS……..vi
ABBREVIATIONS……..……..……...……..….….vii

Chapter 1: The Research Context …….…….....…1
Chapter 2: Literature Review …….…….8
Chapter 3: Research Design and Methodology ……...…….20
Chapter 4: Current climatic risk information ……...…….....35
Chapter 5: Rainfall Analysis for Smallholders …….75
Chapter 6: Dissemination of Climatic Information …….……..……...…86
Chapter 7: Changes in Farmer Decision Making for Agricultural Productivity …….……...156
Chapter 8: Climate Learning Changing Livelihoods: Mujika Personal Stories ……173
Chapter 9: Handbook for Community Agrometeorological Participatory Extension ……200
Chapter 10: Summary, Findings, Conclusions and Recommendations...……237

References...…….....245
Appendices...……...…….256

ABBREVIATIONS

CABLAC	Capacity Building, Learning and Activity Center
CAPES	Community Agrometeorological Participatory Extension Services
CAPEST	Community Agrometeorological Participatory Extension Team
CCAA	Climate Change for Adaptation Africa
CFU	Conservation Farmers Union
CIDP	Community Information Dissemination Plan
CO	Camp Officer
LD	Livestock Diseases
DACO	District Agriculture Coordinating Officer
DC	District Commissioners
ER	Erratic Rainfall
FAO	Food and Agriculture Organization of the United Nations
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IDRC	International Development Research Centre
IRI	International Research Institute for Climate and Society of Columbia University
LDP	Lack of animal draft power
LSF	Low soil fertility
LW	Lack of water
MDG	Millennium Development Goals
NGO	Non-Governmental Organization
OPV	Open Pollinated Variety
P	Poverty
PPL	Public Project Launch
PM&E	Participatory Monitoring and Evaluation
PRA	Participatory Rural Appraisal
PT	Planting at wrong Times
SCF	Seasonal Climate Forecast
SDA	Seventh Day Adventists
SSA	Sub-Saharan Africa
UFS	University of the Free State
UN	United Nations
UNDP	United Nations Development Program
WMO	World Meteorological Organization
ZNFU	Zambia National Farmers Union
ZMD	Zambia Meteorological Department

CHAPTER ONE: THE RESEARCH CONTEXT

1.1 Introduction to the Study

One of the world's greatest future problems is sustainable development and livelihood in Africa under the climate change scenarios. Africa's widespread poverty and limited adaptation and coping capabilities makes it one of the most vulnerable regions of the world to the current and projected impacts of climate change and climate variability (IPCC, 2007). Endemic poverty, disease, HIV/AIDS, complex governance and institutional dimensions; limited access to capital and markets, ecosystem degradation; and complex disasters and conflicts are some of the contributing factors (IPCC, 2007). The situation however is getting worse. IPCC/20 on "Perspectives on climate change and sustainability" says **"***Climate change will impede nations' abilities to achieve sustainable development pathways as measured, for example, by long-term progress towards the Millennium Development Goals (MDG)*" (IPCC, 2007).

The efforts to develop African economies and achieve the MDG must contend with the increasing challenge of climate variability (see for example Love et al., 2006; Stern, 2006; UNDP, 2006). Global warming is expected to impact global climate including Africa and sub-Saharan Africa (SSA) given the multiple layers of environmental and economic stress on the continent where the most vulnerable are the poor and marginalized people. Climate change scenarios generally indicate higher temperatures for most of Africa, although projections for precipitation trends vary from slight increases in West Africa to slight decreases in some parts of Southern Africa (Stige et al., 2006; Washington et al., 2004). There is a general consensus about a higher climate variability, which will lead to an increase in drought (both inter- and intra-seasonal) and flood events, and more uncertainty about the onset of the rainy season. This impacts the social as well as cultural and economic development of rural poor communities. Stresses resulting from amplified droughts and floods, and significant plant and animal species extinctions and associated livelihood impacts are some of the challenges for SSA (IPCC, 2007). Drought is a recurrent feature of the southern African agricultural climate occurring both within and between seasons (Twomlow et al., 2006). In fact, it is increasingly unusual for drought not to occur somewhere in southern Africa each year (UNEP, 2002). Increased interannual variability has, however, been observed in the post-1970 period, with higher rainfall anomalies and more intense and widespread droughts reported (Fauchereau et al., 2003; Richard et al., 2001). In different parts of southern Africa a significant increase in heavy rainfall events has also been observed, including evidence for changes in seasonality and weather extremes (Tadross et al., 2005).

The agricultural systems of SSA are diverse and vast, with water a transient resource in both space and time. In comparison to all other regions, the agricultural productivity per unit of water ('crop per drop') in Africa is the lowest worldwide, and is far below its potential (Rosengrant et al., 2002). Despite many research initiatives, development corporations, NGOs and strong efforts by FAO and local governments, SSA still suffers from food insecurity and under-nutrition. The chronic food emergencies that have afflicted Malawi, Mozambique, Zambia and Zimbabwe are likely to become more frequent. Yields for staple cereals can decline with a 1°C – 2°C rise in temperature especially when compounded by other factors such as more erratic rainfalls and low inputs (Stige et al., 2006; Cane et al., 1994). The impacts of future climate change on society are uncertain but that of climate variability is known. An increased knowledge about the usefulness of seasonal climate forecasts, of most appropriate dissemination modes and their application by producers, extension and smallholder farmers can contribute to reducing the impacts of climate variability and build resilience to future climate change. Zambia and Zimbabwe worked together on the main IDRC/CCAA funded project of "Building Adaptive Capacity to Cope with the Increasing Vulnerability due to Climate Change". The proposal for the main project to IDRC was approved on 29th March, 2007 and given a grant number 104144-001 but activities in Zambia commenced in May, 2007.

Prevailing lessons on adaptation to climate change from the SSA are able to help farmers cope with increased climate variability. Inhabitants of the SSA have always adjusted their livelihood plans to large variations in climate, on both short- and long-term time scales. There are some traditional practices and various coping strategies that have been developed by some innovative farmers and communities that enable inhabitants to survive extreme climatic events (Mazzucato and Niemeijer, 2000; Scoones, 1994). By studying the coping strategies of these rural poor with respect to climate, one may find hints that, when combined with the contemporary scientific knowledge of seasonal climate forecasting models may help to explore new opportunities that will enable improved livelihoods with adjusted farming systems.

Mitigation and adaptation are the two threads to any strategy for tackling the threat posed by climate change and climate variability (Solomon et al., 2007). Mitigation is about reducing future climate change impact by weakening the link between economic growth and carbon emissions. According to the online TheFreeDictionary by Farlex, adaptation is a "process of adapting, being changed or modified to suit new conditions or needs". It may be change in behaviour of a person or group of people in response to new or modified climate (different temperatures, altitude or environment). Adaptation is about facing up to the fact that climate change is inevitable and

changing some operational things to counteract it, however, many of the most threatened countries have the least capacity to adapt (Muller, 2009; Ndiyoi and Nanja, 2007). Adaptation also includes changes in the management of activities and institutional setup for easier response to changes that occur in climate. There is a need to implement a variety of options for diversification of production systems and livelihood options to help vulnerable people cope with climate variability, more extreme events, increasing variability of precipitation, and the associated socioeconomic implications of these changes. Most people now agree that by focusing on improving the resilience of the current production systems and smallholders' coping strategies in the short-term; one can support adaptation to longer term effects of climate change (McKeon et al., 1993). Capacity should be developed in the ability of a system to adjust to change, moderate potential damages, take advantage of opportunities or to cope with the consequences (IPCC, 2001). It is therefore, important to focus on building resilience so as to enhance adaptive capacity.

Dissemination of climatic information to smallholder farmers is hence vital for improved agricultural decision making. Dissemination is a one way process of transferring or delivering knowledge and innovations from creators to users for its effective and sustainable application (Wilson, 2005). Dissemination is the scattering or spreading abroad or distribution or dispersion of demanded climatic information (The Free Online Dictionary; Diener and Seligman 2004; Day et al., 1995). Walker (2006) identified that a new approach was needed to address specific queries and requirements of farmers in any particular region if one is to achieve improved agricultural decision making by smallholder farmers using climatic information. This approach was to come from interactions between climatologists, meteorologists, agrometeorologists and extension personnel. It is the role of the agrometeorologists in the communication channel to the smallholder farmers as users of climatic information to ensure this approach is implemented. Zambia Meteorological Department (ZMD) and through its agrometeorological extension services is trying to respond to public demand for climatic information by disseminating the seasonal climate forecast (SCF). Other adaptation methods/strategies being addressed worldwide (Shetto and Owenya, 2007) include breeding more drought-tolerant and/or short season maturing crops and promoting improved crop management strategies. Such strategies could have evolved over a long period of time through peoples' long experience in dealing with the known and understood natural variations across different seasons combined with their specific responses to each season as it unfolded.

Other comprehensive projects using this approach for dissemination of climatic information were not found. So a combined system is recommended. The concept of "CAPES" was developed in this project for the dissemination of climatic information to Mujika community. This concept of a

community agrometeorological participatory extension service (CAPES) includes the source of climatic information, intermediaries or agrometeorological extension and the smallholder farmers themselves. CAPES was used with communities to improve farmer understanding and utilization of climatic information. This could improve smallholder farmer agricultural decision making and resilience to climate change. The resilience of the smallholder farmers depending on rainfed subsistence farming could have the ability to withstand climatic stresses and absorb shocks whilst continuing to function normally (Folke et al., 2002).

CAPES in this study comes from the following dictionary definitions:-

Cape: (1) A headland or promontory into the seas. This is a new feature in the waters.

(2) Short cloak/covering outer sleeveless garment, fastened around the neck falling loosely from the shoulders. It is a mantle, a protective cloth against weather (The Free Online Dictionary, 2009).

Therefore CAPES embodies these aspects

- as a headland pointing into the sea of other aspects of their livelihood with new ideas, and interventions to adapt and make it work.
- as a cloak it covers and protects the community suffering from climate change.

This thesis considers the dissemination of climate risk information and its usefulness in coping with risks using the community agrometeorological participatory extension service approach and explores its suitability and effectiveness in addressing climate variability concerns while using available dissemination modes.

1.2 The Purpose of the Study

The purpose of this research is to develop, test and disseminate climatic risk communication materials using appropriate delivery interventions in Mujika, Monze district of Southern Province, Zambia. The specific objectives considered in this study are:

a. To analyze long-term rainfall data for two stations as a basis for developing climate risk communication approaches for Mujika area;

b. To establish the current status of climatic risk information and dissemination practices in Mujika area;

c. To document the social/institutional aspects that enable farmers to adopt appropriate alternative interventions; and

d. To operationalize the community agrometeorological participatory extension strategy so as to evaluate its effectiveness.

Part of the CAPES was to explore and monitor smallholder farmers' reactions to climate risk information. This also explored the suitability and effectiveness of the community agrometeorological participatory extension strategy in addressing climate variability concerns. While using the available dissemination modes it considered six research questions. These focused on the long-term rainfall trends, adaptation strategies required, relationship between the existing social and institutional aspects and the farmers' ability to adopt appropriate alternative interventions. The others were about climate risk information for dissemination, available modes of dissemination available and development of an appropriate agrometeorological extension service.

Major research questions:-

a. What trends are found in the long-term rainfall records for Mujika area?
b. What adaptation strategies are available in Mujika?
c. What institutional aspects enable farmers to adopt appropriate alternative interventions?
d. What available climate risk information can be disseminated for coping with the increased climate variability?
e. What modes are available for disseminating climatic risk information to Mujika area?
f. Given the limited smallholder farmers access to climatic information, can we develop an appropriate agrometeorological extension service?

As there is little specific experimental evidence that links dissemination of climatic risk information and improved smallholder livelihoods, this thesis examines the contribution that the community agrometeorological participatory extension strategy made to improve decision making by smallholder farmers in agriculture production and the effect on their overall livelihood. The focus was mainly on the smallholder farmers in semi-arid areas and their livelihood, reaction to disseminated climate information, behavioural change and adoption of appropriate intervention strategies.

1.3 An Overview of the Thesis

This thesis is divided into ten chapters whose contents are briefly summarized below. In Chapter 1 the theoretical structure of the thesis is presented, how the research questions arose and an overview of the thesis. In Chapter two, the available literature on data collection methods/techniques and the applications of the participatory approach and dissemination of climatic information were reviewed. The information collected during baseline assessment was reported and used for tracking changes following the dissemination of climate risk information. The participatory approach and opportunity of using a multi-dissemination approach was identified.

Chapter three explains the research design and methods used to answer the research questions. A flexible research design for the semi-structured interviews was used together with the participatory action research approach. The case study area was then described. Details of the quantitative and qualitative methods for data collection and type of analysis are also given.

Chapter four presents the current climatic risk information and dissemination modes as pertaining to the case study area. This information is derived from a variety of sources across SADC, the world, Zambia and southern province including the project area. The prioritization of information for dissemination is then described and how it is used to develop and integrate into the new approaches.

Chapter five gives the rainfall data analysis for the project area. The details of the rainfall trends, start and end of the season, length of the season, dry spells and planting risks are presented and discussed. The relationship of this data to the smallholder farmer perceptions is also explained.

Chapter six describes the dissemination of climatic information and the various media used. The media modes used are meetings, radio, radio listening clubs, print media, and personal contacts, farmer to farmer and driving/passing through the area. The other modes used are field experiments, field days and monitoring and evaluation. Emphasis was placed on identifying farmer participation, suitability of the dissemination modes and participatory approach for the development of an appropriate agrometeorological extension service.

Chapter seven describes the changes in farmer decision making for agricultural productivity under a variable climate. An observation method was used to track the farmer investment decisions with reference to the results of the semi-structured interviews. The changes identified were highlighted and used to evaluate the influence of the community agrometeorological participatory extension strategy and feedback to developing appropriate community agrometeorological extension services. Chapter 8 traces the stories of a few key informants, as they interacted with researchers and other farmers. Their growth in the area of climate information and how they used of SCF was monitored so as to show some typical reactions to information.

In Chapter nine the handbook for community agrometeorological participatory extension (CAPES) is presented. Aspects of the handbook regarding introduction of the community agrometeorological participation extension, development, participation activities, monitoring and evaluation are described.

In Chapter 10 the summaries and findings from all the other chapters are integrated and discussed.

The contribution of different levels of the participatory approach to the dissemination of climatic risk information through the community agrometeorological participation extension strategy is discussed. Smallholder farmers' change of behaviour from their perception of climate change and approaches to adaptation, to new interventions as adaptation strategies are considered. The effectiveness of the approach and suitability of the dissemination modes to CAPES in addressing the current and future climate change impacts is reviewed. The conclusions on the implications of the findings from the research are then drawn. The chapter closes by reflecting on the insights that a multi-dissemination approach offers to the dissemination of climatic risk information and recommendation are made for other areas in Zambia and SADC.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Smallholder farmer perceptions of rainfall performance, how it affects their livelihood and relates to the long-term rainfall data analysis is investigated from past literature. The focus is on the process of adaptation to climate change and variability. Literature considers the manner of community adaptation and why some people were more vulnerable to climate variability than others especially during flooding or drought events. Farmers' livelihoods and alternate interventions and investment options are reviewed. Understanding of a community is essential for designing appropriate programmes that address smallholder farmers' current and future concerns related to climate change and climate variability. Climate Change using the meteorological definition is any change in global temperatures and precipitation over time due to natural variability or to human activity (IPCC, 1996). "*Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability)"* (IPCC, 2001b).

Investigations covered literature on the following topics: rainfall analysis, adaptation strategies, social and institutional aspects, available climatic information, dissemination of climatic information and community agrometeorological participatory extension service. Previous research considered as they pertains to a variety of social, environmental and development challenges including that of adaptation to climate variability and climate change. The suitability of a variety of approaches that could be used in this study was investigated.

2.2 The Use of Rainfall Analysis

Climate change will force farmers and their supporting institutions to take steps to minimize yield loss and negative climate change impacts and to maximize yield gain using the beneficial seasons (Easterling, 1996; Schneider et al., 2000). Relatively small variations in climate can warrant large variations in management. For example, if climate change lengthens the growing season by a few days more at one location than another, they may require two different maturity classes of the same crop. Climatic variation especially rainfall have significant effects on the agricultural production management practices starting from planning the season to harvest (Hollinger, 1994). Crops managed especially under rainfed systems have often suffered severe water stress from abnormally high temperatures during dry spell periods. Unfavourable rainfall performances usually affected

intensive input applications such as that of fertilizer hence becoming uneconomical (Mjelde et al., 1993). Information on rainfall analysis is hence vital for farmers' crop management as input decisions were often made on assumptions that the average weather conditions would occur during the cropping season (McNew et al., 1991). Rainfall data are essential as basic data input to hydrologic, engineering, agricultural, social and economical studies and determination of the flooding potential as seasons progress. The rainfall data provided by the National Meteorological Services (NMS) was usually raw daily data or monthly summaries (Donthamsetti et al., 1990) not analysed.

Boyle and Hellmann (2006) in their editorial review essay, argue that climate dramatically affects our daily lives. It shapes livelihood and can determine how many people live in a location, as well as what they do for work and pleasure. FAO defines livelihood as "*the sum of ways in which households obtain the things necessary for life, both in good years and in bad. These necessities include food, water, shelter, clothing and health care (with education often included too)"* (FAO, 2008).

Benson and Clay (2004) also agree that the frequency of natural disasters such as heat waves, floods and droughts affect economies and standards of living and even affects the course of history. Boyle and Hellmann (2006) further argue that the importance of understanding climate is to be able to prepare for the future. Glantz (2006) in his editorial review essay states that climatic information can be used in decision making. An example was given of how the Californian government used the strong 1997–1998 El Niño forecast to clear drainages to avoid flooding. When the rains came the impact was minimal. When rainfall analysis information is used correctly by community, it is able to contribute to improvements in their livelihood. Society' hopes of improving livelihood conditions with respect to climate must however involve a deeper understanding and their full engagement in managing climate affairs. Three critical goals for engaging in climate affairs are then suggested. *"First, the field of climate affairs needs to educate the public on ways of knowing and predicting climate change and its consequences".* "*Second, one should encourage policy endorsement surrounding climate change and climate vulnerability"*. These are used to explain how climate information can and is used in decision making. *"The third is that climate affairs should address inequity inherent to climatic problems".* However the matter of imbalance between those responsible for and those vulnerable to climate change which requires attention is not addressed by Streets and Glantz (2000). This concern contributes to lack of capacity to succeed in the face of harsh conditions (Homer-Dixon, 2000), thus allowing climate change impacts to widen the economic gap between the developed and the developing world (Boyle and Hellmann, 2006).

2.3 "Surprise"

Communities were at times surprised by weather or climatic events (Streets and Glantz, 2000). The Free Dictionary, (2009) describes "surprise" as *"to encounter suddenly or unexpectedly; take or catch unawares"*. Thus "surprise" is some sudden change from what the individual, community, country or region understands and consider as a normal occurrence. One is either surprised or not. The possibility that people will be "surprised" by future climate change will be determined to a large extent by the way information has been explained to them up to that point in time as well as their grasp of the information. Information on climatic events when available has been provided to the public in printed and electronic media, however Streets and Glantz (2000) argue that extreme and "surprise" events cause the most damage to human health and property. We are in most cases surprised by certain climatic changes when in fact we should not be at all. These are usually slowly developing changes which we fail to distinguish due to "habituation, apathy or inexperience" until they become significant. Watchfulness and monitoring of all the parameters is encouraged to identify these kinds of surprises.

Habituation

Habituation arises from an incorrect understanding of the actual climatic conditions by individual(s). Individuals get surprised when they think that they have fully understood the phenomenon when they actually do not understand (Streets and Glantz, 2000). Wikipedia, the free encyclopedia (2010) viewed on 26th August, 2010 describes habituation as *"a form of non-associative learning, is the psychological process in humans and other organisms in which there is a decrease in psychological and behavioral response to a stimulus after repeated exposure to that stimulus over a duration of time"*. Drought as an example, the first time an individual (s) is/are informed of it, they pay great attention but the more it is repeated the less they will listen (Bear et al., 2007). This may result in an individual being surprised by the impact of drought when it occurs.

Creeping (slow onset) surprises

Not all surprises will come so suddenly. Some will come in so gradually and unless the earlier perception is changed fast enough to allow perception of new perception information, one may be surprised. The absence of a clearly identifiable threshold of change can also lead to this kind of surprise. In these situations warnings are usually not given in a timely fashion until a visible calamity situation has occurred (Streets and Glantz, 2000; Brooks, 1986). Again watchfulness and monitoring should be encouraged to enable the population to be warned and prepared for the situation (Guijt et al., 1998).

Minimizing surprise

Occurrence of "surprise" can be minimized when rainfall analysis results are integrated in the decision-making processes of local, national, and international institutions (Streets and Glantz, 2000). For example, when rainfall analysis results are disseminated to users, it can enable them to evaluate their decisions and also reduce the impact of the climatic event. Experts should provide advice to decision makers based on their knowledge or opinion which can be used in the forecasting of future events (Streets and Glantz, 2000). Participatory monitoring and evaluation of climatic events should be used as a systematic approach of all interventions. The increased number of people monitoring and evaluating the events can help avoid habituation and even identify the slow creeping changes (NGO Programme Karnataka-Tamil Nadu, 2005).

Preparedness

Two approaches are considered important to cope with climate surprises. First, is to improve the capacity of climate institutions to forecast possible surprises; and second, is to improve community coping mechanisms which could either be in preparedness or reaction to the surprise. The role of research is hence considered vital in order to be better prepared for surprises and must address issues on both sides the source of the forecast and the recipients of the forecasts. Our ability to respond to surprises and reduce their impacts is hence important. Communities should be able to address surprises by economic systems diversification, usage of multi-technologies, creation of adaptive management systems and effective disaster-coping mechanisms together with social adaptation learning (Yohe et al., 2007; Streets and Glantz, 2000).

2.4 Adaptation Strategies to Cope with Climate Change and Climate Variability

Adaptation practices refer to actual changes in livelihoods enhancing resilience to observed or expected changes in climate. Adaptation practices can be considered at different levels such as spatial (local, regional, national); sectors (agriculture, tourism, etc); type of action (investment, physical, policies, market); actors (national or local government, NGOs, local communities and individuals) and by some other categories (Adger et al., 2007).

"Adaptation to climate risks can be viewed at three levels, including responses to: current variability (which also reflect learning from past adaptations to historical climates); observed medium and long-term trends in climate; and anticipatory planning in response to model-based scenarios of long-term climate change" (Adger et al., 2007). Communities therefore have to adapt to current climate variability given the evidence of unfavourable impacts (Smit et al., 2001) which may then foster resilience to long-term climate change. Appropriate policies and prioritization of

development programmes will have to support this kind of adaptation (Ribot et al., 1996). Appropriate adaptations can reduce negative impacts or even take advantage of new opportunities due to changing climate conditions.

Adaptation capacity

"Adaptation capacity" is the ability of population' adjustment process to become better suited to its habitat. (Wikipedia, the free encyclopedia, 2010, theFreeDictionary, 2010). Adger et al., (2007) says, "*Adaptive capacity is the ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behaviour and in resources and technologies. The presence of adaptive capacity has been shown to be a necessary condition for the design and implementation of effective adaptation strategies so as to reduce the likelihood and the magnitude of harmful outcomes resulting from climate change. Climate change will impede nations' abilities to achieve sustainable development pathways as measured, for example, by long-term progress towards the Millennium Development Goals*. The communities or individuals' adaptive capacities to climate change vary. Human and social capitals are identified as key determinants of adaptive capacity at all scales, and that they are as important as levels of income and technological capacity. Dankelman (2002) states that climate change has gender-specific implications which include both vulnerability and adaptive capacity. Women, for example in southern Africa, work longer hours coping with and addressing drought and flood impacts to improve their livelihood. The capacity to adapt is dynamic and usually it is influenced by a number of factors such as available economic and natural resources, social networks, institutions and governance, human resources, and technology (Adger et. al., 2007). Adoption of different food production methods for dryland areas with large climate variability is essential to improving food security for human populations in these areas (Sivakumar et al, 2005).

2.5 Social and Institutional Aspects to Enable Farmer Adoption of Appropriate Alternative Interventions

Research in communities is required with a view to introducing alternative intervention to improve smallholder farmers' livelihood. The question asked is "Do farmers really adopt these interventions and if they do, what are their limitations?" Farmers in practice do or do not adopt all the principles of Conservation Agriculture (CA) according to various reasons such as limited access to inputs (herbicides, cover crop seeds), labour constraints, or insufficient resources to grow cash crops (Baudron et al., 2007; Shetto and Owenya, 2007). Their practice may often be quite different from the appropriate alternative intervention developed during "on-station" trials. The actual benefits realized from CA practiced by farmers are then questionable (Bolliger et al., 2006). The farmer

constraints to adopt appropriate alternative interventions make it imperative that the benefit of each component is properly evaluated in conjunction with the community.

Socio-informational networks for farmer decision making are vital because they focus on the transfer of knowledge. Buttel et al. (1990) in reviewing the Sociology of Agriculture, states that farmer' decisions are affected by neighbouring farmers' opinions and advice, as well as institutions such as locally accepted traditions, extension and mass media. The more enlightened smallholder farmers become, the more they can play the role of experts in different disciplines and provide advice to other members of the community. This can be done through various approaches such as the farmer to farmer interactions, management of the community information dissemination plan and field days. A particular farmer may have some reservations in implementing a particular technology when the majority of the farmers in the community are not considering it at all (Seabrook and Higgins, 1998). Hence, those complex relationships and interactions would then have an effect on the individual farmer's decision.

For sustainable agriculture technologies to benefit the poor, it requires a new approach that integrates social, cultural, environment, political and economic pillars of sustainability as responses to climatic challenges (Walker and Stigter, 2010; Conway and Barbier, 1990). These pillars when used in evaluating the impacts of activities being implemented in community will provide a community view (GECC, 2006). These have an influence on a community's quality of life as it is closely related to the quality of its cultural engagements, dialogue, expressions and celebrations (Hawkes, 2001). Agriculture is mainly recognized as a source of livelihood for the African poor rural communities as well as the means for economic growth for the country (FAO, 2008). The political sector is expected to prepare appropriate policies for moving agricultural products and services between countries to stimulate and facilitate trade (FANRPAN, 2004).

2.6 Climatic Information for Coping with Climate Change and Climate Variability

It is now widely recognized that if society can have advanced weather and climate information, some of the undesirable effects associated with weather phenomenon could be minimized. Relevance of climate information to climate-sensitive sectors and society in general, can be confirmed when it influences changes in the decision making process and actions taken by stakeholders (Sonka et al., 1992). Currently available climatic information that could be helpful for meeting society expectations is derived from the proven and helpful forecasting tools. As forecasting skills are still imperfect, an increased investment into those fields is required if the appropriate warnings are to be made (Meinke et al., 2001; Hammer et al., 2001).

Prior to the commencement of the growing season, farmers make a number of crucial land and water management decisions based on climate for implementation during the growing season, (Sivakumar, 2006a, Hoon et al., 1997). Farmers are increasingly demanding trustable climatic information for inclusion in their practices. Farmer expectation in including seasonal climate forecast (SCF) into agricultural management decisions has reduced vulnerability of agriculture to droughts and negative impacts in developing countries (Hansen et al., 2009; Sivakumar, 2006b). Sivakumar (2006b) further argues that climate prediction information should be included into the planning process as an input into the design of adaptation plans.

Farmers require weather forecasts for their daily decision making because these decisions usually affect their financial returns and overall welfare. Even though the effects arising from these decisions may not immediately be known with certainty until after some later time. The outcomes from such decisions could be better or obvious (Fraisse et al., 2004). Weather is defined as the state of the atmosphere at a given place and time. For instance, it could either be cloudy, rainy or windy. Weather-based decisions are mainly for operational purposes and may involve activities to be undertaken, usually within less than a week. Examples of decisions that are dependent on weather factors include planting, weeding, irrigation, frost protection, fertilizer application, and harvesting. Inter-annual variability of agricultural yields depends on the cumulative effect of weather experienced through the growing season. Impacts of extreme weather events like hurricanes and droughts have been obvious on annual harvests (Chen et al., 2004). Literature indicates that weather forecasts are usually accurate in terms of predicting the significant weather features for the coming 1 to 2 days. The accuracy however decreases with the increased length of the forecast period.

Climate refers to the state of the season over a long time period such as usually being a wet, cool or hot winter, or dry summer relative to the long-term. Climate-based decisions are decisions made before the commencement of the season and are usually for planning purposes. Examples given can be the choice of variety to plant, land allocation, pre-season purchase of inputs, and plans for marketing (Fraisse et al., 2004). Useful SCF for some regions can be made for the coming three months and sometimes up to six months (Manuel, 2009; Gibba, 2004; Parry et al., 1988). The ability to predict climate has improved in recent years with corresponding significant efforts devoted in application to adapt or improve agricultural systems (Jagtap et al., 2002). Hansen (2002) suggests that the seasonal forecast information must address the real smallholder farmer needs if benefits are to be achieved through viable decision options. To effectively be utilized, precipitation or temperature variations whenever predicted should be disseminated to the people.

Increasing climate knowledge and prediction capabilities amongst smallholder farmers will promote the development of new technologies for use in reducing negative impacts due to climate variations in agriculture productivity. It also enhances planning of appropriate activities based on the developed capacity in using contemporary scientific knowledge (Sivakumar and Hansen, 2007). Smallholder farmers are generally vulnerable to climate change and climate variability mainly due to their limited capacity to manage and cope with shocks. Vulnerability to climate change is defined as the extent to which a natural or social system is at risk to damage from climate change. "*Vulnerability is a function of the sensitivity of a system to changes in climate (the degree to which a system will respond to a given change in climate, including beneficial and harmful effects), adaptive capacity (the degree to which adjustments in practices, processes, or structures can moderate or offset the potential for damage or take advantage of opportunities created by a given change in climate), and the degree of exposure of the system to climatic hazards"* (IPCC, 2001a).Farmers require weather, seasonal climate information, intra-seasonal, start and end of season information for coping with effects of climate change and climate variability on agriculture productivity.

2.7 Dissemination of Climatic Information

Unless there is a flow of climate information to agri-business and farmers the available information may not be utilized (Walker, 2007). Dissemination can be defined as the *"scattering, distribution or dispersion of certain information"* (The Free Online Dictionary, Diener and Seligman, 2004**)**. Walker (2006) further argues that, dissemination as the distribution of information, should involve the identification of climate sensitive decisions, interactions between the climatologists and the role players to develop technological useful products that should be evaluated prior to introduction at an operational level. She also highlights that dissemination can employ various modes of information delivery such as mass and electronic media, group and individual relationships.

The National Meteorological Services (NMSs) around the world are collecting daily weather data and other climate information that must be linked to users for their successful utilization. For this to be done, one needs to identify the critical factors for successful dissemination including good communication channels, preferably based on a relationship between agrometeorologists and users of information (Sivakumar, 2006b) in the agricultural industry. Walker (2006) relates dissemination to a two-way communication channel system while Day et al. (1995) considers it as a one-way flow of communication.

Walker (2006) suggests the dissemination process should include the following:-

a) Identification of users;

b) Participatory interaction between agrometeorologists and users to identify climate-sensitive decisions which helps develop credibility of the NMS amongst users and further identification of information gaps;

c) Development of tailored forecasts with specific climate-data analysis;

d) Participatory postmortem of the scientific analyses results, which gives an opportunity for parties to evaluate the suitability of results; and,

e) Restructuring of the operations of the NMS to accommodate the new innovations.

If these factors are implemented it can promote the use of participatory methods for interactions with farmers (Martin and Sherington, 1997) and bring about successfully dissemination of agrometeorological information needed for improved farmer decision making.

Dissemination modes

The dissemination modes are required to link the originator and his/her information with the user for the transfer of knowledge. These are pathways through which climatic information has to be disseminated to the users. The multi-disciplinary dissemination approach is preferred as it gives a greater chance of reaching the client or user (Bembridge, 1991). The effectiveness of dissemination hinges on the alignment of both parties' objectives, so that the receiver will finally get the information using the designated mode in the most preferred format (Dewatripont and Tirole, 2004). However, unfortunately, individuals in some NMSs sometimes refuse to provide this crucial information in the required format. They often erect barriers to shut out others in situations they consider hostile. Most dissemination failures in organizations can be traced to these one-on-one barriers. Dissemination barriers *may* usually spring from an individual's unfavourable past experiences thereby hampering information flow and disrupting developmental activities (Buchholz, 2001).

Communication model

Communication is vital for the dissemination of climatic information. Bembridge (1991) suggests most definitions of communication include five fundamental factors being: an initiator, a message, a mode or vehicle, a recipient, and an effect. It is further suggested that it must also be a two-way process to be considered successful. The dissemination of agrometeorological information should therefore consider the vital components of initiator, communication mode and recipient as a user. Often it is the farmer who makes the initial information request to the NMS to which it responds to. Dissemination is hence the NMSs' act of responding by providing the farmer with the requested

climatic information using the agreed upon modes. Doing so is thus completing the two way communication cycle (Mukhala, 2000)

Smallholder farmer as users

Farmers require that their needs should be identified and addressed. Smallholder farmers as users of climatic information require agrometeorological data and product dissemination to them to be able to improve their agriculture productivity (Stigter et al., 2010). They require seasonal climate forecast information for example disseminated to them timely, in an appropriate language using the most appropriate dissemination modes (Hansen, 2010). To get this information and service there has to be a strong communication linkage and flow of information between smallholder farmers and suppliers of the climatic information (Lee, 2010). This linkage and information flow will provide access to information and help farmers make successful application of all types of weather and climate information available to them (Mosher, 1978). The personal relationship between the parties must further be supported by continued extension, regular contact and interactions with open communication channels where exchange of information takes place (Edgar and Solomon, 2004).

2.8 Community Agrometeorological Participatory Extension Service

A community agrometeorological participatory extension service (CAPES) is a simple tool which enables farmers working individually, or with research or extension workers, to improve their on-farm activities in the use of climatic information and h associated resources. CAPES were developed as agrometeorological services may not be provided by an agrometeorologist only but with the full involvement of all stakeholders including the smallholder farmers. Each stakeholder has a specific role to play in the agrometeorological service. Dorward et al. (2007) identifies some of the following activities in a community agrometeorological participatory extension services;

a) Needs assessment: Farmers help in identifying and understanding the actual problems they face and identifying opportunities for addressing these problems. Assumptions by agrometeorologist or insincerity on the part of farmers regarding their actual problems will render the community agrometeorological participatory extension services efforts futile.

b) Identification of dissemination modes: Farmers will identify the climate information dissemination modes to be used in the community agrometeorological participatory extension services.

c) Programme implementation: The stakeholders will introduce the new activities while comparing with the previous ones. They should document every development for later analysis as it seems good for use in the study.

Another example is that of the Climate Field Schools (CFS) (FAO, 2008a). The main objectives of

the field climate school are to:

(i) increase farmers knowledge on climate;

(ii) assist farmers in observing climatic parameters and train them on how the information is used to support their farming activities; and

(iii) assist farmers in translating climate forecast information to support farming activities, like planting decision and cropping strategies.

The participatory transferring of climate knowledge to farmers, which involve intermediaries (Stigter, 2006) and at times use of the learning by doing engagement process is called Climate Field School (CFS) (FAO, 2008b). The SCF are primarily meant to reduce the agriculture production risks thereby increasing productivity.

Participatory action research, as a form of experimental research, focuses on the outcome of the interactions with the researcher and community. The participatory action research goal is improving the livelihoods of that particular community (Dick, 2002). Action research involves utilizing a systematic cyclic method of planning, taking action, observing, evaluating (including self-evaluation) and critical reflection prior to planning the next cycle (McNiff, 2002; O'Brien, 2001). It is a collaborative method of introducing or exploring new ideas and implementing action for change. It involves direct engagement of stakeholders (farmers) in a research process, while monitoring and evaluating the influence of actions with the aim of improving practice (Dick, 2002; Hult and Lennung, 1980). McNiff (2002) also agrees that one of the main reasons is to increase understanding of how change of attitudes can mutually benefit a community of smallholders.

"Essentially Participatory Action Research (PAR) is research which involves all relevant parties in actively examining current action (which they experience as problematic) in order to change and improve it. They do this by critically reflecting on the historical, political, cultural, economic, geographic and other contexts which make sense of it. Participatory action research is action which is researched, changed and re-researched, within the research process by participants" (Wadsworth, 1998). Community agrometeorological participatory extension strategy is highly dependent on the attitude of stakeholders and skills of the facilitator (Dorward et al., 2007).

2.9 Summary

Literature considered in this chapter pertained to a diversity of social, environmental and development challenges of disseminating climatic information. Also investigated from past literature was the participatory type of agrometeorological extension or services and smallholder farmers' adaptation to climate variability and climate change. Climate variability is variation in the

climate, whilst climate change refers to any change in global temperatures and precipitation over time due to natural variability or to human activity. The highlights from the review are as follows:-

- Rainfall analyses can lead to better understanding of climate trends in climate extremes. Boyle and Hellmann (2006) argue that the importance of understanding climate is to prepare for the future. Efforts in improving the human condition with respect to climate must however involve understanding and engagement in climate affairs. Climate change is major challenge currently, hence society has to adapt to climate change and climate variability to survive.
- Adaptation refers to actual adjustments or changes which might ultimately enhance resilience to observed or expected changes in climate (IPCC, 2007a).
- Adaptation must however address the social/institutional aspects in the small scale farmers system that include limited access to inputs (herbicides, cover crop seeds), labour constraints, or insufficient resources to grow food and cash crops (Baudron et al., 2007; Shetto and Owenya, 2007). Such aspects enable farmers in practice to adopt or not to adopt appropriate alternative interventions.
- Weather and climate information is required for minimizing the undesirable effects associated with climate change and climate variability.
- Society is able to use the current climatic information from the current operational forecasting tools. There are still challenges to face on forecasting skills so an increased investment is required into those fields (Meinke et al., 2001; Hammer et al., 2001).

Dissemination of climatic information from the source to the user can employ various modes of information delivery

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The chapter begins by outlining the research approach used in this thesis for the research conducted in Mujika area of Monze district. The research design follows including a description of the development of the community agrometeorological participatory extension strategy and its community information dissemination plan. This is followed by the description of the dissemination of climatic information, monitoring and evaluation of activities before ending up with a reflection on the research management process. This is participatory action research where all stakeholders are involved.

3.2 Research Approach and Philosophy

To have an easy entrance into the Monze districts where the project was undertaken, this researcher requested for introductory letters from the University supervisor introducing him to all the relevant authorities such as the District Commissioner for Monze; His Royal Highness Chief Mwanza; the respective Village Headmen; local change agents; and international development workers; extension staff and policy makers. The first introductory letter was given to the District Commissioner for Monze district at the first meeting which served two purposes. The first was to inform policy makers of the project activities while the second was preparing them for future engagements such as in the creation of appropriate policies that would promote best bet adaptation options to climate change. The "Building Adaptive Capacity to Cope with the Increasing Vulnerability due to Climate Change" (IDCR/CCAA) project, main project of which this is a part, had selected Monze district but not the specific project sites. The interaction with the District Agriculture Coordinator (DACO) was to obtain support and to select the specific project site in Monze district, so Mujika was then selected. Following this the research team introduced the project, firstly to the respective village Headmen in Mujika, then to the larger Mujika community at the Public Project Launch (PPL) and to the three selected village communities, Nkabika, Bulimo and Malomo villages in small group meetings.

The first step was to collect as baseline, the smallholder farmer perceptions and existing adaptations to the impacts of past and current climate variability and change. This was to obtain a better understanding of their environment in terms of potential opportunities and limitations for human adaptation to future climate. This was followed by the development of the community information dissemination plan (CIDP) through which the community agrometeorological participatory extension strategy (CAPES) was going to be tested. The participatory monitoring and evaluation of

the whole process was to provide for the effectiveness of the CAPES.

The Participatory Rural Appraisal (PRA) techniques were used in small group meetings (Cavestro, 2003) to collect spatial data (community sketch maps, farm sketches, and transects), time related data (historical time lines, trend lines and seasonal calendars); and social data (household interviews, institutional analysis and gender daily timeline) from three villages in the Mujika area. This information was used as a baseline for the project. Lelo et al. (1999), in the Ergerton PRA Field Handbook argues that PRA enables a community to identify their own way to sustainable development and be involved in the developmental process. PRA leads to the creation of the Community Action Plan serving as a guide to implementing the various climate related programmes.

The rainfall analysis for Mujika area was performed using two stations Magoye and Moorings. This information was then compared with the farmer perception so as to ascertain if it related really. The **in**teractive **stat**istics (Instat+) software (www.ssc.rdg.ac.uk/software/instat/instat.html) was used to analyze rainfall trends, start and end of the season, dry spells during the growing season, length of the season, planting dates for maize crop in the season. The results were then presented to the smallholder farmers in Mujika so as to correlate them with farmer perception of long-term climatic changes. The detailed rainfall analysis is presented in chapter 5.

Following the development of the Community Information Dissemination Plan (CIDP) during the baseline assessment**,** climatic risk materials for coping with climate variability were disseminated. English and the vernacular Tonga pamphlets, cartoons and oral presentations were used. The vernacular radio programs and radio dramas were also broadcast at regular intervals during the summer from Chikuni radio station, Monze (see chapter 6).

The developed community agrometeorological participatory extension strategy (CAPES) was tested using community interactions and where meetings were held with local leaders, small and large groups of community members. Farmers also engaged with the seasonal climate forecast (SCF) in its interpretation and dissemination using the farmer to farmer, vernacular radio programmes and radio listening clubs. The on-farm experiments using the mother-baby trial concept provided knowledge through learning by doing while the field days provided for receiving feedback on the effectiveness of the strategy. Other data collection and analysis was through observations and assessments of farming systems.

During the operationalization of the participatory agro-meteorological extension strategy, the social/institutional aspects that enable farmers to adopt appropriate alternative interventions were identified. The project also investigated the effectiveness of the all aspects of the project levels such as project introduction to community, implementation, farmers' participation, relationships, behavioral change, monitoring and evaluation.

3.3 Research Design

This thesis used a wide range of methods, both qualitative and quantitative including case studies. Research designs can either be 'fixed' or 'flexible' (Robson, 2002), but a 'flexible' research design was used here. Uses of the case studies and the interactions made during the release of each seasonal climate forecast of the 2007/08, 2008/09 and 2009/10 seasons were using a 'flexible' design method for responding to the unfolding seasons. Qualitative data about participants' perceptions was also collected using a range of methods. The rationale for the case study design and the selection is discussed. The case study areas: Nkabika, Malomo and Bulimo village in Mujika area of Monze district are described.

3.3.1 Limitations of the study

This study was limited to one district Monze and only three villages were identified, so as to concentrate the available research time on in-depth data collection during the three year time period. The availability of long-term rainfall data (Moorings 86 years; Magoye 28 years) was another condition used when selecting the case study site.

3.3.2. Case study description

The main details of the three villages used in the study are shown in Table 3.1. Figure 3.1 shows the location of Monze district, in southern province of Zambia. The Tonga people were mainly dependent on cultivation (mainly growing maize, sweet potatoes and groundnuts) and livestock rearing. The total village populations by 6th September, 2007 were 74, 262 and 350 for Nkabika, Bulimo and Malomo respectively.

Nkabika, Bulimo and Malomo villages are located in Mujika about 18 Km east of Monze town in southern province to the border with the Kaumba area. Mujika area is composed of 16 villages. Access to the villages is mainly by off road vehicles using perennial dirty feeder roads off the main road between Monze and Njola area. Figure 3.2 shows the Mujika project village map.

Table 3.1: Key features for study area

	Case study area		
District	**Monze**		
Area	**Mujika**		
Village	**Nkabika**	**Bulimo**	**Malomo**
Household population	74 people	262 people	350 people
Tribe groups	Tonga	Tonga	Tonga/Ndebele
Main crop	Maize, sweet potatoes, groundnuts	Maize, sweet potatoes, groundnuts	Maize, sweet potatoes, groundnuts
Main livelihood	Cultivation and livestock	Cultivation and livestock	Cultivation and livestock
Annual rainfall (mm)	801 mm	801 mm	801mm
Seasonal rainfall (mm)	756 mm	756 mm	756 mm
Climate change related events last 10 years	Drought, floods, animals diseases	Drought, floods, animals diseases	Drought, floods and animals diseases
Social and economical changes last 10 years	Population increase	Population increase	Population increase

Figure 3.1: Location of the case study at Monze

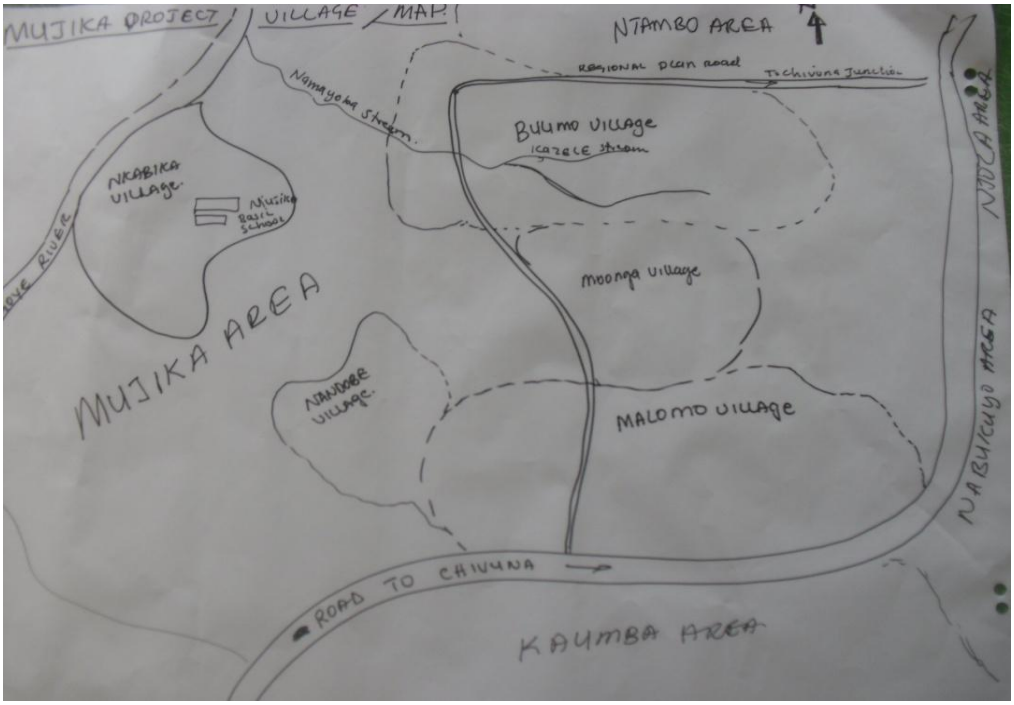


Figure 3.2: Mujika project village map drawn on 6th September, 2007

Figure 3.3: Headman Bulimo and his wife Rosemary at their baby field trial (1st January, 2010)

The soils are sandy loamy and the vegetation cover is mainly of *Fiadherbia albida* trees. The community livelihood is mainly subsistence agriculture and livestock farming. Only about 30% the homes are permanent roofed houses in Mujika and the village homesteads are situated some distant apart and some are in some family groups. There are several religions represented in Mujika. The majority of the people are Seventh Day Adventist (SDA), followed by Catholics then Salvation

Army members. The SDA have church buildings in nearly every village but there are very few Catholic and Protestant churches. Bulimo village members started a nursery school and an adult school at the agriculture shed in 2008. Mujika Basic School is the only school teaching up to grade 9. There are also two agriculture marketing depots at Bulimo and Brunelli in Mujika on the western border with the Kaumba area, where there is a health clinic called "Kaumba clinic" despite being in Mujika area.

3.3.3 Timing of research activities

The data collection activities were organized into three phases. The first phase was for sites visits, project introduction and launching of project at the case study site; with the second phase being for assessing the baseline information. The third was used for implementing the community agrometeorological participatory extension strategy (CAPES).

The first two months, August and September, 2007, were used for site visits, consultations with village Headmen and launching of the project. This was immediately followed by the PRA activities and development of the Community Information Dissemination Plan (CIDP) for Mujika. The third phase of implementation of the CIDP and CAPES commenced with the release of the SCF in September followed by a review from February to May, 2008 using a field day, village and project meetings. During May to June 2008 the researcher returned to University of the Free State (UFS) to report on developments, do climatic data analysis and plan for the second and third year of testing the approach. The third phase was repeated during 2009 and 2010 allowing for amendments to methods used in the case study area. This was followed by a period of data analysis, writing and presenting results.

3.4 Methods of Data Collection

3.4.1 Philosophy of the community in using the action research cycle

The data collection strategy as designed in sections 3.3.2 was aimed at addressing the research questions which were used to identify data requirements and suitable research methods. The specific objectives, research questions, data needs and possible methods of collecting the data are shown in Table 3.3. However adjustments were made as the focus of the research became clearer. Most of the social data was tracked through the stories of selected farmers (ch 8), household interviews and semi-structured interviews (ch 4). The participatory rural appraisal, on-farm experiments, one-on-one individual contacts and radio listening clubs were necessary for disseminating, learning and confirmation of the social data from the survey and interviews. The public meetings were used for the project launch, dissemination of climatic information and

receiving of feedbacks from the community. The different research methods are discussed in detail below. They have been classified under community interaction and other data collection and analysis. This section is concluded with a description of the research management.

3.4.2 Community interaction

3.4.2.1 Leaders and key informants meetings

Planning meetings with Village Headmen as local leaders and key informants were initially used for project introduction and consultations but were called every year for planning of field days. According to Corbetta (2003), the term 'key informants' is used to describe individuals interviewed for their special knowledge or expertise of the phenomena being observed due to their privileged observational position. The required support and guidance in project management such as when the launch and various PRA meetings could be held and how the field days could best be organized came as a result of the meetings with the Village Headmen and key informants. By considering the leaders contributions it allowed for a better planning and implementation of Public Project Launch (PPL) and Participatory Rural Appraisal (PRA) meetings, as researchers were not aware of the other community commitments for meetings. With the initial site visit meetings the researchers began to understand the project area. During the project 7 local leaders and 2 key informants were interviewed in Monze including the Village Headmen, local government officials, extension officer and lead farmers in the community. They provided their point of view on infrastructure, impact of climatic and non-climatic factors on local agriculture, and also trends in the village and district as a whole. This information was particularly useful in the development and management of the research.

3.4.2.2 Large group meetings

Large public community meetings, held in each village, were used for initial public launch and every year for the announcement of seasonal climate forecast and to receive feedback on the effectiveness of the community agrometeorological participatory extension strategy. Public meetings were appropriate for collecting quantitative data on the larger community. Other large group meetings were also held during field days so as to share lessons from the field trials. Community reaction and participation was monitored after each of the meetings.

Table 3.3: Specific objectives, research questions, hypothesis, data needs and possible methods used during the research process

Specific Objectives	**Research Questions**	**Data needs (what data needs to be collected)-Include specific variables**	**Possible methods of collecting the data**
1. To analyze long-term rainfall data for two stations for Mujika area.	What trends are found in the long-term rainfall records for Mujika area?	Long-term rainfall data	Visit at weather station and data collection from the ZMD.
2: To establish the current status of climatic risk information and dissemination practices in Mujika area.	What dissemination modes are available for disseminating climatic risk information? Are there any that are appropriate for use in Mujika area?	Time related historical data Historical time line Trends lines, rainfall Population, crop production, soil fertility and water availability Seasonal calendar: Food crops, cash crops, diseases, food availability Labour demand, labour availability, crop varieties and legumes	PRA Semi-structured interviews Literature review Internet, literature, regional experts,
3: To document the social/institutional aspects that enable farmers to adopt appropriate alternative interventions.	What institutional aspects enable farmers to adopt appropriate alternative interventions? What family or personal aspects are needed for adopting new alternatives?	Type of institutions, NGOs, Private family structure, relationships/local leaders etc	PRA baseline, semi-structured interviews
4. To operationalize the community agrometeorological participatory extension strategy so as to evaluate its effectiveness.	Can we develop an appropriate agrometeorological extension service? Will agrometeorological service be effective	Current dissemination strategies in use Feedback on the usefulness/effectiveness of climatic disseminated information Farmer participation in SCF dissemination modes	PRA, questionnaire, Semi-structured interviews, field trials, farmer discussion groups, radio listening clubs and individual farmer stories Participatory action research

3.4.2.3 Small group meetings

The small group meetings served to collect baseline data using the PRA process in the creation of the Community Information Dissemination Plan (CIDP). Other meetings were also used to receive feedback for farmer monitoring and evaluation and especially involving radio listening clubs and the participatory field experiments. Smallholder farmers in Mujika were exposed to seasonal climate forecast so as to couple it with their indigenous knowledge systems for predicting seasonal rainfall. These were used to develop crop management options that could respond to the specific SCF for the 2007/08, 2008/9 and 2009/10 seasons. The interactions were held immediately after the announcement of the SCF in September each year by the ZMD where training workshops were also held with about 30 farmers. These were platforms for training smallholder farmers about the concept of climate forecasts and their usefulness in making decisions to maximize crop productivity for any given forecast. After discussion with the researchers, farmers came up with crop management options that would be suitable to the specific seasonal climate forecast.

3.4.2.4 One-on-one individual contacts

The one-on-one individual interaction provided for a detailed research exploration for both data collection and receiving of feedback. These contacts took the form of semi-structured interviews in a flexible research design without prepared questions but guided by the current topic. They were more useful in data collection and receiving of feedback when a mutual relationship was created between researcher and individuals. This approach was commonly used with key informants, village residents, project partners and policy makers. These contacts resulted from planned or chance meetings during the researchers visits to the area.

In most interactions with the 25 recorded respondents general questions were allowed regarding previously discussed topics. In the discussions, there were usually deviations from the current topic according to the respondents' choice and feedback information provided. A conversational approach provided a free atmosphere of open sharing on the specific topic of interest. The gestures, tone of voice of respondents and what they actually said helped to gain a sense of their attitudes and beliefs. All these were recorded so as to paint a picture of the people's response to the project.

3.4.2.5 Stories of selected farmers

The data on the impact of the disseminated climatic information and effectiveness of the dissemination modes for smallholder farmers can easily be gained qualitatively from the one-on-one contacts, and was reported by writing stories about some selected farmers. These stories introduced the smallholder farmer's background before interactions and were developed through continued

interaction on climatic information but concluded at some point in time. This provided valuable details on the individuals' growth and development in understanding the seasonal forecasts. The details of the story from these farmers were collected through an informal interaction on various subject during home visits or by chance meetings, and confirmed by evidence of farmer field practices seen during field visits. By becoming friends and developing a good working relationship with these farmers it was possible to have an increased opportunity for getting more information. Each farmer was at each project stage expected to know the general trend of interaction as it involved them. A total of five stories of selected farmers were recorded and used for evaluation of the process.

3.4.2.6 Participatory Rural Appraisal (PRA)

The PRA techniques were used for the collection of data with an overall aim of formulating the CIDP to serve as a guide in addressing the community problems by delivery of information. Rapid rural appraisal refers to a collection of field techniques that are primarily used to extract knowledge from local people in a manner that is quicker, more cost effective and often more revealing than questionnaire surveys (Chambers, 1994). This information gathered by group PRA methods forms a consensus viewpoint of a community but that from semi-structured interviews and questionnaire interviews gives only the individual's perceptions. Using PRA at small group meetings, details were investigated on the topics shown in Table 3. 4.

3.4.2.7 Researcher observations

Recording people observations was one of the methods employed throughout all the phases of the research project. These were made on farmer participation, their reactions and change of behaviour. Further observations were on their living conditions; farmer to farmer interactions and adoption of best bet strategies for adapting to climate change and variability. The other aspects observed were the influence of other non-climatic factors on the agriculture development. The means of collecting observations was by watching and making notes while undertaking the other research activities. These observations and notes were more descriptive (Robson, 2002) and were later shared by discussion and exchanging notes between members of the research team.

Table 3.4: Exercises carried out during PRA field work in the Mujika case study villages

Activity	Information obtained
Spatial Data	
Sketch maps	Community boundaries, farm sketches, village resources, and development projects, problems & opportunities
Transect	Consolidated and verified village sketch map information
Time-Related Data	
Historical time lines	Document community major historical events and extreme climatic events
Trend lines **Rainfall, population, soil fertility, crop productivity**	Community perception of changes in rainfall, population, soil fertility and crop productivity.
Social and Agricultural Data	
Seasonal calendar	Length of season, types of crops grown, gender participation in crop production. Labour availability and demand and food availability and prevalence of human diseases.
Household interviews	Review as how best the CIDP would benefit individual community members
Institutional analysis **Venn diagrams**	Relationships of institutions working in area
Gender daily timeline	Who worked on what at homesteads and for how long
Problems and Opportunities Analysis	
Ranking of problems	List of problems/risks/stresses experienced in villages. Climate /non climate related problems. Ranking of problems
Ranking of opportunities	Order of community project to be managed
Way forward	
Designing of plan	Community Information Dissemination Plan (CIDP)

These observations assisted the team in understanding the context of the research and checking the accuracy of some of the information given by respondents to interview questions. The use of the video recorder in some cases allowed the capture of nearly all the details which were later replayed for documentation to obtain the in-depth meanings which were either in gestures or tone of voices etc. Living in Monze town 18 km away from Mujika area, for most of the three years research period made access to much of the needed information easier, though living in the villages would have provided more detailed information on daily tasks.

3.4.2.8 Semi-structured interviews

Semi-structured interviews are commonly used in the flexible research designs and usually combined with other methods (Robson, 2002). Here they were mainly used for the collection of social data during all phases of the research: exploratory, implementation and follow-up. Semi-structured interviews were used when interviewing local leaders, key informants, smallholder farmers and policy makers and implementers in Non-Government Organizations (NGO). Of the recorded 30 interviewees 3 were with local Village Headmen, 3 with local government officials, 4

with extension officers and 1 with lead farmers in these communities the rest with local farmers.

An interview where the interviewer has an outline of the topics for discussion with the respondent to use in one own format and style is considered as a semi-structured interview (Kajornboon, 2005; Corbetta, 2003). Although following the same topics the approach to each interview may differ. The flexibility of the semi-structured interview allows for considerations of the respondents interests and available time. It also allows for creation of an atmosphere that is conducive for interaction before getting into the conversation and thus allowing for a relaxed atmosphere and a collection of genuine information. In times when one was not using an audio recorder or video camera to aid data gathering, it is important to be very attentive to what is being said and watchful of the body language. It is helpful to record data so that later one can remember the details as one's writing speed during interviews may be too slow to easily capture all information. So every evening following these interviews the notes were translated and documented for further records of other details made.

3.4.2.9 On-farm experiments

Following smallholder farmers' engagement with seasonal climate forecasts coupled with their indigenous knowledge in predicting the quality of the next season, these farmers came up with crop management options that could respond to the quality of each season 2007/08, 2008/9 and 2009/10 seasons. This included growing of appropriate varieties, water harvesting, selecting of drought tolerant crops, adding lower levels of manure and fertilizers during years that were predicted to be dry. These options were tested on-farm using the mother-baby field trials explained under section 3.4.2.9.10. There were five baby field trials in each of the two participating villages of Nkabika and Bulimo while six baby field trials were in the third village of Malomo making a total of 16. The mother field trial with replicates was in Bulimo village. The experiments for the first year did not have any replication in the mother field trials but replications were present in the next two seasons of experimentation. Repeating the experiments in the following season allowed for improvements in decision making and trials management.

3.4.2.10 Mother-baby field trials

The mother-baby field trial is an on-farm research field experimental approach (Rusike et al., 2006) which uses the participatory approach where the researcher manages a replicated *"mother field trial"* at a central place usually at a farmer's field (Figure 3.3). While scattered around on other nearby farms are a number of fields managed by the volunteer farmers called *"baby field trial"* with only one or two treatments (Figure 3.3). The treatments in the baby field trials are part of those

replicated in the mother field trial. The farmer innovations from the engagement may produce other field trials called *"grandchildren" (*Rusike et al., 2006).

The preparations for field experiments were done in a timely manner as it required a lot of preparation before the growing season. The main management of the science and technological part of trials was done by a fellow UFS PhD researcher, Prospard Gondwe. The selection of the treatments for the mother-baby trials was done during the "participatory modeling exercise" held on 6th – 8th October, 2008 and 27th October, 2009. The crop varieties, fertility treatments and tillage practices involved (Walker et al., 2009) in trials; were a result of discussions with farmers on SCF and APSIM model output. A systematic diagram of the mother-baby field trials layout is given in Figure 3.3.

The local agriculture camp officer together with the Village Headmen selected the baby field volunteer farmers, so as to provide a balanced community set of results with the gender balance of volunteers considered. Though the smallholder farmers managed the daily aspect of the baby field trials, periodical on-farm visits or monitoring was done. This assisted farmers in reviewing their attitude towards the experiments. The taking of notes by smallholder farmers and researchers of every activity like the date of planting, weeding, application of top dressing etc, provided for easy appreciation of experimental benefits. The researcher's living near the project area promoted improved management of the mother field trial.

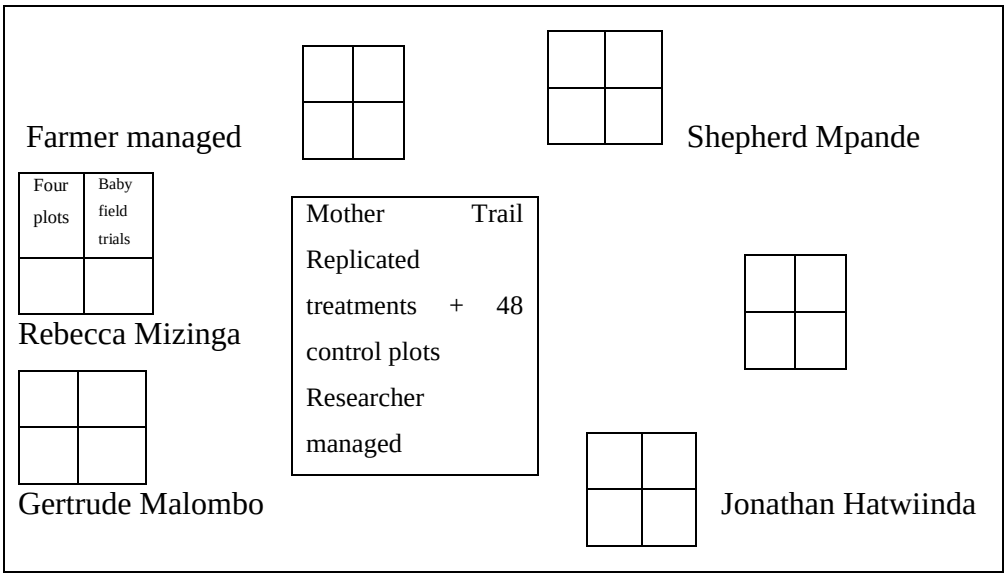


Figure 3.3: Mother-baby trial layout in Mujika area

3.4.3 Other data collection and analysis

3.4.3.1 Climate data analysis

Long-term rainfall data was used as a scientific basis for the climatic information given to the farmers. Long-term rainfall data sets from two rainfall stations around Mujika were used for analysis, namely Magoye meteorological office (1978-2006) and Moorings rainfall observing station (1921-2006). This data was collected from the Livingstone meteorological office of the ZMD and was updated with a visit to both stations. The data was stored in the Instat+ format for analyses. Rainfall trends, start and end of the season, season lengths, dry spells and risks of planting too early were calculated with Instat+ for Mujika area using data from these two stations.

3.4.3.2 Vernacular radio and radio listening clubs

The vernacular radio programmes together with radio listening clubs were introduced before the start of each season and continued until mid-season, for dissemination of SCF and supporting of farmers' agricultural decision making. Vernacular radio programmes on farmer selected topics were broadcast from Chikuni radio station started November, 2007, with volunteers in each village recorded the programmes for replaying at the radio listening clubs. Farmers' participation to the radio listening clubs over the three years period and participation by gender was recorded by farmers' representatives for later analysis. This was repeated over the following two years to investigate farmers' reactions. Radio listening clubs served as tools for collecting data on farmers' response to climatic information through participation.

3.4.3.3 Farming systems assessment

The structured interviews and observations were used to investigate the current farming systems and practices in Mujika. The PRA held at the beginning provided additional information of farming systems. The result served as baseline information on farmers' engagement with SCF.

3.4.4 Research management

This study was conducted with the help of the local agriculture camp officers, Mr Philemon Hakalembe who was based in Mujika area. The other PhD student Mr Prospard Gondwe managed the technical aspects of the mother-baby field trials but unfortunately died out of Pneumonia in 2010. The camp officer was the researchers' referral at project introductions in the case study area. He, in conjunction with the Village Headmen, organized and facilitated at all formal meetings. Philemon shared the same interest with researchers in this research as this work assisted him in his work of agricultural.

The frequent interactions with smallholder farmers in the area increased farmer confidence in the team while sharing more information than at the beginning of the project. This researcher's

understanding of the local language Tonga allowed for the easy capture of gossip comments such as, *"don't give them information they will sell the land*", that were helpful in project management. This also encouraged the farmers to easily trust the researcher and share more information. During the field work this researcher made notes on opportunities, challenges, impressions, reflections, reactions and frustrations etc. The evenings were characterized by debriefing and report writing. There were no payments made to the community but volunteers to the baby field trials were allowed to use the produce for home consumption.

CHAPTER FOUR: CURRENT CLIMATIC RISK INFORMATION

4.1 Introduction

The principal interest in this chapter is identifying the climatic risk information available in Mujika area and its relevance in establishing a community information dissemination plan. Different areas, depending on their geographical location, accessibility, available dissemination modes, and previous engagements with that community and providers of climatic information may have different available climatic information (Sivakumar, 2006). Current climatic information provides the researchers, understanding of what is available, its accessibility, adequacy and influence on smallholder farmers before undertaking any information dissemination activities with the community. This current information including its dissemination modes and effectiveness has the potential and influence to reshape the planned dissemination strategies for a particular area when considered. It is with the full analysis and meaningful consideration of the available climatic information that a new climatic risk information dissemination plan would effectively meet the climate change and climate variability concerns of that community.

Community adaptation and livelihood is usually shaped by its consideration and use of the available climatic information. When a community is considered vulnerable to climate change and climate variability, building capacity programmes should amongst other things consider the available climatic information and non-climatic factors; and their influence before introduction or suggesting new ones. This can easily be done by involving the affected community in reviewing their livelihood. The affected community understands their situation better; and their contribution is fundamental to coming up with the climatic information dissemination plan that will be sustainable and addressing their climatic concerns. An appropriate procedure for getting the current climatic data from community is therefore essential to allowing acquisition of all the relevant information for developing an effective Community Information Dissemination Plan (CIDP).

This chapter presents the current climatic and non-climatic information, and the process of developing a CIDP. The readers are also encouraged to see the level of community participation and the benefits of the interactions in the CIDP development. It is also important to note that the communities may not provide all the necessary information in public meeting for addressing their concerns as some may be too personal for public consumption.

4.2 Materials and Methods

The detailed data collection strategy is explained in section 3.4.1 where research questions which were used to identify data requirements and suitable research methods are presented. Most of the

current information pertinent to natural resources management and climate change for this chapter was provided through community interaction during small group meetings. Participatory rural appraisal and semi-structured interviews were employed. The small group meetings served for community baseline data collection through the PRA process to formulate the CIDP. The semi-structured interviews using the flexible research design approach with an outline of the topics for discussion in own format and style with the respondent (Corbetta, 2003) was also used. This approach was commonly used with key informants, village residents, project partners and policy makers. It was undertaken before the development of the CIDP and its implementation. The PRA data collection meetings were held on 4th, 5th and 6th September, 2007 in Nkabika, Bulimo and Malomo villages respectively. Researchers facilitated the PRA activities basing on the core PRA study objective of ending up with a community action plan after collecting the relevant spatial, time-related and social data for each village.

4.3 Results and Discussion

The participatory technique was used for collection of a wide range of information pertinent to natural resource management and climate change. All the techniques cantered on the smallholder farmers providing the accurate information on the situation and their perception. This information served as a guide in the development of alternative corrective measures to their climate related concerns.

The PRA approach used has been used by others before (see literature review) but the clue to the success in data collection in Mujika area was in balance where community was esteemed as source of this vital information and that with their input, the possibility of improving their situation using their own available resources including that the researchers could access was feasible. Further, these concerns would be addressed with their full participation as stakeholders during the implementation stage. The full range of approaches and data collected on the creation of the community agrometeorological participatory extension services is in Appendix 2.

The Agrometeorologist was in contact with the Village Headmen and community members of Nkabika, Bulimo and Malomo villages, as well as the female farmers in the community. He held small group meetings with village community members, interviewed those met on the transect walks undertaken in the respective villages and with individual families members during the semi-structured interviews confirming community wide view of climate change and available natural resources with that of the actual on-farm situations. So the current community information was from a personal touch using small group meetings, personal observations during the transect walks

and semi-structured interviews at selected individuals homesteads. The current Mujika situation was evaluated with the interaction of the community and researchers. The specific information collected will be given by category. This information about Mujika community is special in that it created the baseline for this project, helped to improve project design and its management.

4.3.1 Spatial data:

4.3.1.1 Community sketch maps

Village communities made the contributions to the draft sketch map showing all that they thought was in their area through a participatory approach during the PRA meeting. The interactive contribution exercise was done as a single group. The drawing of the draft sketch map for Nkabika was done by one person while those for Bulimo and Malomo were being alternated by two people. The final drafts were redrawn by a selected number of people who presented the final copy to the meeting approval and later photographing. Final community sketch maps for Nkabika, Bulimo and Malomo villages show homes, roads, and public buildings (Figure 4.1, 4.2 & 4.3).

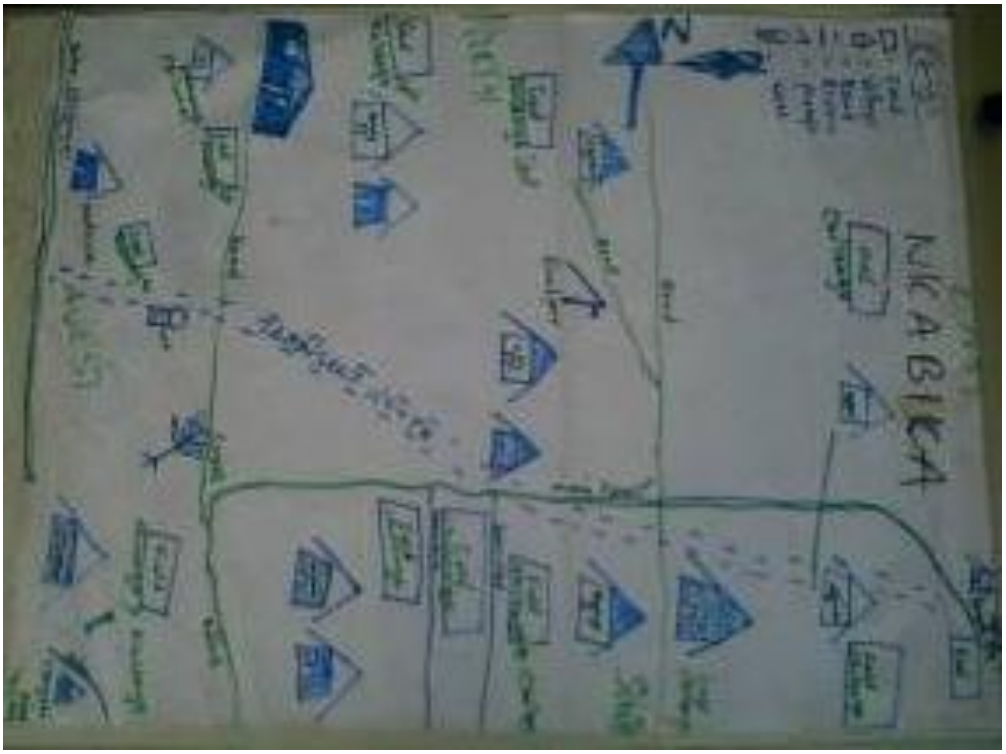


Figure 4.1: Community sketch map for Nkabika village drawn on 4th September, 2007

Figure 4. 2: Community sketch map for Bulimo village drawn on 5th September, 2007

Figure 4.3: Community sketch map for Malomo village drawn on 6th September, 2007

Malomo community spent the longest time identifying the village boundaries before making community resources. The exercise of drawing community draft sketch maps took only 33, 41 and 45 minutes for Nkabika, Bulimo and Malomo villages respectively to complete.

4.3.1.2 Transect

Transect for Nkabika village was done on 4th September, 2007 after the PRA meeting under the guidance of four selected local people. The team started from the eastern side following the transect route as indicated on the Nkabika sketch map towards the west. Transect details are shown in Figure 4.4. From the transect walk through, Nkabika, it can be seen that according to the community all the soils are heavy clay and the *Acacia karro* trees are growing throughout. There are also two sources of water – a well and the Magoye River next to which vegetables are planted.

Crops	Nil	Nil	Vegetables
Soil	Heavy clay	Heavy clay	Heavy clay
Vegetation	Musangu/Acacia	Bananas, roofing grass, Acacia	Oranges, sisal, Acacia
Water	Handy pump	Nil	Magoye River
Social	Nil	Nil	Foot ball ground
Problems	Dambo / water logging	Water logging Lack of drought power	Waterlogging
Opportunities	More boreholes Business enterprises	Grazing grounds	Grazing grounds, Building of wearer / Damming, Irrigation

Figure 4.4: Transect through Nkabika Village, Mujika area Monze district

The transect walks verified information on the community sketch maps as well as adding those details not indicated earlier, such as land in Nkabika village was slopping westwards towards Magoye River on the western end of the village. Half of the village land was low lying and with heavy clay soils and prone to waterlogging and during the transect walk this was identified as a problem. The first and second sector of transect was arable land with the nitrogen fixing *Faidherbia Albida* (Musangu) trees. Nkabika's potential therefore was in the maximized use of this piece of land. Nkabika had very few temporary and permanently roofed houses on the first transect segment but increasing towards the third segment. The Magoye River nearby with running water throughout the year was yet another opportunity for irrigation. It is therefore true that during the transect walk one may find additional information on problems and opportunities not indicated on the sketch map and it helps to improve designing and planning of CAPES strategy.

The Bulimo village transect was undertaken on 20th September, 2007 under the company of two selected local people Ricky Hamaundu and Pious Mwiinga (Figure 4.5). The team did not interview anybody at all along the transect route as those met were all from outside Bulimo village. The team started from the southern end towards the northern direction. Bulimo village has more water points and the slope to Kazele stream is gradual. There are several places of learning such as the adult school and the agricultural marketing boards and the soils are predominantly sandy loamy and as it was autumn there were no crops. The first southern sector of the transect line in Bulimo village was mainly a Dambo area with roofing grass and Acacia trees growing, an area fit for grazing animals.

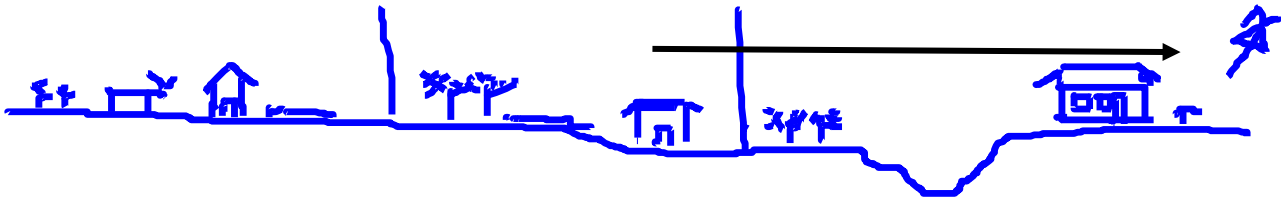
Crops	Nil	Nil	Nil
Soil	Sandy loamy	Sandy loamy	Sandy loamy
Vegetation	Natural bushes Acacia trees	Roofing grass, Muunga	Acacia, roofing grass
Water	Dambo	Wells (2)	Kazele stream, well(3)
Social	One permanent buildings	Most permanent roofed houses, Adult learning school, Good shed, Agric camp house	Agric board depot, most permanent roofed houses
Problems	Animal disease, Lack of clean drinking water	Poor soil fertility, animal draft power	low food production, erratic rainfall
Opportunities	Boreholes, fencing farms & grazing land	Building dip tank, use of legumes	Grazing grounds, Building of wearer / Damming, Irrigation

Figure 4.5: Transect through Bulimo Village, Mujika area Monze district

The second sector with mostly permanently roofed houses, marketing board and adult training learning was appropriate for crop production with its loamy soils and land gradually slopping towards Kazele stream in the northern direction. The third sector was forested with Acacia trees. The land beyond Kazele stream had sandy loamy soils was the villages' main farming block. The Kazele stream provided opportunity for building a dam wall for animals and irrigation water. This opportunity was another opportunity for Bulimo village found on the transect route not indicated on the village sketch map.

The Malomo village transect was done on 7th September, 2007 under the guidance of some three selected local people (Figure 4.6). The transect route from the south eastern to the north western

direction was chosen at the meeting for being the main established route through the village. On the first sector the team interviewed Mr Shepard Mpande while on the second segment it was Mosley Hamabuyu and his wife Sharon and Violet Nangela. On the last segment it was Mrs Sibanda and Mr Nambaale. The transect walk took one hour to complete. Malomo village has a good number of water sources (wells), the natural bushes and swampy areas provide for animal grazing grounds. Malomo village is mainly on flat land with a gradual slope towards the northern and western direction. Much of Malomo village was arable land with sandy loam soils. The soil fertility problem identified could be improved with the use of organic or green manure in the cases of limited access to fertilizer. Malomo also had a sloping swamp area in the eastern sector which served as grazing area. Availability of bananas, sisal, Acacia trees and roofing grass was some of the additional information discovered not indicated on the village sketch map. Therefore it is true that on every transect walk undertaken in all villages additional information was found that was used in improving the project design and management options.



Crops	Nil	Vegetables	Vegetables
Soil	Sandy loamy	Sandy loamy	Sandy loamy
Vegetation	Natural bushes	Roofing grass, Muunga	Bananas, sisal, Acacia, roofing grass
Water	Wells (2)	Wells (3)	Swamps, well
Social	Few permanent buildings, grave yard	Grocery, few permanent roofed houses,	Football ground, Carblac School, few permanent roofing building
Problems	Animal disease, Lack of clean drinking water, Poor crop yield,	Poor crop yield, low soil fertility, animal draft power	Livestock disease, low food production, erratic rainfall
Opportunities	Boreholes, Use of legumes, fencing farms & dipping animals, old fuel filling station	Grazing grounds, use of legumes,	Grazing grounds, Building of wearer / Damming, Irrigation

Figure 4.6: Transect through Malomo Village, Mujika area Monze district

Shepherd Mpande living on the south eastern boundary confirmed Chivuna road was the boundary for Malomo village. A closed filling station existed and nearby community graveyards for Malomo

village not indicated on the map were also identified. On the second sector of the transect route Mosley Hamabuyu and his wife Sharon complained of the poor soils as depicted by the grass of the grazing grounds nearby and alluded this was the reason for the poor crop yield at the end of the last growing season. Mrs. Sibanda and Mr. Nambaale who live on the last sector of the transect route both underscored livestock disease as one major problem which had deprived them of their animals.

The natural resources in three villages of Nkabika, Bulimo and Malomo are similar in that they all have rural dirty roads, have grass and permanently roofed house, water points, fields and grazing areas for their animals. From the sketch maps one can tell that the communities are of rural nature and not developed as the modern urban standards. The transect walk provided a detailed view of the community problems and opportunities. Bulimo village, and the largest of all, had the highest number of developmental activities which the community members well acquainted with. Malomo village was the second largest with more developmental activities followed by Nkabika village. The long debate on community boundaries especially for Malomo village revealed some members did not fully understand and know their village boundaries. For some living near the borders did not know where they belonged but the sketch maps' completion gave them confidence of belonging to Malomo village. Nkabika and Bulimo community's full knowledge of their village boundaries enhanced their drawing of their respective community sketch maps and placement of community resources. The individual community sketch maps presented the visual picture of what Nkabika; Bulimo and Malomo villages looked like with locations, size of resources, and development activities.

4.3.2 Time-related data

Information was also needed about how conditions changed over time. The three time related data sources were: historical time lines, trends and seasonal calendars.

4.3.2.1 Historical time lines

Working as one group the farmers from each village provided their historical trend lines. The researchers guided the group with simple questions regarding settlements, diseases, floods, droughts, feminine, migration and infrastructure development. This was to recall events they felt were significant in the past and may have contributed to their current attitudes. The time lines for Nkabika, Bulimo and Malomo are shown as Tables 4.1, 4.2 and 4.3 respectively.

Nkabika community belongs to the Bachindu clan whose history in the area stretches as far back as 1800. Their main extreme events are of hunger, social, human and animal disease and

infrastructural development. According to community, human health was affected once with yellow fever and animal health twice, with the later almost continuing to the start of the project period. Infrastructural development is related to that of education where the Mujika Basic School is central. Their social events relate to changes in local Village Headmanship governance. Their main events started from 1930.

Nkabika community had only 6 events they considered as major (Table 4,1). Communities highlighted what they considered as their major historical events. None of the Nkabika community members present could remember any major event happening for over 130 years from 1800 to 1930. The next wide gap without any major event being remembered was 26 years extending from 1948 to 1974.

Table 4.1: Historical time line for Nkabika village

Year	**Event**
1800	The Bachindu clan of the Tonga people settled in the area.
1930	There was a severe outbreak of yellow fever.
1947	Serious hunger due to drought occurred in the village.
1948	Relief yellow maize called Kenya was brought to the village to cushion the effects of hunger that occurred the previous season.
1974	Mujika school became an Upper primary school.
1982	Serious outbreak of corridor disease wiped out huge herds of cattle
1991	Headman Nkabika II died
2005	Headman Nkabika V was installed. And with funding from PAF, a nursery school was established in the area.

Bulimo village historical events starting in 1927 highlights major events as those being of human disease, social, agricultural infrastructural development and hunger nature (Table 4.2). According to community, human health was affected once with polio in 1927 while infrastructure related to agriculture was built. Their social events relate to changes in local Village Headmanship governance. All these are mainly referred from 1930 as Bulimo historical time line began from 1927. The longest period without a major event for Bulimo village is 18 years from 1933 to 1952 followed by the period of 16 years from 1974 to 1991.

Table 4.2: Historical time line for Bulimo village

Year	Event
1927	Polio vaccination (outbreak)
1928	Bulimo village established
1928	First Headman Bulimo installed
1933	Locusts outbreak
1952	Second Headman Bulimo installed
1956	Agriculture Marketing Board built
1957	December first Headman died
1958	Hunger (Floods)
1963	Namayoba was built
1974	Agriculture Shed built (Brunelli)
1991	Food handouts
1992	Drought
1995	Borehole
1998	Bulimo Community School built
2003	Hunger

Malomo village main extreme event starting from 1910 are mainly of gospel mission, hunger, social, human and animal disease and infrastructural development nature (Table 4.3). According to the community, human health was affected once with smallpox and animal health affected twice with the later continuing until the start of the project. Infrastructural development is related to the building of the Seventh Day Adventist churches and CARBLAC education centre. Their social events relate to changes in local Village Headmanship governance. The information gaps for the period 1910 to 2006 are minimal and consistent for Malomo village. The gaps reduce in number of years as we draw towards the present time. All villages started with longer period gaps in their trends which were reducing in number as they approached 2007.

4.3.2.1.1 Observations

The older people alone declared the earlier historical events of the villages more confidently while the young listened. More hands of the younger people in every village could be seen raised in the air desiring to mention an event when the time lines had reached the 1970s. There were times when farmers consulted amongst themselves to come up with the date of a particular event. A date could then be fixed when you could tell doubt still existed on the faces of other farmers. Loss of community memories about events if not documented would in future compromise the accuracy of the historical community timeline. It is here where documentaries and annual traditional ceremonies find their relevance in communicating with the community major historical events to the future generation. The historical timeline was necessary for an improved understanding of community, like why they behaved the way they did when designing a community agrometeorological participatory extension service.

Table 4.3: Historical time line of Malomo village

Year	Event
1910	The Malomo village established by Seventh Day Adventist (SDA) missionaries under the first headman Philip Malomo
1918	Smallpox breakout in the village
1927	Smallpox breakout in the village again
1930	Savory, a white commercial farmer introduces clothes to the Malomo villagers.
1942	Death of the first headman
1944	First adult education established where both the adults and young pupils could learn together in the same class
1946	The second headman installed
1947	Hunger befell the village
1952	Disappearance of the major wild animals in the area
1953	The first Malomo SDA church built
1956	Break out of polio and whooping cough in the village
1958	Floods engulf the village
1966	The first borehole for water supply was installed
1969	Measles epidemic in the village
1973	Corridor disease breakout and herds of cattle wiped out
1975	The first Malomo community school established and death of the second headman (Dingilizwe Malomo)
1976	Job Malomo installed as the third headman of the village
1987	Nkalanga health post established
1988	Outbreak of Corridor diseases in the village
1990	Hunger befell the village
1994	Chicken disease broke out
1995	Hunger befalls the village and yellow maize brought as relief
2001	Death of the third headman
2002	Drought and hunger befell the village
2003	The fourth headman installed. The first community based organization called Capacity Building, Learning and Activity Center (CABLAC) formed.
2005	CABLAC erects its first building in the village
2006	Occurrence of floods in the village

4.3.2.2 Trend lines

Trend line information was required to learn the community perception of rainfall, crop production, population and soil fertility. This was to help in designing the project and improving of farmer perception when related to climatic information. The farmers spent longer time (25 minutes) on the rainfall trend line while soil fertility, crop production and population an average of 15 minutes was used. One member plotted the rainfall details on a flip chart paper with a marker while the rest provided the details. The researchers' inquiry for change in the trend whenever it was indicated was ably provided for by community.

4.3.2.2.1 Nkabika village trend lines

In 2007 Nkabika village had a small population of 74 (32 men and 42 women) and is situated at the extreme western end of Mujika area towards the Moorings station farm. The village boundary on the western side is well marked with the natural Magoye River. They are friendly Tonga speaking people. The Nkabika village rainfall trend line indicates that performance from 1970s to the mid 1990 was always consistently above average (Fig. 4.7). The people remember that the rainfall received from during 1990s was erratic and varying between near normal and below normal until 2006. The perception of Nkabika community concerning rainfall is that it has reduced since early 1990s and become more variable till 2007.

The Nkabika village soil fertility trend line shows soil fertility had been high from 1967 to 1980 when it assumed a steady declined through medium to low in 2007 (Fig. 4.8). The Nkabika villagers' view of their crop production trend (Fig. 4.9) is that it was about medium or average level from 1967 to 1974 when it suddenly dropped to a lower amount for two years and then was very high 1977. This high production remained till 1980 when it suddenly dropped to medium again in 1981 until 1985. Productivity remained low up to 2007 since it declined in 1986. The Nkabika village population trend line shows a steady raise from low to medium between the years 1800 and 1950 after which there was a rapid increase to high in 1975 (Fig. 4.10). The population had since maintained a high level till 2007. The population levels used were with respect to the highest population ever reached by the particular community. If the current population was perceived the highest, it was termed as high. Population review for the whole historical timeline was hence made with respect to the highest ever reached. The earliest part of the trends mainly depended on the information the oldest person present was (Mr Jonathan Hatwiinda who were born in 1950) had. The information for trend lines for Nkabika village hence started from 1967 when the oldest present had grown up and could remember some major events.

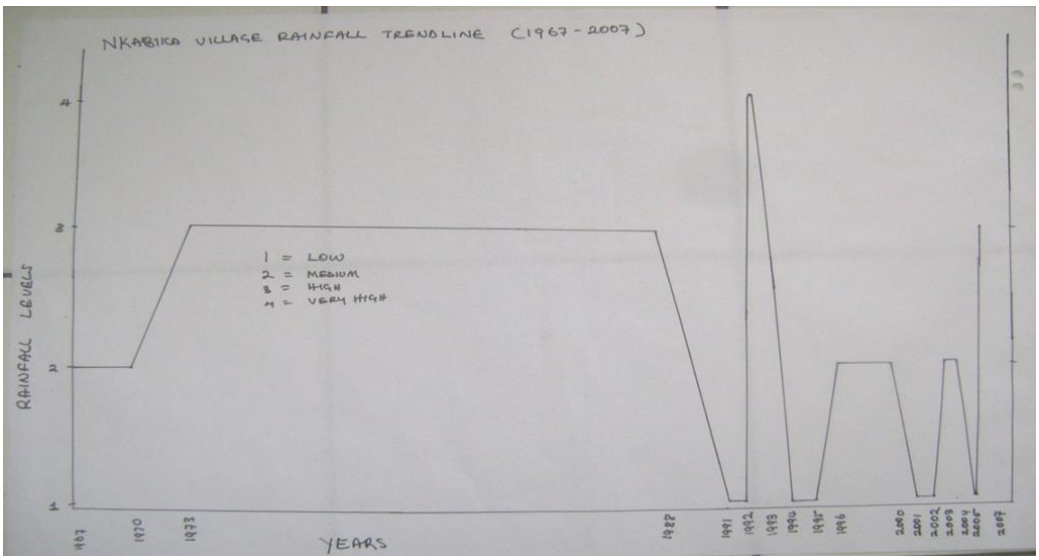


Figure 4.7: Nkabika village rainfall trend line from 1967 to 2007 drawn on 4th September, 2007.

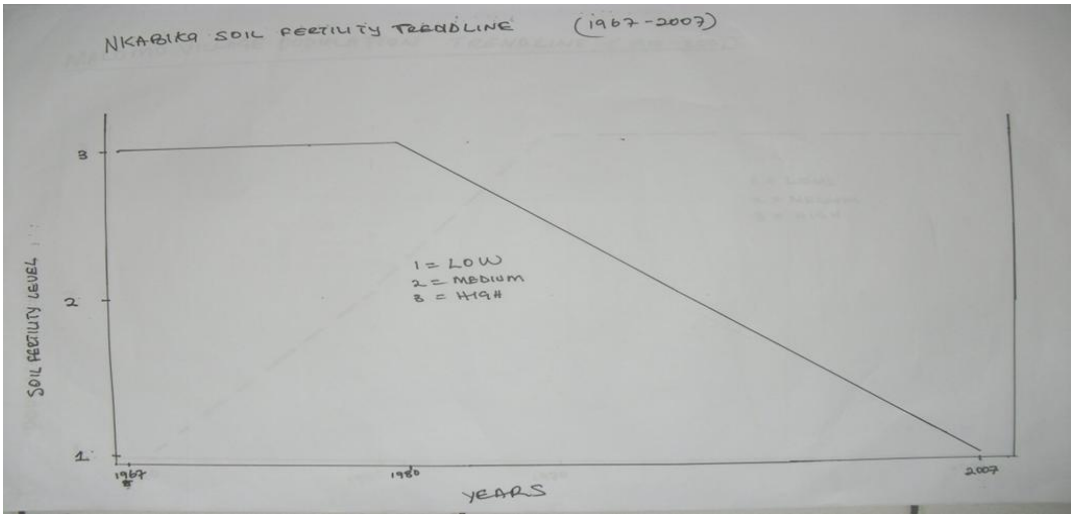


Figure 4.8: Nkabika village soil fertility trend line from 1967 to 2007 drawn on 4th September, 2007

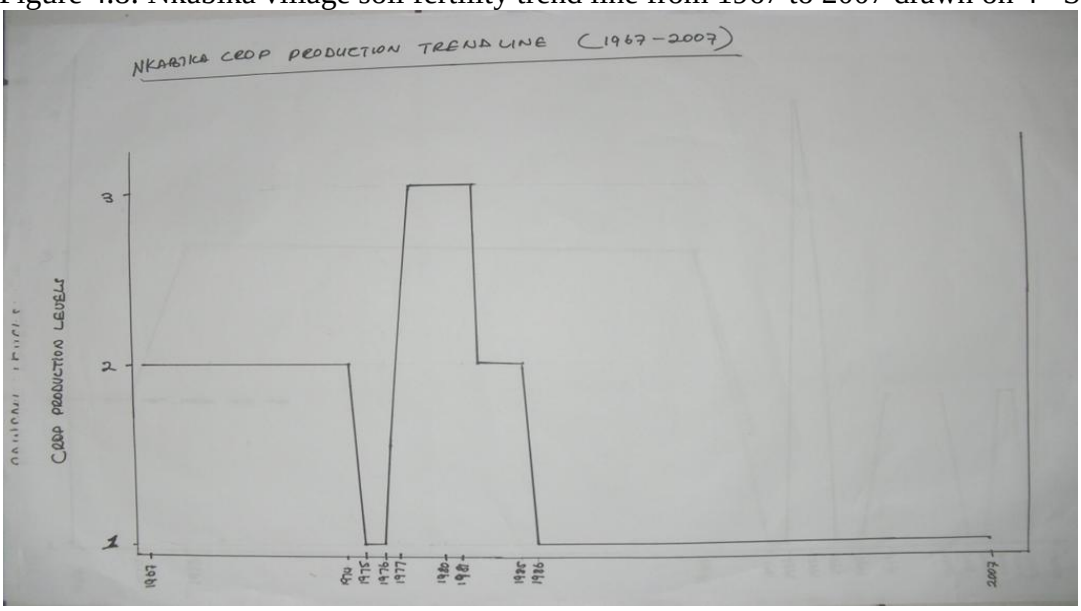


Figure 4.9: Nkabika village crop production trend line from 1967 to 2007 drawn on 4th September, 2007

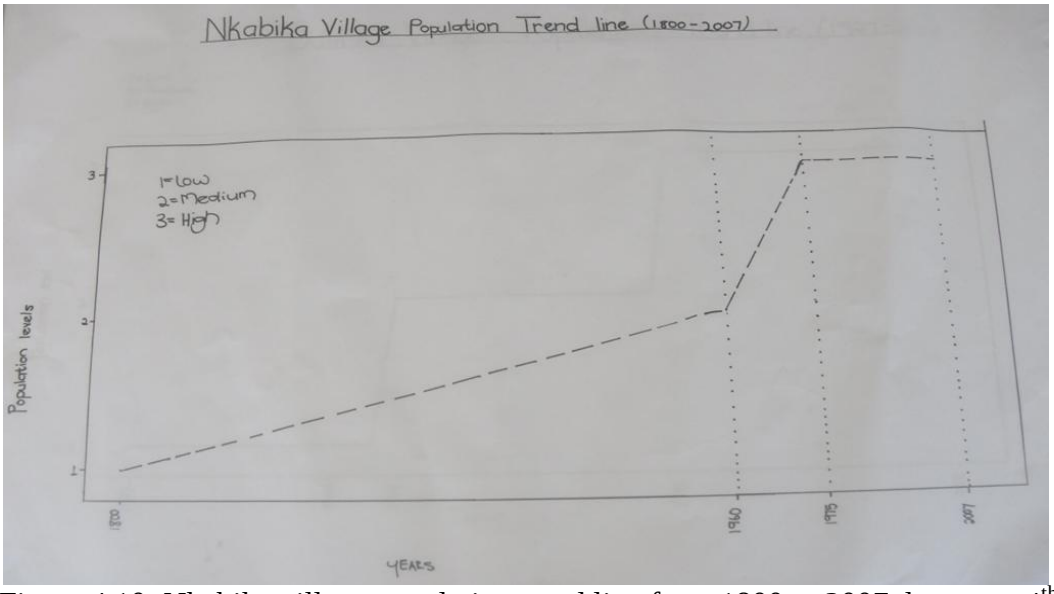


Figure 4.10: Nkabika village population trend line from 1800 to 2007 drawn on 4th September, 2007

4.3.2.2.2 Malomo village trend lines

Malomo village located to the south of Mujika area along the northern border with Chivuna road had a population of 262 (121 men and 141 women) in 2007. Its mainly Ndebele speaking people, settled in Zambia in 1910 to establish the Seventh Day Adventist Church in Zambia. They are very hard working farmers and friendly people. The village however, has a number of Tonga speaking people though fewer that the Ndebeles. The Ndebeles paid attention to major events that took place in their village and passed it on to their future generation through the village Headman's Royal family. For this reason they have a longer and more detailed account of the historical trend line than the other villages of Nkabika and Bulimo. Though the oldest person present at the meeting Mr Sibanda was born in 1940, community was able to tell of major historical events before they were born.

Malomo village rainfall trend line (Fig. 4.11) indicates that rainfall performance from 1910 to the mid -1970 was always consistently higher than average with the exception of the 1946 season when it was low and that of 1958 when it was high extremely. Rainfall from the late 1970 to 2000 had returned to normal with four cases of low performances and one extreme high occurrence. The later years show an erratic pattern. The perception of Malomo community about rainfall was therefore that it was consistently above normal though with one low extreme and one high extreme incidence till the late 1970s when it varied between near normal and below normal till 2007. The Malomo village soil fertility trend line shows soil fertility had been high from 1910 till 1950 when the trend declined sharply to medium level around 1951 (Fig. 4.12). This new state had maintained till the 1990 when a gradual decline started to low by 2007. The Malomo village crop production trend line shows crop production was high from 1910 to 1946 when it had dropped to low level until 1948 before raising to medium until 1980 before dropping to low again (Fig. 4.13). The Malomo village population trend line from 1910 to 1970 shows population increased progressively from low through medium in 1945 to high by 1970. It stabilized thereafter by remaining high till 2007 (Fig.4.14).

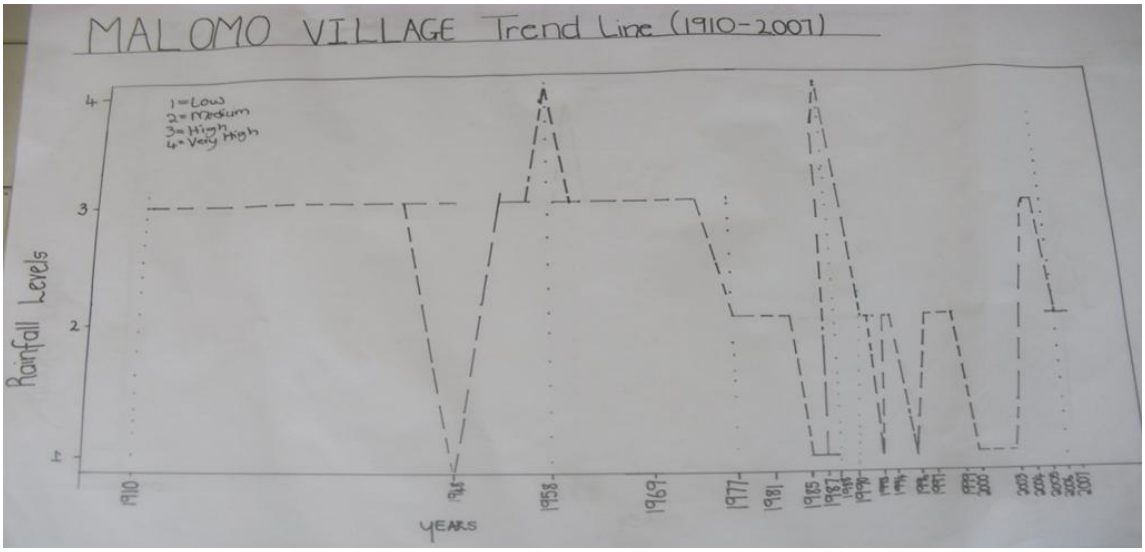


Figure 4.11: Malomo village rainfall trend line from 1910 to 2007 drawn on 6th September, 2007

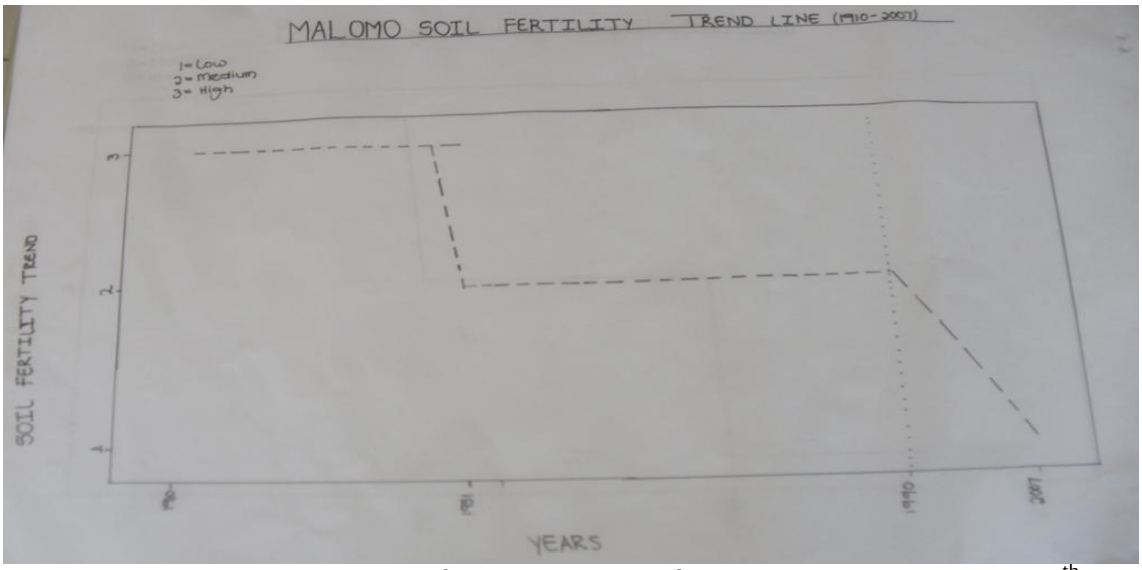


Figure 4.12: Malomo village soil fertility trend line from 1910 to 2007 drawn on 6th September, 2007

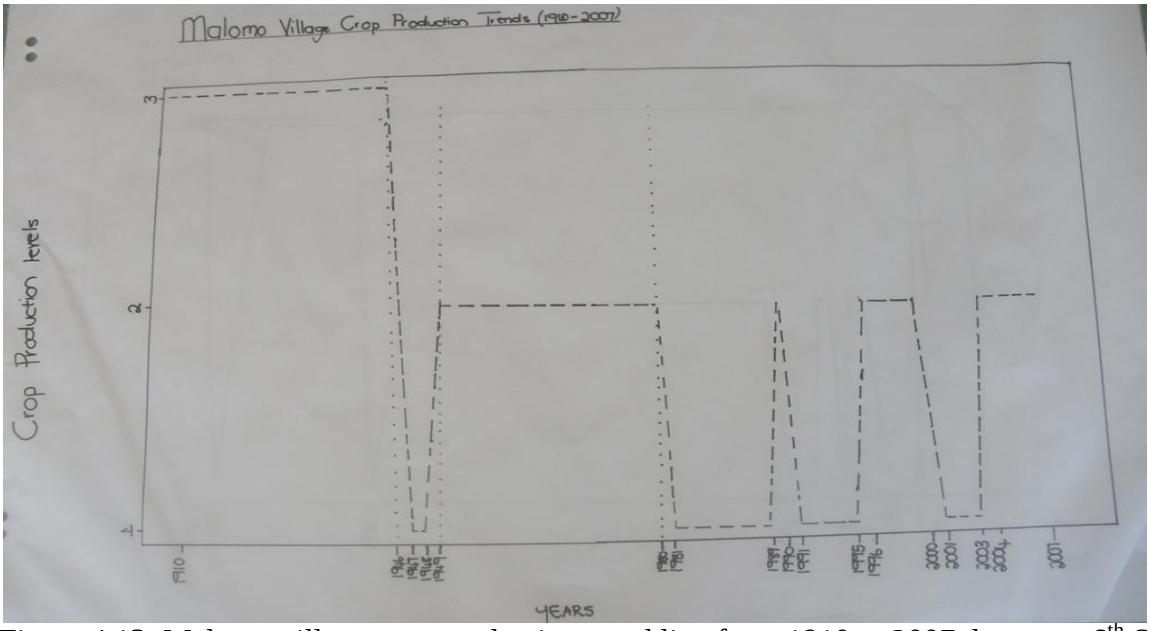


Figure 4.13: Malomo village crop production trend line from 1910 to 2007 drawn on 6th September, 2007

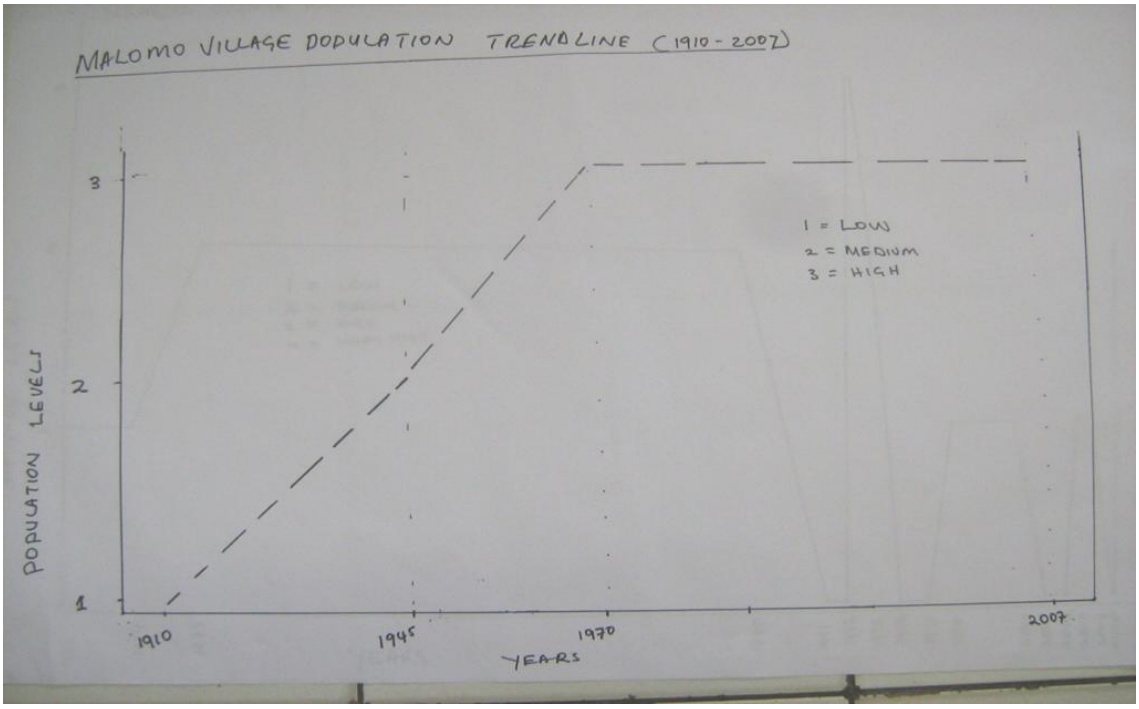


Figure 4.14: Malomo village population trend line from 1910 to 2007 drawn on 6th September, 2007

4.3.2.2.3 Bulimo village trend lines

Bulimo village is situated in the eastern part of Mujika area and borders on Ntambo area with boundary as the old "Regional plan" road as they called it joining Chivuna road further eastwards. The Tonga inhabitants with a 2007 population of 350 (171 men and 179 women) had a reputation of being good productive farmers whose agriculture productivity had enable them to build most of the permanently roofed houses they lived in.

According to the people, Bulimo village had maintained a low population up until 1941 before having a sharp increase to medium level in 1948 (Fig. 4.15). This state was maintained untill 1979 when there was another sharp increase to a high level where it has remained up to 2007. The Bulimo villagers' perception of rainfall trend line shows above average rainfall amounts from 1927 to 1972 except in 1958 when extremely high rainfall occurred (Fig. 4.16). From 1973 to 1990 it was average after which it became erratic between below average and average until 2007, with the exception of 2004 when rainfall was above normal. The perception for Bulimo village on rainfall is therefore that there was a reduction from high amounts in the early 1970s to varying on the lower side of average from 1990s to 2007. The soil fertility for Bulimo village which was high since 1927 and only reduced to medium in 1957 (Fig. 4.17). This new state was maintained until 1985 when it had turned to a lower value until 2007. Apart from 1933 when Bulimo crop production trend line had dropped to a very low amount, it generally was maintained high from 1927 to 1957 (Fig. 4.18).

This state changed in 1958 turning low and medium again in 1959 to 1990. Crop production trend had thereafter oscillated between low and medium until 2006.

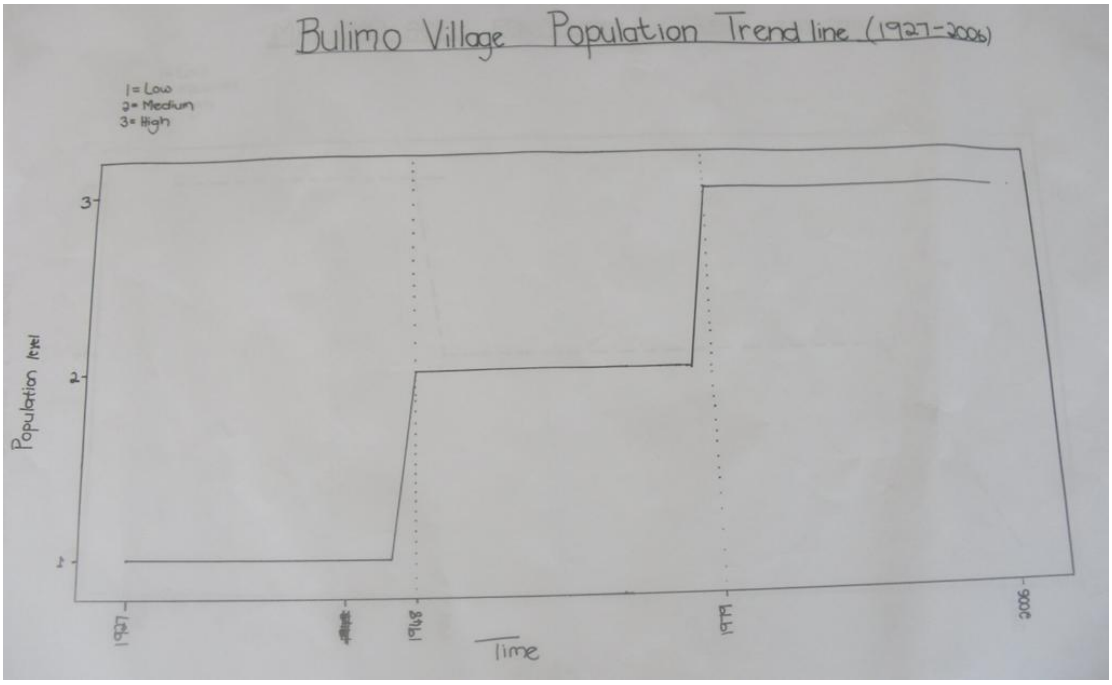


Figure 4.15: Bulimo village population trend line from 1927 to 2006 drawn on 5th September, 2007

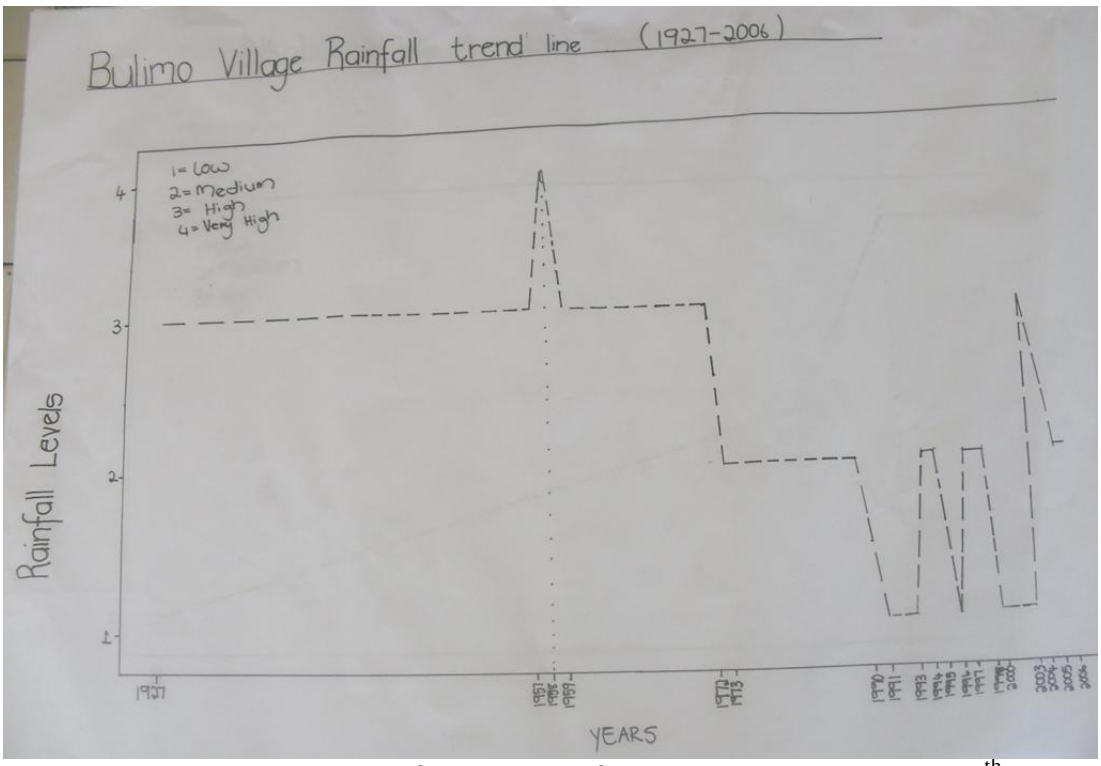


Figure 4.16: Bulimo village rainfall trend line from 1927 to 2006 drawn on 5th September, 2007

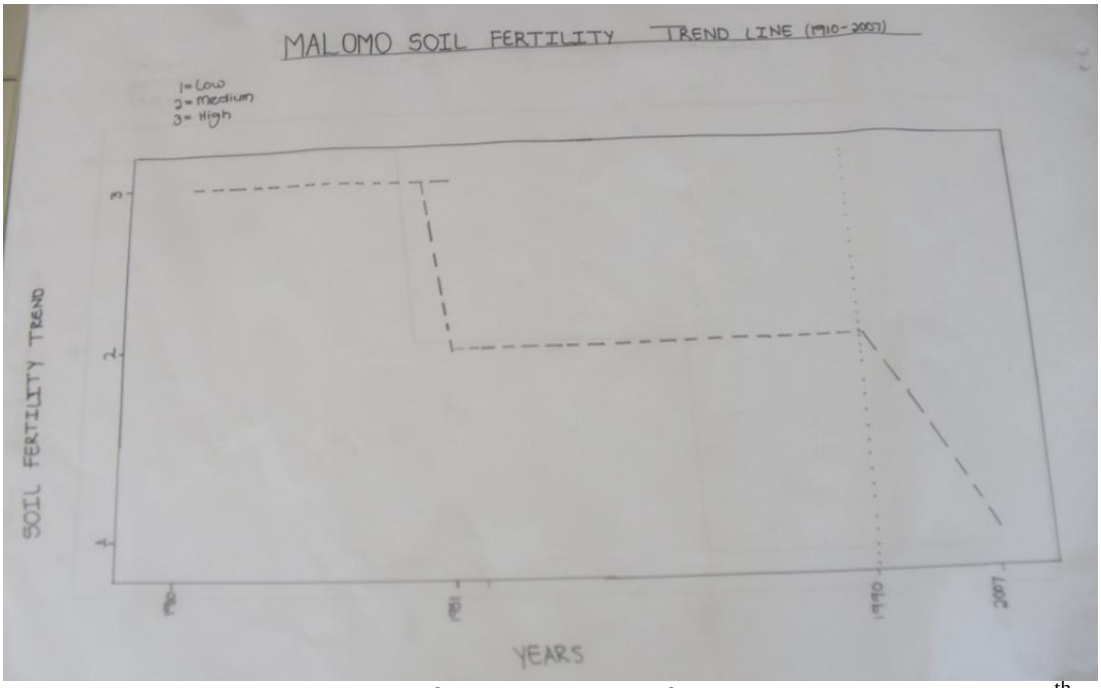


Figure 4.17: Malomo village soil fertility trend line from 1927 to 2006 drawn on 5th September, 2007

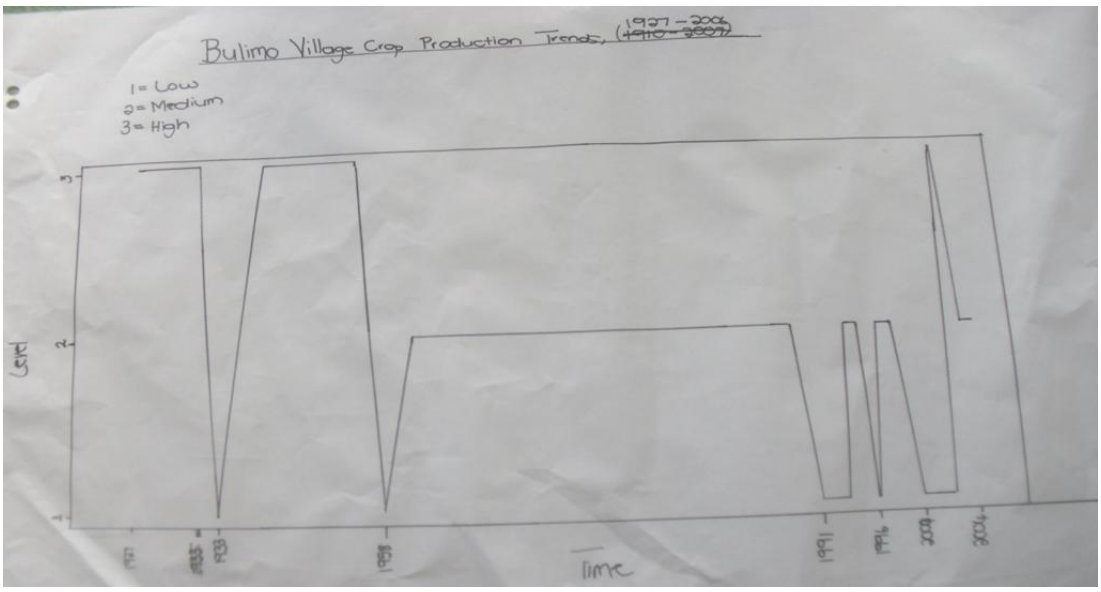


Figure 4.18: Bulimo village crop production trend line from 1927 to 2006 drawn on 5th September, 2007

4.3.2.2.4 Summary and interrelationships

While all the villages begin their trends with high soil fertility showing declines in 1950s, 1980s to end with low value by the start of the project in 2007, the Nkabika village trend reduced gradually with constant and sharp declines. There was no major reason given but could only be assumed the population growth logic might have been misunderstood when enquired for by the researcher.

In all the trends of rainfall, population, soil fertility and crop production, the elderly people gave details for earlier parts of trends while the young ones listened attentively. In the absence of a forum for sharing community major events individuals depended on their memories since a few years after they were born. Nkabika had the shortest range of trend lines followed by Bulimo and Malomo villages. The oldest person present during the PRA meeting in Bulimo village was Headman Bulimo (Nathan Chiluli) born in 1914. Nathan also could only remember major events about ten years after his birth and hence the start of Bulimo village trend line from 1927. Most Malomo village inhabitants were able to tell of major historical events long before they were born due to their means of communicating major events to their future generation though the village Headman's Royal family. This also was reason why they had the longest trend lines though the oldest person present at the meeting Mr Sibanda was born in 1946.

There was an inverse relationship between population increase and those of soil fertility and crop production. When population increase was experienced around 1975, it almost coincided with the soil fertility and crop production decline by 1980. This low state was maintained till the 2007. PRA provided an opportunity for documenting the community major events, trend lines and social data events. Though they may not be accurate they provided community's perception which served as a baseline for community agrometeorological participatory extension strategy that ensued. Farmer perception was vital in guiding the project design and its management especially on the type of fertilization to be considered. The prospect of an improved explanation using the multi-disciplinary approach on the value of SCF information to the community was with this information enhanced. Therefore with SCFs there is more chance; however, this is only the case if these SCFs can be trusted and are viewed by farmers as trustable.

4.3.2.3 Seasonal calendar

The researchers started by explaining what was going to be involved in developing a seasonal calendar before the community started working together. Then they continued facilitating the discussion with probing questions as to when specific activities were being undertaken. The community provided details on every aspect on a horizontal common time scale axis where they indicated who was responsible for the type of activity starting with the month of October. Tables 4.4, 4.5 and 4.6 were presented as the seasonal calendars for Nkabika, Bulimo and Malomo villages.

Communities' activities in the seasonal crop calendars were similar in all the villages. The seasonal crop calendar started in October with land preparations, an activity which continued through to

December. Crop planting commenced a month later in December after the start of the rain season in November. A wide variety of crops such as maize, groundnuts, cotton, sunflower, cowpeas and sweet potatoes were cultivated. Harvesting commenced from April when the crops had dried after the end of the rain season in March. Though the community was involved in the crop productivity, their food security was generally considered low and inadequate to suffice throughout the year despite picking up to medium from March and being high in May before dropping again to low in September. This trend was exactly opposite of labour availability. Malaria was their common disease from the start of the growing season in November to April. The malaria prevalence was low from October through December becoming medium in January and February and then turning high for March and April. This information was vital to know how the people perceived the rainy season for an area, usual crops a community planted, how long the yield lasted them, disease prevalence, availability of labour and its demand that in project design. Commencement of the community seasonal calendar in October and ending in September suggested livelihood mainly dependent on the rainfed agriculture system. Hence interaction in CAPES worked within their livelihood supporting system.

Table 4.4: Seasonal crop calendar for Nkabika village

Activity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall												
Food Crops												
Maize	land prep (♀+♂)	land prep (♀+♂)	Planting +weeding (♀+♂)	Planting +weeding (♀+♂)				harvesting (♀+♂)				land prep (♀+♂)
Groundnuts	land prep (♀)	land prep (♀)	planting (♀)	weeding (♀)			harvesting (♀)					
Sweet potatoes			land prep (♀+♂)	planting (♀)	Planting + weeding (♀)	weeding (♀)			harvesting (♀)			
Cowpeas			land prep (♀+♂)	planting (♀+♂)	weeding (♀+♂)			harvesting (♀+♂)	harvesting (♀+♂)			
Cash crops												
Cotton	land prep (♀+♂)	land prep (♀+♂)	planting+weeding (♀+♂)	weeding (♀+♂)	weeding (♀+♂)		harvesting (♀+♂)	harvesting (♀+♂)	harvesting (♀+♂)			
Sunflower	land prep (♀+♂)	land prep (♀+♂)	land prep (♀+♂)	planting (♀+♂)				harvesting (♀+♂)				
Labour availability	High	Low	low	Low	low	medium	medium	Low	low	medium	high	high
Labour demand	Low	Medium	high	High	medium	low	medium	High	high	high	low	low
Food availability	medium	Low	low	Low	low	medium	high	High	high	high	medium	medium
Diseases	coughing diarrhea Malaria bilharzia	malaria (low prevalent)	malaria (low prevalent)	malaria (medium prevalent)	malaria (medium prevalent)	malaria (high prevalent)	Malaria (high prevalent)			sore eyes	coughing +sore eyes	

Note: ♀ is a symbol for women while ♂ is for Men as persons doing that activity.

Table 4.5: Seasonal crop calendar for Bulimo village

Activity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall												
Food Crops												
Maize	land prep (♀+♂)	land prep (♀+♂)	Planting +weeding (♀+♂)	weeding (♀+♂)		winter ploughing	winter ploughing (♀+♂)	harvesting (♀+♂)	harvesting & preparation of planting basins(♀+♂)			land prep (♀+♂)
Groundnuts	land prep (♀)	land prep & ♀)	planting (♀)	weeding (♀)			harvesting (♀)					
sweet potatoes			land prep + planting (♀+♂)	land preparation, planting (♀)	Weeding (♀)	weeding (♀)	weeding (♀)		harvesting (♀)			
Cowpeas			land prep (♀+♂)	land preparation, planting & weeding (♀+♂)	planting (♀+♂)			harvesting (♀+♂)	harvesting (♀+♂)			
Bambara nuts			Land preparation &planting	Planting (♀+♂)	weeding (♀+♂)			harvesting (♀)				
Sorghum	land prep (♀+♂)	land prep (♀+♂)	Planting + weeding (♀+♂)	weeding (♀+♂)				harvesting (♀+♂)				
Cash crops												
Cotton	land prep (♀+♂)	land prep (♀+♂)	Planting (♀+♂)	weeding (♀+♂)	weeding (♀+♂)	weeding (♀+♂)		harvesting (♀+♂)	harvesting (♀+♂)	harvesting (♀+♂)		
Sunflower			land prep (♀+♂)	planting (♀+♂)	weeding (♀+♂)		harvesting (♀+♂)	harvesting (♀+♂)				
Soyabeans		land prep (♀+♂)	land prep+ planting (♀+♂)	weeding (♀+♂)			harvesting (♀+♂)					
Labour availability	high	Low	Low	Low	Low	Medium	medium	Low	low	low	medium	high
Labour demand	low	Low	Medium	High	High	Medium	medium	High	high	high	low	Low
Food availability	High	Low	Low	Low	Low	Medium	medium	High	high	high	high	Medium
Diseases	coughing diarrhe	malaria (low prevalent)	Malaria (low prevalent)	malaria (medium prevalent)	malaria (high prevalent)	malaria (high prevalent)	Malaria (medium prevalent)	Coughing	coughing & sore eyes	Coughing		

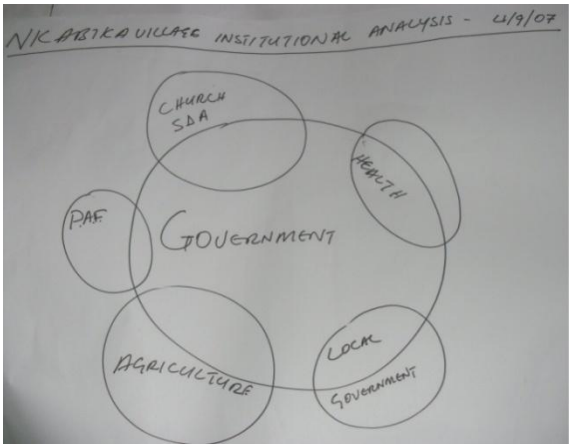
Table 4.6: Seasonal crop calendar for Malomo village

Activity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall												
Food Crops												
Maize	land prep (♀+♂)	land prep (♀+♂)	Planting +weeding (♀+♂)	weeding (♀+♂)		winter ploughing	winter ploughing (♀+♂)	harvesting (♀+♂)	harvesting & preparation of planting basins(♀+♂)			land prep (♀+♂)
Groundnuts	land prep (♀)	land prep (♀)	planting (♀)	weeding (♀)			Harvesting (♀)					
sweet potatoes			land prep (♀+♂)	land preparation, planting &weeding (♀)		weeding (♀)	weeding (♀)		harvesting (♀)			
Cowpeas			land prep (♀+♂)	land preparation, planting &weeding (♀+♂)	planting (♀+♂)			harvesting (♀+♂)	harvesting (♀+♂)			
Bambara nuts			Land preparation &planting	land preparation &planting	weeding (♀+♂)			harvesting (♀)				
Sorghum	land prep (♀+♂)	land prep ♀+♂	Planting+ weeding (♀+♂)	weeding (♀+♂)				harvestng (♀+♂)				
Cash crops												
Cotton	land prep (♀+♂)	land prep (♀+♂)	Planting (♀+♂)	weeding (♀+♂)	weeding (♀+♂)	weeding (♀+♂)		harvesting (♀+♂)	harvesting (♀+♂)	harvesting (♀+♂)		
Sunflower	land prep (♀+♂)	land prep (♀+♂)	land prep (♀+♂)	planting (♀+♂)	weeding (♀+♂)		harvesting (♀+♂)	harvesting (♀+♂)				
Soybeans	land prep (♀+♂)	land prep (♀+♂)	land prep (♀+♂)	weeding (♀+♂)			harvesting (♀+♂)					
Labour availability	High	Low	Low	Low	low	medium	medium	low	Low	low	medium	High
Labour demand	Low	Low	Medium	High	high	medium	medium	high	High	high	low	Low
Food availability	High	Low	Low	Low	low	medium	medium	high	High	high	high	Medium
Diseases	Coughing, diarrhoea, sore eyes	malaria (low prevalent)	Malaria (low prevalent)	malaria (medium prevalent)	malaria (high prevalent)	malaria (high prevalent)	Malaria (medium prevalent)	coughing	coughing & sore yes	sore eyes		

4.3.3 Social data

4.3.3.1 Institutional analyses

Institutional analyses provided information on organizations available in Mujika and their influence on the community. Each village community worked together as a group to identify institutions working in Mujika and discussed their roles, influence on community and how they related one to another. Community members in villages spent less time in drawing their institutional analysis than on other PRA tasks. The institutions included were central government, local government, education, agriculture, health, church and NGO (Figures 4.19a, 19b and 19c.



Figures 4.19a: Institutional diagram for Bulimo village on 4/9/2007

Figure 4.19b: Institutional diagram for Nkabika village on 5/9/2007

Figure 4.19c: Institutional diagram for Malomo village on 6/9/2007

The same organizations were working throughout Mujika as provided by the three villages. The community' spending a short time on institutional analysis indicated they were very few institutions they could single out easily and that they had no frequent interactions with their staff. The analysis however gave community a better view regarding their strength, weakness, opportunity and threats.

The institutional maps helped researchers to learn the presence of other organizations, their activities, how they related to each other in community view and possibility of linkages in managing the project.

4.3.3.2 Farm sketches

The farmers drew their individual farm sketch maps on plain papers and writing materials with the help of the researchers. The exercise took a bit of some time as some farmers could not easily draw. At the end of the exercise three farmers from each village asked to share their sketch map details in plenary. A farm sketch for Mosley Hamabuyu of Malomo village is given as an example (Fig. 4.20).

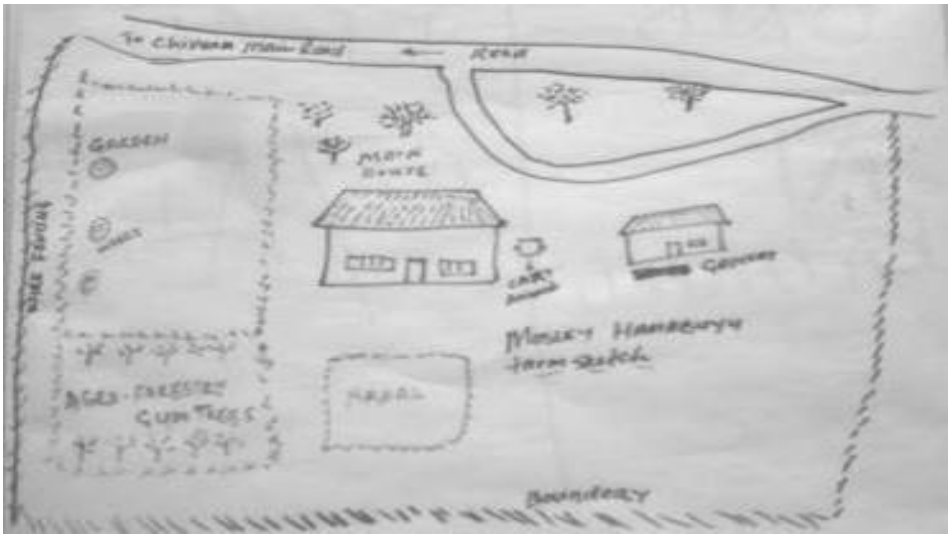


Figure 4.20: Mosley Hamabuyu farm sketch, Malomo village, Mujika, Monze district on 6/9/2007

Most farmers expressed happiness at seeing how their farm sketches looked like and to think of how best they could integrate climatic information at individual farmsteads. From sketches they understood the varying details of land use, resources availability, house structures, and location of opportunities they could use in addressing their problems.

4.3.3.3 Gender Daily Calendar

In the two separate groups of men and women (with both the young and old farmers) they worked separately to develop their individual gender daily timelines. While discussing their timelines researchers facilitated with the discussions such as when do you go to fields or have your supper? The two gender timelines were later presented in plenary. The arrangement of separating into two groups of men and women was mostly appreciated by women due to the traditional setup where women were not very free to deliberate in the presence of men.

Table 4.7: Gender daily timeline for Nkabika village

Time	Male Daily Calendar	Female Daily Calendar
0500 am		Wakes up, works in personal field digging or weeding
0600 am	Wakes up & goes to field	
0700 am	Working in the field	Cleans yard/house, prepares food for family
0800 am		Working in main field
1030 am		Collects firewood & returns home to prepare lunch
1100 am		Prepares lunch
1300 pm	Lunch break at home & continues working after lunch	Takes lunch to the field
1530 pm		Retires from field, fetches relish for family, cleans pots & plates
1600 pm	Retires from field & goes for meetings &/or social gatherings	Prepares super
1700 pm	Rests and waits for dinner	
1900 pm		Serves supper to the family
2000 pm		Cleans plates, tells stories to children, around fire, weaves baskets
2130 pm		Private family meetings
2200 pm	Retires to bed	Retires to bed

Table 4.8: Gender daily calendar for Bulimo village

Time	Male Daily Calendar	Female Daily Calendar
0500 am		Wakes, works in field digging/weeding Cleans yard/house, prepares family food
0600 am	Wakes up and goes to field	
0800 am		joins the husband working in the field
1030 am		collects firewood
1100 am		Prepares lunch
1300 pm	Lunch break at home	Serves lunch
1430 pm	Returns to the field	Returns to the field with husband
1600 pm	Retires from field & goes for social gatherings	Retires from field, fetches relish for evening
1630 pm		Starts preparing super
1700 pm	Rests and waits for dinner	
1900 pm		Serves supper to the family
2000 pm		Cleans plates, tells stories to children around fire, weaves baskets
2130 pm	Private family meetings	Private family meetings
2230 pm	Retires to bed	Retires to bed

Table 4. 9: Gender daily calendar for Malomo village

Date	Male Daily Calendar	Female Daily Calendar
0500 am		Wakes up, works in the field digging or weeding
0600 am	Wakes up and goes to the field	
0700 am	Working in the field	Cleans the yard/house, prepares food for the family
0800 am		Working in the field
1030 am		Collects firewood
1100 am		Prepares lunch
1300 pm	Lunch break at the field and continues working after lunch	Takes lunch to the field
1500 pm	Retires from the field & goes for meetings, social gatherings	Retires from field, cleans pots and plates. Goes fetching relish for the evening
1600 pm		Prepares super
1700 pm	Rests and waits for dinner	
1900 pm		Serves supper to the family
2000 pm		Cleans plates, tells stories to children around the fire, helps children with home work and weaves baskets
2200 pm	Private family meetings	Private family meetings
2300 pm	Retires to bed	Retires to bed

The other women that had not been contributing freely at the main group meeting were seen and heard doing so. The timelines developed for Nkabika, Bulimo and Malomo villages which were later presented in plenary are shown as Tables 4.7, 4.8 and 4.9.

While some household activities in Mujika were done by both men and women (like going to the fields and having private family meetings) there are some (e.g. fetching firewood and cooking) that were done specifically by men or women alone and at different times. It was therefore necessary for both men and women to plan and coordinate their activities together. This action would be challenging their tradition of women taking a low profile especially at public meetings.

The gender daily commitments in all the villages of Mujika were similar in exception of Nkabika villager's time for retiring to bed which was 2200 hours when for Bulimo and Malomo villages was later at 2230 hours and 2300 hours respectively. The communities' activities were mainly agriculture related and done from 0800 hours to 1700 hours with a lunch hour break. The other hours were spent on family and household aspects. The women in Mujika worked longer working hours than their men counterparts. They wake-up early at 0500 hours when the men were still sleeping until 0600 hours. After 1700 hours they worked in the kitchen when the men were waiting for dinner to be ready but retired to bed together. The daily gender commitment provided a better spatial point of view as to who was doing what work in the family. The women's contribution to the

wealth of Mujika community, based on the time spent was considered higher than that of men. The community's daily commitments explained the current community social-economical status and determined their future economical development if unchanged. The women's commitments to the daily family engagements revealed they were more concerned about the family affairs than men. Adoption of climate risk information by women in community would influence the use of climatic information in the agriculture production. It also allowed researcher insight into the best time for meetings or home visits. Climatic programmes scheduled from after lunch hour to about 1600 h would be better attended by women before getting busy again with the preparation of the evening meals for the families. The same time would also be appropriate for men though their availability to meeting could be extended to slightly beyond 1600 hours.

4.3.3.4 Household Interviews

The semi-structured interviews held were designed to investigate availability of climate information, effective and appropriate climatic information dissemination modes; and other factors likely to affect implementation of the CIDP. The exercise provided the researcher with the household conditions as they related to the community-wide view and confirmed or added to information provided during the PRA. Socio-economical information was collected from a cross section of households (total 75) in these interviews. This information helped understanding the variations between families and other norms not identified during the community that meetings needed consideration for effective application of the CIDP. The questionnaire designed for the semi-structured interview is appended as Appendix 3. The semi-structured interview considered historical rainfall performance, investment decisions (traditional forecast indicators and access to SCF) and household characteristics.

The farmers visited were very helpful in responding to the semi-structured interview. Visits were done to a total of 75 people with whom the semi-structured interviews were held. A total of 8 different guides were facilitated in these interviews. On 1st October, 2007 Owen Hatwiinda was guide on the transect in Nkabika village to interviewing Jonathan Hatwiinda and his wife Ronah; Joseph Hampongo, Vainess Hachaaba and Matron Hanyaana and himself. The interviews which started from 08:30 h to 13:00 h took about 30-45 minutes at each homestead with the extra time spent on being shown around checking on land use, natural resource management practices and travelling from house to house.

In Bulimo village on 2nd October, 2007 from 08:30 h till 12:00 h, Ricky Hamaundu guided this researcher to the homesteads of Ricky Hamaundu himself, Headman Bulimo (Nathan Chiluli), Rebecca Mizinga, Fabian Mwiinga, and Olah Chiluli that were interviewed. Shepherd Mpande in

Malomo village on 9th September, 2007 guided this researcher to his homestead and those of Clement Mwiinga, Violet Ngwenya, Violet Nanjela, and Hector Malomo were interviewed from 09:00 h to 12:00 h. The presence of the local guide allowed for an informal interviews atmosphere such that farmers were very free in responding and showing us around their homesteads.

Amongst the 75 interviewed included local leaders, key informants, smallholder farmers and policy makers and implementers in NGOs. Appendix 4 shows the list of those interviewed and the basic information about the interview (e.g. date, name of respondent, gender, occupation, overview of respondent, case study area and topic). The summary shows a total 75 interviewees, with 3 Village Headmen, 3 local government officials, 4 extension officers and 1 lead farmer in community. The other 64 conversations with smallholder farmers. There were only five people that indicated they had access to SCF information. Of these five one was a farmer while the other 4 were government and NGO leaders living in town.

Table 4.10: Details of access to seasonal climate information versus use of traditional indicators from structured interviews in Monze district

	Monze	
Total number contacted	75	
	Number	%
Access to SCF (farmers)	5	6.67
Relied on traditional indicators for seasonal forecast	70	93.33

The interview results indicate there was little formal climatic information available to the community of Mujika area and confirmed the community wide view. The communities relied on indigenous indicators for forecasting the season. They provided a better view as how best the CIDP would benefit individual community members at household level by targeting information. Information availability varied from household to household. The use of the radio listening club was considered relevant by those visited in targeting climatic information.

4.3.4 Data analysis and synthesis

The data analysis and synthesis followed the social data collection. Here the farmers identified their community problems and opportunities which they used in the ranking and formation of the Community Information Dissemination Plan (CIDP).

4.3.4.1 Problems and opportunities analysis

The problems and opportunities were identified, discussed and later ranked using a matrix system in the large groups. The members started by mentioning what they considered were major community problems affecting their livelihood. Other farmers simply confirmed whether the mentioned

problem was major or not before documenting it. Some problems could not be documented because the members had voted they were no major community problems. This was an interactive exercise with the researchers guiding the meeting with probing questions to ensure all aspects including gender were considered. Seven major problems were identified which they felt if solved would allow the village to develop. Table 4.11 shows the summary of main problems Nkabika, Bulimo and Malomo communities selected. Five out of seven major problems being erratic rainfall, livestock disease, planting at wrong times, soil fertility and lack of water were climate related. By addressing climate change one could be responding to five of Mujika's problems.

Table 4.11: Summary of identified major problems for Nkabika, Bulimo and Malomo villages

Nkabika village	**Bulimo village**	**Malomo village**
Lack of animal drought power	Lack of drought power	Lack of animal draft power
Poverty	Lack of money	Lack of Money
Lack of Water	Lack of implements	Lack of Water
Planting at wrong times	Erratic rainfall	Lack of facilities for entrepreneurship training
Low soil fertility	Planting at wrong time	Low soil fertility
Erratic rainfall	Annual diseases	Erratic rainfall
Livestock diseases	Planting wrong type of seed	Livestock diseases

The meetings identified the causes of problem, current coping strategies and opportunities for addressing those selected problems. Every aspect was debated before it could be accepted or rejected. The opportunities for those very problems were subjected to the same treatment before being documented in Table 4.12, 4.13 and 4.14.

The causes of problems and strategies identified in all communities were similar. Example of erratic rainfall for deforestation, pollution of the atmosphere, and lack of water bodies were similar in all except of an inclusion in Nkabika of overgrazing and soil erosion. This indicated that the problems and solutions to these problems were similar and could be solved using similar approaches, training and information.

Table 4.12: Identified problems, causes, coping strategies and opportunities for Nkabika village community in Mujika, Monze district identified on 4th September, 2007

Problems	Causes	Coping strategies	Opportunities
Lack of animal draft power	Cattle diseases Cattle theft Grabbing of animals from owners by relatives after the husband's death	Conservation agriculture using of basins. Seeking employment Selling labour in turn of having your field ploughed Hiring animals from farmers with animals	Cattle dipping and restocking Increased police patrol in the area Community awareness on property grabbing
Poverty	No capital Lack of markets Low prices for their produce Laziness	Selling of produce Growing vegetables Doing some piecework. Selling Chibwantu Keeping poultry Selling goats Selling doormats	Access to money Lending institutions Learning skills
Lack of water	Lack of boreholes Reservoirs Deforestation Low rainfall	Digging of wells/boreholes Planting vetvar grass to control runoff Make basins for water harvesting	Build more water reservoirs Government to sink more boreholes Afforestation
Planting at wrong times	Ignorance	Encouraging each other to attend agriculture meetings	Awareness of climatic information
Low soil fertility	Mono cropping Too much use of fertilizers Soil erosion Lack of manure usage Poor soil management	Crop rotations Plant green manures use of kraal manure Use of compost manure planting of vetvargrass and contour banding	Encourage conservation farming
Erratic rainfall	Deforestation Over grazing Erosion	Use of basins and potholing Contour banding	Afforestation Build water reservoirs Contour banding
Livestock diseases	Lack of cattle dip tanks Goats sleeping on wet surfaces Poor water quality Lack of paddocks	Dipping the animals Building improved goat housing De-worming of the goats Supply good quality water	Build more dip tanks Build more water points in the village More veterinary services

Table 4.13: Identified problems, cause, coping strategies and opportunities by Bulimo village community in Mujika, Monze 5th September, 2007

Problems	Causes	Coping strategies	Opportunities
Lack of animal draft power	Cattle diseases Cattle rustling Property grabbing	Conservation agriculture digging basins Selling labour in turn of your field ploughed Hiring animals from farmers	Cattle restocking Building dip-tanks. Build police post Sensitization on property grabbing
Lack of money	Laziness Lack of markets for produce Low prices for their produce	Selling of produce Selling of doormats Doing some piecework Keeping poultry Selling goats Selling animals	Access to money lending institutions
Planting at wrong times	Ignorance People not willing to attend meetings	Grow cash crops Make planting basins fro water harvesting Encourage others to attend agricultural meetings	Agrometeorological services
Lack of implements	Poverty	Digging basins Selling labour to have your field ploughed	Learning conservation farming methods
Planting wrong types of seed varieties	Ignorance	Grow more crop varieties	Increased agricultural services
Erratic rainfall	Deforestation	Use of basins and potholing Contour banding Contour banding	Afforestation Build more water reservoirs Awareness
Livestock diseases	Lack of cattle dip tanks Goats sleeping on wet surfaces Poor water quality	Dipping the animals Building improved goat housing De-worming of the animals	Build more dip tanks Build more water points in the village More veterinary services

Table 4.14: Identified problems, cause, coping strategies and opportunities by Malomo village community in Mujika, Monze 6th September, 2007

Problems	Causes	Coping strategies	Opportunities
Lack of animal draft power	Cattle diseases Cattle rustling Grabbing of animals away from owners by relatives after the owner has died	Conservation agriculture by making of basins Selling labour to have your fields ploughed Hiring from farmers with animals Go look for work	Cattle restocking Building dip-tanks Build a police post in the area Sensitization for property grabbers
Lack of money to purchase agricultural inputs e.g. fertilizers	Laziness No entrepreneurship skills Lack of markets Low prices for their produce Lack of processing facility adding value to the crops	Selling of produce Selling of doormats Growing vegetables Doing some piecework Selling chibwantu Keeping poultry Selling goates Selling bricks	Access to money lending institutions Entrepreneurship training
Lack of water	Low rainfall few boreholes few water reservoirs deforestation	Digging of wells Planting vetvar grass to control runoff Make planting basins for water harvesting	Build more water reservoirs Government to sink more boreholes Afforestation
Lack of facilities for entrepreneurs hip training	People not willing to attend meetings Ignorance Lack of trainers	Encourage each other to attend meetings	Create community based organizations
Low soil fertility	Mono culture Over use of fertilizers Soil erosion Lack of manure input Burning of crop residues	Crop rotations, Plant green manures, use of kraal manure, planting of Agroforestry trees Use of compost manure planting of vetvar grass and contour banding Use of lime in the area. leave plant residues	Put up regulation against bush burning
Erratic rainfall	Deforestation Pollution of the atmosphere Lack of water bodies	Use of basins and potholing Contour banding	Afforestation Build more water reservoirs Contour banding Awareness
Livestock diseases	Lack of cattle dip tanks Goats sleeping on wet surfaces Poor water quality Lack of paddocks. Poor sanitation of dead diseased carcasses	Dipping the animals Building improved goat housing De-worming of the goats Supply good quality water. eat the dead animals	Build more dip tanks Build more water points in the village More veterinary staff to be sent to the villages

The Malomo community members spoke against some of their negative activity of deforestation and demanded the village Headmen council to introduce some by - laws that would discourage it. Farmers also identified coping strategies for dry, normal and wet conditions that are recorded in Table 4.15. This reaction showed community had some solutions to some of their current problems.

Table 4.15: Summary of coping strategies for dry, normal and wet scenarios in Mujika area

DRY	NORMAL	WET
➢ Digging basins ➢ Early planting ➢ Planting early maturing varieties ➢ Winter ploughing ➢ Ripping ➢ Making ridges ➢ No burning residues ➢ Early weeding and early basal dressing application. ➢ Plough in Dambo areas.	➢ Early planting ➢ Early weeding ➢ Late varieties ➢ Medium varieties	➢ Planting on higher grounds. ➢ Planting on heavy clay soil. ➢ Making ridges ➢ Crop staggering.

The farmer coping strategies under dry conditions were mainly of conservation farming type where water harvesting, increasing humus in the soil, reducing tillage, timely weeding and application of fertilizer were recommended. For the normal season the same approach was considered but with use of late and medium maturing maize varieties recommended. During wet seasons farmers opted for higher ground fields where ridges were made and crop staggering practiced. Farmers' change of strategies under different conditions proved they had some understanding regarding how to address some of the climate change problems.

4.3.4.2 Ranking of problems and opportunities

The ranking of problems came after the community had identified the problems. The ranking exercise where problems and opportunities were put in the order of influence exerted on community involved researchers, local agriculture extension officer and the local community.

4.3.4.2.1 Ranking of problems

The criterion for ranking problems was the degree of influence exerted on the community. The pairwise ranking matrix prepared by the researchers was used for the exercise. Farmers were happy using the matrix after the researchers had explained how it worked. They weighed each identified problems in a pair at a time. The one that weighed against the other was recorded in the given space. They repeated this for all the problems and the total number of occasions a problem out weighed another was put in the totals column. The one with the highest number of instances was ranked the number one community problem and down to the least. Malomo spent only ten minutes

to complete the exercise while Nkabika and Bulimo used 14 and 23 minutes respectively. Tables 4.16, 4.17 and4.18 show ranking results for Nkabika, Bulimo and Malomo villages respectively.

Table 4.16: Problems matrix and their ranking for Nkabika village

Problems	**LDP**	**P**	**LW**	**PT**	**LSF**	**ER**	**LD**	**Total**	**Rank**
Lack of animal draft power (LDP)		P	LW	PT	LDP	ER	LD	1	5
Poverty (P)			P	PT	LSF	ER	LD	2	4
Lack of Water (LW)				LW	LW	ER	LW	4	2
Planting at wrong times (PT)					LSF	ER	PT	3	3
Low soil fertility (LSF)						ER	LSF	3	3
Erratic rainfall (ER)							ER	6	1
Livestock diseases (LD)								2	4

Table 4.17: Problems matrix and their ranking for Bulimo village

Problems	**LDP**	**LM**	**L IM**	**ER**	**PWT**	**AD**	**RL**	**PWS**	**Total**	**Rank**
Lack of drought power		LDP	LDP	ER	LDP	AD	LDP	LDP	5	2
Lack of money			LM	ER	PWT	AD	LM	PWS	2	4
Lack of implements				ER	PWT	AD	LIM	PWS	1	5
Erratic rainfall					ER	ER	ER	ER	7	1
Planting at wrong time						AD	PWT	PWS	3	3
Animal diseases							AD	PWS	5	2
Reduced labour								PWS	0	4
Planting wrong type of seed								PWS	5	2

All the communities ranked erratic rainfall as their number one problem. All the ranked problems from 1 to 3 in all the villages were climate related indicating climate change was a major challenge to the Mujika community. However, not all farmers had erratic rainfall as number one problem but preferred livestock disease. Farmer's view on when they were considering some their problems such as lack of money and livestock disease could only assumed that they were concerned with the immediate solutions. However, the idea is also good while you are addressing problems whose benefits take longer to time to realize.

Table 4.18: Problems matrix and their ranking for Malomo village

Problems	LDP	LM	LW	ET	LSF	ER	LD	Total	Rank
Lack of animal draft power (LDP)		LDP	LW	LDP	LDP	ER	LD	4	3
Lack of Money (LM)			LW	LM	LSF	ER	LD	1	6
Lack of Water (LW)				LW	LW	ER	LD	3	4
Lack of facilities for entrepreneurship training (ET)					LSF	ER	LD	7	0
Low soil fertility (LSF)						ER	LD	5	2
Erratic rainfall (ER)							ER	6	1
Livestock diseases (LD)								2	5

One can therefore tell that farmer when considering their current situation were of two opinions that identifying problems that require immediate solution and those that would take longer to address

such as awareness of climate information. It showed each village community understood the order of solving their problem after their number one problem of erratic rainfall. For Nkabika it was lack of water while Bulimo and Malomo it was lack of drought power and low soil fertility problems respectively.

4.3.4.2.2 The ranking of opportunities

Opportunities were also identified during the PRA meeting. The ranking of opportunities was for assessing farmers' sincerity and opportunities' suitability in solving the said problems. The pairwise matrix, like in the problems ranking, was used in the opportunity ranking to select the most preferred opportunity. Using their experience gained during problems ranking, the farmers provided the following results in Tables 4.19, 4.20 and 4.21.

Table 4.19: Ranking matrix of opportunities for Nkabika village

Opportunity	**AF**	**BD**	**CF**	**A**	**Times selected**	**Rank**
Aforestation (AF)		AF	CF	A	1	3
Build Dams (BD)			CF	A	0	4
Conservation Farming (CF)				A	2	2
Awareness of climatic information (A)					3	1

Table 4.20: Ranking opportunities summary for Bulimo village

Opportunity	**AF**	**BD**	**CF**	**A**	**Times selected**	**Rank**
Aforestation (AF)		AF	CF	A	0	4
Build Dip tanks (BD)			CF	A	1	3
Conservation Farming (CF)				A	2	2
Awareness of climatic information (A)					3	1

Table 4.21: Ranking opportunities summary for Malomo village

Opportunity	**AF**	**BD**	**CB**	**A**	**Times selected**	**Rank**
Aforestation (AF)		BD	CB	A	0	4
Build Dams (BD)			CB	A	1	3
Contour Banding (CB)				A	2	2
Awareness of climatic information (A)					3	1

Organization of available data for ranking purposes was a prerequisite for farmers' management of climatic concerns through a plan. Organization beginning with problems and opportunities identification was necessary for formation of a plan called the "Community Information Dissemination Plan" (CIDP). The similarity of problems in all villages revealed the community Mujika had common problems with some like rampant deforestation acts being caused directly by community. The ranking process was instrumental in identifying the most pressing community problem. The exercise also revealed Mujika community had a coping practice for nearly every

problem identified. Their full understanding of the causes of the problem helped them to see options for addressing some of problems.

The community opportunities ranking in Mujika concluded by ranking awareness of climatic information as its number one followed by conservation practices. Farmers' ranking awareness of climate information as its number one opportunity matched with the need for addressing their number one problem of erratic rainfall. Their conviction was, if they understood the climatic information, they would have an improved agricultural decision making, leading to sustainable coping strategies, confirms the conclusion made by Eversole (2003) that smallholder farmers affected by a particular problem will always have the best solution to that problem though they may not always have the means for addressing it. The ranking exercise provided for an unbiased selection of the first problem and opportunity to be addressed in the Community Information Dissemination Plan (CIDP) to be developed.

4.3.5 Community Information Dissemination Plan (CIDP)

The exercise started by identifying the current information dissemination pathways to serve as baseline for developing new ones. The current dissemination pathways were similar in all villages indicating whatever approach was used could be applicable to all the villages (Table 4.22). Though the pathways were few, they were used as baseline information in the formation of the community information dissemination plan that was tested.

Table 4.22: Summary of current information dissemination pathways for Mujika area by village

Nkabika Village	**Bulimo village**	**Malomo village**
Radio Agriculture extension officers Person to person	Radio Agriculture extension Farmer to Farmer	Radio Letters through village Headmen Agriculture extension officers Road posters Through farmer contact

In the CIDP farmers indicated the required information for dissemination followed by the appropriate dissemination modes for each of them. The suppliers of information, when the program was going to start and organization responsible for each specific activity were also identified. Farmers demanded for a slot in the CIDP because they understood the problem better and had relevant solutions for erratic rainfall performance. Each village with the guidance of the researcher finally came up with the community information dissemination plan shown below Table 4.23; 4.24 & 2.25.

Table 4.23: Nkabika Community Information Dissemination Plan (CIDP) formulated on 4th September, 2007

Opportunity	Dissemination mode	Information needed	Provided by	Start date	Facilitator
Awareness of climatic information	Farmer to farmer Agriculture extension Local Agro meteorological extension services vernacular radio Farmer weekly meetings	Agricultural practices Seed variety for SCF Seasonal forecast Other crop varieties that can be planted Adding nutrients to soil. Appropriate tillage practices Seasonal preparations Planting opportunities Farmer's view.	Ministry of Agriculture Meteorology CFU Agriculture CFU Agriculture Meteorology Meteorology Mujika Community	September	Agrometeorologist Camp officer

Table 4.24: Bulimo Community Information Dissemination Plan (CIDP) formulated on 5th September, 2007

Opportunity	Dissemination mode	Information needed	Provided by	Start date	Facilitator
Awareness of climatic information	Radio Chikuni Agriculture extension Agrometeorology meetings Vernacular leaflets	Weather and seasonal forecast Field selections Agricultural practices Methods of farming during drought and floods Contour making Deforestation Seed varieties Crop rotation Record keeping / Budgeting Water Harvesting Voice of the farmer Individual / Community Action Plan	Meteorology Ministry of Agriculture CFU Meteorology Meteorology CFU ZARI CFU Agriculture Mujika Community Agriculture	September	Researchers

Table 4.25: Malomo Community Information Dissemination Plan (CIDP) formulated on 6th September, 2007

Opportunity	Dissemination mode	Information needed	Provided by	Start date	Facilitator
Awareness of climatic information	Vernacular radio Agrometeorological extension Agriculture Extension Officers Literature Field days Public meetings Radio listening clubs Contact farmers Field experiments	Seed varieties Soil erosion control Seasonal rainfall forecast Basins making Planting opportunities Start and end of the season Nitrogen fixing in the soil Soil sampling Water harvesting Contour ridges Voice of the farmer in agriculture development Agriculture Action planning	Meteorology Ministry of Agriculture Meteorology CFU Meteorology Meteorology CFU ZARI CFU Agriculture Mujika Community Agriculture	September	Researchers

The involvement of the farmers in developing the CIDP gave them a sense of project ownership hence a motivating factor in programmes implementation. The CIDP served as a guide in the management of the plan by cross checking. The main objective of the PRA exercise in the project was to come up with a plan that would then be testing smallholder farmers' decisions with SCF.

4.4 Findings about Current Climatic Risk Information

The following were major finding in the collection of pertinent natural resource and climate change information from Mujika area:-

The means of collecting information using small group meetings, transect walk and semi-structured interviews was vital to understand smallholder farmers' perception of climate change and their natural environment.

Table 4.29: Summary of Community Information Dissemination Plans (CIDP) in Mujika area

Opportunity	Information needed	Dissemination mode	Provided by	Start date	Facilitator
Awareness of climatic information	Seed varieties	Vernacular radio	Meteorology	September	Researchers
	Soil erosion control	Agrometeorological extension	Agriculture	September	
	Seasonal rainfall forecast	Agriculture Extension Officers	Meteorology	September	
	Basins making	Literature	CFU	September	
	Planting opportunities	Field days	Meteorology	September	
	Start and end of the season	Public meetings	Meteorology	September	
	Nitrogen fixing in the soil	Radio listening clubs	CFU	November	
	Soil sampling	Contact farmers	ZARI	September	
	Water harvesting	Field experiments	Met. & Agric	September	
	Contour ridges	Agrometeorological meetings	Agriculture	September	
	Farming practices by season	Vernacular leaflets	Meteorology	November	
	Voice of the farmer in		Mujika community	December	
	agriculture development		Agriculture	November	
	Agriculture Action planning		Agriculture	September	
	Field selections		Meteorology	September	
	Agricultural practices		CFU	September	
	Deforestation		Meteorology	September	
	Crop rotation		Agriculture	September	
	Record keeping / Budgeting		Agriculture	September	

Farmers in small groups freely provided their perceptions of climate change, drew community and farm sketch maps which explained their understanding of their own environment, with a view to using the available information to respond to impacts of climate.

The transect walk provided additional information on soil type and level of fertility, type of vegetation such as *Faidhebia Albida* trees in Nkabika, grassland and water resources from wells and rivers that are available to farmers. The semi-structured interviews provided detailed information at household level. It was found that farmers experienced droughts and floods in the recent years and had problems in accessing seasonal climate forecasts. This information was vital in designing the dissemination of climatic information to household level through radio programmes and radio listening clubs.

4.5 Conclusions

The interaction with the community in Mujika through the PRA process is useful in providing relevant baseline information for a community agrometeorological participatory extension service. It is also here that the community sketch maps proved to be useful tools for understanding village details including boundaries and giving confidence to individual community members of belonging to a particular community. Undertaking a transect walk was vital, as additional information was acquired compared to that provided by community on the sketch map, that would be useful in project design and management. It also allowed for some informal time to build relationship with the people. The value of information collected using PRA contributed much to the success of project. Understanding the environment at household level influenced the evaluation of climatic information dissemination modes with regard to their suitability for use in Mujika.

The people had intimate knowledge of the natural resources and the climate pattern of the area, and used indigenous knowledge to plan their cropping season. They understood the relationship between climate and the normal cropping patterns. Some of the elderly people could easily recall the wet and dry periods over the last 100 years. Following the identification and prioritization of the problems, they were able to identify a number of farm management strategies for dry, normal and wet conditions. Erratic rainfall was ranked as the most pressing problem, followed by lack of water, livestock disease and wrong choice of cultivars. The community recognized that the use of climate information provided a viable opportunity for improving their crop productivity. This was indorsed by the development of the CIDP which focused on climate crop interaction and the necessity of routine climate information dissemination together with agricultural information.

A community agrometeorological participatory extension service requires the full participation of all stakeholders, but the absence of a forum for sharing community major events with the younger generation inhibits the young's ability to remember and learn from historical events during periods before they are born. Major community events would also eventually be forgotten such as the installation of the Headman at Nkabika village, if knowledge remains only in the minds of very few elderly people. The relevance of documentation, community forums or traditional ceremonies is here by endorsed so as to enhance the learning from past experience.

CHAPTER FIVE: RAINFALL ANALYSIS FOR SMALLHOLDERS

5.1 Introduction

This chapter describes the long-term data analysis from two (2) stations in southern province of Zambia which were relevant to Mujika. Magoye weather station and Moorings rainfall observing station are in ecological "region" II which is a plateau region. Region II receives annual rainfall on average of about 700mm (Stern, 2004). Rainfall data analyses are essential and fundamental for improved dissemination of climatic risk information to smallholder farmers in Mujika who currently mainly depend on Indigenous Forecasting Knowledge (IFK). It is that expected farmers' decision making could improve as a result of available long-term data analysis together with the SCF. The accuracy of the rainfall record at this point becomes extremely significant for full farmer benefits. This chapter discusses the seasonal rainfall totals, dry spells; lengths of the season, risks for long dry spells, start and end of the rainy season. Also discussed is the relationship between El Niño, all years mean and La Niña, years.

5.2 Point Rainfall Data

Rainfall measured by a rain gauge (Figure 5.1) is called point rainfall. The rain is captured in an inner container placed in the rain gauge. The rain gauge shown in (Figure 5.1) is known as the standard rain gauge and has a 127 mm diameter metal receptacle. At the top of the rain gauge is a knife edge receiver cap known as a funnel, so as to precisely catching rain falling into the collecting container of the gauge. Accurate measurements are then made using a special standard measuring cylinder able to measure up to 50 mm at once. When recorded daily rainfall is more than 50 mm, it is measured in smaller amounts and then added together to get the total amount.

The standards control of the Zambia Meteorological Department (ZMD) over rain gauges is that they should be of 127 mm diameter and at a standard height of 1.2 meters above ground. There should be no obstructions around but should there be any, its position should be three times it own height away from the rain gauge. The long-term rainfall data collected from Magoye and Moorings rainfall observing stations were measured under the above conditions. The daily 24 hours rainfall was measured at 0800 hours every morning and reflected on the previous day. A day was defined as rain *"If it gets rainfall of more than.0.85mm. This seemingly arbitrary value is to avoid any complications at sites that may be inconsistent in their recording of very small rainfalls, and also to avoid possible complications in the use of mm in the recordings"* (Kurji et al., 2006). Magoye meteorological station at Longitude 27º 38" and Latitude -16º 08" is 30 km from Mujika while Moorings at Longitude 27º 32" and Latitude -16º 15" is 5 km away.

Figure 5.1: Standard rain gauge used in Zambia, left side is outer brass cylinder in the middle is the inner cylinder and on the right is the glass measuring cylinder to ensure accurate measurements.

As a result of this, Moorings rainfall observing station is 5 km from Mujika and was accepted by the Mujika community as a representative station for Mujika area with Magoye 25 km on the other side of Moorings as the alternate station. Magoye and Moorings stations had long-term data sets from 1979-2006 and 1921-2006 respectively which were used for analysis. One criterion at project inception for selections of the project areas was the availability of a meteorological observing station with long rainfall records. It is for this reason that both Moorings and Magoye stations were analysed. In Zambia the rainfall starts from the northern part of the country around October and progresses towards the south to commence around November (Kurji et al., 2006). The main rainy season months in Zambia are from October to March, with occasional rains in April and sometimes even in May. In southern Zambia around Mujika the rains usually commence from November.

5.3 Materials and Methods

Long-term rainfall data for Magoye meteorological and Moorings rainfall stations was collected from the ZMD Provincial Meteorological Office and the observers' records at the respective stations. The accuracy of records by comparing with that from the source stations. The rainfall data was analysed using the Instat+ software. Instat+ is a general, **In**teractive **stat**istics package for microcomputers (www.reading.ac.uk/ssc/software/instat/instat.html). It is both simple and powerful enough to assist research in any discipline that requires the statistical analysis of data. The calendar days in this study when using Insat+ start from 1st July to 30th June next year so as to create a uni-modal curve. Dates of occasions such as start and end of the season are presented in numbers and then converted using the calendar of 1st July to 30th June numbered as 1 to 366. (Appendix 1)

Each station daily rainfall data was analysed separately and then compared with the other station. The analyses considered the three categories of the "all years", "El Niño" and "La Niña" years which were then compared. The "El Niño" and "La Niña" years were identified using the September SOI calculated from the SOI of June, July and August months (IRI, 2010). From each

station the exploration was on the annual, seasonal rainfall totals, start, length and end of the season and dry spell length during the growing season following the criteria set for start and end of season.

5.4 Results and Discussion

5.4.1 Annual and seasonal rainfall for Magoye and Moorings stations

The analyses produced the combined graphs of annual and seasonal rainfall Figure 5.2. a & b for Magoye and Moorings stations. The figures show similar trends for annual and seasonal rainfall. The seasonal trend line was in all cases lower than that of the annual. This is so because the seasonal rainfall only covered the month periods from November to March while the annual was for the 12 month period. The difference also indicates Mujika area did not only receive rainfall during the crop growing season alone but at other times of the years also.

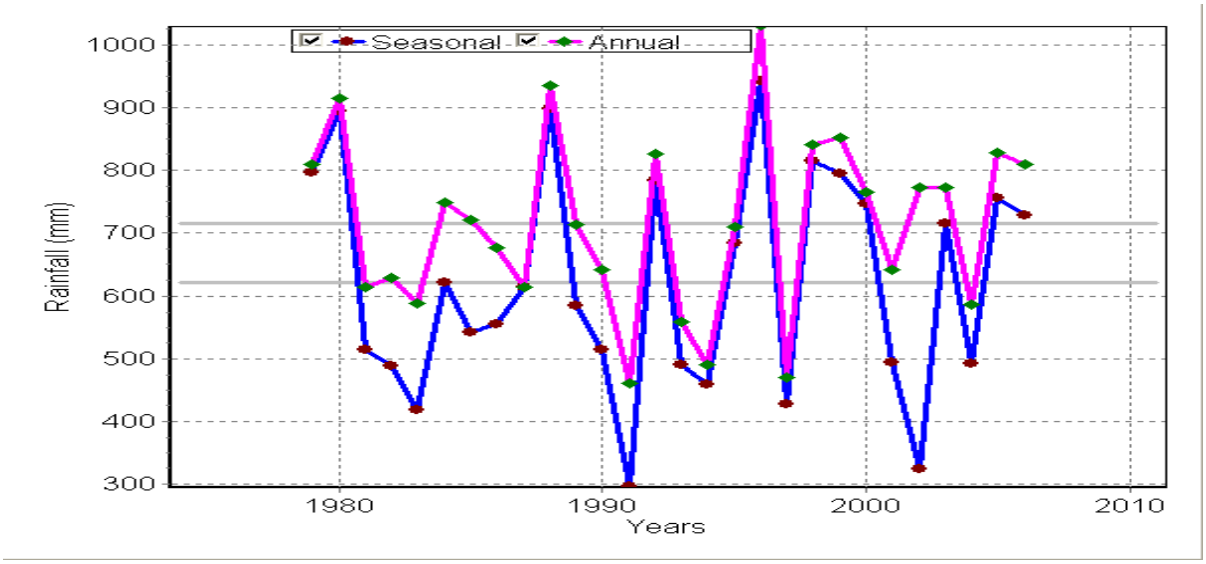


Figure 5.2: Seasonal and annual rainfall trend for Magoye station

Table 5.1: Seasonal and annual descriptive statistics

Category	Magoye station			Moorings station		
	Seasonal Rainfall (mm)	Annual Rainfall (mm)	Difference annual & seasonal	Seasonal rainfall (mm)	Annual Rainfall (mm)	Difference annual and seasonal
No. observations	29	29	0	86	86	0
Minimum	296.2	461.1	164.9	132.2	213.5	81.3
Maximum	943.6	1031.8	88.2	1176.5	1290.1	113.6
Range	647.4	570.7	-76.7	1044.3	1076.6	32.3
Mean	621.3	715.3	94.0	701.1	801.0	99.9
Std. deviation	176.6	142.5	-34.1	195.7	201.2	5.5
20th percentile	482.6	588.2	105.6	546.2	648.1	101.9
50th percentile	599.0	717.4	118.4	695.9	788.3	92.4
80th percentile	795.7	830.5	34.8	865.8	965.8	100

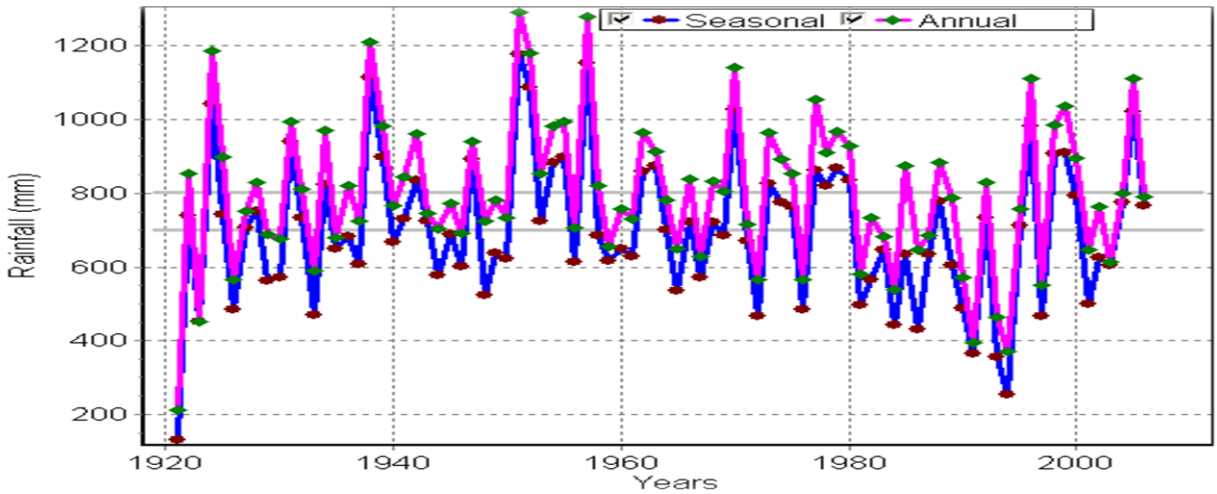


Figure 5.3: Seasonal and annual rainfall trend for Moorings station

The mean rainfall for annual and seasonal rainfall for Magoye was 715 mm and 621.3 mm while for Moorings they were 801 mm and 701 mm respectively. The difference in means (of almost 100 mm) over a station suggests that use of annual rainfall information for seasonal crop planning purposes could be risky and hence should be taken with care as much as possible. Moorings' annual mean rainfall was higher than the seasonal rainfall mean by 86 mm while that of Magoye was 79.7 mm. Since the difference between stations is only 25 km, the difference could probably be due to the daily rainfall distribution. The descriptive statistics (Table 5.1) also shows the differences between annual and seasonal rainfall for both Magoye and Moorings are 93.7 mm and 100 mm which are significant in crop development. This also indicates that the two stations share the same rain bringing atmospheric system.

Table 5.2 provides a summary of climatic conditions for Moorings and Magoye stations on mean All-years, El Niño and La Niña conditions. Though the La Niña condition when considering the annual rainfall over Moorings (802.6 mm) and Magoye (723.5 mm) are wetter than those for El Niño conditions (moorings 777 mm and Magoye 709.7 mm) the difference is insignificant. Statistically the difference if more insignificant for seasonal rainfall when you consider the differences for La Niña and El Niño years for each station (see figure 5.2). Seasonal rainfall is more important for the smallholder farmers and either value for La Niña and El Niño years for both Moorings and Magoye stations could be used for planning with seasonal totals. It however is important to note that Moorings station has a higher average rainfall for All-years than Magoye station by 79.8 mm. The other significant aspect is the difference between the annual and seasonal rainfall figures for both Moorings and Magoye stations under All-years. Moorings and Magoye stations have 99.9 mm and 94 mm respectively. This reveals that both Moorings and Magoye stations receive some significant rainfall amounts outside the growing season.

Description of El Niño or ENSO

The El Niño or El Niño Southern Oscillation (ENSO) comes as the result of a cyclic warming and cooling of the surface ocean of the central and eastern Pacific. Generally this region of the ocean being normally colder than it's equatorial regions suggests, due to the influence of northeasterly trade winds, a cold ocean current flows towards the coast of Chile, and to the upwelling of cold deep water off the coast of Peru. At times, this may cause the surface of the eastern and central Pacific to warm up under the tropical sun - this is an El Niño event.

Table 5.2: Climatic summary for Moorings and Magoye stations on mean All-years, El Niño and La Niña conditions.

	Moorings			**Magoye**		
Category	**All-years**	**El Niño**	**La Niña**	**All years**	**El Niño**	**La Niña**
Number of years	86	25	18	29	14	6
Annual rainfall	801	777	802.6	715.3	709.7	723.5
Seasonal rainfall	701.1	745.4	750.4	621.3	695.1	684.7
Start	13 Nov.	28 Nov.	28 Nov.	15 Nov.	20 Nov.	16 Nov.
Startdry	29 Nov.	3 Dec.	1 Dec.	29 Nov.	8 Dec.	28 Nov.
End of season	24 Mar.	1 Apr.	2 Apr.	18 Mar.	2 Apr.	4 Apr.
Length of season without dry spells days	132.4	122.4	126	122.2	133.5	139.8
Length of season with dry spells days	115.7	120.1	125.7	103.5	116.1	127.5

This results in heavy rainfall in different parts of the world like South America, but severe droughts in southern Africa. If the El Niño is intense, it then means a more intensive drought situation. When the situation is opposite and an injection of cold water becomes more intense than usual with the surface of the eastern Pacific becoming cool, this is a La Niña event. This turns into heavy rainfall in parts of the world including southern Africa.

5.4.2 Start of the season

The start of the season was calculated from two aspects of “start” without considering any dry spells” as well as “stdry” being “start with dry spells” after setting the criteria for each one of them. The following definitions were used:-

“Start” of rains: first occasion with more than 20mm in 2 days after 1st November.

“Stdry” of rains: first occasion with more than 20mm in 2 days after 1st November where no dry spells occur that exceed 9 day after the first planting rain.

Figure 5.4 and 5.5 show the start and stdry trends for Magoye and Moorings station are different in all cases. Like the annual and seasonal rainfall trends (Figure 5.2 and 5.3), the start trends are lower than the stdry ones. This is so because the stdry days come later than those for start conditions. This is a confirmation that the two stations at times experience dry spells at the beginning of the season

of more than 9 days after receiving planting rains. Appendix 11 shows Moorings experienced 38 different start days (44.2%) out of 86 whenever the dry spells were considered while Magoye experienced 13 out of 29 years which is 44.8%. The risk of dry spells at the start of the season is similar and significant for Moorings and Magoye stations and should not be overlooked. The 38 and 13 years for each are number of years in which planting failed and farmers would have had to replant.

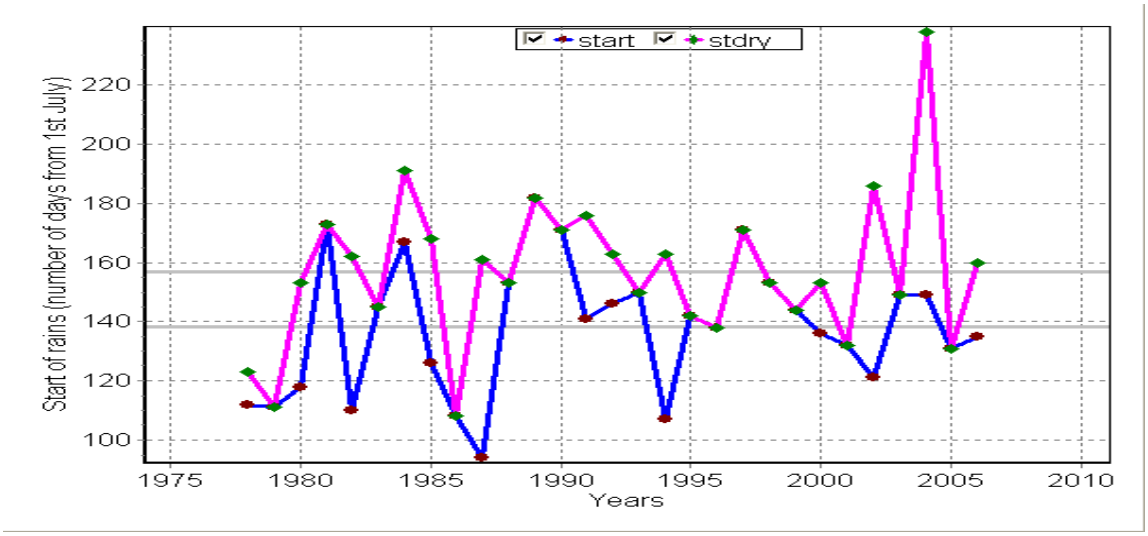


Figure 5.4: Start and stdry of the season (number of days after 1st July) against time (years) for Magoye station

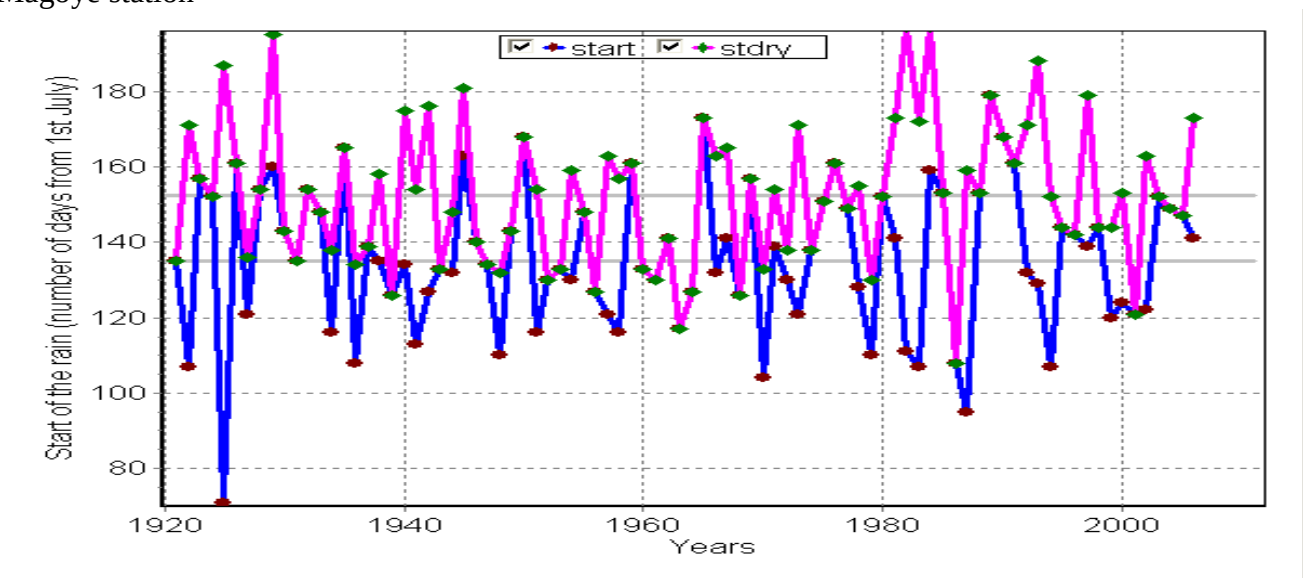


Figure 5.5: Start and stdry of the season (number of days after 1st July) against time (years) for Moorings station

Averaged all years, start days of the "start" and "stdry" of the season for Moorings were 13th November and 29th November while for Magoye station they were 15th November and 4th December respectively. The start of the season for La Niña and El Niño conditions [(28th November and 28th November) and 16th November and 20th November] over Moorings and Magoye station respectively is more delayed than that of the all years (13th November and 15th November) (Table

5.2). The situation is similar even when the dry spells were considered at the two stations (Table 5.2). The reason as to why it was so will require further investigations. However, given the forecast of a La Niña or El Niño condition, one is able to plan and design the cropping season and especially that of planting crops, more effectively using this data.

Table 5.3: Descriptive statistic of the start and stdry of the season (number of days after 1st July) for Magoye and Moorings stations.

Column	**Magoye station**		**Moorings station**	
	Start	Stdry	Start	Stdry
No. of observations	29	29	86	86
Minimum	94	108	71	108
Maximum	182	238	179	197
Range	88	130	108	89
Mean	15th Nov	4th Dec	13th Nov	29th Nov
Std. deviation	22.4	25.7	19.4	18.6
20th percentile	112	138	120.4	134.4
50th percentile	141	153	135	152.5
80th percentile	153	173	153	169.8

5.4.3 The risk of planting too early

Crop planting especially at the start of the season goes with risks and these risks for each station were calculated by subtracting the start days from stdry and the differences for all years are shown in appendix 11 column "Years > 0 at risk".

The difference in the comparison under "all years" category following start and stdry conditions for each station is what is called the "planting risk". Appendix 11 shows the average risk number of days for Moorings was 16.7 while that of Magoye was 17.8 days. The average number of risk days for both stations is similar and also confirmations that the two stations are under the same climatic conditions and that use of either's data in Mujika could be acceptable. The average risks of planting too early (16.7 and 17.8 days) at the two stations is high, considering that some crops may not be able to stand that long without water and may die and demand for replanting.

5.4.4 End of season

Analysis of "end of the season" from the water balance showed 24th March, 1st April and 2nd April for Moorings under All-years, La Niña and El Niño conditions respectively as the average end of rain. But for Magoye station it was 18th March, 2nd April and 4th April for All-years, La Niña and El Niño conditions respectively (Table 5.2). The end of March may generally then be taken as when the season ends in Mujika area. This information becomes helpful in planning the cropping season so as to have your crops reaching maturity stage by the end of the rainy season. It also serves as a guide as to when crop harvesting could be likely.

Comparison of the average end of the season during La Niña and El Niño conditions [(2nd April and 1st April) and (4th April and 2nd April) for the Moorings and Magoye stations with all years is that, that both La Niña and El Niño conditions come much later than that of the All-years average (24th March and 18th March). The delayed, start of the season during La Niña and El Niño conditions appears therefore to have an effect of delaying the season end when compared with the All-years and planning for delayed start and ending of the season during La Niña and El Niño conditions is therefore encouraged. These are average end dates and should not be used in planning as though every season will end "on" those dates.

5.4.5 Length of the season

With the end of the season calculated, it was now possible to know the "length of the season". The subtraction of the average start dates from end dates of each category (All-years, La Niña and El Niño) provided the length of the season in Table 5.2. The length of the seasons under start conditions were as follows:- Moorings under All-years had 132.4 days, El Niño had 122.4 days while La Niña had 126.0 days while Magoye had 122.2 days, 133.5 days and 139.8 days for All-years, El Niño and La Niña conditions respectively. For stdry conditions, Moorings had 115.7 days, 120.1 days and 125.7 days for All-years, El Niño and La Niña conditions while Magoye had 103.5 days, 116.1 days and 127.5 days respectively.

The La Niña conditions had the longest average seasonal lengths for both the start and stdry categories except for Moorings, where All-years (132.4 days) had longer days than La Niña (126 days). The picture was the same with El Niño when compared with All-years of having longer seasonal lengths except for the condition of Moorings, where All-years (132.4 days) were longer (122.4 days). The condition for El Niño would then require more investigation as to why it was so. However, given the forecast conditions of La Niña, planning for longer rainy days in that particular season would be appropriate. The approach could be similar for El Niño conditions when compared against the All-years conditions. Analyzing the neutral years on their own could probably provide an explanation however, it is useful to know that when the All-years analysis result is considered in planning the season, a shorter season should be expected than the other specific conditions of El Niño and La Niña. Figure 5.6 shows how the individual seasons differed by years over Mogoye station. It is also important to know that each season will have its own lengths (Figure 5.5) hence the need for effective planning, so as to maximize crop productivity.

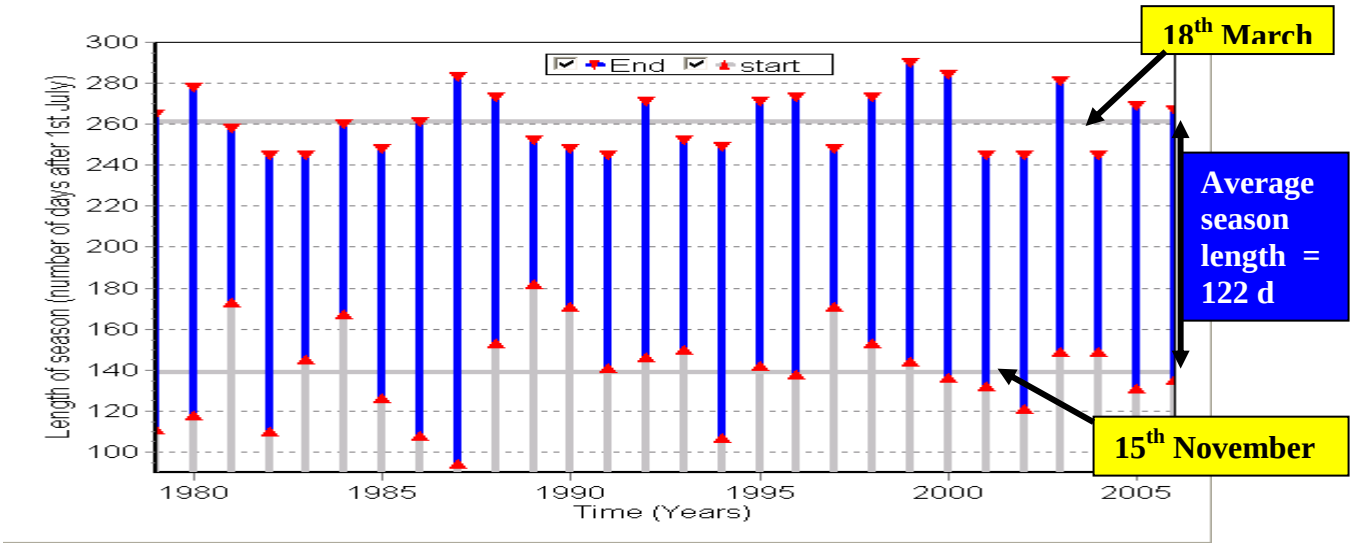


Fig 5.6: Length of the season (number of days after 1st July) against time (years) for Magoye station.

5.5 Findings

Magoye (715 mm and 621.3 mm) and Moorings (801 mm and 701 mm) despite being close to each other have different mean rainfalls for annual (86 mm) and seasonal (79.7 mm) rainfall. The differences are substantial especially in crop development; hence use of annual rainfall information for planning crop development could be risky. This also indicates that Moorings and Magoye received rainfall outside the crop growing season (November to March). The difference (6.3) between the mean annual and seasonal rainfall for the two stations (86mm and 79.7 mm) is less indicating they were in the same climatic region and depend on the same rain systems. Use of Magoye station information over Mujika for planning purposes is therefore appropriate.

La Niña conditions over Moorings and Magoye stations received the highest annual and seasonal rainfall amounts when compared with the All-years and El Niño conditions in exception of the All-years condition under annual rainfall over Moorings. La Niña conditions are wetter than those for El Niño and planning for wetter conditions during La Niña is advisable. The El Niño condition under seasonal rainfall category over Moorings and Magoye received higher rainfall than the All-years condition, but received less rainfall under annual rainfall category than the All-years condition. Planning for the seasonal cropping systems during All-years and El Niño conditions demands extra care for a maximized crop production.

The average start of the season day (13th November) was always earlier whenever stdry conditions (29th November) was considered and this was true for all categories of All-years, El Niño and La Niña conditions. However, there were also some years in which the “start” and “stdry” conditions were the same. The risk of planting too early with the start of the season for Moorings and for

Magoye stations were 44.2% and 44.8% respectively. A careful approach to every cropping season was therefore needed to manage these risks of dry spells or false starts effectively. The start of the season for La Niña and El Niño conditions [(28th November and 28th November) and (16th November and 20th November)] over Moorings and Magoye station respectively is more delayed than that of when All-years were calculated together (13th November and 15th November). The trend is also similar even when the dry spells were considered at the two stations. Planning for a longer cropping season under La Niña and El Niño condition over Moorings and Magoye stations would be advisable.

The end of March may generally then be taken as when the season ends in Mujika area. The "end" of season for El Niño conditions (1st April and 2nd April) was always later than that of the All-years condition (24th March and 18th March) but not earlier under La Niña conditions (2nd April and 4th April) for Moorings and Magoye stations respectively. The start of the season during La Niña and El Niño conditions had a delayed start and ending compared to the All-years conditions.

The average length of the seasons under start conditions for Moorings were; 132.4 days for All-years, 122.4 days for El Niño and 126 days for La Niña conditions. For Magoye it was 122.2 days for All-years, 133.5 days for El Niño and 139.8 days for La Niña conditions. The average length of the stdry of the seasons for Moorings was 115.7 days for All-years, 120.1 days for El Niño and 125.7 days for La Niña conditions while for Magoye it was 103.5 days for All-years, 116.1 days for El Niño and 127.5 days for La Niña conditions. The La Niña conditions had the longest average seasonal lengths for both the start and stdry categories except for All-years condition over Moorings and Magoye stations.

5.5 Conclusion and Recommendation

Stations that are close to each other (25 km), under the same climatic conditions in Southern Zambia, depending on the same rainy bringing system and have long-term daily rainfall data can have different annual and seasonal rainfall means. The difference however, between their mean annual and seasonal rainfalls for the two stations was not large and so then information from the other station could be used for planning purposes at the other nearby station.

La Niña conditions are usually wetter than those for El Niño seasons though the difference is insignificant when viewed from the annual perspective over Moorings and Magoye stations. The difference for the seasonal rainfall however, is statistically insignificant for the same stations. The

availability of rainfall outside the growing season indicates that annual rainfall will always be higher than the seasonal rainfall.

The introduction of a different criterion for analyzing the “start” and “stdry” of the season at Moorings and Magoye stations which may always have some years with different average “start” and “stdry” of the season days under All-years, El Niño and La Niña conditions suggest that “start” and “stdry” of the season is dependent on the criterion set. The availability presence of 44.2% and 44.8% risk of planting too early with the start of the season over Moorings and for Magoye stations indicates the start of the season is reasonably variable. Risk considerations when planning for maximized crop production with seasonal cropping are hence appropriate.

The “start” and “end” of the season during La Niña and El Niño conditions [(28th November and 28th November) and (16th November and 20th November)] over Moorings and Magoye stations respectively that is usually delayed than that of “All-years” condition (13th November and 15th November) suggests that the rain bringing systems delay in establishing themselves at the start of the season and retreating at the end of season over Moorings and Magoye station.

The end of March may generally then be taken as when the season ends in Mujika area. The “end” of season for El Niño conditions (1st April and 2nd April) that always later than that of the All-years condition (24th March and 18th March) but not earlier La Niña conditions (2nd April and 4th April) for Moorings and Magoye stations respectively suggest that the end of season during La Niña conditions may always be in April. Given the fact that La Niña conditions had the longest lengths of season in three out of four conditions over Moorings and Magoye station, for annual and seasonal categories leads to a conclusion that La Niña conditions usually have longer seasons than the All-years under El Niño conditions.

CHAPTER SIX: DISSEMINATION OF CLIMATIC INFORMATION

6.1 Introduction

The most vulnerable group to the effects of climate change and climate variability is the smallholder farmers who live in dryland communal areas and have the least ability to adapt to climate variability and change (Galvin et al., 2001). These poor and vulnerable communities living in rural areas directly depend on substance from rainfed agriculture. They are also the most vulnerable to ecosystem changes that leave them exposed to natural and human disasters such as drought, famine and floods. This vulnerability is aggravated by the fact that they live in areas that are already degraded (Koch *et al.*, 2006 and Clark *et al.*, 2002), of low productivity (e.g. drylands), high vulnerability (e.g. flood prone areas) (Chagutah, 2006), and lack of institutional support and capacity to manage stresses and shocks. The semi-arid areas cover about 70% of Zambia land surface area (Galvin et al., 2001).

Rainfall is erratic and poorly distributed in time and space in the semi-arid areas resulting in frequent crop failures. In drier parts of Southern Africa, the coefficient of variation in annual rainfall is between 20 and 40 %, while the variation in yield is from less than 15 % to 60 % with high implications for food security (Lumsden and Schulze, 2007). This makes smallholder farmers living in these marginal areas food insecure especially when the changing climate makes droughts and floods more common. This implies that farmers have to take a number of crucial land and water management decisions during the growing season, based on climate information, and at times these decisions have to be taken several weeks in advance (Sivakumar, 2006a). It is therefore important for farmers to integrate the issues of climate variability into resource use and development decisions (Sivakumar, 2006a). A more informed choice of policies, practices and technologies may reduce agriculture's long-term vulnerability to climate variability and change (Sivakumar, 2006a). The introduction of seasonal climate forecast into management decisions can reduce the vulnerability of agriculture to droughts (Sivakumar, 2006a) and reduce negative impacts. Sivakumar (2006b) argues that climate prediction information should be introduced into the planning process as an input into the design of adaptation and mitigation plans. However, since seasonal climate forecast could at times be wrong some permanent measures like in table 4.26 could be considered (stigter, 2010). Seasonal climate forecast introduction should be considered as one of the other parameters whose consideration would lead to an informed decision that would help to reduce the risk involved.

The Zambia Meteorological Department (ZMD) like in other Southern African countries, offers in-country annual Seasonal Climate Forecast (SCF) after the Southern African Regional Climate Outlook Forum (SARCOF) meeting. This forecast is meant for dissemination to all farmers in the country. However, most of these smallholder farmers living in marginal areas have not been able to access these forecasts because of the dissemination methods being used (Mubaya, 2010; Mubaya et al., 2008). Print media, television, and most radio stations being used are mainly circulated and broadcasting to urban and peri-urban areas only. The larger population of smallholder farmers live beyond these boundaries where such media is not accessible. In cases where farmers have had access to the forecasts they have not been able to use them to improve crop management because they do not understand the language being used. The SCF terms of "Below Normal", "Near Normal" and "Above Normal" and the percentage probabilities should be explained for instance by an agrometeorological extension service with interpretation which is not available (Stigter et al., 2000). This eventually leads to their not knowing how to use it for decision on tillage practices, cultivar and field selections.

For seasonal climate forecasts to have an impact on society, it is required that they are reliable, timely, well presented and readily accessible (Clivar, 2007), which is not the case in the rural outlying areas of Zambia where most of these smallholder farmers live. Zambia has scanty long-term climate data for use in developing a reliable forecast (Mulambu, 2009). Furthermore, there is still a high demand for trained personnel to prepare a reliable SCF. While there has been a tremendous improvement in the SCF which is presented, accessibility and utilization is still limited. The absence of a meteorological department office in each of the districts and agrometeorological extension services in areas where smallholder farmers live, compounds the problem. Most smallholder farmers as a result use indigenous knowledge in formulating an outlook for the next season similar to smallholder farmers in South Africa (Zuma-Netshiukhwi, 2010). Climate indicators include floods or excessive rains in the preceding season, strong winds around October and an extended cold season extending until August or sometimes September (Mubaya et al., 2008).

The aspects limiting the use of SCF include inappropriate content from a user perspective and communication problems (Walker, 2007). A number of studies have reported the use of SCF to assist farmers in making appropriate decisions (Hansen, 2002). A study carried out by McCrea et al. (2005) in Australia shows that adoption and use of SCF by farmers depends on the level of understanding of the forecast, the format used in the presentation of forecasts and the attitude of farmers towards the usefulness of the forecast as an indicator of future rainfall.

SCF have been used by farmers to make decisions relating to crop choice, choice of cultivar, fertiliser use, area planted with a given crop, timing and tillage type. Apart from SCF and how to respond, it is equally important to understand the socio-economic status of the recipient because their wealth endowment influences which adaptation strategy they can adopt in order to cope with the climate risk. Some studies in Zimbabwe (Patt et al., 2005) demonstrate that farmers who used SCF significantly improved their yields over the baseline amounts and also that farmers who attended a participatory workshop on forecasts are significantly more likely to use the forecasts than those farmers who learn of the forecasts through non-participatory channels. This project used the community agrometeorological participatory extension strategy to disseminate climatic information using multi-disciplinary dissemination approaches, based on a well analyzed community baseline and Community Information Dissemination Plan (CIDP).

Dissemination is a one way process of transferring and translating or interpreting knowledge and innovations from creators into effective and sustainable application for users (Westbrook & Boethel, 1997; Wilson, 2005). Dissemination assumes climatic information

(a) is packaged in the appropriate format;

(b) has been understood, evaluated and requested for by the farmer(s); and

(c) is disseminated using the most suitable farmer identified media.

The one way process, using agreed upon modes at a specified time, is considered complete when the requested user information from the source, which could be through an intermediary, has been received (Burkhardt & Schoenfeld, 2003; NCDDR, 1996; Fletcher et al., 1977). The main objective of the farmer to obtain information is to use it. Dissemination is therefore a transfer of generated knowledge and innovations by an appointed individual or organization from the source to the user through a well managed and facilitated process capable of being planned and systematically implemented by stakeholders (Wilson, 2005).

Status quo in 2007

Monze district has a history of dissemination of climatic information as shown in Table 6.1. The information dissemination activities mentioned in Table 6.1 were targeted at extension, communities west and northwest of Monze district, general public as they listened to local radio since 2000 to 2004. There had been no pervious direct agrometeorological extension services with community in Mujika area until the start of this project.

Table 6:1: Historical engagements on climatic issues for Monze district

Period	Monze
1996	Survey of climatic information users by the Zambia Meteorological Department Southern (ZMDS) in all districts of southern province
1998	Southern province crop weather bulletin development meeting at Fairmount Hotel
2000	Crop weather bulletin performance review meeting with extension officers at Zambia College of Agriculture in Monze.
2000-2004	Vernacular radio programs. Distribution of SCF literature by agriculture extension during the same period
2004	Agrometeorological extension west and northwest of Monze.
2007-2010	Commencement of the, "Building adaptive capacity to cope with increasing vulnerability due to climate change" project with the dissemination of climatic information to Mujika area.

Mujika has 16 villages but this project selected Nkabika, Bulimo and Malomo villages where the project was to be done but Muyaba (2010) did her project in three others also. In consultations with the Mujika community, the community agrometeorological participatory extension service (CAPES) used nine different kinds of media to disseminate climatic information. The study on the dissemination of climatic information was undertaken in order to investigate its effectiveness. This chapter therefore discusses the kinds of media employed in the dissemination of climatic information and their relevance to the overall dissemination objective to reach smallholder farmers in Mujika area and their reactions. It also discusses details of engagement from farmer observations, reflections and interactions on how seasonal climate forecasts can be coupled with their indigenous knowledge systems for predicting the rainfall season in order to develop appropriate crop management options during the 2007/08, 2008/9 and 2009/10 seasons.

The aim of this chapter was to investigate the effectiveness of a combination of climatic risk information dissemination modes in disseminating climatic risk information to Mujika community and evaluate its influence on the Mujika smallholder farmers' attitudes, knowledge, practices and visioning towards agriculture crop production.

6.2 Materials and Methods

The CAPES disseminated climatic information in Mujika by implementing the CIDP described in chapter 4, (section 4.3.6) and section 6.3. The following 10 different methodologies were used to complement each other thereby making this CAPES approach unique.

Meetings

A number of planned meetings with village Headmen, small and large community groups were held to facilitate the dissemination of climatic information to smallholder farmers in Mujika. The

advisory meeting started the process followed by that of consultations and others meetings for large and small group in each village.

The key informers meeting was for:-

Field advice: consultation with the District Agriculture Coordinating Officer (DACO) for selected the project area (Mujika) and project sites (Nkabika, Bulimo and Malomo villages).

Village Headmen meeting was for:-

Consultation: The Village Headmen of the respective villages provided for project feasibility and recommendation for project launching in Mujika area. They also organized for small and large group meetings throughout the project.

The small group meetings were for:-

PRA data collection (trends of rainfall, soil fertility, population and crop production; to record farmers' responses to changes; and issues of access to weather information; and some training on climatic information were also given as well as dissemination of climatic information to groups in participating villages in Mujika.

The large group meetings were for:-

Project launching: This was information for the larger Mujika community and commencement of project after the Village Headmen's recommendation.

Dissemination of climatic information: Results of the long-term rainfall data analysis were presented at the start of the project. The seasonal climate forecasts for 2007/08, 2008/09 and 2009/10 were also disseminated using this approach each year in September.

Electronic media

A vernacular radio programme was used for the following steps:-

Preparation: involved developing 15 vernacular radio discussion programmes and designing a radio drama on climate issues for a total of 30 minutes per programme. As coordinator, this researcher organized the topics provided by community into a preferred order for presentation.

Recording: The programme signifying tune was recorded first, followed by announcer's opening remarks. Then the discussion after which the drama was given before the concluding remarks of the announcer and again the signature tune lastly. An assigned expert or farmer(s) discussed the topic of the day while the local professional drama group presented the same topic in drama form. The different topic experts, including farmers, participated in radio discussion programmes following the developed order of topics.

Broadcasting: The recorded programme was taken to Chikuni radio station in Monze for broadcasting at 20:00 hours every Thursday starting first week of November, 2007.

Farmers listening and tapping of programme: The farmers listened to the programme at broadcast time while the listening club representatives taped it for later use.

Radio listening club: Farmers gathered every Monday 14:00 hours at one of the five formed radio listening club centres in Mujika to listen to a replay of the broadcast programme.

Discussion: Farmers then discussed the programme details and advised each other accordingly.

Documentation of activities: The respective club representatives recorded, by gender, all the farmers present.

This approach was used for all 39 broadcast programmes over three years divided in three segments of 13 programmes every year. The weekly programme entitled ***"Cuulu Cibomba ku dinkila"*** in English translated as (An anthill softens with continued pounding) started every first week of November from 2007 to 2010. The vernacular language Tonga was used in all programmes.

Print media

This media involved:-

Collection of SCF: Collecting the English SCF from Zambia meteorological headquarters

Translating SCF: Translated English SCF into Tonga, the local vernacular language.

Reprinting: There were 500 Tonga and 50 English copies of SCF printed every year for distribution in Mujika area.

Distributing SCF: The SCF was distributed at small and large group meetings, then

Interpreting SCF: It was interpreted in a participatory manner at small and large group meetings.

Personal contact

During household interviews, issues such as ownership of livestock and agricultural implements were covered in addition to enquiring about the current utilization of climatic information. With visits to homes and fields of baby field trial farmers, and chance meetings, the researcher had increased interaction on SCF, received farmers' project observations, reflections and reactions to SCF. In the third year, efforts were made to check whether farmers had developed coping strategies to impacts of climate change.

Farmer to farmer

Farmers disseminated climatic information amongst themselves. The effectiveness of the two forms of organized and unorganized farmer to farmer interactions on climatic information dissemination was investigated. Under the organized form, a farmer organized a field day to share with fellow farmers the lessons learnt during the project. In the unorganized form, farmers disseminated climatic information in their own time, place and most convenient ways with some other farmers

but unknown to the researcher. This form did not allow opportunity for cross-checking the shared information.

Passing/driving through

With increased contact, communities become familiar with the way of walking or transport means of the Agrometeorologist, such that they are able to identify him or her when passing or driving through a community using the usual means. By identifying the agrometeorologist, they are reminded of his or her official role. Doing so is disseminating climatic information as your mere presence is associated with your official portfolio.

Community modelling meeting

Selected community members assembled on the first day to get community perceptions of their natural resources and the potential for crop production in Mujika area. Farmers deliberated as one group on farming problems they encountered and possible solutions to these problems given the correct seasonal climate forecasts. They then divided into village groupings for the natural resources mapping exercise where farmers draw a map of their own area – including houses, roads, fields and sources of water. Later individual farmers proceeded to draw individual maps of their own farm, again including the homes and fields as well as soil types and water resources. Other information such as previous yield, land preparation method, planting dates, fertilization, weeding and grain production were written on the maps. This information was to be used to compare with model output (Walker et al., 2009).

During the second day, researchers, on their own discuss the maps and prepare data in APSIM format and run the model for several scenarios. They then prepared outputs in forms of simple graphs for presentation at the next meeting with farmers the following day. At this second meeting with farmers they were asked what variations in management or adaptations they could make if the season was drier or wetter than normal. After receiving this information concerning the past experiences with a variety of rainfall conditions, the current ZMD seasonal climate forecast was presented. Crop modeling was introduced and the model results for 10 years simulation of at least two particular farmer's resource maps were given. There was much discussion about the merits of the computer model output versus the reality. The possible treatments for the on-farm trials were after modelling discussed in relation to the model output and suggestions considering the specific SCF.

Field experiments

Mujika farmers were given a chance to participate in on-farm field experimentation during the 2007/8, 2008/9 and 2009/10 seasons in search for answers to some of their farming questions. The emphasis here was mainly looking at farmers' reaction to field experiments, their learning, interaction around the field days and the treatments.

In the first year, farmers opted to investigate the effect of on yield of early versus medium and late plantings using three tillage practices of basins, ripping and conventional tillage. On the mother and baby farmers trials were to be planted three cultivars on {5 M x 3 x 25 M} x 3 plot sizes. The mother trials in the second and last year had two tillage treatments (conventional and ripping), two cultivars and four fertility treatments.

The mother/baby field trials are complementary field experiments with related management approaches (see Figure 3.3). The mother field trial on a farmer's field (Headman Nathan Chiluli) was researcher managed with a randomized block layout and three replications at a central community location while the baby field trials were managed by volunteer farmers and only each have 4 plots, (each 5 m x 10 m) located at the farmers' own fields with either 2 cultivars or 2tillage treatments and 2 fertility treatments. The split plots are however of the same size for those of the mother and the baby field trials. The mother/baby field trials were engagements of ***learning by doing*** from which both the researcher and the farmers were going to learn something. Figure 3.3 shows the layout of the typical mother/baby field trials.

Field days

At least once a year, a field day was held where researchers, baby trial volunteer farmers and participating village members shared lessons learnt from SCF and experimentation fields with the larger community. The farmers provided feedback to the disseminated SCF and engagements with the agrometeorological extension strategy. All three village communities participated in organizing and making contributions toward the field days.

Monitoring and evaluation

Participatory monitoring and evaluation of activities was done such that farmers were engaged from project onset, through SCF interpretation, decisions making for experiments, growing of crops, monitoring and evaluation of trials, harvesting and postmortem. Farmers monitored every project and development by participating at every level of the project while taking notes of significant changes and were well informed. Farmers' evaluation was done at field days, training workshops and review meetings to assess the project progress.

6.3 Results and Discussion

A wide variety of dissemination modes were used in this project, but all of them centred on the resource contact between the Agrometeorologist and the farmers. This streamed from the philosophy that each person was valuable (worthy in the eyes of God) and also needs climate information to be able to make wise decisions regarding their own crops so as to increase their household food supply

All the dissemination modes have been used by others before (see literature review), but the clue to the success in Mujika is that they were used in the right balance and at the right time and with the foundation that each and every person is of value and that their concerns should be addressed. The summary of all the dissemination modes used in this project are given in Table 6.3. Most of the methods used to communicate SCF messages had a personal touch and this lead to their success. The Agrometeorologist was in contact with the Village Headmen and the lowest female farmer, as well as other leaders of the radio listening groups and the farmers with the baby field trials in their fields; throughout the three years of the project. Thus all modes of dissemination had a personal touch - large and small groups, as well as the radio presenter, visiting on farms or in their homes, at mother-baby trial and SCF main presentation meetings each year. The people could touch the expert and so it worked.

Details of the different modes will be given one by one. In light of this personal touch and personal contact with all the modes of dissemination of climatic information about Mujika area and SCF – there is also a special touch to reach into the lives of the five of the farmers (Table 6.2). The five people became special as they represent the typical farmers of the Mujika area and their stories will be used to show how the people reached and developed and grew in knowledge about climate and the usefulness of SCF in her own personal lives as farmers (ch 8). However in this chapter they will be used to illustrate the usefulness of the various communication and dissemination modes between the ZMD and the farmers. (…… watch how it unfolds…..).

6.3.1. Meetings

6.3.1.1 Village Headmen's meetings

Meetings with Village Headmen were vital in project design and management. The Headmen as community respected leaders were needed for project guidance, mobilization of community to meetings and enabling community interactions. On 29th August, 2007, this researcher went to Mujika for the first site visit, project introduction and consultations with three local village Headmen and their secretaries. This was after the District Agriculture Coordinator (DACO) for

Monze had made arrangement with the village Headmen. The meeting was held at the marketing shed in Bulimo village from 0900 hours. The DACO introduced this researcher and the project mission to the Headmen of Malomo, Nkabika and Bulimo villages. There was no camp officer in Mujika at that time but the DACO promised to transfer an officer there shortly. This researcher introduced the details of the project which they welcomed and together they planned for the Public Project Launch (PPL) and Participatory Rural Appraisal (PRA) meetings. They set 4th September, 2007 as date for the PPL at Mujika Basic School and 4th, 5th and 6th September, 2007 as dates for the PRA meetings in Nkabika, Malomo and Bulimo villages respectively. The Headmen offered to mobilize people to attend these meetings. The meeting ended at 11:00 hours with a prayer by Mr Philemon Nakoonge, Vice-Headman for Bulimo village. Mr Philemon Hakalembe the new camp officer for Mujika arrived, on transfer from Moomba area on 1st September, 2007.

Meetings with village Headmen were also organized each year when field days were being planned in Mujika. The team planning the field day was composed of three village Headmen and their deputies, three secretaries, the agricultural camp officer and this researcher. The field day planning team usually met at Headman Bulimo's home to make plans. The 27th February, 2008 was selected as the date for the first field day, the team then made the programme for the day. The camp officer said a field day was necessary so that other farmers in Mujika and the surrounding areas could come and learn what was happening in the project. As the researchers funds (K2,000,000) for the field day was considered inadequate, the other Village Headmen in the field day planning committee indorsed the suggestion by Hector Malomo (Headman for Malomo village) that participating villages were to contribute to the cost of the field day. The agreement was that each village would contribute six chickens, one goat and make two 210 litres of Chibwantu, the local sweet beer. Other food requirements were to be purchased from the K2, 000,000. All the required committees were made and given specific assignments to ensure smooth running of the field day. The planning meeting which had started at 09:00 hours ended at 11:30 hours.

During the second year, Headman for Nkabika village and his secretary were the only ones absent on the 25th February, 2009 when the field day planners again met at Headman Bulimo's home to plan for the 2009 field day. The meeting was informed that the Ministers of Agriculture and Cooperatives, Communications and Transport, and Southern Province were invited to the field day. Community and local district heads of various government departments were also to participate in the field day organization. The chairman emphasized the need to improve on the organization since three ministers were attending and consequently attracting more people. Farmers from the participating villages were requested to provide feedback during the field day on the lessons learnt.

Table 6.2: Quotation summaries from selected farmers stories in Mujika as they relate to the media forms used

Media column	Mr Mosley Hamabuyu Malomo Village	Mrs Beatrice Chiluli Bulimo village	Mr Owen Hatwiinda Nkabika village	Gertrude Mizinga Bulimo village	Mr Clement Mwiinga Malomo village
1.Meetings Public	Very few people attended last year (2007) because they said you were claiming the role of gods. Please wait in starting the meeting people are still coming (2008).	People don't like attending meetings that provide them with knowledge but those for handouts (2007). There are more people attending meetings these days. I think they learnt a lesson from the floods of 2007/08 season and fear it may repeat (2009)	I received advice and learnt how others were coping with climate change. It helped me to decide on the type of seed variety to buy, tillage practices to use and selecting of field to plant. Apart from that it also helped me to decide when to plant my crops (2010)	More people have attended the weather meetings because they want to get the forecast from you. They don't want to loose crops again as last year through floods (2008).	I don't miss weather meetings any more after the lesson I learnt in 2007/08 of disregarding the forecast. You may think it is me alone thinking that way. It is the view of most of my friends (2008).
Training	People expected input handouts a part from training only (2007).	After returning from training people started planting Sunn Hemp for improved soil fertility for the next crop planting (2008).	The 2008/09 season performed as forecasted and that SCF is a factor in improved agriculture productivity (2009).	I learnt that each forecast season requires a different farming approach (type of seed to be bought and tillage practice to use) (2009).	We have wasted yet another year in crop productivity but are glad to have learnt a life time lesson (2008).
2. Electronic Radio	Why do you end the radio programs in mid-season? People want them all the time. There are so many Nkwaambila Bbwes in Mujika (2009).	Some losses farmers incur would not have been there had they been listening or coming to the radio listening club (2008).			I only like Rumba music but we differ with my wife over listening to your programme (2007). I repented. This time I make sure my radio is working every progamme time. My wife is happy (2009).
Radio listening club			People like the radio programme especially Nkwaambila Bbwe's behaviour because it is what most farmers do (2009).	I don't miss radio listening clubs unless I have a problem. Further more I have no radio of my own. People enjoy it. You must come during meetings and see (2008).	My wife and I attend radio listening club meeting always. I like sharing my story at meetings (2008).
3. Print media Handbills	Most of you are getting forecast papers you wont use (2008).	Most of the women who can't read or write have since started attending the new adult school in the village. Some boast of reading English now (2009).	People want forecast papers. You can leave a number of them with me for distribution. But is it you who drew the cartoons?	I an now able to read the Tonga forecast with the help of the introduced adult school in Bulimo village (2009).	I always ask for a copy of the forecast (Tonga) every year (2009).
	Most are not planting	With the cartoons most farmers		We like cartoons because	I think the one who was drawing

Cartoons	even when the rains have started. They are behaving like Nkwaambila Bbwe in the cartoon (2007).	including the shy ones were free to talk. Go and draw more cartoons (2007).		you can deduce the meaning from pictures even though most of us especially women can not read (2007).	the cartoons was talking about me but just changed the names. They teach the truth and have kept copies in my house for reference (2008).
4. Personal contact	More people will attend next year's meetings because most of them lost their crops due to floods People have a habit of planting late in December till January (2008)	You will be surprised what we are able to do, just let Bulimo village stage the main sketch during the meeting and see what happens (2009).	I have learnt a lot of lessons from the experiments that I am considering of hosting a field day (2009).	Thank you for coming because we have learnt a lot and have answered all our questions (2009).	From the day you and my friend Mosley visited me, I vowed to consider the weather forecast in my planning (2008).
5. Farmer to farmer	Farmers influence each other regarding what and when to plant. Even on the type of meeting to attend Like James of CFU and his friend to forecast meeting (2009)	Some farmers still depend on traditional indicators for season expectations despite the availability of the forecast (2008).	At the field day I want to share information with my fellow farmers. I received 23 inquiries 2009 concerning my field trials and kept sharing my lessons learnt from the project (2009).	I inform others that at these meetings we learn should use the forecast in planning his/her agriculture. Edson Malambo has since stared attending to meetings (2008).	Mosley my friend helped me a lot and am trying to help others to know weather forest are important in agriculture planning.(2008)
6. Passing through	Saw you pass by and suddenly a very serious argument started while …on the role of the Meteorological department and the use of the SCF in agriculture productivity. Others said you are liars and not gods while others said it help improve crop production	We laughed when my father (Nathan Chiluli-Headman for Bulimo village) saw you at a distance on a motorbike and said there comes the weather man (2009).			You have now become my friend. Whenever we see you even at a distance my friends say there goes your weather man friend (2009).
7. Experiments	Farmers are complaining they want plot sizes as of last year (2007). These are too small to get a meaningful harvest they say (2008).	I have no field trials but what I am doing using information from the trials is benefiting more than those with (2008).	Long maturing crops are better planted early in the season (2008). Without some form of fertility added to crops one is like to get no harvest at all (2010)	I think I am learning a lot from these trials. One can know what to do in different in seasons (2009).	I have no experimental field but I think I have learnt a lot even more than those with fields because I practice the lessons on very bigger plots than those small ones(2009).
8. Field day	Most people especially men come to the field day	But prepare for a larger gathering than that of last year because more	Forecast is useful in agriculture decision	A lot of people will come to the field day because you	I don't miss field days at all. It is a good time for learning more

	for the meat that is available and not to learn (2008).	people are planning to attend (2009).	making (seed selection and planting time) I chose medium variety and planted early. Any form of fertility will bring about change in crop performance. I hope you have learnt something useful for your individual agriculture practices	mostly discus crop production and rainfall which affects them most (2009).	from others. Men are difficult. I think they mainly attend field day for eating meat than learning because when we invite them to other weather meetings they don't come (2010).
9. Monitoring and Evaluation	Some experimental farmers for not committed and are just doing it to please you. Their main interest is yield and not experiment results. Their behaviour proves this (2009).	I have to be frank the project has been success. It is unfortunate for those who haven't learnt anything over the three years of working together on weather issues (2010).	I am happy with the project performance and most people are learning something. Especially the value of forecast in decision making. This is revealed in the way they attend all meetings (2008)	Come and see my field trials I believe I managed it the way we had agreed and I am very happy (2008).	It is from my monitoring through participation and evaluation of the project activities that I was able to make major decisions regarding weather and agriculture productivity (2010).

Table 6.3. Summary table of dissemination modes

What	Why	When	How	Where
1.Meetings Headmen	Initial consultation, site visitation and project introduction. Planning of field day programmes. Researchers do not know project the areas, whether project would succeed or not.	At the commencement of the project and field days planning stages	Going to project area. Coming together and planning for project and field day management and feeding of the community	Selected places in Mujika area.
Small group	Data collections for baseline assessment. Dissemination of SCF for farmer improved decision making in agriculture productivity, and	Before the start of the project, at release of SCF and during project management	Through PRA by Problems identification, opportunities analysis and creation of CIDP. Engagements with SCF in interpretation, decision making, experimental designs, management options, monitoring and evaluation and project postmortem. Scheduled meetings after release of forecast and during project management, radio listening clubs and training workshops	Usual selected village meeting place
Large group	Project launching, community project planning, reviews, receiving of feedback, dissemination of long term climatic results and seasonal climatic forecasts.	After project introduction, reviews at SCF and long term climatic results dissemination meetings.	Public meetings for participating and non participation village community members. sharing of information	Usual or selected community meeting place
Training	Interpreting SCF and designing crop management options that respond to SCF	During the project period.	Workshops using selected farmers from the participating villages.	CARBLAC
2. Electronic Radio	Broadcasting of climatic information and reaching the wider Mujika and surrounding areas	Before the start of the season and during the season	Live and recorded SCF programs	Chikuni community radio station
Radio listening clubs	Increasing farmer interaction on climatic information	Before the start and during the growing season	Playing the recorded climatic radio programmes in the community	Village radio listening selected meeting places
3. Print media	Increasing access to climatic information	Before the start of the season and during the growing season	Distributing SCF handbills at start and cartoons in season	SCF dissemination and tailored meetings

4. Personal contact Home visits	Agrometeorological extension, increased interaction on SCF and supporting decision making	Before the start of the season and during the growing season	On and without appointment	Farmers homes
Field visits	Confirming farmer claims	During the growing season	Getting to the field and evaluating farmer actions	Farmer' field
5. Farmer to farmer	Extended dissemination of SCF information	Before the start of the season and during the growing season	Indiscriminate and organized approaches	Available opportunity
6. Passing/ driving through	Attending to other programmes beyond	After development of credibility	Using familiar mode of transport	On the community highway
7. **On-farm Experiments**	Testing farmer choices / options given the SCF	Planning during the growing season	Mother/Baby field trials	Mother field trial and farmer own fields
8. Field day	Sharing lessons learnt from engagements	Before the harvest time	Public field day at Mother field trial	Bulimo village on Mother field trials
9. Monitoring and Evaluation	Tracking changes for improvement of engagements	During and at the end of the project	Physical engagement of farmer in all levels of the project and documenting changes	Mujika area

The Zambia Meteorological Department Southern (ZMDS) was contributing by funding the 2009 field day. The three villages also pledged to each provide one goat, eight chickens and brew of two drums of 210 litres of Chibwantu and participate in the physical preparations for the field day. ZMDS amongst many other things bought a cow to slaughter and six 25kg bags of mealie meal. Before the closure of meeting, members had requested for ample time to prepare for the 2010 field day in order to make it successful. They proposed and agreed to have the planners meeting day 17th December, 2009. The meeting which had started at 14:00 hours ended at 17:30 hours.

During the third year, the field day planners met on 17th February, 2010 for the 2010 final project field day preparations. Nkabika and Malomo villages were only represented by the Vice Headmen, while Bulimo village had the Headman, his Vice and Secretary present with Mr Over Munyama, Francis Malundu and Peter Mweemba also attending as community members. Also present were this researcher and the Agriculture Camp Officer, Philemon Hakalembe. The team agreed to make the same contributions as made in the previous years with contributions from each village.

In all these years the Village Headmen organized the field days preparations and gave welcome remarks during the field days as they were committed to helping the researchers help the people. The Village Headmen's presence and assistance was vital to guide the management of the project as the researchers and camp officers did not fully know the other village commitments and could not organize the PPL and PRA meetings successfully on their own. They neither fully understood the community environment nor the likelihood of success of the project, so the Village Headmen guided as to when and where the PPL meeting and field days etc were to be held. They also endorsed the relevance of the project and its possibility of being successful in Mujika area by personally using the knowledge gained from the site visit, project introduction and consultative meeting held with them at the start. They guided the project to success in all public small and large climatic information meetings in the community by mobilizing the community to attend. It gave the community an impression that the climatic meetings being supported by Village Headmen were of relevance to community development and so they attended. The meetings with Village Headmen were thus vital for an improved and better project planning and management in Mujika area and selected villages.

The involvement of Village Headmen in the planning of all climatic information dissemination meetings and programmes made the burden lighter for researchers and confirmed the project as being participatory through all levels. Their willingness and involvement also confirmed that the project was addressing community concerns of climate change and climate variability for improved

livelihoods. Overall, project success in Mujika discussed in this thesis was due to its being planned together with Village Headmen. The full participation and presence of the Village Headmen at small and large group meetings allowed for easy community mobilization to meetings, as well as peace and orderliness at meetings. The Village Headmen's outstanding performance was supported by commitment received from the research team members during the site visit meetings. The Village Headmen's meetings are therefore vital for creating a firm foundation for successful small and large group meetings.

6.3.1.2 Large group meetings

These meetings provide a forum for the wider community to obtain information on project activities and endorsement of projects. They also allow for tracking of community interaction, interest, and change of attitude towards climatic information as well as sharing of research results and lessons learnt.

The project launch on 4th September, 2007 at Mujika Basic School was a large group meeting where 98 (45 men and 53 women) smallholder farmers from 16 villages attended. After the welcome remarks by Headman Nkabika, the Block Officer (BO) for Agriculture, Mr. Coilard Chinene introduced Prospard Gondwe as a researcher from Zambia Agriculture Research Institute (ZARI) and Durton H. Nanja from Zambia Meteorological Department Southern (ZMDS). Durton introduced and provided the details of project activities, duration and the expected roles of the community. The three year project aim was to build adaptive capacity to cope with the increasing vulnerability due to climate change was supposed to build capacity of farmers as well as that of learning institutions. As a participatory type project, data gathering was going to precede the dissemination of climate information and field trials. They were informed that climate information could help to improve decision making while field trials would be a process of "learning by doing". For members from the non-participating villages, this launch served as an awareness meeting on what will be happening in their neighbourhood. The community welcomed the idea and promised to participate fully after some clarifications were given in answer to questions. Farmers from the non-project participating villages requested for inclusion in the project in future. The meeting which commenced at 09:00 hours closed with a prayer at 11:30 hours.

The second large group meeting at Mujika Basic School for the dissemination of the 2007/8 SCF was held on 25th September, 2007 and 76 (35 men and 41 women) farmers from eight villages attended. Before handing out the English and Tonga SCF handbills to each farmer, an inquiry was made to determine how many were aware of the ZMD's existence in Zambia and that it produced

the SCF. The revelation showed that 52 out of 76 farmers were not aware of the ZMD's existence nor the production of SCFs for the country. Most farmers had little or no previous contact with personnel from ZMD; therefore it did not really have credibility in the community for disseminating SCFs.

However, farmers were informed that the ZMD produced the Zambian SCF annually around September. They also learnt how the department arrived at a particular forecast and how the sea surface temperatures affected the local climatic weather. Then farmers requested for the timely dissemination of the forecast as soon as it was released in September. The 2007/8 forecast was then presented as near normal for October, November and December (OND) of 2007 and Near Normal to Above Normal for January, February and March (JFM) of 2008. The impacts of the SCF for possible flash floods in low lying areas during JFM were also discussed. The meaning of the terms Below Normal, Near Normal and Above Normal were explained using the long-term climatic data for Magoye meteorological and Moorings rainfall observing stations. Interactions on SCF took about 35 minutes during which the presentation was repeated three times. The possibility of planting all the maize varieties starting with the late maturing followed by the medium and then early maturing was also discussed and encouraged. The meeting was not highly interactive as farmers asked very few questions.

The farmers were requested to share the forecast information with those who had not attended. A test of the farmer to farmer dissemination of the forecast was undertaken. This researcher decided to tell a secret message to one farmer who he requested to pass it on to the next until it reached the last person on the queue. The message was "The forecast for 2007/08 is Near Normal for October to December (OND) and Normal to Above Normal for January-March (JFM)". The last person was asked to tell the audience the secret message. The message turned out to be, "The season is normal" which was a truncated version of the original message and conveyed a different message. This emphasised to the farmers the importance of sharing the correct information including details to each other. The survey, to assess the level of understanding of the forecast by the farmers was conducted at the end of the meeting by showing of hands and it revealed that only 15 farmers had understood. A written exercise for those15 farmers revealed only 5 (3 men and 2 women) could state the SCF correctly. The SCF was thereafter repeated again for increased farmer retention. These brief evaluations illustrated that further climate information and training sessions were necessary for these farmers to really grasp the meaning of the SCF. The launch of the vernacular radio program and radio listening clubs for the three villages of Nkabika, Malomo and Bulimo in

Mujika took place at the end of the large group meeting. See launch details under radio section 6.3.2.1.

During 2008, the presentation of the 2008/9 SCF was held on 22nd September, 2008 at Mujika Primary School using the large group meeting approach again. This meeting was attended by 87 (39 men and 48 women) farmers from eleven villages. After the formality of opening the meeting the researcher enquired of the audience's memories about the 2007/08 SCF. Nearly all the people showed that they could remember the forecast. Jonathan Hatwiinda of Nkabika village said, *"Do not be surprised that everybody appears to remember. It is because the forecast was correct and those who ignored it lost their crops"*.

The 2008/09 forecast was then given and said to be Normal for both OND and JFM parts of the season. The farmers' height differences illustration, explained under seasonal climate forecast section 6.3.1.3.2, used to describe the forecast terms the previous year, was repeated with reference to the long-term rainfall data analysis result from Magoye meteorological and Moorings observing stations. The presentation was repeated twice, based on the lessons learnt the previous year, that farmers did not fully comprehend the SCF when presented the first time at a public meeting. Towards the end of the meeting a survey on comprehension and retention of the disseminated SCF for 2008/09 information was undertaken. A total of 53 hands were raised indicating they knew and understood the disseminated forecast. There was some murmuring when leaflets seeking a written statement of what they thought the 2008/09 forecast said, were distributed. The survey result indicated 42 (24 men and 18 women) people knew the disseminated forecast correctly. The forecast was again presented before the close of the meeting, for a third time, to ensure everybody understood it correctly. It shows that there was an improvement over the previous year comprehension of SCF. It can though not be proven to have been due to the same people but rather that it showed learning by farmers.

Another large meeting was held at Mujika Basic School on 8th October, 2009 for the presentation of the 2009/10 SCF, where nine villages were represented, with a total of 73 (33 men and 40 women) farmers. The Vice Headman for Nkabika village, Mr Jonathan Hatwiinda, apologized saying some community members had gone to town for registration of new cooperatives through which members would receive their subsidized inputs. The 2009/10 SCF was presented and was said to be near Normal for both OND and JFM. The usual participatory interpretation followed thereafter and the usual survey was conducted at the end of the meeting to evaluate comprehension and retention of the disseminated forecast, revealing that 59 farmers could understand it. The written exercise for

those 59 however proved that only 48 really knew what was predicted in the 2009/10 SCF. The smallholder farmers' participation in large group SCF dissemination meetings is summarized in Table 6.2..

Table 6.4: Smallholder farmers' participation in large group SCF dissemination meetings in Mujika

Meeting date	Total attendance	Men	Women
25-09-2007	76	35	41
22-09-2008	87	39	48
08-10-2009	73	33	40

The larger Mujika community was made aware of the community agrometeorological participatory extension strategy through the large group meetings. Large group meetings were needed to endorse the village Headmen's approval of the community extension strategy. Community commitment to project participation, as declared at the large group meeting, was necessary for project execution and sustainability. The community approval of the climate information dissemination project confirmed the village Headmen understood community needs very well. So community approval of the project at large group meetings was useful in providing researchers with a better vision of the project likelihood of success and also a type of commission to continue with the project.

Large group meetings are good for tracking overall community response to climatic information, sharing of research results and for making an evaluation. These meetings also prepared them for future project results and further more personal engagements with them. Their willingness to be involved in future confirmed the project would be addressing their concerns as well. Farmer comprehension of SCF at the start of participatory project in a new area was very poor at the first SCF public meeting. Farmers' poor response at the meetings should not only be attributed to their limitations on the subject alone but also on those of the presenter, and showed that farmers needed more training in SCF.

6.3.1.3 Small groups meetings

Small group meetings were held for data gathering, dissemination of SCF and long-term data analysis and results; and review of CIDP in all the participating villages in Mujika. At the small group meetings, the chairman Mr Hakalembe, first introduced Durton H. Nanja as the local visiting team leader. Durton then introduced Prospard Gondwe as one of the researchers who was going to manage the mother-baby field experiments in the community while explaining that he was to manage the dissemination of climatic information himself. This researcher also explained the available IDRC project entitled "Building Adaptive Capacity to Cope with Increasing Vulnerability due to Climate Change" that was taking place in both Zambia and Zimbabwe for the following three

years. The community's role was emphasized and a request was made for full involvement in all aspects of the project, from the layout to its completion. There were very few questions asked from the village audiences concerning the project on how and where it was going to be conducted. Active community engagement on data gathering, analysis and synthesis followed thereafter in each area. It is important to have an effective project introduction to the community at the initial meeting for full farmer participation during project execution. Farmers' understanding of the project and their roles was important from the start.

The PRA meetings in Mujika area commenced as planned on 4th September, 2007 starting with Nkabika village. Bulimo and Malomo villages did their PRA on 5th and 6th September, 2007 respectively. This activity for Nkabika village started after the end of the public project launch meeting at 10:00 hours. The agriculture camp officer, Mr Philemon Hakalembe, chaired the meetings because the community had made the arrangement that the agriculture camp officer would chair all technical meetings. The Village Headmen of the respective villages were available at these small group meetings and were instrumental in the mobilization of the community, providing guidance and ensuring there was peace and order during the meetings. They made welcome remarks at these meeting in their respective villages, thus putting their stump of approval on the project. In Malomo village on 6th September, 2007, the meeting was held at their usual meetings place under the Gum trees near Mosley Hamabuyu's home. The Headman Hector Malomo thanked all the people for coming because it showed they valued the topic of discussion of that day. Using the knowledge gained from the initial visit, he called the project a great blessing, given the pressures the community was facing from previous poor rainfall performance. He welcomed the visitors and urged the community to ensure the project was a success.

Long-term data analysis results dissemination

The long-term rainfall data analysis of a nearby representative station was necessary to increase their understanding of their environment. The long-term daily rainfall data analysis results for Magoye meteorological station and Moorings rainfall observing station were presented to the Mujika community at small group meetings. The Nkabika meeting was held on 19th September, 2007 with 30 smallholder farmers (12 men and 18 women) in attendance (Table 6.5). Those for Bulimo and Malomo villages were held on 20th September, 2007 and 21st September, 2007 with 31 (12 men and 19 women) and 38 (15 men and 23 women) smallholder farmers in attendance respectively (Table 6.5). The presentation of the long-term data analysis results was done after the usual formality of opening the meeting with prayer, welcome remarks by the village Headman and chairman in each village. The rainfall results included were on the start, end and length of the season; planting risks and opportunities together with the other information on planting window for

various crops, risks of dry spells and tillage practices. The long-term rainfall analysis results dissemination meeting only happened once at the beginning of the project in all three villages selected as project sites. Farmers accepted the results though their facial expressions did not show that, probably because they were overcome by the amount of information and the technical nature of presentation.

Table 6.5: Farmer attendance at long-term data analysis small group meetings during September, 2007 by village and gender against community population

	Attendance			**Total inhabitants**				
Village	**Men**	**Women**	**Total participants**	**Number of men**	**Number of women**	**Village population**	**% of Men**	**% of women**
Nkabika	12	18	30	32	42	74	43.2	56.8
Malomo	15	23	38	121	141	262	46.2	53.8
Bulimo	12	19	31	177	183	360	49.2	50.8

Flip charts were used to provide the visual point of view with farmers agreeing with the presentations but asking very few questions, despite the fact that the results were repeated three times. A recap of what was presented was also done before the end of every meeting. The details of the information presented are shown in chapter five. An evaluation on farmers' comprehension on the discussed results was undertaken at the end of the meeting using the survey questions shown in Table 6.5. They only had to raise their hand showing they knew the answers to the questions asked. From the quick evaluation of the farmers' comprehension of the long-term rainfall data (Table 6.5), it is seen that a large proportion of each group is in the "unsure" column. This shows that they did not grasp the information on rainfall that was presented. Although more women attended each of the three village meetings, the evaluation shows that few of them understood the concepts about climate that were presented (Table 6.3).

Table 6.6: Mujika farmers correct responses (divided by gender and village) to questions (Q) asked

Q#	**Village >**	**Nkabika**			**Bulimo**			**Malomo**		
	Date of meeting >	**4th September, 2007**			**5th September, 2007**			**6th September, 2007**		
	Question	**Men**	**Women**	**unsure**	**Men**	**Women**	**Unsure**	**Men**	**Women**	**unsure**
	Total	12	18		12	19		15	23	
1	What is the mean rainfall for Magoye?	5	0	25	3	1	27	5	0	30
2	What is the start of the season without dry spells?	7	6	17	5	4	22	8	5	25
3	What is the start of the season with dry spells?	3	1	26	3	2	26	2	1	35
4	In how many of the 28 years analyzed, did the start of season fail?	0	2	28	1	3	27	0	1	37

Farmers' failure to ask many questions could have been due to a number of reasons such as it being too technical or that they had not understood anything at all or that the presenter did not connect with them. It seems that a single meeting of few hours was not adequate to allow for a thorough comprehension of the climate information being heard for the first time. This could have also contributed to the poor evaluation at the end of the meeting. The men's comprehension of climate information based on the number of respondents was higher than that of women by 23.6%, though women's participation to meetings in Mujika was higher than that of men by 21.2% on average. A further investigation is required but was not possible during the project period due to limited resources.

It can be noticed that not all the smallholder farmers in each village attended the long-term data analysis dissemination meetings. The ratio of farmer participation to the total smallholder village population to the long-term data analysis meetings for Nkabika, Malomo and Bulimo villages was 40.5%, 14.5% and 8.6% respectively, which is lower than the expected 60% of smallholder farmers from each village (Table 5). It shows there are more people not attending the meetings than those attending. An investigation into why this occurs and how to improve attendance was necessary but could not be possible within the project period with available funding. The challenge is how to get a higher attendance of the village smallholder farmers' population at the small group meetings.

The percentage participation difference between men and women at long-term data analysis dissemination meetings (Table 6.5) in all the villages was good regardless of the community population size. Women formed the larger part of the group attending the small group meetings, at 50%. This indicated that women were more responsive to climatic information meetings in Mujika than men. The assumption can only be that they were more concerned with the daily livelihood of the family than men and thus had experienced hazardous weather and thus they were keen to learn about forecasts. Farmers' understanding of their environment was increased though they needed more time to study the results than the single meeting provided. The very low percentage participation could mean that farmers could not yet relate climatic information to their livelihoods.

Seasonal Climate Forecast (SCF)

SCF as a long range (6 months) forecast was meant to provide smallholder farmers with information on the seasonal rainfall outlook with its implications and assist them to improve agriculture decision making. SCF was released by the ZMD in September each year and one large group and one small group meeting per village was arranged soon after in Mujika. These meetings were preceded by three live SCF radio presentations from Monze as discussed under the radio

program section 6.3.2.1. Nine small group meetings for disseminating seasonal climate forecast were scheduled from 2007 to 2009 (Table 6.7).

Table 6.7: Schedule of various SCF dissemination meetings for Mujika

Year	Nkabika village	Bulimo village	Malomo village
2007	25-09-2007	26-09-2007	27- 09-2007
2008	23-09-2008	23-09-2008	24 -09 2008
2009	14-10-2009	14-10-2009	19 -10 2008

Meetings took place at usual community meeting places without clashes, apart from the one on 14-10-2009 in Nkabika. Before the presentation of the current SCF, farmers at small and large meetings discussed the terms used in SCFs. They were told that the SCF given by ZMD was either said to be Below Normal, Near Normal or Above Normal against the thirty years long-term mean rainfall. The Moorings and Magoye long-term rainfall values were referred to by the forecasters. In the second and third year of interaction before presenting the SCF, an evaluation of the previously presented forecast was done at each of the village meetings. This was a general inquiry where farmers only raised their hands to indicate if they remembered what was said about the forecast, followed by a written exercise for those who said they remembered the previous seasonal forecast. After some lengthy interaction on terms and principles of the SCF, the meetings considered the actual SCFs for the current agriculture growing seasons. The farmers read the Tonga vernacular SCF handbills that were given out and then gave their individual understanding of it.

2007/08 seasonal climate information

Nkabika village: The small group meeting for disseminating SCF in Nkabika village, attended by 34 (14 men and 20 women) farmers, was held on 25th September, 2007. After an interaction on the SCF terms and principles, the SCF was presented as Near Normal for October, November, December (OND, 207) and Normal to Above Normal for January, February and March (JFM, 2008).

Bulimo village: The small group meeting, attended by 27 (11 men and 16 women) farmers in Bulimo village, was held on 26th September, 2007. It was held at the agriculture shed which was their usual meeting place.

Malomo village: In Malomo the small group meeting of 32 (13 men and 19 women) farmers was held at their usual meeting place under the Gum trees near Mosley Hamabuyu's residence on 27th September, 2007 to receive and discuss the 2007/08 seasonal forecast. The Headman Hector Malomo, in his welcome address, using the information given during the initial visit said the project was timely considering the erratic rainfall performance and the consequent food insecurity. He urged his community to consider SCF in their agricultural practices an improved food security.

Farmers' reserved participation and asking of very few questions in the all the villages in the first year of interaction was of concern to the researchers. They were expected to either be in full support showing anticipation or reject the concept showing remorse to the participatory process but neither of these happened. The researchers were careful and patient with the community in this regard so that they could understand and evaluate the presented SCF and that was a good thing to do. It seems that there were other aspects such as credibility and relevance of the topic that needed to be understood or cleared prior to good participation by the farmers.

2008/09 seasonal climate forecast

Nkabika village: The small group SCF dissemination meeting in Nkabika was held on 23rd September, 2008. There were 25 farmers out of 40 (18 men and 22 women) who said they still remembered the disseminated 2007/08 forecast. But when the written exercise was undertaken by these 25, it revealed only 8 farmers could correctly remember the 2007/08 forecast. There were 7 different versions remembered by farmers in Nkabika villages as the previously disseminated forecast which respondents indicated they received from this researcher at the public and village meetings held the previous year. The response raised some concern as to whether there was any communication at all during those meetings on SCF. An investigation was carried out as to why so many versions of the forecast were recollected from one presenter! There appeared to be no clear reasons for this outcome but possibility that farmers had forgotten what was said; they did not understand or there was no communication at all. A careful and improved dissemination approach of repeating the forecast presentation three times, using illustrations to capture the audience's attention and asking more participants to explain the forecast in their own words during the meeting was introduced. The innovation of presenting the SCF in a song was also attempted. Here there was need for other methods of dissemination to be tried.

Table 6.8: Farmer recollection of previously disseminated SCF by village in Mujika

Year	**Nkabika village**			**Bulimo village**			**Malomo village**		
	Total attendees	Perceived understanding	Correct	Total attendants	Perceived understanding	Correct	Total attendants	Perceived understanding	Correct
2008/09	40	25	8	33	15	7	43	18	9
2009/10	26	14	9	35	19	9	52	21	12

Farmers' recollection of SCF from table 6.8 shows there was a slight increase from 24 to 30 with increased years of interaction. The total number of farmers getting forecast correct was used to calculate the total participant comprehension percentage. Table 6.9 shows that not all those who attended the presentation of the SCF meeting could remember the previously disseminated forecast.

Table 6.9: Smallholder farmers' recollection of the disseminated SCF in Mujika

Year	Total attendance	Perceived understanding	Correct	% perceived understanding	% correct
2008	116	58	24	50	20.7
2009	113	54	30	47.8	26.5
Total	229	112	54	48.9	23.6

Farmers' recollection of SCF was very low at public meetings with only 20.7% and 26.5 % for the 2008 and 2009 total participants remembering the previous forecast. There were more people not remembering what was said of it than those who could remember. This is a worrying fact calling for self evaluation and choices of alternative methods. Farmers' general claim of understanding SCF at public meetings could be misleading as evidenced in the verbal recollection in Mujika. A more practical investigation such as the written exercise seemed to show their real recollection. There however was a positive trend with 58% increase for those who got the forecast correctly in 2009, however it is important to note that this increase is not based on the same people attending the 2008 and 2009 meetings. It is also not true that this change was the effort of the small group interactions alone, as this result could have been due to the increased interaction on SCF through the multi-disciplinary climatic dissemination approach that took place in Mujika. It could then be deduced that increased interaction concerning SCF with smallholder farmers, tends to increase their comprehension and recollection of the disseminated forecast. Patt et al. (2005) found that those attending a participatory style SCF workshop could learn more easily.

At the Nkabika village meeting, the 2008/09 seasonal forecast was then presented and said to be Normal for OND 2008 and Normal to Above Normal for JFM 2009. The illustration using nine people standing in an ascending height order starting with the shortest on the left to the tallest on the right was used to explain the Below Normal, Normal and Above Normal concept. The shortest three represented the Below Normal phase while the next medium three the Normal, and the last tallest three the Above Normal phase. The shortest of the shortest, medium or tallest three represented the lowest limit of the category and vice versa. The same illustration was used in explaining the type of maize cultivar (early, medium and late maturing) and how they could be used under different given forecasts.

The 2008/09 meetings were highly interactive in all the villages when farmers especially women shared their lessons learnt from the previous season. There was a major difference in participation from that of the previous year. The participation of the visibly happy women in explaining the 2008/09 forecast details exceeded that of men, with a lot of references to the 2007/08 experiences.

The implications were discussed, with farmers agreeing the strategy was to plant early and avoid the extreme low lying grounds due to probability of flooding.

The participating farmers were again evaluated for comprehension of SCF. At least two farmers used participants height differences when responding to an enquiry of whether they had understood the terms of Below Normal, Near Normal and Above Normal or not. Nearly all the farmers were at that time sitting upright and listening attentively to the presentations while wondering whether their colleagues would explain the terms correctly. The audience simply smiled with excitement with clapping at times when their counterparts got the interpretations correct. This reaction was a confirmation that according to their understanding, their friends had explained the forecast correctly. Those who still doubted regarding the correct interpretation had an opportunity of getting it from their friends. Asking participants to explain the SCF at small group meetings was good in motivating farmers' interest in SCF and its dissemination. By making contributions on SCF at meetings, farmers were actually disseminating the SCF information to their fellow farmers. Peer explanation of SCF challenged other farmers and aroused an interest and understanding of it.

Later farmers discussed the type of maize cultivar seed to be purchased and planted for particular seasons. The interactive discussion arrived at the recommendation, if that particular rainfall season was forecast to be Normal; farmers would buy and plant Medium and Early maturing varieties. The recommendation was to plant cultivars systematically though the planting window where the medium length varieties were to be planted first followed by the early maturing varieties. Discussions on the relevance of SCF to agricultural practices such as tillage and selection of fields in a particular season aroused a number of questions and attracted a lot of farmer interest. The ensuing discussions agreed that for this specific year, they should avoid using the low lying fields, as the season was forecast Normal to Above Normal, and in general it was a good idea. Interest in discussing SCF in relation to other agricultural practices was because it addressed their continual concerns about making decisions thus showing the relevance of SCF to all farming activities.

Farmers were also requested to inform the other farmers not present about the details of the forecast and recommended farming activities. A SCF comprehension exercise at the end of every meeting in each village allowed for 10 farmers to share their understanding and recommendations on the released forecast. The general audience was only allowed to make comments as to whether they agreed or not with the presentation made by the farmer presenter. There were always different interpretations and presentation on what farmers had read and understood. There were 6 farmers in Nkabika village who gave different versions of the forecast out of the ten farmers. Results for other

villages are also shown in Table 6.10. The session concluded when there was an agreement on the SCF interpretation with the help of this researcher.

Table 6.10: Farmer comprehension of SCF by 10 smallholder farmers at the end of the meeting in Mujika area by village

Year	Nkabika village respondents			Bulimo village respondents			Malomo village respondents		
	Date of meeting	Correct	Wrong	Date of meeting	Correct	Wrong	Date of meeting	Correct	Wrong
2007	25-09	4	6	26-09	4	6	27- 09	5	5
2008	23-09	5	5	23-09	6	4	24 -09	7	3
2009	14-10	8	2	14-10	9	1	19 -10	Refused but sung it as a song	

Table 6.10 shows that the numbers of farmers remembering the SCF correctly at every end of the meeting kept increasing with increasing years of interaction on SCF. Malomo farmers refused on 19/10/2009 to have 10 farmers make individual presentations on the presented SCF and decided to singing it as a short chorus was yet another way of saying they understood the forecast very well. It could also be right to say there are so many different ways one could indicate he/she understood the SCF. The SCF comprehension survey at the end of the meeting using 10 farmers revealed that while a long time was devoted to SCF, a number of farmers could still not remember the forecast nor interpret it correctly (Table 6.10).

Bulimo village: The small group meeting in Bulimo was held on 23rd September, 2008 with 33 (14 men and 19 women) smallholder farmers in attendance. Though there were 15 farmers indicating they could remember the disseminated SCF for 2008/09 in the SCF recollection exercise at the beginning of the meeting, the number reduced further to 7 with the written exercise. There were 6 different versions of the forecasts presented during the recollection exercise as SCF for 2007/08. The SCF comprehension evaluation after the engagements revealed that 6 farmers got the forecast correct with the other 4 getting it wrong

Malomo village: In his opening address, Hector Malomo the Village Headman for Malomo, encouraged other farmers to consider SCF in their decision making. He hoped the incidence where most farmers lost crops due to floods in the previous season, although they had been warned, would not be repeated. The SCF recollection survey in Malomo revealed there were 8 different versions of the forecasts for the 2007/08 that farmers claimed were from one presenter. Though there were 18 farmers indicating knowing the previous forecast, the number still reduced further with the written exercise to 9. The SCF comprehension survey using 10 farmers at the end of the meeting in Malomo village showed 3 farmers failing to correctly interpret the 2008/09 SCFs that had just been presented (Table 6.10). There were 43 (19 men and 24 women) farmers attending the 24th September, 2008 meeting. The women at this meeting were visibly happy and made a lot of

contributions on SCF interpretation more than men. Mr Clement Mwiinga, on behalf of men, revealed most of them attended the meeting because they were now convinced SCF was helpful in crop production.

The revelation during field visits, lessons shared during the 2008 SCF dissemination meetings and remarks by the Malomo village Headman at the 2009/10 SCF meeting confirmed most farmers had not embraced the 2007/08 SCF nor its advice given. The scenario however changed during the 2008/09 and 2009/10 growing seasons when most farmers considered the advice. A number of factors such as increased farmer understanding of the SCF, increased farmer to farmer and farmer with researchers' interactions including the fresh memories of the 2007/08 wet season's impact on their livelihood contributed to this change.

The change in enthusiasm displayed by women during the small group SCF meetings from 2008 onwards was influenced by their understanding and experience with the SCF. Most of women had attended the initial SCF meeting at Mujika Basic School compared to their husbands who had for some reason or another stayed away. This had given them an increased understanding of the forecast above that of their husbands. Since the final decisions on agriculture development, according to tradition are made by men, the women's reported advice and implications of SCF was not acknowledged by most of their husbands in the 2007/08 season despite the efforts made. When the 2008/09 SCF was being disseminated the women felt it was the right time and opportunity to reprove their husbands for disregarding their contribution on SCF. This was to serve as a lesson and prevent similar occurrences in future. The visibly happy women went beyond their traditional norm of women taking a low profile at public meetings by being out spoken just to show their male counterparts that they also had a role in disseminating SCFs.

2009/10 seasonal climate forecast

In the morning of 14th October, 2009 26 (7 men and 19 women) farmers from Nkabika village gathered to receive and discuss the 2009/10 SCF. This meeting was affected by another coinciding nearby meeting which divided the community participation, a matter the Headman regretted happening. The evaluation for SCF comprehension had 8 farmers getting the forecast correct. This was a great improvement and could mean their previous experiences could have contributed this change. The 2009/10 SCF was then presented and said to be Normal for OND 2009 and JFM 2010 for southern province. The presentations were repeated three times during the meeting to try to increase smallholder farmer understanding.

Bulimo village: In the afternoon of the same day 35 (13 men and 22 women) farmers gathered at the marketing board, their usual community meeting place in Bulimo village, to receive and discuss the 2009/10 seasonal climate forecast. Explanations of the SCF terms and the illustration of using participants' height differences, Bulimo farmers standing in the height ascending order from left to right was used in the illustration of long-term rainfall values (Figure 6.1). Farmers then read the Tonga 2009/10 forecast handbills (Figure 6.2) and gave their own understanding of the SCF. Given the Near Normal forecast, farmers agreed that the medium and early maturing maize varieties were recommended for this season.

Figure 6.1: Illustration of participants heights in forecast terms explanation at Bulimo village on 14th October, 2009

Figure 6.2: Village participants reading the 2009/10 SCF in Tonga on 14th October, 2009 at Bulimo village

Malomo village: The 2009/10 SCF presentation meeting for Malomo village was rescheduled from 15th October, 2009 to 19th October, 2009 by the Headman when only 22 farmers had assembled by 10:00 hours so as to allow more people that were committed with another coinciding meeting to attend. The Village Headman expressed happiness at the attendance (52) on 19th October, 2009 meeting. *"I hope the presentation of the 2009/10 SCF will help each one of you in attaining an improved crop yield this coming season"* he said. He warned people against disregarding information that helped them to improving their livelihoods. He referred to the consequences of the community's negative reaction to the 2007/08 forecast, when most of them did not consider the SCF advice in their agriculture practices as one that should not be repeated. The Chairman, Mr Philemon Hakalembe also encouraged them saying, *"The attendance is good and I agree with those who felt postponing the last meeting was a good idea for all to benefit"*.

Farmers did not only ask questions but made contributions on SCF discussions. Many farmers shared their personal experiences regarding understanding and use of the SCF. Discussing the tillage practices, given each forecast season, farmers in Malomo and Bulimo villages in 2009 concluded it was beneficial to practice conservation tillage when the season was forecast as Normal to Below Normal to meet the crop water requirement through water harvesting. However they

challenged the concept of making maize planting basins before knowing the type of forecast for the next season. *"You may be forced to cover the basins on realizing seasonal performance was Above Normal, a matter that may not be possible given the labour constraints. The end result would be unnecessary crop losses",* said Chileya Moonga of Malomo village. The 52 (20 men and 32 women) farmers of Malomo community were visibly happy with the forecast presentation. They refused to do random SCF comprehension exercise with 10 farmers at the end of the meeting but instead started singing the SCF in a short chorus as Normal from the start to the end of the season.

The decision to postpone the SCF presentation meeting to 19th of October, 2009 by the 22 farmers present revealed community's appreciation and understanding of the seasonal forecast and its implication to their agricultural practices and livelihoods. They preferred that every farmer should be able to receive the forecast details from the experts as opposed to the grapevine approach, which had its own unpreferred consequences. This was further evidenced by the joy that the Village Headman expressed in his remarks at the opening of the 19th October, 2009 meeting. They wanted all farmers to gain the full benefits of the disseminated forecast. The Village Headman's recommendation and those present for meeting on 15th October, 2009 reveals that the community knew how they would benefit and it was confirmed by the larger attendance (52) on 19th. Flexibility in climatic information dissemination schedule therefore enhanced effective participation of community at small group meeting.

The full value of SCF to smallholder farmers in Mujika depended on other factors such its accuracy, management options available to farmers to take advantage of it, the quality of decision made as a result of their understanding it, the manner and quality of presentation enhanced its utilization (Nicholls, 1991). Feedback provided by farmers at 2010 field day showed this was achieved. While there are other factors that enhance attainment of the full SCF benefits, attending the SCF presentation meeting and understanding it was the first step towards making an improved agricultural decision, as was also found by Patt et al. (2005).

Participation during small group meetings on SCF increased slightly with years as interactions did (Figure 6.3). More farmers activity participated in forecast interpretation and provision of advisories based on the released forecast. The general farmer participation at SCF meetings showed a consistent and positive trend at all three villages as for all years except 2009 Nkabika when there was a coinciding meeting nearby. This indicates that the multi-disciplinary climatic information dissemination approaches used was effective.

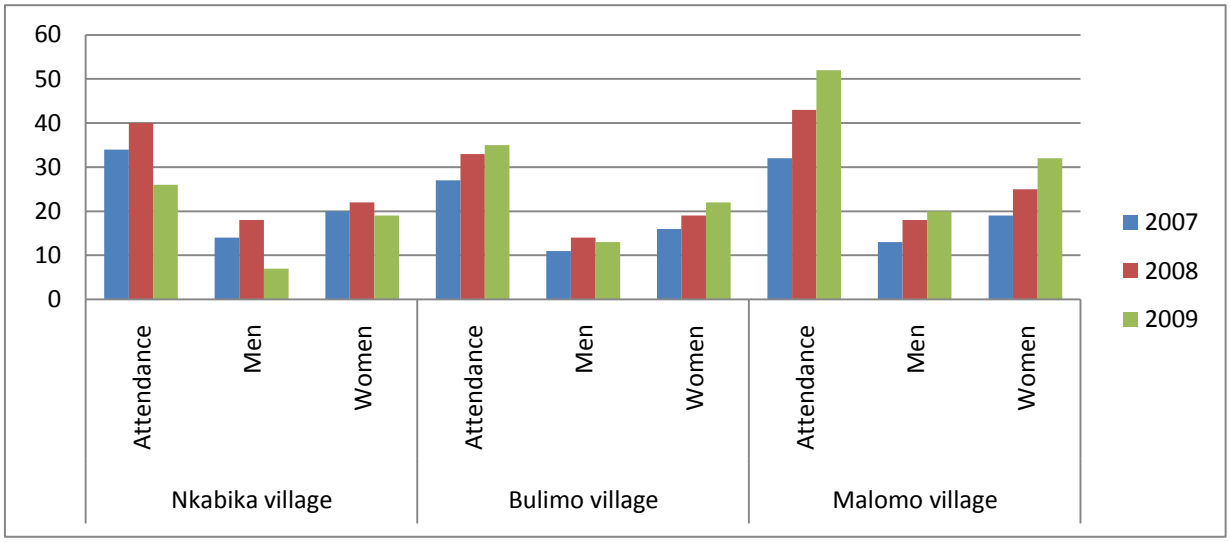


Figure 6.3: Farmer participation to SCF by village and gender in Mujika for 2007, 2008 and 2009

The total number of farmers that participated at the SCF meetings was compared to the total population of the three participating villages in Mujika, calculated as percentage participation ratio. Though the trend increased from 2007 to 2009, it was constant to 2009 with farmer percentage participation ratio for 2007, 2008 and 2009 were 13.56%, 16.91% and 16.47% respectively (Table 6.11). The gender average participation over the three years period shows as 12.93% and 17.67% for men and women respectively. The annual percentage participation trend was positive and consistent women rising from 15.03% in 2007 to 18.03% and 19.94% in 2008 and 2009 respectively while that of men rose from 11.51% in 2007 to 15.15% and declined in 2009 to 12.12% (Table 6.11). The observed reduction in male attendance in 2009 was still slightly higher than that of the first year. In 2008 the men increased their participation to SCF to remove the embarrassment and rebuke by women concerning use and understanding of SCF information. Throughout the years, a higher percentage of the females attended the SCF meeting showing their concern with food production that is dependent on the rainfall.

Table 6.11: Summary of Mujika farmers' percentage attendance by gender in the SCF small group meetings

Year	Total inhabitants in three villages			Attendance	% participation	Men	Women	% of Men	% of Women
	Men	Women	Total						
2007	330	366	696	93	13.36	38	55	11.51	15.03
2008	330	366	696	116	16.67	50	66	15.15	18.03
2009	330	366	696	113	16.23	40	73	12.12	19.94
Average					15.42			12.93	17.67

It can be noticed that less than 20% of smallholder farmers in each village attended the SCF dissemination small group meetings. There remains therefore a challenge on how to get the community at large to attending SCF meetings. The small group meetings were instrumental in

identifying farmers' commitment including that of females, to dissemination of climatic information and challenges available.

Though the farmers were trained on SCF and received accurate forecasts for three years, other factors such as poverty, limited access to loan facilities and land for agriculture purposes stood as major constraints. *"I received training on SCF and understand its importance in agriculture development quite well, but I am poor and have no capacity to use the information"* said Daughty Lwiindi Miyoba of Nkabika village on 19th December, 2008. The limited options available to farmers constitute a major constraint to the use of accurate SCF information in Mujika. Understanding the limitations/challenges/constraints of farmers helped the effective targeting of climate information.

Farmers' participation in SCF by village was also calculated and compared (Table 6.12) showing that Nkabika, the lowest populated village, has the highest percentage participation of 45.0% followed by Malomo and Bulimo villages with 16.1% and 8.8% on average. While there was a positive percentage increase in exception for Nkabika village, in 2009, those for Malomo and Bulimo villages are rather too low and it remains a challenge on how to increase them to the expected 60% perhaps in Nkabika, the word of mouth, farmer to farmer worked better as more people knew each other via a small place and there was more accountability to attend the meetings.

Table 6.12: Farmer percentage attendance at SCF meetings by village for each year, 2007 - 2009

Village	**Village population**	**2007**		**2008**		**2009**		
		Total participants	Participation %	Total participants	Participation %	Total participants	Participation %	Average %
Nkabika	74	34	45.94	40	54.0	26	35.1	45.01
Malomo	262	32	12.21	43	16.4	52	19.8	16.14
Bulimo	360	27	7.5	33	9.1	35	9.7	8.77

Observations

- The traditional norm of only men making decisions for the household concerning agricultural development had a negative effect on the application of the SCF. This problem is expected to continue for some time as long as fewer men continue attending SCF meetings and the women's understanding and contribution on SCF continues to be disregarded by men.
- The food relief programs, though with a good intention, have negatively affected the development of agriculture, and rather encouraged the development of the donor/government dependency syndrome, to a level where dissemination of climatic risk information has a reduced benefit. *"Most farmers have taken the disaster relief programs for granted and it has become an adaptation strategy to climate variability"* (Hamabuyu, personal communication,

22nd December, 2007, Malomo village). The well supported government/donor disaster relief and subsidy program contributed to the birth of a new syndrome called the "Government/donor dependence syndrome" for livelihoods. There were 29 out of the 35 farmers, who did few farming activities before receiving their expected agricultural support inputs from government on 13th December, 2007. This date was considered late as the 2007/08 rainfall season had commenced on 7th November 2007. The lower yield gained was also due to their dependency on government support resulting in planting late.

The impact of the previous seasonal rainfall performance on community and the increased farmer to farmer interaction on SCF including the rebuke from women could have contributed to more people remembering and stating the forecast correctly at the 2008/09 SCF dissemination meeting. The increased interaction on seasonal climate forecast brought about an increased farmer understanding and experience in interpreting SCF. The increase in number of people attending the SCF dissemination meetings confirms that increased interaction on SCF had a positive influence on the community. This interaction could have also influenced the increase in the number of people from different villages attending the meeting. The positive community response to climatic information could have been contributed by the improved credibility of ZMD with time to produce seasonal climate forecast, farmer experiences on SCF in previous season and the explanations given on the SCF terminologies. Also the first year ZMD distributed the SCF at Mujika, the rainfall season was correctly forecast and this helps to build confidence in ZMD activities. Small group meetings were vital for easy collection of PRA data, dissemination of climatic information. They are also good platforms for testing farmers' participation in climatic information dissemination meetings.

6.3.1.4 Training

With the introduction of the IDRC project, farmers needed training in the use of climatic information in decision making. The subsequent training workshops were for increasing farmers' understanding of climatic information and improved decision making while the field tour provided for a practical experience. One mid-season review workshop was held from 21st -22nd January, 2008 at CARBLAC to increase farmer understanding of SCF and its application under different situations. Two crop modelling training workshops were held after the release of the ZMD SCF just before the start of the growing season in the two years of 2008 and 2009.

6.3.1.4.1 Mid-season review workshop

The first day of seasonal review workshop was spent on interacting with community members while the second day was a field tour trip to Monze Farmers Training Centre. The agriculture camp

officer, with the help of community selected 40 participants from Mujika for the training. On the first day, the community reviewed the disseminated 2007/08 SCF and received the long-term rainfall data analysis result for Magoye and Moorings. Farmers recalled the 2007/08 SCF meeting, and reported on seasonal performance and their reactions to SCF. "*The forecast was accurate including the implications, however most of us disregarded the forecast and experienced major crop losses*", Chileya Moonga from Malomo village said. The long-term rainfall data analysis presented was on start and end of the season, dry spells and planting opportunities. The others were annual rainfall totals, seasonal rainfall totals, all years mean rainfall and length of the season. Farmers asked very few questions. Most farmers revealed that they were not aware of the seasonal forecasts by the ZMD and that they relied on different indicators to predict the type of season. Some farmers revealed that they were hearing the long-term data analysis results for Magoye and Moorings station, for the second time, following the small group meetings. Presenting the long-term rainfall results at the start of the training allowed farmer to compare the data with their own perception of rainfall performance while the review of the presented SCF enhanced farmer understanding of it. Farmers started comparing the forecast with the rainfall performance thereby building confidence in it.

The second day was spent on a field tour trip to Monze Farmers Training Centre (MFTC), where under the guidance of the Officer in-Charge, Mr Sitali, farmers were exposed to different research crop rotation trials with different treatments.

Figure 6.4: Mujika farmer on field tour to MFTC on 22nd January, 2008

They also learnt how the centre used SCF in crop selection and tillage practices. Farmers expressed joy and gratitude for the opportunity of this field tour. Commenting on the lessons learnt Clement Mwiinga of Malomo village said, *"We have wasted yet another year in crop productivity but are glad to have learnt a life time lesson".* Field tours opened farmer understanding of SCF and

exposed them to practical field benefits of applied climatic information and alternative cropping practices.

6.3.1.4.2 Community modelling workshop

A total of 40 farmers (equal numbers of male and female) attended the first three day crop modeling workshop at CARBLAC from 6th – 8th October, 2008. These were drawn from six villages of Bulimo, Homooya, Kayumba, Malomo, Nkabika and Sikaula villages and had been selected to be the farmers that would host a "baby" trial experiment. On the first morning farmers drew individual maps of their own farms. Farmers shared their tillage practices, crop varieties grown and access to inputs such as seed, basal and/or top dressing fertilizers. The 2008/09 seasonal rainfall forecast was then presented and said to be Normal for October-November-December (OND) 2008 and Normal to Above Normal for the January-February-March (JFM) 2009 season. After receiving the forecast, farmers discussed a range of options but finally opted for suitable crop management options such as planting of the maize varieties with the number range starting with 5 or 6 (500 and 600) (e.g medium maturing varieties), planting with first rains, weeding and top dressing at optimal time for the 2008/9. Farmers response to SCF gave them hope of a good yield every year.

From the individual maps two dominant soil types, namely a sandy loam and a clay soil occurring mainly in the low lying parts of the landscape were identified. There was a wide variety of different maize varieties (up to 19) with most farmers planting medium length varieties (500 & 600 series). The meeting ended at 18:05 hours. On the second day the modelers led by DR John Dimes of ICRISAT worked on their own discussing the individual farmer maps and farm management activities so as to formulate the management options for APSIM. After compiling the available climate data into the necessary format for the APSIM model, they ran for several management scenarios (Carberry et al., 2004). Outputs were then transferred onto simple graphs for presentation to the farmers on the third day and the researcher explained what the crop model was and how it could help us. Discussions of the rainfall variability were done using a graph of the daily rainfall from the previous season which showed that it rained almost every day during December 2007 causing flooding, waterlogging of fields and consequently poor maize production. The last 11 years seasonal rainfall amounts, presented on a graph, were used to consider variation between seasons. This graph was then compared with another of the model predicted yield graph, which showed low yield in one season when rainfall was high and average yield in one low rainfall year.

Figure 6.5: Constantine Manyanga and Dr John Dimes receiving comments from farmers on Constantine's crop modelling result on 8th October, 2008 at CARBLAC.

But the overall comparisons showed the model had predicted farmers yield well for some years over the last 11 years. This was also true for the case study on Constantine Manyanga's field from Hamooya village; where he had applied manure in two consecutive years. Though there was slight difference between the predicted values for the last two seasons (2006/07 & 2007/08) the model had accurately predicted his yields. He acknowledged the model as a useful tool for predicting the effect of various interventions. Simulating yield correctly for the eleven years and those two seasons for Constantine Manyanga revealed that APSIM model is reliable for showing effects of climate variability under different interventions. It is important for farmers to understand their natural resources and SCF first before they can be introduced to crop modeling. Farmers' appreciation of the simulation model results was because they were able to identify and relate different scenarios with their own real environment (Walker et al., 2009).

Discussions on use of basal and top dressing fertilizer's for optimum yield from the clay soil was illustrated with a graph and comparing the predicted yield with and without fertilizer over the same years. Farmers observed yield was less than the model prediction, so they were encouraged to include fertilizer treatments in the mother-baby trials. Design of the experimental field trials for the mother-baby trial could not be concluded due to time limitation only finishing at 18:00 hours and hence was moved to 22nd October, 2009. Four different treatments with different soil fertility treatments were agreed upon, as follows:-

(a) Zero added fertility level;
(b) 100Kg/ha ratio for basal of D-compound and Urea for top dressing;
(c) 200Kg basal D-compound and urea for top dressing; and;
(d) animal manure for basal and 200Kg urea for top dressing

In the second year the modeling workshop was held on 27th October, 2009 there were 30 (14 men and 16 women) farmers from eight villages in Mujika for the crop modelling training workshop at CARBLAC. The number of participants had reduced from 40 to 30 though we had two new people from Maimbo and Moonga villages. The objective of the one day workshop was to receive feedback from farmers about the baby trials and about the mother field trial; review the 2008/09 SCF and present the 2009/10 SCF; to receive farmer reactions to the 2009/10 SCF and design the 2009/10 mother-baby field trials.

The farmers wrote their feedback and lessons learnt from the 2008/09 season and the baby field trials management on loose papers then presented in plenary. Joseph Hampongo of Nkabika village said, *"Planting a medium maize variety immediately at the start of the season on conventional tillage in a normal (OND) and normal to above normal (JFM) forecast season was not advisable. I lost 50% of my maize crop under conventional while that planted the same day under ripping faired well"*. Owen Hatwiinda observed the 2008/09 season performed as forecasted and that SCF is a factor in improved agriculture productivity. The Namayoba rainfall station at Bulimo village recorded 700 mm for the 2008/09 season showing consistence with the forecast of above normal.

Mother-baby field trials yield comparisons as summarized by Prospard Gwondwe showed some major differences. The mother field trials showed a lower crop yield as compared to the most baby field trials. Investigations revealed that some farmers had planted their trials on a field previously planted with groundnut or had animal manure applied while others secretly applied additional fertilizer. Corrections were hence made to improve management of the 2009/10 field trials as it appears that the farmers did now correctly understand this type of experiment.

Farmers selected medium maize varieties, ripping and basins for their tillage practices and using any fields except the extreme low lying lands in response to the 2009/10 Near Normal forecast. They questioned the conservation tillage practice of making basins at the end of the rain season when the SCF that was supposed to serve as a guide for doing so was not yet available. A lengthy discussion concluded that the practice was wrongly adopted but meant for water harvesting purpose when forecast was expected to be Below Normal. *"Since the forecast is normal for the whole season and have opted for a medium variety which is similar to that of last year, it is only prudent that we continue with the same trials"* said Constantine Manyanga. Farmers opted for similar trials as those in 2008/09 season with planting of maize crops early and to take extra care on standard controls.

At the end of the workshop two farmers were randomly picked and asked to present a workshop overview. Mr Forward Chijikwa of Hamooya village mentioned the objectives of the workshop

after which he eluded farmers in the previous season had made some notable mistakes with both information uptake and trial management. He requested for changes in the following year. Ms Vainess Hichaaba of Nkabika reminded members, that SCF was expected to be normal for the whole season after which she sung the SCF song. The farmers' overview showed they had learnt something from the training and it also revealed training enhanced the farmers understanding of the crop modelling exercise.

The reduction in the time spent on the crop modeling meetings in 2009 was due to farmers' knowing how to interpret SCF and understanding of the mother-baby concept. Farmers' previous SCF exposure and knowledge contributed to the reduction of the engagement period from two to one day. Engaging farmers with SCF over a long time is crucial before leaving them alone with the SCF handbill they would understand it on their own without assistance. The challenge is extension workers especially agrometeorologists should be able to bring the SCF more accurately and in time for continued application in formulating with crop management options that respond to the seasonal climate forecast. Varying maize varieties, tillage practices and soil fertility levels; understanding and diligent use of the SCF and available management tools such as APSIM for simulating crop yield enhanced agriculture decision making on management options.

Feedback provision in training workshops by researchers and farmers on SCF is a measure used to evaluating farmer comprehension of workshop deliberations and project management; leading to an improved SCF dissemination, as well as its understanding and utilization by farmers. Singing SCF was an innovation and should be promoted and improved upon to aid SCF dissemination. Farmers' evaluation of conservation farming systems of making basins at the end of the rain season, in the absence of SCF as guide demonstrated understanding of linkages between SCF and tillage practices. Their concluding the practice needed reviewing, as it was only appropriate to use water harvesting when the forecast was expected to be below normal, was an informed decision and showed the farmers' in sight and learning.

6.3.2 Electronic

The radio programmes were essential for disseminating climatic information to the wider Mujika community in their relaxed homestead environment even when it was not possible to be physically presented. The radio allows for discussions of climatic information at community and family level without external influence from outsiders. The organization of farmers into radio listening clubs increased their access to climate information (Muchemi, 2008).

6.3.2.1 Radio

The launch of the vernacular radio program and radio listening clubs for the three villages of Nkabika, Malomo and Bulimo in Mujika took place at the end of the large group meeting on 25th September, 2007 when five radio listening clubs were formed. Each club was given a radio cassette, four blank tapes and 48 dry battery cells so as to record the weekly broadcast of Tonga climatic risk information programmes. One radio listening club was created in Nkabika with two each for Malomo and Bulimo villages. The size of the village and distance to the meeting point within the village determined the number of clubs to be formed. Nkabika village is smallest in size and population of only 74 (32 men and 42 women) in 31 households as compared to Malomo and Bulimo that have 262 (121 men and 141 women) and 350 (171 men and 179 women) in 30 and 60 households respectively.

Each club chose a representative that was given the radio cassette recorder for recording all climatic information broadcasts from Chikuni radio station situated in Monze. Mrs Gladys Mukwapa, the guest of honour from the Permanent Secretary's office in Livingstone presented the radios to the representative through their respective village Headmen. They were told programmes would be broadcast from Chikuni radio station every Thursday in the growing season from 20:00 to 20:30 over the three years period. The representatives would re-record the programmes from the broadcasting and then replay at the club meeting. Starting every first week of November for thirteen weeks, the 30 minutes programme was split into two segments of 15 minutes of discussion and then 15 minutes of drama. All clubs had chosen Monday 14:00 as their meeting time to listen to the recorded programs at selected places. The representatives made a record of what happened each week and took attendance register.

Radio Chikuni was paid to air the 30 minutes meteorological Tonga vernacular radio programme. A total of 39 vernacular pre-recorded radio programmes were delivered to Chikuni radio station and broadcasted over a period of three years. These programmes centred on maize varieties, soil erosion control, seasonal climate forecast, making planting basins and planting opportunities as topics selected by farmers during the PRA meetings (Box 6.1). Others topics were start and end of the season, nitrogen fixing in the soil, water harvesting, contour ridges and voice of the farmer. Production each year presented information on similar topics but in a different way each year.

All the programmes followed the same format (Box 6.1). There were also nine live radio broadcasts on SCF not designed in this format at both SKY FM and Chikuni community radio stations as requested for by the respective radio stations as they saw the community interest in the program.

In 2008 during the monitoring tour of the Director of Meteorology to the radio station, Mr Elvis Milambo, on behalf of Chikuni community radio station management said they were very happy with the programming and hoped the programs would continue. *"The feedback received from farmers at Chikuni radio station indicate they were happy with the programmes aired. I presume farmers find the programme relevant to their agriculture activities"* Elvis said. Rhoda Siatwiinda wife of Vice Headman Nkabika commented on the program on 22nd January, 2008 by saying people in the villages referred to the radio program as "***Nkwaambila Bbwe",*** the name of the controversial drama artist instead of the programme title ***Cuulu Cibomba Kundinkila*** *(An anthill softens with continued pounding)* **.** ***"****My children refuse going to bed early every Thursday until they have listened to the programme"* she said. She termed the program "a farmer's delight".

Box 6.1. Example of the radio programmes presented at Chikuni radio station in Monze

A 2009/10 SCF vernacular radio programme presented on 29th October, 2009 is given as an example. The signiture tune, ***Nobantu ba Zambia*** *commenced the programme at 20:00. This song encouraged farmer to consult with the Meteorological department about SCFs for improved decision making and increased agriculture productivity. The song which was composed by this researcher was sung by staff members from the Zambia Meteorological Department Southern (ZMDS). As producer and presenter of the radio programmes, this researcher introduced the program and presented the SCF starting by explaining the terms used. The forecast was presented as Normal for the whole season in southern province covering the months of October, November and December (OND 2009) and January, February and March (JFM 2010). Normal was discussed with reference to the long-term rainfall average over 30 years for Magoye meteorological station which is between 650 and 750mm. However, emphasis was made that different places had different normals, which users of information in those specific areas should be mindful of and to contact the ZMD for specific details.*

The 15 minute drama on seasonal forecast followed, after a short break by a meteorological advert. Two different traditional norms, both not true yet known to any community in Zambia were used to indicate each area had a different rainfall normal. A son marrying his mother after the death of his father was considered normal by community A and a taboo for community B, which ate the poisonous puff udder snakes which community A considered a taboo. While the two colleagues were still getting perplexed at each other's different norms, the visiting Agrometeorologist, in response to the question, asked, told them the 2009/10 SCF was Normal for southern province for both OND and JFM. The normal values however were different from area to area within southern province just as their traditional norms were different. The presenter wrapped up the program and ended with a signiture tune.

Introducing climatic radio listening clubs to the target community at the start of the project was a good thing because it enabled a larger number of people listening to the programme. Community participation in selecting topics for broadcasting and designing the programmes enhanced the community's desire to listen to the same programmes. Presenting the same climatic information in different formats such as discussions and drama attracted audiences of all age groups. Repeating

topics over the three year period on radio aimed at increasing farmer understanding of climatic information and enhancing improved decision making. In order to keep all programmes interesting for the community required a proactive mind for the designer. From the report of changing the meteorological radio programme title to that of the drama artist means that community listened to the programmes and enjoyed them and that they most liked the drama segment, which also confirmed Elvis Milambo's report that programming was good.

The fact that SKY Fm and Chikuni radio stations allowed for free live radio broadcasts on climatic information proved they also found the programmes relevant to the community and preferred to be associated with efforts targeted at improving the farming community's livelihood. Starting radio programs by the first week of November would be considered late for southern province unless they were preceded by dissemination of SCF using other medium prior to their commencements as the case was in Mujika.

6.3.2.2 Radio listening clubs

At the beginning of every November for the three years of the project, the radio programme began broadcasting and radio listening clubs also commenced in Mujika. The facilitators took account of what happened and who attended (Table 6.13, 14,15). Meetings did not always take place on the same day each week due to other village commitments and/or technical problems. *"Kindly help repair my radio cassette as it has a problem with recording. I failed to record the last programme but made a copy from Malomo A, which we listened to" reported* Abigail Moonga of Malomo village on 17th November, 2008 during the monitoring of the "Malomo B" radio listening club. Farmers in all three villages usually gathered every Monday at their usual meeting places to listen to the recorded programmes. At the end a representative or the chosen person led the discussion on the programme after which they advised each other concerning details.

Farmers recruited each other to the radio listening clubs where they discussed and assisted each other understanding the context of the topic of the day. From Tables 6.13, 14, 15, it can be noted that all villages missed listening to at least one of the week's programs. Village funerals, demands by other village commitments and cassette recorder problems leading to recording failure were some of the reasons given for failure to hold a meeting. Their being consistent to radio listening showed they enjoyed the programmes and learnt something (Owen's Comment, Table 6.2).

Table 6.13: Farmer participation in radio listening clubs by gender and village during summer 2007/08

	Nkabika village		Malomo village A		Malomo village B		Bulimo village A		Bulimo village B	
Week	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
1	7	9	6	11	7	8	6	8	5	7
2	8	12	4	9	5	12	7	9	5	9
3	8	9	7	8	6	9	5	3	3	8
4	7	7	5	5	2	3	0	0	4	8
5	3	6	3	7	0	0	1	6	6	7
6	0	0	7	6	0	0	6	10	2	5
7	6	8	0	0	8	11	4	7	7	9
8	7	11	8	10	7	8	0	0	6	5
9	6	7	9	9	6	9	0	0	0	0
10	4	8	5	10	8	9	5	6	5	7
11	3	6	2	7	3	5	6	8	4	7
12	7	9	6	7	5	8	6	4	7	9
13	6	10	8	9	7	10	7	9	4	5
Total	72	102	70	98	64	92	53	70	58	86
Average	5.5	7.8	5.3	7.5	4.9	7.1	4.1	5.4	4.5	6.6

Table 6.14: Farmer participation to radio listening clubs by gender and village during summer 2008/09

	Nkabika village		Malomo village A		Malomo village B		Bulimo village A		Bulimo village B	
Week	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
1	6	11	7	12	4	9	9	9	7	9
2	9	13	5	8	6	11	11	11	6	9
3	7	9	8	9	5	10	10	5	5	7
4	8	12	4	7	7	7	7	7	7	10
5	4	7	7	7	6	9	9	7	5	8
6	3	8	6	9	4	8	8	12	0	0
7	6	8	8	8	7	12	12	9	5	8
8	9	15	0	0	0	0	0	12	7	11
9	5	8	6	11	5	11	11	14	6	9
10	0	0	6	9	9	12	12	8	4	8
11	0	0	4	6	4	7	7	11	8	11
12	7	10	0	0	6	7	7	9	5	10
13	9	8	9	11	5	9	9	7	6	9
Total	73	109	70	97	68	112	112	121	71	109
Average	5.6	8.4	5.4	7.5	5.2	8.6	8.6	9.3	5.5	8.4

Table 6.15: Farmer participation to radio listening clubs by gender and village during summer 2009/10

	Nkabika village		Malomo village A		Malomo village B		Bulimo village A		Bulimo village B	
Week	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
1	4	9	6	9	5	10	7	11	8	11
2	7	10	4	7	7	9	9	12	9	10
3	6	11	7	10	8	8	6	9	5	7
4	9	13	3	9	6	8	5	10	6	9
5	6	9	9	13	0	0	8	9	4	7
6	5	7	7	8	6	9	7	11	3	8
7	7	9	0	0	9	13	9	13	5	7
8	7	13	5	7	2	7	3	8	0	0
9	0	0	4	10	6	9	0	0	2	8
10	3	8	5	7	4	11	6	11	5	9
11	3	6	7	8	6	9	6	9	0	0
12	9	13	7	7	5	9	8	10	9	11
13	8	11	0	0	2	7	4	8	8	10
Total	74	119	64	95	66	109	78	121	64	97
Average	5.7	9.2	4.9	7.3	5.1	8.4	6.0	9.3	4.9	7.5

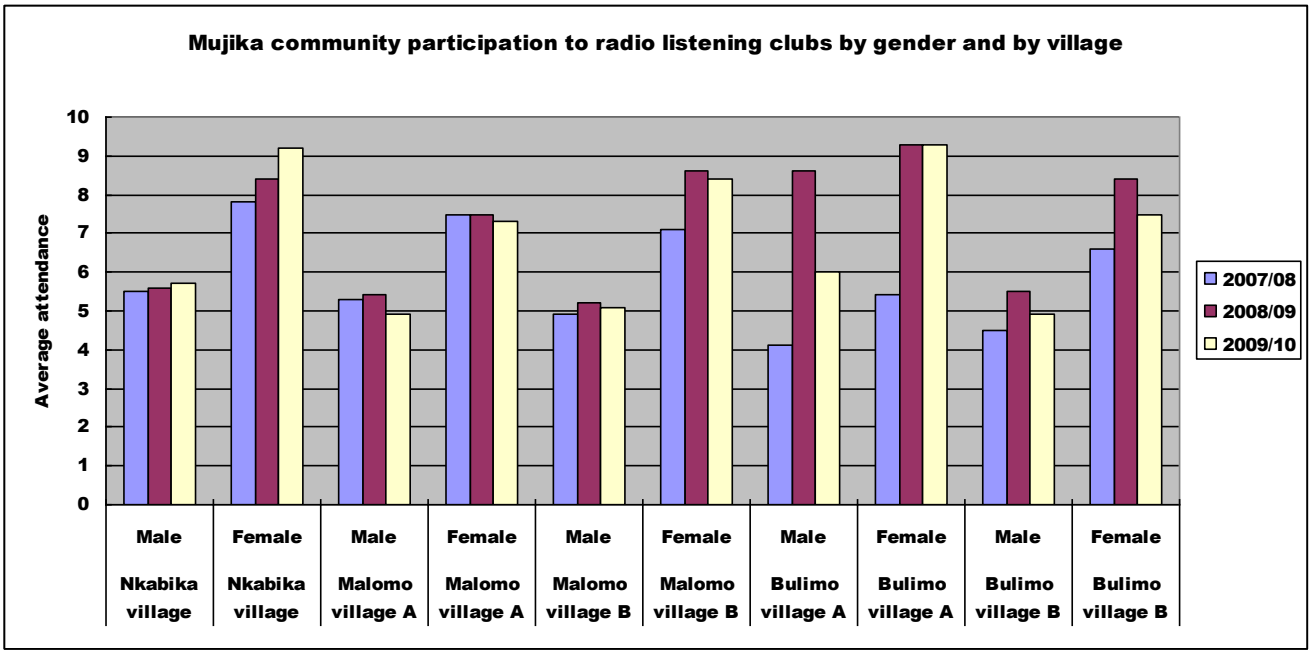


Figure 6.6: Summary of farmer participation to radio listening clubs by gender and by villages in Mujika

Radio listening clubs increased farmer to farmer interaction concerning climatic information and was without external influence. Club members' selection of the meeting date, time and place was creating a suitable participation schedule for themselves not an imposed one which would not have been appropriate. Monitoring and documenting activities during radio listening club meeting provided for the statistical data on farmer responses which was found to be consistent over the three years period. In general, more women than men attended the weekly radio listening club meetings

in all villages, Nkabika, Bulimo and Malomo. The reason for this needed investigating but was not possible towards the end of the project when it was noted. Overall radio programmes and the radio listening club meetings showed a positive bearing on community of increasing interaction on climatic information (see Getrude's comment Table 6.2).

6.3.3 Print media

Print media is vital in disseminating climatic information as it provides a hard copy that can be retained by the people so that they can refer to it later. Printouts of climatic information were made and given to smallholder farmers. English and Tonga copies of the current seasonal climate forecast were distributed according to farmer preferences at small and large group meetings and workshops where SCF was being disseminated each year. There were a variety of opportunities for distribution of printed material; those used here were handbills or pamphlets and cartoons.

6.3.3.1 Handbills

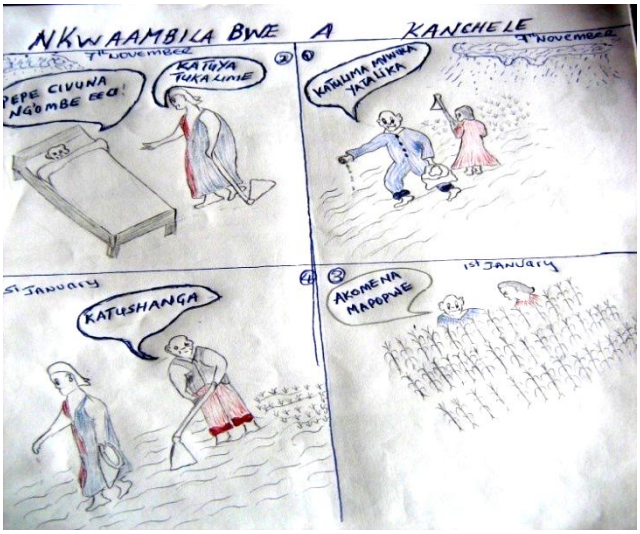
The two page Tonga and English handbills carried the SCF on first page with a set of four maps; two on OND and JFM forecast for the particular year period and two OND and JFM mean rainfall maps for the same periods on the second page. English and Tonga seasonal climate forecasts shown in appendix 16, 17, 18, 19 and 20 were distributed immediately they were released by ZMD. Farmers started reading the forecasts as individuals before doing it as a group where interpretation was done in an interactive manner. There were 500 SCF printouts in their preferred language Tonga and 50 in English distributed every year. Farmers were glad to receive them, even for those who could not read were happy to have a copy of the forecast in their hands. When a SCF interpretation was made by anybody, farmers referred to the handbill to confirm or question it. Those who could not read requested their friends at the meeting to read for them so they could confirm whether what was said was correct or not. It should be noted that not all print media forms could be appreciated by all farmers. Other farmers preferred the Tonga version while others the English, according to their preferences and literacy levels. Disseminating climatic information in the most preferred media form to each target farmer group enhanced farmers' interest in SCF.

6.3.3.1.1 Cartoons

Autriche Niongere from the Zambia Adventist University (ZAU) in Monze and Golden Tila of River Side Seventh Day Adventist Church in Monze drew the cartoons of farmers' responses to the 2007/08 agriculture growing season. Golden and Autriche used the famous radio drama characters Nkwaambila Bbwe and Kanchele to portray the benefits of SCF and planting with the first planting rains. The names of "Nkwaambila Bbwe" and "Kanchele" are both made up and or not real people but represent a typical person in this area. The cartoons (Figures 6.7 and 6. 8) were only distributed

at a small group meeting of 34 (16 men and 18 women) farmers on 23rd November, 2007, in Bulimo village. Farmers showed greater interest and attention to studying cartoon information than they did to SCF handbills. In response to why they appeared to like the cartoons, Getrude Mizinga said, *"Because you can deduce the meaning from pictures even though most of us especially women cannot read".* Two cartoons were distributed.

Figure 6.7 has the story of Nkwaambila Bbwe calling the start of the rains on 7th November, 2007 as water for saving the drought stricken animals and continues sleeping in bed while Kanchele used it for commencing crop planting. At midseason on 1st January, 2008 Nkwaambila Bbwe also commences planting when Kanchele's crops were already at the tussling stage. Figure 6.8 has the story of the agrometeorologist informing smallholder farmers of the 2007/08 seasonal forecast. Nkwaambila Bbwe interrupts the meeting saying they are liars because they are not gods. Later in the season Kanchele appreciates the good maize planted while Nkwaambila Bbwe was drowning from floods and calling for help.



Figures 6.7: Nkwambila Bwe and Kanchele's reactions to the 2007/08 season

Figures 6.8: Nkwambila Bwe and Kanchele's reactions to the 2007/08 season

The interaction was alive, with women having an increased participation than before. It turned out to be a humorous moment full of laughter and joy while sharing light messages via cartoons with their immediate neighbours. Women showed understanding of the cartoon message through their increased participation and excitement. Cartoons are useful in drawing smallholder farmers' attention to climatic information and enhancing their participation at the small group meeting. Use of cartoons breaks down the inferiority complex especially for the semi-literate, shy and traditionally disadvantaged women. None of the farmer was showing any inferiority complex any more when they were discussing the cartoons freely with each other. This therefore was an

indication that cartoons had the ability to break individual inferiority complex when discussing climatic information and was useful in disseminating climatic information.

6.3.4 Personal contacts

Project management led to increased personal contact on SCF with smallholder farmers through home and field visits as well as by chance. This increased opportunity for a family or individual farmers to discuss and even ask questions related to SCF or project activities. The community agrometeorological participatory extension strategy suggested regular home visits to interact on awareness of climatic information. During the first year, interaction centred on SCF and community perception of SCF. In the second year, interactions were mainly on context of SCF, farmers' observations, reflections and reactions to SCF. While in third year, efforts were on how farmers' identified and developed alternative coping strategies to avoid the impacts of climate change. During these visits farmers provided personal observations of the project and the adopted strategies.

6.3.4.1 Home visits

Some Mujika community members' homes and especially those of the baby field trial farmers were visited during the introduction of the community agrometeorological participatory extension strategy. *"I made a mistake by disobeying your advice this year (2007/08 season). I hesitated and did not plant my crops at the time the mother-baby field trials were being planted. I only planted a small portion of the local maize variety because I was discouraged by my peers. Thinking the rains had not established themselves but they continued and my small portion of local maize is the best around. I hope to plant with the first rains and follow your advice according to the expected seasonal forecast next year",* said Chileya Moonga a farmer from Malomo village. One can tell that some farmers learnt making use of the first rains given a particular forecast was a good practice. However for farmers to think of planting with the first rains based on the previous information or rainfall performances could be misleading but better more on the forecast given and the response farming approach. Farmers were advised during the visit. Despite attending the 2007/08 seasonal forecast dissemination meeting at Mujika, Davison Makala the Secretary of Village Headmen's council in Mujika reported during a visit that he had planted in the low laying lands during the 2007/08 season. *"I have lost all my crops through floods and will not harvest anything from here. I have learnt that considering SCF in agriculture planning is a good thing. I will wait for the forecast next year" Davison said. "If you had not come I would have made a mistake of waiting to plant. I have since planted the MRI 709/734 late maturing maize varieties I would have never planted without the disseminated climatic risk information"* said Mosley Hamabuyu on 28th January, 2008 during a home visit. Some farmers learnt the risk of disregarding the SCF in agriculture planning

while others acknowledged the advisory given during home visits as having been time for decision making.

"Don't worry, more people will attend this years' SCF presentation as they have learnt a big lesson from last year's interaction", said Getrude Mizinga on 5th May, 2008 when commenting at her home on whether farmers were learning something from the project. Thank you for coming, I have learnt more from today's discussions she concluded. Clement Mwiinga on 12th April, 2008 while at his home in response to what his view was of the last seasonal rainfall performance said *"I hope to plant Sunn Hemp on a half hectare to improve the soil fertility of my field where I will plant maize first the following year".* There were more of such comments on the participatory project from farmers during the home visitation.

Visiting the smallholder farmers' homesteads, during the CAPES exercise, provided researchers with a better understanding of the real environment in which farmers operated. Most farmers found home visits pleasing due to having ample time for discussing climatic information they initially found difficult to comprehend. This as a result improved individual farmer planning for the following season. Continued home visits contributed to the smallholder farmers' change of attitude and behaviour towards SCF and its utilization. Home visits were instrument in receiving feedback on farmers' reaction and reflections on the disseminated climatic information and project engagements (see ch. 8).

6.3.4.2 Field visits

Field visits were helpful to increase farmer motivation, do spot correction and making improvements in the field trials management. They also allowed for full expression by individual farmer concerning the benefits or otherwise of applied climatic information and practices as they lead researchers through the field. It is during field visits that farmer claims about baby field trials management can be confirmed.

All the fields of the 16 baby trial farmers and the 5 selected farmers (ch. 8) were visited at least once during every growing season mainly during the distribution of the top dressing fertilizer. It was at Violet Ngwenya's field in Malomo village on 23/12/2007 when it was discovered that the initial farmers' view of disseminated SCF was negative. *"My sons, God bless you. People used to rebuke me for working and following your advice saying, you were Satanist. They have now lost out due to floods but I am food secure"* said Violet Ngwenya when she was overwhelmed with the benefits of agrometeorological extension services received during the 2007/08 season. But it was a

different story for Clement Mwiinga, also of Malomo village, on 15th January, 2008 while returning from the field visit: *"I regret my initial stance on SCF. I refused the report my wife gave on SCF and said they are not gods to tell us about the coming rains for that is the prerogative of the gods. Your forecast is correct but I have lost all my crops due to waterlogging and flooding as you have seen",* During the top dressing fertilizer distribution on 23/12/2007, 30/12/2008 and 01/01/2010 researchers received feedback on baby field trials management, application of climatic information and individual farmers' view of community response to disseminated climatic information. The findings of the 23/12/2007 on volunteer farmers' baby field management are show in Table 6.12 where 2 out of 16 farmers had failed to manage as agreed. The farmer's baby field management is indicated in the table regarding when he planted and the type of tillage applied.

On 30/12/2008 in the 2008/09 season, the field visit found that 6 out of 16 farmers in Mujika failed to manage the trials, with 5 of them complaining of small baby field plot sizes and having abandoned the ripping tillage. Corrections were made on the spot with farmers promising to make the necessary adjustments in the following year. But during the field visit of 01/01/2010 in the 2009/2010 season, 8 farmers out of 16 again had not managed the trials as expected. There were five farmers who changed locations seeking more fertile soil especially for the zero fertilizer plots though, one was due to the former plot being repossessed by the owner. The other three farmers had different planting dates for both ripping and conventional plots which made it hard to compare results. Table 6.16 shows in brief, baby field farmers' management of the baby field trials. In the third year, Crivet Chiyabi dropped out and in his place was taken by Duly Hampongo also of Nkabika village.

Table 6.16: Baby field trial farmers planting information for the 2007/08 season

Name	**Age**	**Village**	**Plot 1**	**Plot 2**	**Plot 3**
			Date of planting/ Practice	**Date of planting/ Practice**	**Date of planting/ Practice**
Mr Owen Hatwiinda	30	Nkabika	18/11/07 R/B/C	28/11/07 R/B/C	12/12/07 R/B/C
Mr Crivet Chiyabi	39	Nkabika	23/11/07 R/C	Did not plant	Did not plant
Mr Shepard Mpande	33	Malomo	19/11/07 R/B/C	28/11/07 R/B/C	09/12/07 R/B/C
Ms Susan Mboozi	37	Nkabika	21/11/07 R/B/C	29/11/07 R/B/C	12/12/07 R/B/C
Ms Teresa Milimo	27	Nkabika	19/11/07 R/B/C	4/11/07 R/C	9/12/07 /C
Mr Jonathan Hatwiinda	80	Nkabika	15/11/07 R/B/C	22/11/07 R/B/C	09/12/07 R/B/C
Mr Edson Malambo	51	Bulimo	16/11/07 R/C	26/11/07 R/C	15/12/07 R/C
Miss Esther Chiluli	51	Bulimo	22/11/07 R/B/C	4/12/07 R/B/C	11/12/07 R/B/C
Mrs Rabecca Mizinga	69	Bulimo	20/11/07 C	29/11/07 C	23/12/07 C
Mrs Getrude Malambo	43	Bulimo	26/11/07 B/C	Did not plant	Did not plant
Mrs Violet Nanjela	50	Malomo	26/11/07 R/B/C	19/12/07 R/B/C	22/12/07 R/B/C
Miss Violet Ngwenya	67	Malomo	20/11/07 R/B/C	27/11/07 R/B/C	09/12/07 R/B/C
Miss Agnes Hamabuyu	70	Malomo	21/11/07 R/B/C	29/11/07 R/B/C	08/12/07 R/B/C
Mr Chileya Moonga	36	Malomo	15/11/07 R/B/C	25/11/07 R/B/C	11/12/07 R/B/C
Mr Dumisani Sibanda	34	Malomo	15/11/07 R/C	29/11/07 R/C	19/12/07 R/C
Mr Nathan Chiluli (Headman)	97	Bulimo	11/11/07 R/B/C	23/11/07 R/B/C	10/12/07 R/B/C

Note: R= Ripping, B= Basins, C= Conventional

Most baby trials were planted in November as agreed. There were no sign of change in the trial management despite receiving more instructions at other forums and promising to do so. Field visits are therefore vital in improving design and management of field trial so that results can be credible findings. There could be a few reasons as to why most farmers could not effectively manage the baby trial. One could have been the lack of credibility by ZMD with the community during the first year. The other could have been that, the only previous experience these farmers had was with government "handout" of seed. So they expected that they would receive sufficient seed for their whole field and so they became disgruntled when only receiving a small parcel of seed for a 10 m x 5 m plot. They were discouraged and some then neglected the baby trials.

Field visits were vital in understanding farmers' serious unexpressed feeling about the project information and personnel which were involved. The increasing number of farmers failing to manage the trials correctly from 2, 6 and 8 in 2007/8, 2008/9 and 2009/10 seasons does not mean farmers did not understand and consider SCF in their agricultural practices. The reasons given under field experiment, (section 6.3.8) are that of small field trial plot sizes contributed to this because farmers wanted to be supplied with more seed. However, field visits confirmed farmer commitment to baby trials, and comprehension of instructions given during training workshops and their claimed management of baby trials. From the results, one can tell that not all farmers managed the baby field trials well despite making promises to do so. Field visits are good monitoring tool for farmer field trial management. Personal contacts allowed for extended interaction on climatic information and consideration of numerous farmer concerns leading to improved farmer decisions making at every forecast season. Introduction of SCF in a new community is first likely to be met with different opinions before it can be accepted by that community.

"From farmer management of experiments one can tell that the experiments were slightly complicated for some of them", said Prospard Gondwe on 24th November, 2009. It was from the field visits that Prospard Gondwe, the researcher who was managing the mother field trials, learnt that the treatments proposed at in 2008 were slightly difficult for the farmers. This realization was important to know that more time was needed in explaining the detailed experimental layout so as to help farmers understand fully what was going to happen. It also revealed that farmers some farmer had failed in their trial management because they had not fully understood the concept behind.

Table 6.17: Smallholder farmers' baby field trials management by years in Mujika

Name	2008/09	2009/10
Agnes Hamabuyu	Planted 7/1/2009. Farmer not happy with plots sizes. Only managed conventional tillage Date of visit (DoV) 7/01/09 Variety MRI 614	Changed plot location to 16.15.07.8 S, 27.37.37.7 E, Ele. 1108 m, seeking fertile soil and had only ripping. DoP 22/11/09, Dov 30/12/09 Variety MRI 614
Shephard Mpande	Could not tell what treatment was on what plot, trial was messed up as he used children to plant when he was away. Dov 30/12/08 Variety MM 604	Changed field to winter ploughed field. Saw no difference in the crops. Had both conventional and ripping practice. DoP 13/11/09 DoV 30/12/09, Variety MM 604
Violet Ngwenya	The treatments were well managed. There are some differences with zero fertilizer treatment having poor crops followed by manure with the 200Kg as best. Dov 30/12/08	Same location. Differences noticed in crops as last year. Had both ripping and conventional treatments. DoP 12-11-09 Lat. 10 14 27 4 Longitude 27 37 37 3 DoV 30/12/09 Variety MM 604
Violet Nanjela	DoP 25-11-08 and only did ripping. Variety MR1 614 same location Latitude 16 14 27 E Long. 27 37 39.3 Elev. 1109 m. Most crops were eaten by chicken Dov 30/12/08	DoP 22/11/09 and only had ripping. Variety MR1 614 same location Lat. 16 14 27 E, Long 27 37 39.3 Elev. 1109 m. My treatments are well managed this year and are looking better where there is more fertilizer than none. DoV 30/12/09
Chileya Moonga	DoP 18/11/08, Variety MM604, Dov 30/12/08, Conventional	DoP 20/11/09, Variety MM 604 Can see difference in crop performance between trials DoV 30/12/09
Jonathan Hatwiinda	Variety MRI 614, Dov 30/12/08 Conventional/Ripping DoP 15-11-08, Lat 16 12 60.9 long 27 35 22.2 Elev. 1064 m	Same plot Variety MRI 614 Conventional/Ripping, DoP 19/11/09 Lat 16 12 60.9, Long 27 35 22.2 Elev. 1064 m, DoV 30/12/09
Owen Hatwiinda	Variety MRI 614, Dov 30/12/08 Conventional/Ripping DoP 14-11-08, Lat 16 11 27 Long 27 33 12.6 Elevation 1063 m	Variety MRI 614 Same plot DoV 30/12/09 Conventional/Ripping DoP 17/11/09 , Lat 16 11 27 Long 27 33 12.6 Elevation 1063 m
Susan Mboozi	DoP 13/11/08, Dov 30/12/08 Conventional/Ripping Lat 16 12 17.22 Variety MM604 Long 27 35 8.5 , 1015 m	Same plot DoP 18/11/09 and 19-11-09 Conventional/Ripping DoV 30/12/09, Lat 16 12 17.22 Variety MM604 Long 27 35 8.5 Elevation 1015 m
Maureen Phiri	No previous engagement	DoP 15-11-09, DoV 30/12/09 Variety MRI 604 SCF help is to decide on the planting strategies. Conventional only
Joseph Hampongo	Variety MRI 614, DoP 13/11/08 Planted where he put animal manure. onventional/ Ripping, Dov 30/12/08	DoP 15-11-09, Variety MRI 614, Same spot Convention/Ripping MRI 614. DoV 30/12/09
Duly Hamongo	DoP 17/11/08 Variety MRI 614 Lat 16 12 66.1 Elev. 1059 m Lat. 27 34 50.0 Conventional only, Dov 30/12/08	Same place DoP 19/11/09 Variety MRI 614 Lat 16 12 66.1 Elev. 1059 M Lat. 27 34 50.0, DoV 30/12/09 Conventional/Ripping
Edson Malambo	DoP 23/11/08 Variety MRI 614 Conventional only Lat. 16 13 130 Long. 27 37 13 0 Elev. 1085, Dov 30/12/08	DoP 25-11-09 Variety MRI 614, DoV 30/12/09 Same plot but 1/2 fertilizer applied with goat manure. Conventional /ripping Lat. 16 13 130 Long. 27 37 13 0 Elevation 1085 m
Ester Chiluli	DoP 21/11/08, Variety MM604 Trial mixed up Conventional/Ripping	DoP 23/11/09, Variety MM604 Conventional/ Ripping, DoV 30/12/09
Nathan Chiluli	DoP 18/11/08, Variety MRI 604 Conventional/ripping, Dov 30/12/08	DoV 23/11/09, Variety MRI 614 Lat 16 13 12.2 Long 27 38 01.7 Changed plot Conventional/Ripping, DoV 30/12/09
Getrude Malambo	Variety MRI 614 DoP 24/11/08 Conventional only, Dov 30/12/08	DoP 24/11/09 Applied after germination. Ripping better, manure equally good as fertilizer. Changed plot due to owner of field damaging it DoV 30/12/09, Variety MRI 614 Lat. 16 12 37.4, Long. 27 36 23.7 Elevation 1108 M. Level of applied fertilizer at planting but reduced quantity
Rebecca Mizinga	Variety MM604, DoP 23/11/08 Lat 16 12 27.3 Long 27 37 54.9 Trials mixed up Conventional only Dov 30/12/08	DoV 30/12/09, Variety MM 604 DoP 20/11/09 Manure composite, Same plot Lat 16 12 27.3, Long 27 37 54.9 Delayed planting due to lack of drought power. Conventional only no animal

Observations made during field visits revealed that farmers first planted their main crops before considering the baby field fields, despite assurance that they would consider planting the baby field trials first. There were no major reasons given for that but assumptions were they saw fewer

benefits from the baby field trials than their main fields. This could be true as the number of farmers managing the trials correctly continued to reduce with the reduction of experimental plot sizes the 2008/09 season. The sizes of the baby field trials may then have had an influence on the smallholder farmers' management of baby field trials as they became despondent. A detailed observation of the field visit results indicates 5 of the farmers that unsuccessfully managed their baby field trials in 2008/09 failed to do so in 2009/10 also. So when one is preparing for the mother-baby trials has to take care that farmers understand the way they will work. If researchers require soil samples at the baby trial sites, doing it together with farmers could remove every misunderstanding.

6.3.4.3 Chance meetings

Unplanned meetings between the farmer and agrometeorologist are vital for building good relationships to promote community participatory and more easily address climatic information concerns. For example the following illustrates the farmer to farmer dissemination of information. *"Please give me my Christmas present!",* shouted Widen Hamabuyu on 22/12/2009 while following a hired person to deliver on a wheel barrow containing 1 x 10Kg bag of Pannar 67 maize seed and some home groceries. *"Please have a look at the maize seed variety my husband has sent me and advise regarding its suitability for planting the first week of January"* she continued. "I suggest you look for an earlier maturing variety as this one would require more days to mature than the remaining days if the growing season was to end normally by end of March", she was advised. A passer-by Roy Muzhyimba from Njola, Sikaula village when asked to comment by Widen said, *"I suggest you just pack that one to wait for the next growing season and plant it in November next year".* "*I am very discouraged. However I will plant it and leave the rest to God who controls things"* concluded Widen. The farm visit of 1st January, 2010 found her planting the seed despite being a poor choice for the ending season (see Mosley's comment on personal contacts - late planting).

Another example of receiving feedback: *"The rains have not been well distributed in the months of November and December, 2009, but my maize crop planted where I had planted Sunn Hemp last year is performing well, while most farmers have their crops withering. I am for this reason thinking of increasing the Sunn Hemp plots this year as a strategy for managing dry spells"*, said Clement Mwiinga of Malomo village on 24th December, 2009 after meeting Durton by chance in Monze town.

The chance meetings were useful to the researcher for receiving feedback on farmer crop performances and providing additional advice or explain actions' while the farmers benefited by

asking questions on outstanding crop management questions. It is advisable, given these chance opportunities for interaction with stakeholders to use them effectively on project objectives as it enhances the project developments (see Clement's comment on personal contacts). Chance meetings may also give you an opportunity to evaluate the influence of interaction with community.

6.3.5 Farmer to farmer

Farmer to farmer interaction is necessary for disseminating climatic information to nearly everybody in the community at their own time and place. It is also effective for farmers to encourage others to attend climate information forums and be aware of the effects of weather and climate. They did it in an organized and unorganized matter.

6.3.5.1 Unorganized

The 2007/08 SCF dissemination small group meetings were attended by more women than men. The women through the farmer to farmer unorganized approach passed information to their male counterparts which eventually increased farmer participation to SCF meetings the following year. Men at the review meeting of the 2007/08 SCF simply reported they were informed of the forecast even though they didn't use it. The unorganized farmer to farmer approach created anxiety in the men compelling them to investigate further. When they found out about SCF, they started attending the large and small group meetings on SCF dissemination hence the increased number of participants. *"Mrs Gertrude Mizinga recruited me to the SCF meetings, saying they discussed information able to help one in agriculture development",* said Mr. Edson Malambo, of Bulimo village when asked on how he started attending the meetings.

Farmers live in a community where they interact daily on a number of aspects. The unorganized form of disseminating climate information takes place when and where ever there was an opportunity. It was one of their most widely used and far reaching forms. It even took place beyond the knowledge of climatic information initiators. However, its result could be seen in increased farmer participation in climatic information dissemination activities. The fact that a lot more farmers, that had not been present at the first small and large groups meetings were informed through the farmer to farmer approach, means it is effective in reaching a wider community. Though difficult to know when, where and how it was actually done, suffice to know it was done. The unorganized and organized farmer to farmer media forms were used based on the opportunity and capacity available to the individual(s). However, there is a need to be extra careful when relaying on the unorganized form because it has many advantages and disadvantages.

Advantages:

- It passed climatic information quickly to nearly everybody in the community in a very short time.
- It was the least expensive to the initiator of information when employed properly.
- The information can easily be accepted by the other farmers because it is being disseminated by credible fellow smallholder farmer(s) who they trust.

Disadvantages

- The climatic message keeps changing reasonably quickly as it was being transferred from one farmer to the other and therefore required careful designing and presenting in a user friendly format that could reduce the error. The example at the second large group meeting of the broken telephone message, illustrates this point, that the message is changing along the way (section 6.3.1.2).

6.3.5.2 Organized

Owen Hatwiinda one of the baby field trial farmers from Nkabika village organized his own field day on 3rd March, 2009. *"I have learnt a lot of lessons from the experiments that I am considering hosting a field day. I will meet all the meal requirements for the people coming to the field day but you can make any contribution towards the programme as resources may allow"*, said Owen in a telephone conversation on 5th January, 2009. He was supported with a 1 x 25Kg bag of Mealie meal and 2.5 litres of cooking oil.

Starting at 09:00 h with a local singing band that he had invited, farmers were entertained and exposed to the benefits of applied climatic information till 11:30 h. The local singing band also sung the benefits of applied climatic information in agriculture productivity which Owen had told them while the farmers responded with dancing. During the field tour he shared lessons learnt from considering seasonal climate forecast starting from decision making to crop management and expected yield. *"It helped me to decide on the type of seed variety to buy, tillage practices to use and selecting which field to plant. Apart from that it also helped me to decide when to plant my crops"*, Owen informed his audience. He continued *"The meteorological department had told us the 2008/9 season was going to be normal for OND and normal to above normal for JFM which turned out to be so. I selected an open pollinated medium maize crop variety called Afric 1 for planting on this one hectare. This seed takes a total of 125-145 day to mature and has a normal height of 1.2 meters. Has yielding capacity of 10-11 tonnes per hectare. Planting with the first rains, I decided to plant two portions adjacent using different tillage practices of ripping and conventional. In this field, I never applied any chemical basal and top dressing fertilizer but*

depended on the nutrients supplied by the Sunn Hemp legume planted last year on this same plot. This field is promising me a very good harvest this year" Owen said.

Turning to the baby field trials whose treatment is explained in this chapter on section 6.3.7.1 on the mother-baby field trial, he told how it was not good to plant maize crops without putting any form of manure one is likely to have a very poor yield as the case was in the trials. Any form of fertility added to the soil is likely to increase crop yield as being depicted in these trials. He confidently responded to the various questions asked during the field tour, with the agriculture camp officer and this researcher amplifying on specific topics as need arose. *"These reasons compelled me to host this field day and I hope you have learnt something useful for your individual agriculture practices. Thank you for coming and let us now all go and enjoy our meals at home"*, he said in conclusion. He was complemented for managing a field day to share benefits of climatic information in agriculture productivity with other farmers. A total of 120 (70 men and 50 women) smallholder farmers from within Nkabika village and the surrounding areas attended.

The organized farmer to farmer interaction where a forum was used for sharing climatic information with date, time and program set for the exercise was vital in correcting any climatic information error that would have been distributed. This form of farmer to farmer interaction using field days provided an opportunity for information verification, by looking at the fields involved and thus giving correction on the climatic information provided if the farmer had misunderstood any concept.

6.3.6 Passing/driving through

It is yet another way of communicating climatic information to farmers through community awareness of the presence of an agrometeorologist or other experts in their midst. The researchers made many trips to Mujika to interact with the community members on project management from its inception to the end. On 11th January, 2008 the researchers were driving in Mujika distributing top dressing fertilizer for the baby field trials when Abigail Moonga and her husband, of Malomo village, identified them at a distance. On the following day she reported saying, *"We were going for a meeting yesterday and when we saw you driving through at a distance, my husband said, there goes the weather man".*

Another example of disseminating information when identified at a distance *"I had gone to buy some home supplies on Wednesday 20th February, 2008 when we saw you pass by at a distance in town. Suddenly a very serious argument started, while waiting for transport at the bus stop on the*

role of the Meteorological department and the use of the SCF in agriculture productivity. The waiting passengers were divided with two different opinions. One camp saying they are liars and not gods to tell about the coming rains while the other was saying, these people use equipment and what they say is usually correct and can assist farmers in agriculture productivity. The transport came without reaching any form of conclusion. However those who were for, jeered at their friends who had admitted having had a total crop failure under the 2007/08 season when they were warned of flash floods and did not adhere to", Mosley Hamabuyu reported during a home visit on 24th February, 2008 (Table 6.2).

Being identified by members of the community reminds them of your Agrometeorological role amongst them and provides them an opportunity of evaluating the value of agrometeorology or climatic information in their agricultural practices. Being identified as an Agrometeorologist disseminates climatic information even without any personal contact. I call this a silent media form of disseminating climatic information to community where they are familiar with you.

6.3.7 Field experiments

Field experiments were necessary for testing alternative interventions by community farmer participation; acceptability and suitability of farmers' identified opportunities in addressing community problems and identification variable and practical research results. They serve as platforms for "learning by doing" and sharing of results with the wider community.

A total of 16 baby field volunteer smallholder farmers called baby field trial farmers from Mujika participated in the on-farm field trials. Nathan Chiluli, Headman for Bulimo village in Mujika, provided the needed piece of land for the mother field trials. Every October before the start of the season, beginning in 2007 for three years in Mujika, the researchers and farmers engaged with the current SCF to come up with crop management strategies for the mother-baby field trials. With the 2007/08 SCF being Normal for OND and Normal to Above Normal for JFM the farmers in Mujika chose three different tillage methods of ripping, basins and conventional where early, medium and late maturity maize were varieties planted at different planting times.

Table 6.18: Layout for the mother field trial in Mujika in 2007/08

Plot 1		Plot 2		Plot 3
Planting dates: 09/11/2007		Planting dates: 23/11/2007		Planting dates: 7/12/2008
MM 502 Conventional		ZSM 603 Conventional		ZSM 734 Conventional
ZSM 734 Ripping		MM 502 Ripping		MM 603 Ripping
MM 603 Basins		ZSM 734 Basins		MM 502 Basins

All three crop varieties were planted at the same time and on dates within the ideal planting window. The first set of maize crop varieties were planted early with the start of the rainy season on 9th November, 2007, while the other two were planted at two weeks time intervals within the planting window (Table 6.18). In 2007/08 the main treatment was tillage, the plots were 25 m long by 5 m wide for each cultivar at each of the 3 planting dates (9/11/07, 23/11/07 and 7/12/07). In 2008/09, the experimental plot sizes became four plots each by 5 m x 10 m with fertilizer and two tillage treatments. The change had to be brought about as the IDRC/CCAA funds had to stretch to one mother field -baby in both Monze and Sinazongwe districts.

When 2008/09 SCF was forecast as Normal for OND and Normal to Above Normal for JFM, farmers chose medium maturity maize varieties for experiments with four different soil fertility levels following the modelling exercise. The mother trials had two cultivars and tillage treatments (Conventional and Ripping), and four fertility treatments (zero kg ha^{-1}; 100 kg ha^{-1} "D" plus 100kg ha^{-1} urea; 200 kg ha^{-1} "D" plus 200kg ha^{-1} Urea; Manure at 5t ha–1 plus 38 kg ha^{-1} Urea). A split-split plot experimental design was used with tillage in the main plots, fertility in the subplots and variety in the sub-sub plots with three replications (Table 6.19). With the 2009/10 SCF being Normal for OND and Normal again for JFM, farmers opted to repeat the same treatments as the previous year. Faced with the farmers' failure to do ripping during the 2008/09 season, the researcher hired a ripper and labour in 2009/2010 to prepare farmers fields for baby trials before the start of the rains with a view of improving performance and timeliness in planting.

The aim of the mother-baby trial for this thesis was to explore the social aspects of the farmers around the mother-baby trials that had influence on the final output. The relevance of the field experiments in a community may dependent on sincere problem identification by themselves and the possible opportunities for field testing. Repeating the field tests in a participatory manner over a number of years may provide trends regarding solutions to community problems. Information was necessary to fill gaps in community information.

The overall farmer engagements with SCF using the mother-baby field trials suffered some challenges whose results had some negative influence on the overall project outcome. The number of farmers who successfully managing the baby trials declined as the project continued (Table 6.20) and the failure by some farmers to take advantage of labour hired for them to prepare the field before hand. The hired labour and equipment however increased the number of farmers using the correct tillage practices during the second years. This however hampered the sustainability of the

tillage practices after the project, as the cost of this ripping tillage operation is too high, so adaptation to ripping is doubtful. Improved research results were obtained but without farmers' full participation. The smooth running of the mother-baby trials also had some challenges mainly due the researchers' inadequate understanding of the livelihood of the community and due to different expectations by various stakeholders.

Table 6.20: Summary of baby farmer management of the baby field trials each year showing that actually there were unsuccessful baby trials each year

Year	Number of baby trials	Successful	Unsuccessful
2007/08	16	14	2
2008/09	16	10	6
2009/10	16	8	8

6.3.7.1 Previous project influence and researchers' inexperience in community projects

On hearing about the capacity building project on 4th September, 2007 at public launch in Mujika, farmers welcomed the idea and volunteered to participate. However, some of them became discouraged as the project continued when they realized it was not working according to their expectation. Mujika community was accustomed to receiving handouts from government and donors especially during the past frequent drought periods and that some NGOs working in the area had previously supported them with larger demonstration plots from which they had yielded substantially. At the introduction of this project, farmers expected it would provide the kind of donor or government support and so they volunteered.

The researchers' inexperience on community projects contributed to farmers' getting discouraged as they would from the baseline information provided identified this problem early enough and explained the concept of the mother-baby field trials in different manner. Being a research project and not a food security handout project, only farmers willing to undertake research would have volunteered. The lesson to learn from this is, a full use of the community baseline information should be taken in guiding project design and its introduction.

The other aspect of their getting discourage during the project could have been that they had thought the project would change its position with time to giving them handouts and that they would be become beneficiaries. So when this did not happen they were discouraged. The same solution of researchers' effective explanation at the start could have helped to reduce the problem. However it was not all the farmers that had been discouraged and that the project got some good results. It is therefore important to realise that while challenges may come, there will still be some positive result collected from a project that may be used for future improvements in project design and management.

Table 6.19: Mother field trial layout for Mujika – Monze 2008/09 and 2009/10

CONVENTIONAL								**RIPPING**							
0 kg/ha		100kg/ha		200kg/ha		5t/ha manure		100kg/ha		0kg/ha		200kg//ha manure		5t/ha manure	
Mm604 1	MR1614 2	3 MM604	4 MRI614	MRI6145	MM6046	MM604 7	8 MRI614	MM604 9	MRI614 10	11 MRI614	12 MM604	MM604 13	MRI604 14	15 MRI614	16 MM604
RIPPING								**CONVENTIONAL**							
5t/ha Manure		0 kg/ha		100kg/ha		200kgt/ha		0 kg/ha		200kg/ha		5t//ha manure		100kg/ha manure	
MRI614 32	MM604 31	30 MM604	29 MRI614	MM604 28	MRI614 27	26 MR1614	25 MM604	MM604 24	MRI614 23	22 MM604	21 MRI614	MRI614 20	MM604 19	18 MRI614	17 MM604
RIPPING								**CONVENTIONAL**							
0 kg/ha		5t/ha manure		100kg/ha		200kgt/ha		200kg/ha		5t/ha		100kg//ha manure		0 kg/ha	
Mm604 33	MR1614 34	35 MM604	36 MRI614	MRI614 37	MM604 38	39 MM604	40 MRI614	MM604 41	MRI614 42	43 MRI614	44 MM604	MRI614 45	MM604 46	47 MM604	48 MRI614

60 m

Main plot Tillage (Conventional and Ripping) sub subplot: Maize varieties (MM604 and MRI614) Subplot fertility levels-0, 100, 200kg/ha and 5t/ha manure

6.3.8 Field days

Field days were vital for sharing research results with the larger community, receiving of feedback on project performance and its evaluation. An open field day was held every year in Mujika at the mother trial site at Bulimo village for all participating village community members, Mujika residents and people from surrounding villages.

6.3.8.1 Field day 2008

The 2008 field day was held on 27th February, 2008 at the Mother field trial site in Bulimo village. The Director of Meteorology, accompanied by the entire team of Provincial Meteorological Officers (PMOs) in Zambia, was the guest of honour at the occasion. Hundreds of Mujika community members and the surrounding areas, totalling 298 farmers of whom 134 were women attended the field day. The participants were taken round the mother trial by Prospard Gondwe, the researcher managing the mother field trials. Passing through the field, farmers observed different performances of the crop with the different planting times. The one planted on 7th December, 2008 suffered poor germination, leaching of nutrients and waterlogging while differences in earlier planted crops were insignificant.

The radio drama artists staged a sketch at the field where "Nkwaambila Bbwe" accused his friend "Kanchele" of bewitching his yellowing crops. The sketch depicted benefits of SCF for crop productivity. The Director of Meteorology said climate change which was affecting the global climate would still affect the livelihood of human beings in future, with the most affected as the vulnerable from developing countries. He encouraged the Mujika community to adopt lessons emanating from the project as they are strategies for adapting to climate change. The role play by Nkabika village was on the benefits of SCF for early planting, adhering to the SCF warnings and appropriate varieties selection. They showed the SCF considerate farmer with a good harvest while the one who neglected the SCF advice in a pathetic situation. Baby field trial farmers reported lessons learnt in plenary at the village Headman's house. A total of 23 farmers shared lessons from SCF engagements such as SCF improved agricultural planning, timely planting within planting window for each crop variety improved crop performance and yield while use of appropriate tillage practices according to the forecast season enhanced crop development. There were 12 farmers that reported by rising of hands that they had integrated SCF in their agricultural practices during the just ending 2007/8 season.

6.3.8.2 Field day 2009

By December, 2009 the two institutions running the project ZARI and ZMDS had run out of project operational funds, including for a field day at the end of the growing season around March. On

receiving the report in February, 2009 that the field day would be cancelled, Professor Sue Walker asked the most challenging question: *"What will you do with the pool of knowledge gained from all this study if you won't have a field day to provide a feedback to the community at the end of the season"*? A promise to consult with partners was made. On consultation ZMDS, the Permanent Secretary for southern province and Director of Meteorology were willing to support the field day programme in Mujika. The field day was then organized to coincide with the World Meteorological Day celebrations on 23rd March, 2009. Community and the local district heads of various government departments participated in the organization.

On the morning of 23rd March, 2009, the Permanent Secretary for southern province Mr Darious Hakayobe who was the guest of Honour representing the Deputy Minister for Southern Province arrived in Monze. After briefing, the team was led in a convoy of 22 vehicles to Malomo village at Dumisani Sibanda's private field trial. Dumisani also managed baby field trials but the team visited the 2 lima private field of AFRIC 1 maize variety grown under legumes and reduced fertilizer application. Sunn Hemp was grown on the 2 lima plot in the previous season. Under the 2008/09 growing season the 1 lima of AFRIC 1 maize variety was grown without any basal or top dressing fertilizer while on the other lima no basal dressing was applied but a quarter (50 Kg/ha) instead of the recommended 200 Kg of Urea for top dressing fertilizer was applied. Dumisani said he had planted his medium maize crop variety early on 21st November, 2009 in the ideal planting window for the Normal to Above Normal forecast season. He found the practice appropriate for sustainable agriculture productivity and an adaptation strategy to climate change. AFGRIC manager from Lusaka Mr Muchimba Twambo, promoted the benefits of using the maize Open Pollinated Variety (OPV) AFRIC 1. He called it the crop breeder's appropriate response to climate change challenges: *"This crop is ripe, looking very good and one cannot tell the other portion was not applied with any top dressing fertilizer"*, Mr Twambo said.

The team then proceeded to the mother field trials where Prospard guided the visitors through the replicated plots of different soil fertility and different cultivar trials (see 6.3.7.1). Crop performance varied greatly according to the range of treatment. The Zero manure plot had a near crop failure, while that with manure had improved crop performance with best being for the 200 Kg/urea/ha followed by the 100 Kg/ha plot. A number of partners like the Zambia National Farmers Union (ZNFU), Conservation Farming Unit (CFU) and AFGRI the seed supplier, also participated at the field day.

The plenary session had nine farmers making presentations on Sunn Hemp as an ideal legume for improving soil fertility and crop productivity; and on SCF as useful information for improving agricultural crop productivity. Farmers urged the government to promote agriculture development based on some of these best bet option identified during the field day. Each village shared their lessons learnt through a role play. John Dimes, from ICRISAT Zimbabwe, representing the IDRC Project Team Leader, said this was the best interaction between farmers, researchers and government he had ever seen in Africa. The total number of farmers in Mujika reporting use of SCF was 275 of the 457 in attendance.

The Director of Meteorology said the field day had provided evidence that an effective use of climatic information could lead to sustainable agriculture development. The Permanent Secretary, before reading the Deputy Minister's speech, said he was happy with the interaction between the Departments of Meteorological and Agriculture in Monze. He pledged continued and increased support to the department of Meteorology. In his speech the Minister challenged the audience to consider using the lessons learnt from the field day and the project for sustainable agriculture productivity. There were 457 (275 men and 182 women) farmers that attended the field day at Bulimo village.

6.3.8.3 Field day 2010

"*Start preparing your field trials and yourselves because we have invited dignitaries from IDRC-Canada and Kenya to the 2010 field day in February*", Beatrice Chiluli and Ester Chiluli, who were working on their field trials on 29th November, 2009 were told by Durton. *"You will be surprised what we are able to do, just let Bulimo village stage the main sketch during the meeting and see what happens"*, Beatrice replied. *"But prepare for a larger gathering than that of last year because more people are planning to attend"*, Beatrice emphasized.

The field day held on 25th February, 2010 attracted 118 (85 men and 33 women) smallholder farmers and activities commenced from 10:00 h. Many farmers trying to travel Bulimo village were by the overflowing streams nearby after the early morning rains. The farmers were led through a number of farmer initiatives and the mother field trials. The farmers consulted on the trial design and treatments employed. Details of the experimental design as explained in this chapter under section 6.3.7.1 mother field trials were provided. Little or no difference either in he tillage practices or the different fertilizer applications could be seen due to the large amounts of rainfall received. This lack of results of different fertility levels for the mother field trials were observed and discussed. However, the differences were easily noticeable for the Zero and manure treatments where they were shorter, cobs smaller and leaves more yellowing. Yield expectation on some of the

Zero treatment plots was near zero. On farmer initiative, Beatrice Chiluli, of Bulimo village, boasted of her maize crop grown under Sunn Hemp that was looking very good as though a 200 Kg basal and top dressing fertilizer had been applied. She urged other farmers to consider using Sunn Hemp as green manure for crop production as she found it a sustainable method for continual crop productivity.

At the Headman's home, the community was entertained with drama using artists from Nkabika and Bulimo villages, who presented the benefits of SCF information in agriculture productivity and the influence the project had on farmer agriculture decision making. Nkabika artists presented a sketch of a successful farmer after correct SCF application to agriculture productivity. It built on the previous year's sketch of a poor farmer who neglected to use the SCF. The successful farmer explained the family's success story with SCF which led to improved crop productivity, sufficient income for home requirements including the suits they were putting on. The play concluded with the other family promising to integrate SCF information into their agricultural practices. The play by artists from Bulimo village was on sustainable crop production using legumes for improved soil fertility. Family A complained of poor crop yield due to the high prices of fertilizer which had become inaccessible to them. Family B boasted of their new and sustainable strategy for crop production under climate change especially in dry years. They told their friends they used Sunn Hemp for nitrogen fixing in the soil and needed no basal or top dressing fertilizer for improved crop development. Their play concluded with family A, asking for the Sun Hemp seeds so they could also plant their fields.

Durton gave an overview of the three years engagements with community in data collection, problems identification and opportunities analysis, creation of the community information dissemination plan (CIDP) and its implementation, monitoring and evaluation was given to the community. Other engagements were in the interpretation of the seasonal climate forecast, decision making, and designing field experiments, planting and managing crops; and making a postmortem to which the field day was one of the activities.

The feedback session allowed four people, being Harriet Mawala, from Malomo village; Emelda Valanda and Albin Mwiinga both from Bulimo village and James Hanseluka the CFU representative for Mujika area to make presentations. Harriet said she learnt each forecast season required appropriate seed varieties and the field selection for an improved productivity: *"I feel I have a better understanding of the seasonal climate forecast and how to integrate them in my agriculture practices now than before"* she said. Emelda said, *"SCF was important for selecting the appropriate tillage practice for any particular season"*. Albin Mwiinga said, *"Use of the radio and*

radio listening programmes was an effective mode for disseminating climate information. I urge all of you to develop a habit of listening to programmes on climate information for your own benefit", he concluded. James Hanseluka revealed that one of these farmers who after their own evaluation of the dissemination project, initially considered it and its information not workable or worthy for community consumption. *"We boycotted follow up meetings but I ended up loosing all my 7 x 10 Kg bags of maize seed planted when I disregarded the SCF warnings given in 2007/08 through floods. I repented the following season (2008/09) and attended all the meetings and eventually had an increased crop yield. Under the current 2009/10 season, I planted 6 x 10 Kg of maize seed and have a very good looking crop from which I am likely to get a very good yield*", James said. The total number of farmers reporting use of SCF for the 2009/2010 season was 75 of 118 (section 6.3.9).

The IDRC representatives did not attend, but the Director of Meteorology represented by Mr Anderson Mulambu was guest of honour. Given the understanding that the project was a successful one, the Director urged the smallholder farmers to consider adopting the best bet interventions for their improved livelihood. He assured farmers of his office's continued weather and climate monitoring and provision of information of using the appropriate modes evidenced in the project. Albin Mwiinga, of Bulimo village, thanked the Director for realizing as smallholder farmers they needed SCF in their agriculture development. *"As a community we have learnt the benefits of SCF in agriculture productivity and it is unfortunate the project was ending. We however requested for a deliberate structure for continued services provision",* Albin said.

Before breaking for lunch the two researchers used the field day occasion to thank the community for their participation and contributions to the project. They were appreciated for their positive demonstration that a community agrometeorological participatory extension strategy was possible and that use of a multi-disciplinary climatic information dissemination approach was vital for its effectiveness. A promise was made that their contributions would be carefully documented for future references and used in the development of future community climatic projects.

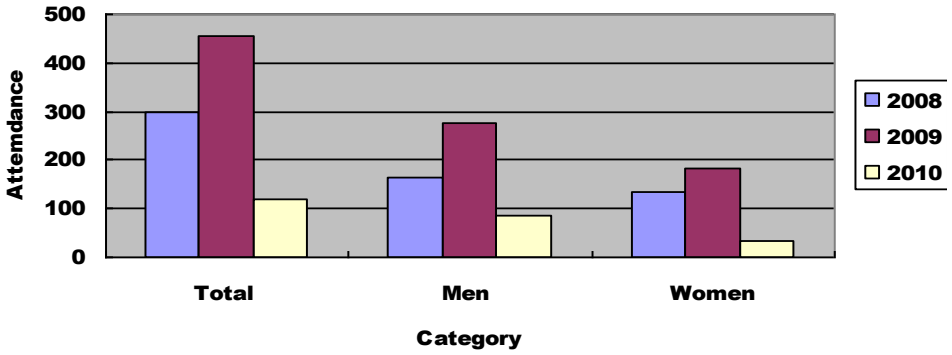


Figure 6.9: Farmer participation by year by gender to field days in Mujika

Figure 6.9. shows farmer participation at field days increased in the second year though a drop was experienced in 2010 due to rain received that morning which flooded the roads. The community participation in field days showed they attached great importance to receive research results and climatic information that was being shared there. The lower farmer participation in 2010 was due to the heavy rains and overflowing streams but even under such conditions 118 farmers attended showing their commitments to the project. Farmer participation by gender however had a complete opposite situation of events with more men participated than women over the three years. This was true even when the occasion was disturbed in 2010 by rains. This difference from the small group meetings requires a detailed investigation as there was no other single meeting in Mujika where more men than women attended. The value men placed on field days above all these other training meetings held in Mujika which provided more information is questionable. It is appreciated that they learnt something but it should have been demonstrated in at least one or more meetings that were held. The only possible and convincing reason is the availability of meals served during the field day must have been attracting men.

The Director of Meteorology's interest and consistent participation to field days in Mujika showed his desire for farmers increased use of climate information in agriculture decision making and have the Mujika experience to be replicated in other provinces where possible. The success of the field days in Mujika was mainly due to team work contributions which were in various forms. The absence of field days' would have denied the larger community of receiving the generated research knowledge but retaining it only with a few people. Field days are good for sharing information on the best bet practices to address agricultural productivity concerns under climate change. For the government it was a learning process and making of commitments in supporting useful interventions, while to the general farming community it was a learning forum and opportunity for revisiting their adaptation strategies for climate change.

The reduction in the number of individuals presenting lessons learnt at field days was due to increased role plays by the same people. This therefore means community may use any form of feedback method such as play or oral presentation. The Nkabika community's ability to relate their drama sketches to that of the previous years showed they followed the project developments and understood the ultimate goal of improved decision making and crop productivity using SCF. The overview of the participatory engagement in the three villages provided at the field days reminded farmers of the project objectives and enhanced their understanding of it. The good way of ending a community agrometeorological participatory extension service project, some of whose activities are

continuing, was by thanking the community for their contribution and encouraging them to build on the lessons learnt.

6.3.9 Monitoring and evaluation

Monitoring and evaluation is necessary for tracking project developments and timely making of corrections that may be deemed necessary in the process of project execution of all modes of dissemination (Table 6.21). Smallholder farmers monitored the project by their involvement and taking of notes at every level of the community agrometeorological participatory extension strategy mentioned in this chapter, where they became fully informed of every development. They considered and noted project influence on community, farmers' participation to programmes, their relation to each other, environment and behavioural changes. Farmer evaluation was provided to community at workshops, annual SCF presentation or crop modeling meeting and the larger Mujika community field days. The project team received feedback at the annual project review meetings and through periodical reports.

The data collection exercise provided by farmers and researchers was by comparison of farmers' perception on climate change and long-term data analysis. The evaluation revealed the project had a positive influence on the Mujika community where farmer participation in radio programmes was consistent, small and large group meetings; and interest in the feedback provision. The limited ripper ploughs amongst baby field volunteers was identified as a problem. Monitoring helped improve some farmers' participation to the baby field trials by timely hiring rippers for farmers in the 2009/10 season for example. The improved farmer to farmer relationship and change of behaviour towards the community agrometeorological participatory extension strategy was only noticed through the monitoring and evaluation process and confirmed during feedbacks. The PM&E confirmed the usefulness of the disseminated climatic information and effectiveness or weakness of the modes employed in the community agrometeorological participatory extension strategy to the Mujika community, particularly the radio listening groups. The process provided evidence that it is possible to develop an appropriate agro-meteorological extension service in the community. So participatory monitoring and evaluation is good for ensuring the project was on track and allowed for timely corrections of concerns in project management. The engagement of smallholder farmers in Monitoring and Evaluating (M&E) of the community agrometeorological participatory extension strategy provided farmers with a better understanding of the disseminated climatic information, its influence on community and effectiveness of the dissemination modes employed.

Table 6.21: Summary of dissemination activities and results in Mujika from 2007-2010

Dissemination mode	Forum	Present/facilitator	Purpose	Number of times & copies produced		
				2007/8	2008/9	2009/10
Meetings	DACOs	DACO and Agrometeorologist	Selection of project area and sites	1	-	-
	Village Headmen's	Village Headmen, DACO and Agrometeorologist	Consultations on project feasibility and project launch planning, planning for field days	2	2	3
	Small group	Farmers, Agriculture Block Officer	Data collection, training dissemination of climatic information and project review	3	3	3
	Large group	Wider Mujika community, Camp officer, Agrometeorologist	Project launch, dissemination of climatic information, project review and postmortem	2 (98, 76)	1 (87)	1 (73)
Electronic	Vernacular Radio	Selected farmers, key informants and Agrometeorologist	Design and record radio programme	16	16	16
	Radio listening clubs	Club members	Listening and discussing weekly topic	13	13	13
Print media	Internal report to ZMD and project	Researcher	Information and monitoring and evaluation	50	50	50
	SCF from ZMD in English and Tonga	Researcher	Information of SCF	500	500	500
	Cartoons	Farmers	Education and training	2	-	-
Personal contact	Home visits	Host and researcher	Project lessons learnt	31	32	32
	Farm visits	Volunteer and researchers	Trial management and lessons learnt	28	30	32
	Chance	Farmer and researcher	Climatic information/ progress/monitoring	8	12	7
Farmer to farmer	Different	Farmers	SCF and lessons learnt	Unknown		
Passing/driving through	Project area	Researcher	Role of Agrometeorologist, agriculture researchers and M&E	2	3	2
Field experiments	Mother field trial	Researcher	Research results	1 Bulimo village	1 Bulimo village	1 Bulimo village
	Baby field trials	16 volunteers each year	Research results	16	16	16
Field days	Large group meeting	Farmer, partners, policy makers and researchers	Research results, effectiveness of CAPES	1 (298)	1 (457)	1 (118)
Monitoring and evaluation	All project levels	Farmer, partners, policy makers and researchers	Positive and negative developments of the project	Continuous and participatory		

6.4 Findings

Having an initial site visit, project introduction and consultation on the dissemination of climatic information with Village Headmen is an effective approach of entering a new area. The process avails local leaders with an understanding of the project and also influenced their degree of commitment to the project and ability to mobilize community and their individual participation in the community agrometeorological participatory extension strategy. They availed themselves to organizing and mobilizing community to climatic information dissemination meetings. Local leaders used the knowledge gained at the initial visit in guiding researchers on the best approaches for disseminating information to the community members. The researcher befitted from this interaction with Village Headmen by improving on the project management such as organizing small and large group meetings was easier when done through the local leadership and that they make major contributions in community mobilization to attend meetings and for meeting stabilization and that it avoided clashing of meetings within the village, absence of key members or having the risk of the entire meeting being cancelled completely. The personal touch with the agriculture extension officer who served as an effective intermediary all the time and with the individual farmers via the radio programmes made the Mujika experience special.

Interacting with farmers using participatory techniques for learning farmer environment and available resources for use in addressing the climatic concerns was vital. The result provided researchers with a better understanding of the project environment such as the identified poor soil fertility guiding to the need for some form of fertility to improve crop productivity. The farmer language preference of Tonga to English literature was identified and guided to the production of more vernacular handbills were distributed in the community. Understanding the individual farmer environment as they related to the community wide view helped the need for targeted climatic information through radio listening club meetings where farmers on an agreed day gathered, replayed and discussed the broadcast climate information. Doing so was increasing smallholder farmers' access to climatic information, a farmer problem identified during the participatory techniques exercise held at the beginning of the project.

Use of small and large group meetings where the expert explained the long-term rainfall analysis results and SCF in explaining climatic aspects such a rainfall Normal values and end of season enhanced farmer understanding and appreciation of their environment when related to the actual occurrences and performances they were able to remember; and also of SCF when presented at the right time, right balance and on foundation of every one of value. These forums were instrumental for exchange of views on climate information and use of different approaches such as farmer height

differences when related to SCF terms or maize varieties of late, medium and early maturing and smallholder farmers presenting their personal interpretation of the current SCF. Interacting on this platform, farmers easily understood and appreciated the climatic information shared and considered it in their decision making though they had stated with some reservations towards SCF presented by ZMD which was not credible with community. The participatory approach continued the role plays farmers presented at field days, the farmer to farmer and interaction around the mother-baby field trial with farmers themselves managing the trials. So the community was involved in the dissemination of the SCF.

The other vital point was the use of the multiple methods for disseminating climatic information. Farmers had some initial limitations in understanding SCF. At small and large group meeting even when SCF was repeated three times at a dissemination meeting there were still some farmers that could not fully understand and interpret it correctly thereafter. This was evidenced by a variety of numerous responses on recollection of the disseminated SCF at the end of the small and large group meetings. However, with the continued use of the multi-disciplinary climatic information dissemination pathways and player over the three years, farmers' situation changed thereby discovering the usefulness of the dissemination modes used in the project. Farmers' eyes saw the field trials and learnt lessons from there, they heard from the radio programmes the climatic information, they touched the seeds and planted themselves, and they also participated at training workshops and went on a field tour. All these approaches with final changed attitude of the farmer in 2010 confirmed they were effective in disseminating climatic information to smallholder farmers. APSIM the crop modelling tool proved its relevance by predicting accurately farmer situation under varying conditions hence encouraging farmer fertilizer in their crop productivity.

Furthermore, a careful explanation of the project objectives when introducing the project to the community was vital for the smooth running of the project thereafter. With increased understanding of SCF, smallholder farmers evaluated their current farming systems including that of CFU, of making planting basins, made informed decisions of planting with the start of the planting rains, and adopting new innovations where use of the Sunn Hemp legume for improving soil fertility was encouraged.

Use of radio proved a viable tool to disseminate climatic information to smallholder farmers. Management of the climatic information dissemination radio programme also required being proactive and inventive to attract farmers' attention.

Use of cartoons attracted more smallholder farmers' attention, increased participation across the gender lines and interest to climatic information at small group meetings. Field visits were instrumental in the confirmation of smallholder farmers' commitments to baby field trials and comprehension of instruction given during workshops. Field visits may always provide you with additional information on farmers' commitments to field experimentations and reactions to SCF given during workshops and home visit. Increased understanding and appreciation of the applied climatic information may compel a farmer to organize a forum such as field day within his/her means for sharing the lessons learnt. Some difficult situation was that while assisting farmers in the management of field trials, such as the hiring of labour and equipment (rippers) was good in improving research results, it did not enhance full participation in field trials nor sustainability of tillage practices at the end of the project. Overall this project was a success.

6.5 Conclusions

This part of the project highlighted three critical factors that can be considered as vital to the development of the community agrometeorological participatory extension services. These are:-

Modes of dissemination: A multi-disciplinary climatic information dissemination approach is effective in increasing smallholder farmer's interest and understanding of the SCF based on community interaction in the community agrometeorological participatory extension services which lead to change of attitude and behaviour. Smallholder farmers understanding of SCF leads to crop management systems evaluation for suitability to forecast season. Given the opportunity in the dissemination of SCF information, women are able to make a major contribution towards community's understanding and utilization of seasonal climate forecasts in agriculture decision making and crop productivity. Radio, radio listening clubs, field trials, small and large group meetings are potential dissemination modes for climatic information to community based on their timely usage and in the right balance and on understanding that each one of them is effective in disseminating climatic information to a section of the community membership that prefers it mostly for receiving climatic information. Personal proactive and inventiveness are major or integrals of a relevant and successful climatic information radio program where use of appropriate signiture tune, discussions and related drama are used in enhancing farmer interest, improved management of field trials and understanding of climatic information. This will as a result lead to smallholder farmers' dedication and consistence to the radio listening clubs.

Personal contact: Personal contacts on climatic information and SCF with individual smallholder farmers through home and field visits or even by chance enhances their choices of crops selection,

tillage practice to use as well the management option in any forecast season. Contacts with the local agriculture extension officer enhanced the CAPES activities amongst farmers. Relevance of a community agrometeorological participatory extension services to a community where climatic information is disseminated using multi-disciplinary climatic information dissemination modes, can easily be measured by the degree to which the local community leadership, stakeholders and personalities with authority in higher government offices are involved.

Tools used: Determining the area's potential for crop production using the APSIM model requires farmers understanding of their natural resources and SCF. The participatory techniques when used for understanding farmer environment are vital for effective project design and management especially for touching individual farmer at the household level with SCF. The monitoring and evaluation through home and field visits may be vital in revealing farmers' commitments to the project and stakeholders' concerns you were supposed to have addressed at the start of the participatory engagement. Intentions to use print media in disseminating climatic information to smallholder farmers should first be preceded by a careful consideration of farmers' preferences with the type, format and language of the print media. Mujika community preferred cartoons more than the hand bills. Cartoons have the capacity of breaking the illiteracy inferiority complex of smallholder farmers and effectively communicating climatic information contained therein.

6.6 Recommendation

- A rural based agrometeorological extension was preferred to the urban based if the impact of the CAPES was to be of any relevance to agricultural productivity in rural communities. Agrometeorological personnel would provide the agrometeorological services on a daily basis since they taught farmers climatic concerns personally. Engagement and efforts in CAPES should ensure there is an effective utilization of all available dissemination modes, improve on the disseminator's credibility with community and consider farmers' personal investment capacity which could become challenges in the process.
- The Agrometeorologists efforts should strengthen training of intermediaries (e.g. local teachers) in climate and weather matters to serve in their respective locations.

CHAPTER SEVEN: CHANGES IN FARMER DECISION MAKING FOR AGRICULTURAL PRODUCTIVITY

7.1 Introduction

Smallholder farmers living in the rural semi-arid areas of Southern Africa have always engaged in agriculture productivity for their livelihood. Their agriculture productivity although has many challenges which are usually of both internal and external nature. Examples of external factors are those of climatic and non-climatic factors (eg economic, social, etc) while those of internal are farmers' lack of knowledge, understanding, management capacity and willpower. The farmers' response within the system of agriculture productivity can help to address these challenges and will usually determine the general food security of the area or region. This may depend on the systems' weaknesses and suitability of means to address the challenges facing farmer. Their agriculture decision making and adoption of a particular system of agriculture depends on a number of factors. Factors such as soil fertility, availability of labour and inputs (seed and fertilizer), available information on climate and market all influence farmer decision making. Farmers' willingness to engage in productive farming when all the other factors are conducive is yet another critical factor. There may be some other livelihood engagements that may attract farmers, thus drawing them away from farming despite the incentives.

Climate information is one vital piece of information farmers require for improved decision making. Availability of and access to this information however is limited in most rural semi-arid areas of southern Africa. The survey result at the SCF dissemination meeting of 25th September, 2007 indicates that very few farmers (24 out of 76 present) in Mujika knew of the existence of the Zambia Meteorological Department (ZMD) and its ability to produce seasonal climate forecasts.

Farmers made changes to agriculture systems when faced with challenges such as climate change and climate variability. These changes were made based on their understanding of the current challenges and a new system's suitability for addressing those challenges. The monitoring and evaluation (M&E) process was necessary for tracking the actual changes so as to judge whether the options met their actual expectations. A Participatory Monitoring and Evaluation (PM&E) process assessing changes in agriculture productivity involving stakeholders affected by the impacts was necessary. It helped the local community and researchers to track changes and judge whether programmes put in place for addressing challenges were effective or not. This chapter discusses changes in farmer decision making for agricultural productivity as observed during and at the end of the project when compared with the historical farming systems baseline.

7.2 Materials and Methods

The PRA where farmers were engaged in the initial physical data collection, analysis and development of the CIDP, provided the baseline on farmers information. Any changes to the baseline created were then tracked, using PM&E, observations made and stories from selected farmers on what people said regarding the interaction, their attitude and any behavioural changes towards the project and then documented.

The farmers' situation at the end of the project in 2010 was then compared with baseline information looking for changes, 'before vs after' / 'with vs without-project' influences (Guijt, 1999). The PM&E approach sought for changes on all project levels over time (Estrella, 2000) like on farmer agronomic practices (tillage practices, planting times, and seed selection), investment decisions and coping strategies. Support institutions changes were sought on interactions and services provisions. The other information collected was during the semi-structured interviews which also provided information on baseline and changes in community. The feedback received from farmers during the field days added information on change made by community.

7.3 Farmer Perceptions of Climate Change

The Mujika community has observed their climate over a long time and since developed a perception of climate change. Their perception is that they had noticed significant changes in the weather patterns and that they were closely related to agriculture productivity over years (Mubaya et al., 2008). Community perception of rainfall performance is that it is declining with time and becoming erratic but fluctuating between low and medium levels as has been shown in chapter 4 (section 4.3.3.2.1 on rainfall shows the details).

Table 7.1: Changes observed in weather patterns from household surveys in Zambia (Mubaya et al., 2008)

Weather changes	Farmers agreeing with	%
Increased number of seasons without enough rainfall	257	72.6
Increased floods	277	78.2
Rainfall starts late and ends early	266	75.1
Extremes in temperatures	207	58.5
Long dry spell	269	76.0
Rains comes earlier	154	43.5

The 2008 analysis is based on interviews with 350 people with whom consultations were done with for the IDRC/CCAA project and presented as baseline survey results (Mubaya, 2010; Mubaya et al., 2008). On the surface it seems that the people's perception are not well balanced, as 72% think there is not sufficient rainfall for crop production, but 78% remembered increasing flooding. This

seemed to be a contradiction. However, it may indicate that the first view is not only about the amount of rainfall, but also about the distribution of rainfall through the summer rainy season. The second view of "increased floods" may indicate that the people may have seen more heavy rainfall within any short time period, thus receiving large amounts of rainfall within a few days that caused the flooding of low lying areas with clay soils. Another point of uncertainty from this baseline analysis is that 75% say the rains start late but 43% say the rains come earlier. Chapter 5 indicates that the long-term start of the season was 13th November, using the representative Moorings station with 86 years and being only 5 km from Mujika area where the interviews were carried out. This is a direct contradiction as there cannot be (75+43=128%), there must be some problem with the understanding of the questions or interpretations of the answers. The only conclusion can be that there is not a clearly defined perception by the people in Monze district. It indicates there must also be some confusion and a lack of understanding of the rainfall trends. These all point to the need for community climate education and training.

7.4 Decision Making Points

7.4.1 Farming systems in Mujika

The semi-arid areas of southern Africa suffer from low and erratic rainfall such that they can usually only achieve good yields in three out of five years (Sawadogo, 2007). Mujika in Monze district southern province of Zambia is mainly composed of smallholder farmers using farming system mainly on small pieces of land with livestock and crop farming on sandy loamy soils.

They mainly keep cattle, goats and pigs though a few have sheep. The cattle are rarely sold as they are considered as emblems of wealthy and may only be slaughtered at funerals or sold when a major need has been identified. One's ability to own cattle for larger conventional land tillage and other smaller livestock that could provide resources for hiring field labour, mainly determined the type of farming to be undertaken and hence was shaping their livelihood. The animals are let loose in open and communal grazing ground and only herded during the crop growing period. Animal rearing however faces the challenge of corridor disease that has wiped out most of them since the early 1990s (Baudeon et al., 2007). Their main poultry is chicken, ducks and pigeons for home consumption.

Their land tillage mainly follows a conventional method with ox-drawn ploughs or hand hoes, which involves turning over the soil surface completely. The availability of animals either by owning or hiring for a few farmers only increased one's opportunity to extend the crop planted area. This also affected the decisions regarding field sizes. Despite the limitation of fewer oxen being available, a few farmers have adopted Conservation Farming (CF) since its introduction in Zambia

in late 1980 by making planting basins at the end of the season on a very small scale of less quarter hectare. Farmer's main land preparation usually starts around September by burning the entire crop residue and this preparation continues till December as they plant their crops.

For their crop farming, on average field sizes of 2 ha, in summer they grow maize as a staple food. Others crops grown are groundnut, cowpeas, sunflower, soybean and cotton as a cash crop. The maize varieties planted was dependent on what the government / donor or input supplies had provided as farmer choices were usually not available and provided; the readily available local maize and recycled maize hybrids. Farmer decisions on crop and variety selection were dependent on what was available to the farmer at that time. Crop cultivation is mainly done in the rainy months of October to March, although occasionally rain also falls in April and sometimes even in May. The period between October and March in Zambia is therefore defined as the rainy season (Parin et al., 2004). However, even with the start of the rains in November most farmers do not plant crops until December.

The results of the semi-structured interviews show their post-seasonal activities are mainly characterized by gardening where a variety of vegetables are grown and supplied to the nearby Monze town. Observations made during the winter (May - July) period of 2008 found that most farmers are transporting their vegetables on bicycles, scotch carts and small trucks to the townships.

Most farmers in Monze district depend on fertilizer application to obtain a yield as most of the soils are degraded; however, access to fertilizer is limited as most of them find it expensive. For this reason most farmers opt to wait for the subsidized government / donor inputs which are usually distributed late in December, hoping they would receive from the little that is provided to farmers every year. They resort to planting local maize without any form of fertilizer when they don't get any inputs (seed and fertilizer). The few farmers with animals used animal manure for fertility to improve crop productivity. The fertility therefore was mainly depended on fertilizer bought according to the individual farmer capacity or one provided through the government / donor inputs subsidies programme. Farmer dependence on government / donor input supplies continued to the end of the project due to poverty in the community. Although they are engaged in agriculture crop production every season, communities' food security is unstable as they are not able to produce sufficient maize to last them the whole year.

Rainfall is a major component determining the management options and yield obtained. The community's view of rainfall and crop yield trends described in chapter 4 (section 4.3.3.2.1 and

4.3.3.2.4) show the rainfall and productivity relationship. My view of the rainfall curve from the rainfall analysis in chapter 5 shows no major changes in performance except that the years from 1980 to 1993 had highest amounts of about the 20 percentile (546.2 mm) which thereafter changed to be around the long-term mean of 701.1 mm. Crop yield was reduced when less rainfall was received or it became more erratic as rainfed subsistence farming suffers from low and erratic rainfall performances. Stigter (2006) predicted that African food production may be severely reduced by impacts of climate variability. Results from the baseline survey (Mubaya et al., 2008) are consistent with this prediction as there is an indication that 79% farmers have experienced food insecurity due to increasing number of seasons without enough rainfall (Table 7.1). Farmers mostly depended on their indigenous knowledge (IK) to determine the outlook of the season which influenced their seasonal decisions and crop management options in that particular season. If they saw too many fruit on mango and wild trees they looked to that season as to be Near Normal to Above Normal and they planted the long, medium and early maturing crop cultivars and extended planting until January. IK requires documenting and support for improved decision making. However increasing farmer understanding and access to contemporary SCF information could improve their choices of maize varieties to plant during a specific forecast season and type of field to plant crops. The farmers' failure to easily access fertilizer in Mujika led to the introduction of a legume Sunn Hemp, for fixing nitrogen in the soil and increased use of composite manure in growing crops. The introduction of SCF made farmers choose higher grounds when the season was forecast as Near Normal or Near Normal to Above Normal.

7.4.2 Planting times

The normal start of the rainy season in Mujika was according to chapter 5 (section 5.4.1) was 13th November. However Nkabika village seasonal calendar in Chapter 4 (Table, 4, section 4.3.3.3) showed most farmers commenced planting of crops only from December to January. Crops may either be planted at different time within the ideal planting window but every decision and action has a corresponding potential yield, like planting early resulted in higher yields while planting late gave lower yields (Mupangwa et al., 2007). On 21st December the sun is overhead the tropical of Capricorn which is south of Zambia, and so to optimize yield one wants to have full crop canopy when it can intercept and absorb high radiant energy for high biomass accumulation and maximized crop production (Fischer and Schrattenholzer, 2001).

The initial survey findings of 8th April, 2008 baseline planting information showed that most farmers commencing planting maize in December even when planting rains could have started in November. This was supported by findings during the field and home visits where very few farmers

had engaged in crop planting by 24th November 2007 though the planting rains were received on 7th November, 2007. The inquiries on late planting in 2007 revealed it was their usual practice. The interview with Clement Mwiinga on 31st December, 2007 alluded to this (Box 7.1).

Box 7.1: Clement Mwiinga's view of Mujika community's late planting
Question*: Why do people not plant when the rains start in November?* ***Mwiinga:*** *People plant late in December because they call the November first rains as, "Civwuna Ng'ombe", rains meant for the drought stricken animals.* *(27/12/2008 12:00 hours in Malomo village)*

The interview with Mosley Hamabuyu revealed yet another reason why Mujika community did not plant in November even when the rains had started but waited till December (Box7. 2).

Box 7.2: Mosley Hamabuyu's view of Mujika community's late planting
Question*: Why do people not plant when the rains start in November?* ***Hamabuyu****: They wait for the rain to be more consistent and reliable.* ***Question****: When do they usually plant then?* ***Hamabuyu****: They plant around Christmas up to end of January* *(Semi-structured interview Mosley Hamabuyu 27th December, 2007 14:00 Malomo village).*

Investigations made over the last ten days of January, in each year (2008, 09 and 10) so as to determine when the farmers finished their maize planting revealed more evidence that many farmers plant in January. Using the observation method and each time driving from Kaumba clinic on the western side of Mujika to Bulimo village east wards, then west to Nkabika village following the main route and finally to the main road at Kaumba clinic, the total number of maize fields that were either at germination stage or freshly ploughed over the three years from 2008 – 2010 had not significantly changed or if anything more were observed during 2010 (Table 7.2).

Table 7.2: Number of maize fields planted late in the season in Mujika

Newly ploughed maize fields at emergence and pre-emergence	**Date**
32	25th January, 2008
27	28th January, 2009
37	27th January, 2010

This showed that even by the end of the project period there were still some farmers practicing late planting. This was also exacerbated by community's waiting for inputs from government which was usually delayed and supplied around December. This practice is not advisable as it contributes to the overall reduction in yield. Farmers are therefore advised to consider sourcing extra resources that they could use to buy appropriate seed varieties they could plant with the start of the season.

The principle of *"Civwuna Ng'ombe"* and waiting for the rains to stabilize is the same. After a long spell of no rains, most water points for available surface water would have dried up so communities considered the first rains regardless of the time and amount to first be for their animals. By this they were also saying the rains for crop planting had not yet started. So it seems that the planting decision about dates of the maize crop is driven by the demands of the whole farming system and the cultural tradition of the area. The fact that most ploughing is done with draught power, shows that the logic is not so bad, as a weak animal would not be able to pull a plough. So the livestock needs to be able to gain some better condition prior to the start of land preparation and planting. However, if winter ploughing or minimum tillage (Mupangwa et al., 2008) could be introduced, then little land preparations would be necessary before planting could begin after the first rains.

With the introduction of SCF in the second year, most farmers considered and practiced earlier planting early in November with the start of the planting rains. However, there were still many farmer evidenced by the late planting surveys (Table 7.2) who believed their reasons for planting late were valid and that the rains would not end as in some previous years that they could remember. *"On Christmas day is when I will plant my Seedco 413 maize variety and will be surprised I will have a good harvest"* said Mosley Hamabuyu on 17th December, 2008 during the home visit. Even in the third year of interaction there were still some farmers like Widen Hamabuyu, met by chance who were only planting in early January.

Continued interaction on SCF during the third year found some farmers had decided to plant early as a strategy to overcoming the sudden end of season by early March that could negatively affect crop yield of the late planted crops. They undertook this weather sensitive decision upon receiving SCF information. The change of "plant date" was their adaptation strategy to climate change and climate variability. This change was a useful one to maximized crop production. But while few farmers made such changes in their crop planting strategies there were still a lot more not convinced of the need to change anything (Table 7.2). Mr Robert Sibanda of Malomo village also planted his MRI 455 maize variety that only takes about 90 days to mature on 25th January, 2008. *"I planted it on the higher ground and believe it will have a good yield",* he said (Box 7.3).

Box 7.3 Individual conviction for planting late
Question*: Where are you going today with a pair of oxen?* ***Hamabuyu****: I am going to plant my Sedco 513 maize variety* ***Question****: Isn't January 25th too late for planting maize?* ***Hamabuyu****: Wait and see. You will be surprised I will have a good harvest. I did it last year also and had a good harvest* *(Semi-structured interview with Mosley Hamabuyu,* 25th January, 2008 *16:00 Malomo village*)

The effective planting window in Mujika area for maize was from 13th November the average start of the season to 15th December. The longer maturing maize varieties were recommended for planting early in this period. Planting maize with required maturing period of 90 days in early January in an area whose average end of rainy season was 18th March could be considered risky (Stern, 2004). The farmer practice of not planting with first rains on account of being thought to be for drought stricken animals alone and even waiting longer to plant in January only provided low yields. The success referred to by Clement Mwiinga, of Malomo village, earlier on was that of being able to harvest some fresh maize for roasting at the end of the season when most crops would have had dried up. Farmer therefore should not wait, but plant their main maize crops once the rains have started in November.

Mr Mizinga realized planting late was not beneficial but given the opportunity he would plant early also as to have a maximized grain production (Box 7.4). However his poverty situation was inhibiting him achieving his dream. This also reveals the fact that not all changes made by farmers due to the introduced SCF could be identified but a farmer regretting unproductive practice is also a positive change.

Engagements on SCF with community should realize there are some community members who even when they understood and appreciated SCF could not practice the change of planting dates due to poverty. Recommendations for addressing such special cases should be made to respective support organizations for attention as poverty could be a major factor influencing decisions of some farmers in Mujika area regarding when to plant.

Box 7.4: Realizing benefits of early planting
Mr Joilly Mizinga of Nkabika village told his late planting story in a different manner on 29th January, 2008. "*I have lost all my crops this season (2007/08) due to heavy rains. I have inspected all your field trials with baby farmers and have found them to be performing very well. I have discovered planting early is a good strategy because by the time the heavy rains come, the crops would have fully established themselves and may not be affected easily if you planted them on a good plot. I planted my maize very late on 2nd January, 2008. I have no top dressing fertilizer to apply though they are yellowing and currently at knee height.* *29th January, 2008, chance meeting at Nkabika village, 11:30 hours*

In general from observations of the farming system, the typical monocropping maize cultivation is usually practiced with low application of fertilizer. This is due to poverty as failure to gain access to inputs except via the government supply system. If the people were able to generate some off-farm income from other sources it would alleviate the problem of lack of inputs. During one of the field

visits the women became inspired to make handcrafts to sell as a means to generate some cash to purchase inputs. However this would need to be coordinated by leaders in the community, if it were to be sustainable and consistent source of income. Smallholder farmers' effective optimization of the rain-fed cropping system with main maize crop activities require timely crop planting with the start of the rainy season.

7.4.3 Investment options with cash crops

There are a number of factors that farmers can consider before making their seasonal investments (Stigter, 1999). I would think of investment as something that generates cash as well as maintaining th capital that was invested. They should evaluate the various options available in their own situation so they can invest and achieve good results. The semi-structured interviews revealed that farmers made investment decisions on the basis that inputs (seed and fertilizer), labour (animal or human) for tilling the land, implements (hand or ox driven), loans from financing institutions available at the planting time. They mainly invested in the growing of annual crops (maize crop, sweet potatoes, sunflower and cowpeas) and livestock rearing. Farmer considered their capacity in terms of labour to plough in the absence of draught power and availability of seed and fertilizer. They also made decisions trusting that the rains would come and did not really consider the expected amount (FAO, 1995). It appears that they have an optimistic view of their prospects each season.

The farmers' limited access to inputs required utilization of a more economical and sustainable methods to improve soil fertility. The use of legumes and especially Sunn Hemp in improving the soil quality would be a good alternative to increase soil fertility. Maize following Sunn Hemp could be grown without added inorganic fertilizer as demonstrated by some farmers in Mujika in search for adaptation strategies to climate change. They planted the 50 Kg Sunn Hemp seed over a half hectare field plot in first year of interaction, where they intended to plant maize the following season. When the crop was harvested they carefully managed the residue by ploughing it back into the soil to improve the soil quality and humus content. The following season they planted their maize with the start of the rainy season and weeded twice to limit weed competition for the available nitrogen in the soil. In some portions of the field where the available nitrogen was not adequate for crop development, as seen from the yellowing of the leaves, a quarter (50 Kg) of the recommended 200 Kg ammonium nitrate fertilizer was applied. This was a major reduction in the use of fertilizer while obtaining a good yield. The project did not measure the yield per hectare but the crops were fully developed. In the same year the four farmers that were monitored increased the area planted to Sunn Hemp to one hectare by planting 100 Kgs of Sunn Hemp seed. These farmers

sold the extra Sunn Hemp seed they harvested from the previous season to their fellow farmers to plant as well.

One of the baby trial farmers, Owen Hatwiinda, who over the three years of interaction had grown Sunn Hemp, was prompted to host a field day to share the knowledge gained when he saw its economical benefits and suitability for improving soil fertility and increasing productivity under climate change. Beatrice Chiluli, a widow who kept planting her maize crop following Sunn Hemp near the mother field trial, boasted at every field day of having found a sustainable investment approach she called an adaptation strategy to climate change and climate variability.

The growing of maize following the Sunn Hemp legume was repeated twice over the years of interaction and it proved to be a useful and sustainable approach. Therefore it is recommended that poor smallholder farmers should consider using the Sunn Hemp legume for improving soil fertility while using SCF in planning to make cultivar choice and planting date decisions.

7.5 Changes in the Decision Making

With the introduction of readily available climatic information, some smallholder farmers in Mujika made changes in their cropping system operations. The changes were progressive as the interaction with climate experts increased, specifically from the seasonal climate forecast information and the mother-baby field experiment.

7.5.1 Situation at the beginning of 2007/08 growing season

Most farmers seem to disregard the climatic information given at the small and large group meetings held on 4-6th September, 2007. Maybe this was so because they could not understand the climatic information or their crop production system. Or maybe they felt that it was too risk making changes based on information provided by someone or an organization that they did not know.

It could also have been possible that they found the Indigenous Knowledge (IK) more reliable for crop management option. For example, when in October, ants were seen everywhere busy collecting food taking into their holes and the Masuku and mango trees produced plenty of fruits, it was believed to indicated that a normal to above normal rainfall season could be expected (Ch 6.3.1.2.).

Then at the SCF large group meeting at Nkabika village held on 25th September, 2007, it was found that 52 out of 76 farmers were not aware of the ZMD's existence. Farmers asked very few questions even when the 2007/8 SCF was presented to be Near Normal for October to December (OND) and

Normal to Above Normal for January-March (JFM). The forecast comprehension held at the end of the meeting showed only 5 farmers could state the SCF correctly.

7.5.2 Changes during 2007/08 growing season

Within 2007/8 some farmers in Mujika were able to make changes with the introduction of SCF by change of attitude towards SCF. "*After attending the training held at CARBLAC and the farmer field tour/trip to the Monze Farmers Training Center (MFTC), I am now able to tell where I have been making mistakes. I used to only plant local maize and planted very late. I will now change and plant Sunn Hemp as well"*, Clement Mwiinga said on 25th January, 2008. Some farmers had an improved understanding of climatic risk information. They had abetter vision of how to plan and manage their crop productivity. This feedback by the smallholder farmers at the 2008 field day confirmed that they now considered using SCF and tried to integrate it into their decision making (Ch 6.3.9 2008 field day report). It also revealed some farmers realized that some maize varieties were not suitable for certain seasons and hence a selection of an appropriate maize variety was necessary. Some smallholder farmers were quick to adopt the climate knowledge within the first year of the climatic information dissemination project by choosing appropriate seed variety. Mosley Hamabuyu said on 22nd January, 2007, *"If you had not come, I would have made a mistake by waiting to plant. I planted the MRI 709/734, a late maturing maize variety, I would have never planted it, had you not come and disseminated the climatic risk information. The seed is appropriate for the normal to above normal forecast seasons"*. This showed than he changed from his usual unnecessary delayed planting to planting with the availability of planting rains during the planting window. It also showed he now considered selecting crop varieties by forecast given as opposed to the usual practice of planting short maturing maize crop varieties regardless the type season.

Improved decision making on choices of crop. As illustrated by Shephard Mpande's comment on 4th March, 2008 during the project partners visit to Malomo village: *"As a cotton grower, the dissemination of 2007/08 SCF made me to concentrate on maize rather than cotton. The above normal rainfall forecast is not good for cotton"*. It showed Shephard had an increased SCF knowledge and used it to determine the appropriate crop to grow. This was not his usual practice. Five farmers planted Sunn Hemp in 2007/08 showing that they were open to experiment with alternative crops, these are obviously early adopters by Wikipedia viewed on28th November, 2010 (en.wikipedia.org/wiki/Early adopter).

7.5.3 Situation during 2008/09 growing season

The farmers were observed to continue to change their crop choices in 2008/9 season. Use of Sunn Hemp as a legume for nitrogen fixing was not practiced in Mujika before the 2007 season. There were 13 farmers who planted Sunn Hemp in the 2008/09 season. On 29th January, 2008 Mary Nakoonje of Bulimo village, reported that she planted her Sunn Hemp field immediately we returned from the farmers' tour at the MFTC.

There were increased enquiries and demand for seasonal climate forecast information by phone and upon contact with the researcher and agriculture extension before the start of the season. There were 27 enquiries for SCF received between August and October 2008 from smallholder farmers in Mujika, agriculture intermediaries in Monze district and planners. This was a major shift in demand for information as there had been no requests during the previous year. This is a wonderful change because of awareness of SCF available and usefulness. This indicates that farmers were finding SCF forecast of benefit in improving their productivity.

7.5.4 Changes during the 2009/10 growing season

Farmers in Mujika planted in November with the start of the first planting rains. This was not their normal previous practice. Table 7.3 shows the details of integrated decisions made for the annual farming systems by the Mujika community. There were 35 farmers who indicated on 25th February, 2010 at the field day that they had planted Sunn Hemp in fields where they plan to plant maize the following season. This was an increase (of 22) in the utilization of MFTC information and forward planning. The visibly excitement of the adopting farmers at field days showed they were convinced of the benefit of this change: *"The practice is good because the nutrients were found in the soil by the crop at germination hence allowing for an improved crop development",* James Hanseluka said on 25th February, 2010 at the field day in Bulimo village. This shows his awareness of change of crop and its benefit. There was also an increase in demand for seasonal climate forecast, with 34 seasonal climate forecast enquiries made during the 2009/2010 growing season. Farmers realising the need for SCF and seeking it for decision making was yet another change. They found SCF beneficial in decision making and planning of the cropping activities.

There was an increased participation at climatic information meetings (Hanseluka, 2010). The farmers consistently attended the radio listening clubs (7-9 on average) and the attendance at the small group SCF meetings also increased (93, 116 to 113 in 2007, 2008 and 2009) respectively (Ch 6.3.2.1 on radio and 6.4.1.2.2 on SCF).Though there was a slight decline in 2009 it was still higher than that of the initial stage. This indicates that farmers found climatic information useful in their cropping planning decision making.

The changes in farmer's decision making were in farmer attitudes towards SCF from disregard in 2007 to utilization in 2009, planting early in the season and use of Sunn Hemp as a nitrogen fixing legume. Cowpeas and Sun Hemp are cultivated by both men and women as they contribute to the productivity of the main staple food crop maize. Their continued participation to climatic programmes showed yet another change in visioning sustainable agriculture production as better with climatic information and IK.

The newly introduced Sunn Hemp was taken up by both men and women who attended the MFTC training and then others learnt from farmer to farmer transfer of information. The commercial cash crop of cotton was cultivated by both male and female members of the family of the household. Only women work on groundnuts and it may be so because it is a food supplement used by women in preparing food for the family and women are traditionally allowed to sell it to raise income for themselves should they have surplus. The livestock of both small and large animals were herded between December to May by herdsmen to protect the crops from damage and this confirmed the community's main crop growing season. They were later let loose to feed at the communal grazing grounds thereafter. The calendar also shows the change of planting maize and Sunn Hemp in November made by the community with project interaction which was adopted by both men and women indicating it contributed to household improved crop productivity and livelihood.

Table 7.3: Seasonal crop calendar for Mujika with integrated decisions made for farming systems

Activity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall												
Maize	land prep (♀+♂)	land prep & ***planting*** (♀+♂)	Planting +weeding (♀+♂)	weeding (♀+♂)		winter ploughing	winter ploughing (♀+♂)	harvesting (♀+♂)	harvesting & preparation of planting basins (♀+♂)			land prep (♀+♂)
Groundnuts	land prep (♀)	land prep& ***planting*** (♀)	planting (♀)	weeding (♀)			Harvesting (♀)					
Sweet potatoes			land prep (♀+♂)	land preparation, planting & weeding (♀)		weeding (♀)	weeding (♀)		harvesting (♀)			
Cowpeas			land prep (♀+♂)	land preparation, planting &weeding (♀+♂)	planting (♀+♂)			harvesting (♀+♂)	harvesting (♀+♂)			
Bambara nuts			Land preparation &planting	land preparation &planting	weeding (♀+♂)			harvesting (♀)				
Sorghum	land prep (♀+♂)	land prep & ***planting***♀+♂	Planting+ weeding (♀+♂)	weeding (♀+♂)				harvesting (♀+♂)				
Sunn Hemp			***Planting*** (♀+♂)					harvesting (♀+♂)				
Cotton	land prep (♀+♂)	land prep & planting (♀+♂)	Planting (♀+♂)	weeding (♀+♂)	weeding (♀+♂)	weeding (♀+♂)		harvesting (♀+♂)	harvesting (♀+♂)	harvestin g (♀+♂)		
Sunflower	land prep (♀+♂)	land prep (♀+♂)	land prep (♀+♂)	planting (♀+♂)	weeding (♀+♂)		harvesting (♀+♂)	harvesting (♀+♂)				
Soybeans	land prep (♀+♂)	land prep (♀+♂)	land prep (♀+♂)	weeding (♀+♂)			harvesting (♀+♂)					
Labour availability	High	Low	Low	Low	Low	Medium	medium	low	Low	Low	medium	High
Labour demand	Low	Low	Medium	High	High	Medium	medium	high	High	High	low	Low
Food availability	High	Low	Low	Low	Low	Medium	medium	high	High	High	high	Medium
Diseases	Coughing, diarrhoea, sore eyes	malaria (low prevalent)	Malaria (low prevalent)	malaria (medium prevalent)	malaria (high prevalent)	malaria (high prevalent)	Malaria (medium prevalent)	coughing	coughing & sore yes	sore eyes		

7.6 Summary of the Findings

- Some smallholder farmers by the end of the project period had made a change in their planting dates in Mujika by starting planting in November with the start of the first planting rains. This was a departure from their usual practice of starting planting in December even when planting rains had commenced in November.
- Some smallholder farmers' planning and management options that mainly depended on indigenous knowledge now included seasonal climate forecast with its introduction.
- Some smallholder farmers with the introduction of SCF and continued interactions had identified value in it that they could use for planning and decision making. This eventually led to SCF demand in the years following introduction.
- The negative attitude of disregarding SCF by some farmers in Mujika had with the end of the project ended. They showed it by their participation to climatic information meetings in the years following its introduction.
- Some women in Mujika became outspoken at public meetings with the understanding and appreciation of SCF. This was a disregard of their traditional norm of women taking a low profile at public meetings.
- With the introduction of SCF in Mujika some farmers adopted the innovation of using Sun Hemp as a nitrogen fixing legume in the soil. They used it as an alternative to the inaccessible, expensive inorganic fertilizer hence making their growing of maize sustainable.
- Some farmers selected appropriate seed varieties for planting in a particular season with the specific given forecasts which was not their usual practice.

7.7 Conclusions and Recommendations

- The introduction of SCF may bring about changes in farmer planting dates to maximize crop production.
- Some smallholder farmers may not with the introduction of SCF disregard IK but use it together in the planning and management options of their cropping systems.
- A continued interaction with SCF brings about the identification of its value for planning and decision making by smallholder farmers and leads to its demand.
- The understanding of SCF that comes with continued interaction leads to a positive change of attitude by smallholder farmers towards SCF and climatic information meetings.
- This understanding and appreciation of SCF is able to influence especially women hindered by their traditional norms such as taking a low profile at public meetings to disregard it and be outspoken as to share their personal views.

- Smallholder farmers adopt a particular farming system such as the use of Sunn Hemp in improving soil fertility when ever they find it sustainable.
- Some farmers with the introduction of SCF may selected appropriate seed varieties for planting in particular season with specific given forecasts.

The following recommendations are made:-

- Interactions with smallholder farmers on SCF should continue for more than one year as changes in attitude, practices and visioning take longer before one can notice adopted by farmers.
- Because smallholder farmers in communities change differently with the disseminated SCF, researchers and practitioners are therefore urged to carefully look for these changes that could be in individuals or community.
- Multiple media channels of large and small group meetings, field visits, on-farm trials are recommended for disseminating climatic information to smallholder farmers when using the CAPES.

CHAPTER EIGHT: CLIMATE LEARNING CHANGING LIVELIHOODS: MUJIKA PERSONAL STORIES

8.1 Introduction

Governments, donors and or communities themselves have often spent appreciable efforts and resources on projects aimed at addressing community problems. The challenges however at times arise in knowing what happened during the project, what influence the project had on the community and even whether it was successful or not. The main purpose of this chapter is to use selected Mujika community members' personal stories to inform one of what occurred during the climate learning project sponsored by IDRC/CCAA conducted from 2007 to 2010. The information required includes how the project began, the community status at the start of the project, what happened during project implementation, the influence it had on the community members and whether it was successful or not. It describes a situation from stories which after evaluation, lessons could be learnt could be drawn concerning the project management or possible improvements. The issues were explored, phenomena sought to improve understanding of the situation and answer some questions. It is about Mujika community's culture, what they said, did, meant, needed or desired. It enables to gain insight into Mujika community's attitudes, behaviour, value systems, concerns, motivations, aspirations, culture and lifestyles by looking at their participation in the climate learning and interpreting the stories of the five farmers. All these aspects are considered as data.

8.2 Material and Methods

Five farmers were identified by the researcher from the three villages, considering 3 males and 2 females. The selection of these farmers was to meet at least one of the following criteria:- considered by the community as being difficult in interacting with community developmental programmes; a crop traditionalists; friendly; desiring to learn SCF outcomes or a key informant. These five people were then tracked at regular intervals without them knowing that their lives and interactions were being documented. Notes were made of their actions during regular visits to their homes and/or fields noting their involvement in the community agrometeorological participatory extension strategy (CAPES) from the beginning through to the end of the project period. However, later th4ey were asked whether they could be included in the report concerning their participation in the project. Documented actions of their project related sayings, actions, changes in behaviour and attitudes informs the story regarding what happened in Mujika during the CAPES project. The translated comments and observations will be presented with date of occurrence in a box prior to the relevant discussion. The comments, were translated from the local language Tonga, and related to a

subject of discussion. These stories were then analysed to follow the Mujika community through the project implementation, giving relevant information as well as insights into how the project influenced community members and individual livelihoods. This is a particular scenario of stories by five "typical" farmers who represent the rest of the Mujika community and provides cross sections of farmer types. Details of "story" farmers are in Table 8.1.

Table 8.1: Details of storytelling farmers in Mujika until 25th February, 2010

Name	**Age 2007**	**Family**	**Field size**			**Village**
			2007/8	**2008/9**	**2009/10**	
Mosley Hamabuyu	35	3	½ ha S			Malomo
Sharon Hamabuyu	31			0.9 ha S	1.5 ha S	
Beatrice Chiluli	46	5	0.5 ha S	1 ha S	1.5 ha S	Bulimo
Owen Htwiinda	24	4	½ ha S	0.7 ha S	0.5 ha S	Nkabika
Getrude Malambo	43		2x (5 m x 10 m) Baby trial	2x (5 m x 10 m) Baby trial	2x (5 m x 10 m) Baby trial	Bulimo
Clement Mwiinga	36	5	¼ ha	½ ha S		Malomo

S = Sunn Hemp field

8.3 Results and Discussion

The identification of the five farmers (3 males and 2 females) from Mujika's three villages of Nkabika, Bulimo and Malomo started the work for this chapter. The number of men in the second year reduced to two while the women became three. This was due to the death of Mosley Hamabuyu whose place was then taken by his wife Sharon Hamabuyu. Owen Hatwiinda from Nkabika village was chosen for being known to have difficulty in interaction with community developmental programmes, while Getrude Malambo from Bulimo village was chosen as she had a desire to learn about the SCF and apply them. Beatrice Chiluli, from Bulimo village, was chosen as she is a friendly and open person with the general public. Mosley Hamabuyu and Clement Mwiinga both come from Malomo village, and Mosley was considered a key informant and Clement always planted traditionalist crop varieties. The choice of these farmers was meant to cover the range of major aspects of community activities related to CAPES. The success of CAPES was dependent on whether the community was either receptive or uncooperative. The project could was to also succeed if the Mujika community was willing to learn and key informants supportive throughout, despite being dependent on their choices such as on the type of crop varieties selected. These five people participated in nearly all the project activities from the beginning of the study, through project implementation to the monitoring and evaluation processes. The interactions were documented by the researcher after each of the encounters, whether it was a public meeting or one-on-one conversation. Sometimes the actual questions were recorded, other times the impression or body language or reactions were recorded. During each of these stages, data was collected for each of these five participants. The absence of a particular farmer from a particular part of the project

activity table means there was no detail captured from that farmer on that particular aspect or occasion. Unfortunately on 17th January, 2009, Mosley Hamabuyu passed away and his story is continued with his wife Sharon. God remember him even for the good lessons we learnt and are continuing to do so from his part of the story. The story of a particular CAPES participating Mujika member usually represents similar behaviour of other members of the community.

8.3.1 Baseline assessment

The farmers stories began during the baseline study where they participated in the groups drawing the community sketch maps, transect walks, presenting time lines, identifying and analysing community problems as well as the creation of the community information dissemination plan (CIDP). Therefore one can deduce that the dissemination of climatic information project in Mujika started during the baseline assessment where the larger community also participated.

8.3.1.1 Community sketch maps

Table 8.2: Farmers observation on community sketch maps

Date	Name of farmer and comment
6/9/2007	Mr Mosley Hamabuyu: We have not put everything on this map. I think the map is too small.
4/9/2007	Mr Owen Hatwiinda: I didn't know that Nkabika village is so small.
6/9/2007	Mr Clement Mwiinga: Malomo covers a very large area bordering with Kaumba to the south, east with Nabukuyu, north with Bulimo village and west with Nkabika village.

The farmer's stories began with the baseline PRA activities by looking at the main community features from the drawn sketch maps. These maps enabled the community to realize the availability of major resources in their own villages and the opportunities that these could provide, such as the sizes of the communities. Although, as Mosley commented, their maps did not provide every detail, Mosley wanted to record all features of the resources of Malomo village on the map. This showed that he knew the resources very well. This acknowledgement of what was available to them was a very good start to addressing community concerns. In contrast, Owen was surprised at how small Nkabika village was, although he had lived there his whole life. Thus drawing the sketch maps of the village was a learning experience for people in their own villages and gave some people a new perspective and in sight to their own home area.

The fact that Clement presented the community sketch map (Fig. 8.1), shows he was respected amongst his fellow farmers in Malomo community, where he came from, when they gathered for the PRA baseline assessment on 6th October, 2007.

Figure 8.1: Clement Mwiinga presenting Malomo village community sketch map in the plenary at CARBLAC on 6th October, 2008.

8.3.1.2 Transect walk

Table 8.3: Farmers observation to the transect walk undertaken

Date	Name of farmer and comment
7/9/2007	Mr Mosley Hamabuyu: *Responding to interview*: We use animal draft power tilling our land, animal manure to improve soil fertility and as a result get poor crop yields.
4/9/2007	Mr Owen Hatwiinda: We shall descend from the school west wards towards the Magoye river. Very few people grow sisal.

The transect walk provided a better view of the terrain details as well as the vegetation cover. It illustrates how the transect team interacted and interviewed people on route, so as to learn specific details such as about areas of poor soil fertility, availability of livestock and usage of animal manure in the Mujika area. The revelation was that Mujika area has rivers and one of the community's main occupations was agriculture managed by use of animal draft power. It provided an opportunity for the community to share and pool the group knowledge.

8.3.1.3 Historical timelines

Table 8.4: Farmers observation to the historical timelines

Date	Name of farmer and comment
6/9/2007	Mr Mosley Hamabuyu: You elderly people must tell us what happened before we were born.
5/9/2007	Mrs Beatrice Chiluli: 1991 had food handouts, 2003 hunger over the whole area
4/9/2007	Mr Owen Hatwiinda: Headman Nkabika V was installed in 2005
6/9/2007	Mr Clement Mwiinga: In 1973 there was corridor disease breakout and I lost seven my animals as a result.

Further revelation was that the Mujika community valued history, and the different community members considered different events to be important while others not. Some of these events extended to before the current generation while others like the hunger situation experienced throughout the whole area in 2003 and the installation of Village Headman, Nkabika V, happened during their lifetime. The earlier events could only be told by the elderly persons revealing community had no usual forum or traditional ceremony for consistently sharing the community history. From these comments, it can be seen that at least two of the story tellers remembered

weather and climatic induced disasters and were aware of the effects climate had on their livelihood. This created a desire for more climate learning. Understanding the community historical background and what they considered as major events improved understanding of that community's current situation and served as guide to planning future events.

8.3.1.4 Rainfall

Table 8.5: Farmers observation of rainfall performance

Date	Name of farmer and comment
6/9/2007	Mr Mosley Hamabuyu: What I know is the rains were more in olden days than these days but 1993 rainfall was very high as my other low lying field was flooded.
5/9/2007	Mrs Beatrice Chiluli: Rains are more erratic from 1991 to date
4/9/2007	Mr Owen Hatwiinda: I don't like the way rains perform from 1995, this is why I am not a big farmer.
5/9/2007	Gertrude Malambo: Rainfall was also high in 2004.
6/9/2007	Mr Clement Mwiinga: It has been performing between normal and below normal since 1985.

Mujika community's perception of rainfall performance was that the years before 1985 experienced above normal rainfall amounts after which variations between the near normal and below normal were experienced with notable high extremes such as those mentioned 1993 and 2004 (Table 8.5). Farmer perception of rainfall performance determined the type of agricultural cropping activities farmers were involved in and that information was useful in designing the community agrometeorological participatory extension service. The community strategies for addressing their food insecurity need to be evaluated as to whether they meet the community expectations given the rise in population.

8.3.1.5 Population

In Table 8.6 stories farmers indicate that population has had a steady increase from the time they could remember to date. This was an indication that by the start of the project in 2007, Mujika community was at its highest. This information was necessary in for planning especially when relating to the current and future community food security demands.

Table 8.6: Farmers observation of population trend

Date	Name of farmer and comment
6/9/2007	Mr Mosley Hamabuyu: There were very few villages when I was growing in the early 1980s but now population is high.
5/9/2007	Mrs Beatrice Chiluli: By the mid 1960s population was high but not as high as it is now.
4/9/2007	Mr Owen Hatwiinda: As secretary of the village I can say the population is high now
6/9/2007	Mr Clement Mwiinga: Population has been increasing gradually since my childhood (1980) and now it is high.

8.3.1.6 Soil fertility

Table 8.7: Farmers observation of soil fertility

Date	Name of farmer and comment
6/9/2007	Mr Mosley Hamabuyu: Soil fertility has just been reducing with time and now it is poor.
20/1/2009	Mrs Sharon Hamabuyu: I need my Sunn Hemp seeds. With the death of my husband on 17 January, 2009 I cannot easily get money for fertilizer unless I use Sunn Hemp for improving my soil fertility.
23/1/2009	I have planted my Sunn Hemp on a one hectare plot and I am assured of enough soil nutrients for my maize in the next cropping season.
23/11/2009	I have planted my Sunn Hemp over a three hectare piece of land. No more worrying of fertilizer for crop development.
5/9/2007	Mrs Beatrice Chiluli: If you don't use fertilizer you can not harvest anything substantial these days.
29/1/2008	From the field tour I learnt maize can grow with the Sunn Hemp fertility alone?
21/12/2008	I have planted my 2 x 50 Kgs Sunn Hemp seeds on a plot next to the mother field trial plot so more people will learn the benefits especially during the field day. Look at my maize crop, looking good as though I had applied fertilizer. I thank God; this is God's answer to a poor woman's soil fertility problems.
15/1/2008	Mr Owen Hatwiinda: My crops are yellowing now except where there are some Faidherbia Albida (Musangu) trees which provide nitrogen. The soils are poor and the fertilizer have become too expensive for some of us to buy.
5/9/2007	Gertrude Malambo; Around early 1970s we could grow maize without fertilizer but not these days
8/9/2008	I am collecting composite manure I made for last year for use in my maize field
6/9/2007	Mr Clement Mwiinga: The soils fertility is poor now because people have been using too much fertilizer in their fields after Zambia's independence in 1964.
28/1/2008	I have planted my 10 Kgs of Sunn Hemp on a plot I will plant maize next year. I am applying what I learnt at MTFC.
14/9/2009	My Sunn Hemp field this year will be bigger because I have bought 1 x 50 Kg bag of seed s from Mrs Sharon Hamabuyu.
	When I will have produced enough Sunn Hemp seeds for about five hectors I will be boasting of being food secure and with surplus maize to sell.

The stories reveal that the level soil fertility at the start of the project in 2007 was considered to be low by most farmers, and this was a greater concern to almost all of them. Therefore this state of the soil needed to be addressed for improved crop productivity, though some portions of the land were naturally being improved by the availability of the *Faidherbia Albida* (Musangu) trees

The new innovations of using Sunn Hemp, a nitrogen fixing legume, was introduced and adopted by some farmers. It could be seen that that Beatrice and Clement have been quick to learn about the Sunn Hemp, and introduce it to other systems following the visit to CARBLAC. This shows them to be early adopters of innovations.

They are both early adopters as they implemented this crop choice as soon as possible. They also show that they had their own small trials before expanding the planting area the following year.

Another characteristic was they were keen to learn from others as well as to share their own learning with fellow farmers.

Mrs Sharon Hamabuyu's continued the use of Sunn Hemp in crop production and Mr Owen Hatwiinda's hosting of a field day to share lessons learnt (Figure 8.2) proved they found Sunn Hemp useful in improving soil fertility. Understanding the initial soil fertility state was therefore essential for building appropriate strategies that promoted community agrometeorological participatory experiments. Owen planted the Sunn hemp in 2007 (Figure 8.2) and the following year (Figure 8.3) he planted maize. You can tell they are very happy with the crop development and so his story continues.

Figure 8.2: Owen in his Sunn Hemp field on 10/12/2007

Figure 8.3: Owen and his wife in their field of maize on 15/12/2008grown by using only his Sunn Hemp to provide nutrients

8.3.1.7 Crop productivity

Crop productivity at the start of the project was considered low to the extent that most farmers did not have enough food supplies to last them for the whole year round as shown byGertrude, Clement and Mosley's personal comments. Yield was low without any form of fertility when growing crops. Some individuals in the community were involved in new innovation of using Sunn Hemp to improve soil fertility and thus increased crop productivity. The current community crop productivity served as baseline for evaluating the community agrometeorological participatory extension strategies' capacity to increase the general food security of the Mujika community.

Figure 8.4: Clement Mwiinga (c), his wife Grace (r) and a friend at home after interviews

Table 8.8: Farmers observation of crop productivity

Date	Name of farmer and comment
11/3/2008	Mr Mosley Hamabuyu: The poor soils are contributing to food insecurity in the villages as farmers cannot produce enough maize to go all year round. I always keep extra maize in my house for assisting and selling to the local community when food security levels are low around August to December.
5/5/2009 8/6/2010	Mrs Sharon Hamabuyu: Mr Nanja, I harvested 189 x 50 Kg bags of maize and 13 x 50 Kg bags of Sunn Hemp which I will sell and gain money for family needs. Where are you? You don't call to ask what my harvest was. I got 145 x 50 Kg bags of maize and 18 bags of Sunn Hemp.
19/5/2010	Mrs Sharon Hamabuyu: More people are buying Sunn Hemp from me after comparing their farming strategies and mine. Thank you for this project and the many lessons I have learnt. My life is sustainable as a widow.
16/9/2009	Mrs Beatrice Chiluli: I remember when I was a child around 1968 my father was ever selling about 1000 x 90 Kg maize bags to the National Marketing Board but these days he only sells about 300 x 50 Kgs. I harvested 27 x 50 Kg bags of maize plus a full granary of maize to run me the whole year round with my family.
20/8/2009	Mr Owen Hatwiinda: My best harvest in life was last year when I used Sunn Hemp and got 45 x 50 Kg bags if maize.
24/9/2007	Gertrude Malambo: We don't usually have enough maize to go all year round.
24/9/2008	Mr Clement Mwiinga: I bought this broken down vehicle some time back from my crop sales but these days I only produce about 10 scotch carts of maize. Last year under floods I only harvested one scotch cart full (8 x50 Kg) of maize. This was one of poorest yield over.

From comments on crop productivity during the 2007, it could be noted that these story tellers are typical of the Mujika community; in that they did not have enough of their own maize to meet their family's demands for the whole year (see Getrude Malambo). It provided motivation for the farmers to be willing to think differently from the traditional methods used for crop production by introducing a legume into the crop rotation. The contrasting report by Clement of low food security in 2008 was however worrying, but it must be noted that he had not used Sunn Hemp.

8.3.1.8 Seasonal timeline

The seasonal calendar begins with land preparations before the start of the season which was around November. However, farmers planted a range of crops such as maize, their main food crop and others like groundnuts and cotton.

There appears to be a large difference between how farmers worked in the community as some prepared land early so as to plant in November (Table 8.9). Those who prepare their lands early do not understand the other farmers who delay land preparations and plant their crops late. Farmers also grew different crops for different reasons. Others found cotton growing difficult for being labour intensive. The growing of maize crop was done by both men and women though a crop like groundnuts was grown by women alone. Their cattle were let loose to communal grazing grounds

and not herded until December; hence the early planted crops risked being consumed by stray cattle.

Table 8.9: Farmers observation of seasonal timeline

Date	Name of farmer and comment
7/11/2008	Mr Mosley Hamabuyu: The rains start around November but people plant crops in December and January when the rains would have established themselves.
13/9/2009	Mrs Beatrice Chiluli: The main community crop is maize mainly grown from December and January. Sweet potatoes and groundnuts are mainly grown by women alone.
7/11/2007	The crops Durton is planting on 7th November, 2007 will be eaten by stray animals because they are still loose to open grazing.
19/8/2008	Mr Owen Hatwiinda: I wonder why some farmers cannot start their land preparations earlier than October because they are never through with it even by the time of planting in December?
13/12/2007	Gertrude Malambo: I don't like planting cotton though most people do so because it is too labour intensive.
21/12/2008	Time is running out for planting groundnuts and must complete this portion before the start of the Sabbath.
24/9/2008	Mr Clement Mwiinga: Planting groundnuts is job for women. *How about eating? his wife asked.* I also manage jobs which you don't help me at all but do benefit the whole family.

These reports recorded during the construction of the seasonal timelines reveal that farmers have individual choices and preferences as seen from Gertrude's comment about low preferences to cotton. So when agrometeorologists formulate advisories, they should remember these personal preferences. Another important aspect highlighted from the crop seasonal calendars was the social-cultural norms of the community. Outsiders from other communities such as extension officers and advisors may inadvertently violet these unwritten rules or regulations. Care must therefore be taken, by spending time with the elders of the community, to learn about the socio–cultural norms. However, sometimes in ignorance one may break the rules (see Beatrice's comment Durton planting maize on 7th November) and suffer the consequences. Sometimes one has to influence community to change such traditional rules so as to gain the increased yield benefit of planting maize earlier.

Understanding Mujika community seasonal activities and the likelihood of success of the project allowed for effective designing of the type of agricultural interactions that can be undertaken. Recommendations for the introduction of new varieties and changes in planting times should therefore be taken cautiously and in consultation with the Headman of the area.

8.3.1.9 Institutional analysis

The farmer stories in table 8.10 indicate that education, health, local government, agriculture and

CARBLAC (a local NGO) are operating in Mujika area. This was informative to know which other institutions working in the area could be approached to support the dissemination of climatic information.

Table 8.10: Farmers observation of available institution in Mujika

Date	Name of farmer and comment
22/2/2008	Mr Mosley Hamabuyu: The agricultural extension officer they have brought is hard working.
12/12/2007 11/2/2008	Mrs Beatrice Chiluli: I am going for a cooperative meeting at CARBLAC. Nobody will help you working tomorrow because it is a Sabbath and we shall all be at church.
13/8/2008	Mr Owen Hatwiinda: Nkabika Basic school is the only basic school in Mujika with other nearest ones being Ntambo and Kaumba basic schools.
19/11/2008	Gertrude Malambo: You are looking for Mr X (real name with held), he has gone to Mwanza court. He has sued someone for ploughing in his land.
7/3/2008	Mr Clement Mwiinga: I am tired as I have been at this clinic for some time waiting to be attended.

However, not all the comments are indorsing of the government, eg it appears that the service at the clinic is rather slow. Therefore it could be a good place to distribute climatic information or hold group discussions as people have to sit and wait for long periods. It also seems they do appreciate the new extension officer Mr Philemon Hakalembe who was also one of the IDRC/CCAA project team members which he attended to together with his normal work load. This endorsement made his work easier and made more pleasant as the farmers were enthusiastic about the changes in the crop production systems. At the end of the IDRC/CCAA project, hopefully these organisations, in Monze area could continue sustaining the development impetus and support the CAPES initiative. The agriculture extension officer was effectively trained in disseminating climatic information and was expected to sustain the Mujika CAPES with support and advisories from ZMD.

8.3.1.10 Farm sketches

From the individual farm sketches farmers, gain a different view of what was available to them for their own agricultural development (Table 8.11). They were glad to have a map of their farmsteads that they had drawn themselves. Farmers could use these sketch maps when planning future cropping cycles. Mr Clement Mwiinga's desire to go home with his personal sketch map was an indication that farmers saw value in developing a better understanding of their own environment from these farm sketches and that they could use them in future. It also revealed personal sketch maps improved the vision and evaluation of the individual farmers' environment and self esteem.

Table 8.11: Farmers observations of farm sketches

Date	Name of farmer and comment
6/10/2010	Mr Mosley Hamabuyu: This is good. Families should know what is on their farms.
6/10/2008	Mrs Beatrice Chiluli: Should I include my father's compound and fields because we live as one large community and share field every year?
6/10/2008	Mr Owen Hatwiinda: My home and fields are far apart how do I link them?
6/10/2008	Gertrude Malambo: But I cannot draw very well.
6/10/2008	Mr Clement Mwiinga: Shall we take these maps home when we finish?

8.3.1.11 Gender daily calendar

Table 8.12: Farmers observations of the daily calendar by gender

Date	Name of farmer and comment
6/9/2007	Mr Mosley Hamabuyu: Not all women wake up earlier than men.
5/9/2007	Mrs Beatrice Chiluli: Women plant groundnuts on their own while men are relaxing.
4/9/2007	Mr Owen Hatwiinda: Men do the hardest work for their families lives
5/9/2007	Gertrude Malambo: Some men can't even cook for themselves but have to wait for the wife to come from where ever she has gone.
6/9/2007	Mr Clement Mwiinga: I have never collected water from the stream for use at home on my head.

At the coming of every new day in Mujika, some jobs were undertaken by both men and women together while others were specifically designated to women alone such as the planting of groundnuts (Table 8.12). It appeared that in general the women worked longer hours than men, although it appears Mosley wanted to disagree with this. Interacting with them about climate learning needed careful activities distributions as women could be overloaded with many important family centred tasks such the project results could be negatively impacted.

The household interviews provided diverse information on current farmer situation at household levels. The Tonga language was preferred in Mujika over other languages. The interviews revealed there were other non-climatic factors that affected agriculture productivity such as laziness. These interviews were vital for comparing a community wide view as given during the PRA meetings with the actual conditions at household level (table 8.13).

8.3.1.12 Household interviews for triangulation of PRA information

After considering household situation one had to redesign the information dissemination strategies to be targeted at household. Climatic information dissemination was a new activity in Mujika and the time needed to be spent encouraging deeper understanding of it, but showed that the community was willing to learn and apply climatic information.

Table 8.13: Farmers observation of household interviews

Date	Name of farmer and comment
	Mr Mosley Hamabuyu: You ask on all details about farmer livelihood. Some will fail to tell you the correct details.
15/9/2009	Mrs Beatrice Chiluli: Some people are poor because they are just lazy. They even ignore climatic meetings that are able to help them improve their farming. I think I have found a solution to erratic rainfall problems with the use of Sunn Hemp.
3/9/2009	Mr Owen Hatwiinda: Every one you will talk to will tell you rainfall performance is poor and amounts are reducing these days.
	Gertrude Malambo: You must ask questions in Tonga.
	Mr Clement Mwiinga: You are the first person talking to us about climate information. It is all new.

Figure 8.5: Owen and his wife Mary during interviews at their home on 3/9/2009

Figure 8.6: Beatrice Chiluli during interviews at her home on 15/3/2009

8.3.1.13 Farmers view of alternative interventions and opportunities

The community had listed various problems such as erratic rainfall performance, animal disease and lack of money, out of which they ranked erratic rainfall as their number one problem (see table 4.11). Understanding their most pressing problem placed the community members in a position to consider what they were to do about the problem (Table 8.14). Their identified number one opportunity was awareness of climatic information and appropriate for addressing their community number one problem of erratic rainfall. It could be noted that not all farmers agreed it was their number one challenge though the majority had voted for it (see Owen's comment on lack of money and Clement's on animal diseases). However he was agreeable that erratic rainfall was a major problem especially for crop productivity. As this project was addressing climatic information one could tell that it was going to focus on farmers concerns and needs. However the opportunity was probably or more involved that just an awareness of climatic information. The opportunity needed to be developed and exploited by obtaining the information and learning how to understand it and incorporate it into their on-farm decisions. The stories farmers show by their comment show arrange of insights into the understanding of the effects of the weather on crop production.

Table 8.14: Farmers view of alternate interventions and opportunities

Date	Name of farmer and comment
6/9/2007	Mr Mosley Hamabuyu: Climatic information is the number one problem because people don't even know of coming rains and when to plant what. So if they learnt about climatic information they would improve their food security.
13/11/2007	Mr Mosley Hamabuyu: Erratic rainfall is the greatest problem people have followed by animal disease. But there are other problems such as type of seed farmers plant for a particular season like my friend Clement Mwiinga who plants local maize every year but gets low yield.
27/11/2007	Mr Mosley Hamabuyu: This is Clement Mwiinga the man I was telling you about planting traditional local maize in every year. Clement show him the seed. By the way there is another problem; people are hesitant of using SCF because they say you are not a god to tell them of the coming rains.
5/9/2007	Mrs Beatrice Chiluli: Poor rainfall performance followed by lack of animals. Not all people have cattle for ploughing fields. I think if we learnt about when and how the rains would come would be very good for us.
4/9/2007	Mr Owen Hatwiinda: Lack of money is number one problem followed by lack of fertilizer. With money you can buy fertilizer and have a good yield. I think if we first learnt about weather and rainfall we could manage our crops well every season because it is rainfall the that makes our maize to dry up when it is not there.
5/9/2007	Gertrude Malambo: I think the biggest problem is lack of animals for ploughing the fields followed by erratic rainfall. I see awareness of climatic information as a solution to most of Mujika community problems
6/9/2007	Mr Clement Mwiinga: Erratic rainfall is the biggest problem followed by corridor disease for animals. One season there is too little rainfall the next may have too much. With animal disease as my number one community problem followed by absence of water we should start by addressing animal disease first.

8.3.1.15 Planning for testing farmer choices

Table 8.15: Farmers' observation in planning and testing farmer choices

Date	Name of farmer and comment
6/9/2007	Mr Mosley Hamabuyu: Since we have chosen awareness of climatic information, does it mean that all the activities to be carried out in this project will be addressing awareness of climatic information?
25/9/2007	I think the team should be composed of all the three Village Headmen, agriculture extension officer and yourselves.
25/9/2007	Mrs Beatrice Chiluli: You should also include the 5 community radio listening club representatives.
6/9/2007	Mr Clement Mwiinga: So we shall have fields to see whether our decision with the forecast was correct or not?

The stories reveal that after evaluating their current situation, the community designed a plan of action especially to address their number one problem, erratic rainfall using awareness of climatic information their number one opportunity (Table 8.16). The main purpose of evaluating their situation was to find the means of addressing their pressing needs and problem. When a community programme was designed it usually required leaders in place and the stories tell now the community participated in deciding who was going to be at the helm in managing CAPES. Their selection of men and women of authority in the community such as Village Headmen to manage the project

Table 8.16: Comments from the selected farmers on project implementation according to type of media used

Media column	Mr Mosley Hamabuyu (Sharon Hamabuyu)	Mrs Beatrice Chiluli	Mr Owen Hatwiinda	Mrs Gertrude Malambo	Mr Clement Mwiinga
1.Meetings Public	23-09-2008: Please wait in starting the forecast meeting as more people are still expected to come. Very few people attended last year because they said you were claiming the role of gods. However their view has since changed on that.	27/9/2007: People don't like attending meetings that provide them with productivity knowledge but prefer those for handouts only. 24/9/2008: There are more people attending climatic meetings these days. I think they learnt a lesson from the floods of 2007/08 season when they ignored and fear it may repeat.	17/2/2009: I received advice and learnt how to use climate information like deciding type of seed variety to buy, tillage practices to use and selecting of fields to plant according to forecast season. I also learnt when to plant what crop in the season.	23/9/2008: More people have attended the weather meetings because they want to get the forecast from you. They don't want to loose crops again as last year through floods. I introduced Mr Edson Malambo to these meetings and he volunteered as a baby field trial farmer (figure 8.6)	10/9/2007: Are they gods to tell us of the coming rains? 22/1/2009: I don't miss weather meetings any more after the lesson I learnt in 2007/08 of disregarding SCF. You may think it is me alone thinking that way. It is the view of most of my friends (2008).
Training	25/1/2008: People expected agricultural inputs handouts from training you had at CARBLAC.	29/1/2008: After returning from CARBLAC training people started planting Sunn Hemp for improving their soil fertility for the next crop planting.	27/10/2009: My report is that the 2008/09 season performed as forecasted and that SCF is a factor in improved agriculture productivity	23/3/2009: I learnt that each forecast season required a different farming approach (type of seed to be bought and tillage practice to use).	22/1/2009: I have wasted yet another year in crop productivity but are glad to have learnt a life time lesson (2008).
2. Electronic Radio	24/9/2008: Why do you end the radio programs in mid-season? People still want them to continue all year round. There are so many Nkwaambila Bbwes in Mujika	24/9/2008: Some losses farmers incur would not have been there had they been listening or coming to the radio listening clubs.	23/11/2007: I don't know why most people don't like coming to radio listening club meetings. May be they have radios in their home but no very few have I know.		I only like Rumba music but we differ with my wife over listening to your programme (2007). I repented. This time I make sure my radio is working every progamme time. My wife is happy (2009).
Radio listening club	17/11/2008: Sharon number 4 in picture figure 8.5 from left: Farmers attend the radio listening to radio programmes every Thursday here. They like the programmes so much. They mostly like the advisory discussions we hold after the programme. Malomo B radio listening club members on 17/11/2008.	24/9/2008: I don't like missing radio listening clubs because people advise on what to do under different weather conditions	5/1/2008: From the time my parents and children heard the local people (Mosley Hamabuyu, Violet Ngwenya and Mrs Simunkombwe) speaking on radio they don't go to bed until it is over. 12/1/2009: People like the radio programme especially Nkwaambila	18/2/2008: I don't miss radio listening clubs unless I have a problem. Furthermore I have no radio of my own. People enjoy the climate programme. You must come during radio listening club meetings and see for yourself.	10/12/2008: My wife and I attend radio listening club meeting always. I like sharing my story at meetings.

			Bbwe's behaviour because it is what most farmers do.		
3. Print media Handbills	23/9/2008: Most of you are getting forecast papers you won't read at all.	12/10/2009: Most of the women who can't read or write have since started attending the new adult school in the village and already some boast of reading English now. Greet them in English at the next radio listening club meeting you will hear for yourself.	18/10/2008: People want forecast papers. You can leave a number of them with me for distribution.	25/9/2009: I am now able to read the Tonga SCF because the newly introduced adult school in Bulimo village.	11/10/2009: I always ask the Agriculture extension officer Mr Hakalembe for a copy of the Tonga rainfall forecast. Please assist me with one copy as I have not yet received any.
Cartoons	23/9/2008: Let us go and practice what we have learnt and not to behave like Nkwaambila Bbwe in the cartoon who was sleeping when his friend was planting.	23/11/2007: With the cartoons most farmers, those who cannot read or write including the shy ones were free to talk. Go and draw more cartoons.	18/10/2008: But by the way is it you who drew the cartoons?	23/11/2007: We like cartoons because you can deduce the meaning from pictures even though most of us especially women cannot read.	23/9/2008: I think the one who was drawing the cartoons was talking about me but just changed the name. The cartoons teach the truth and have kept copies in my house for reference.
4. Personal contact	17/11/2007: Had you not come and introduced SCF, I would have never planted the late maturing seed variety MM 709 which I have planted. It is a good variety for a long season. People have a habit of planting late in December till January	13/1/2009: Just let Bulimo village stage the main sketch during the field day and you will be surprised at what we are able to do.	14/1/2009: I have learnt a lot of lessons from the experiments that I am considering of hosting a field day.	13/1/2009: Thank you for coming because we have learnt a lot and have answered all our questions.	15/1/2008: From the day you and my friend Mosley visited me, I vowed to consider the weather forecast in my planning.
5. Farmer to farmer	23-09-2008: Farmers influence each other regarding what and when to plant and even the type of meeting to attend. 12/4/2009: Sharon Hamabuyu: I will make a lot of money from Sunn Hemp sales this year because I already have 8 people asking for seed.	13/1/2009: Our discussion with Getrude yesterdays discovered some farmers still depend on traditional indicators for season expectations despite the availability of the forecast every year.	14/1/2009: I received 23 inquiries this year on my field trials and kept sharing my lessons learnt from the project.	13/1/2009: I inform others that at these meetings we learn how to use the SCF in planning one's agriculture cropping season. Edson Malambo has since stared attending climatic meetings.	22/1/2009: Mosley my friend introduced me to SCF and its importance in agriculture planning. But Mosley my friend, even if I have considered planting hybrid maize, I will also be planting this local maize because it is resistant to disease and not attacked easily by insects
6. Passing through	25/2/2008: Saw you pass by and suddenly a very serious argument started on the role of the Meteorological department and the use of the SCF in	25/12/2009: We laughed on Wednesday when my father (Nathan Chiluli- Headman for Bulimo village) saw you at a distance on a motorbike and			15/12//2009: You have now become my weather man friend people are saying. Whenever we see you even at a distance my friends say there goes your weather man friend.

	agriculture productivity. Others said you are liars and not gods while others said it helped them improve crop production	said there goes the weather man.			
7. Experiments	3/12/2008: Farmers are complaining they want plot sizes as of last year they say these are too small to get a meaningful harvest. 21/12/2010: Some of your baby farmers whom I won't mention names because I don't want to be beaten are saying they may not plant the trial fields because they don't get any meaningful yields at all. I think they don't understand why they have those small trial fields.	17/2/2009: I have no field trials but what I am doing in my own field using the climatic information you are teaching us and lessons I am gaining from the field trials is benefiting me more than some farmers with baby field trials.	27/2/2008: Long maturing crops are better planted early in the season. 16/12/2008: People were saying I wasted seed when I planted at the start of the season and with minimum tillage on my field where I had Sunn Hemp previously.	17/2/2009: I think I am learning a lot from these trials as I now know how to plan my cropping activities by different seasons. 27/2/2010: Without some form of fertility added to crops one is like to get no harvest at all.	22/1/ 2008: I have worsted another year but wished could carry all these crops to be mine and at my farm. 17/2/2009: Though I have no field trials with you, I believe I am benefiting a lot even more than those with baby fields because I practice the lessons on bigger plots than those small ones
8. Field day	27/2/2008: Most people especially men come to the field day for the meat that is available and not to learn. Sharon: Are we going to contribute and cook in the village grouping as it was last year?	23/3/2009: Please make the people stop at my Sunn Hemp field to watch the drama my sister Esther Chiluli and I have planned to explain the benefits of climatic learning to field day participants. 29/9/2009: But prepare for a larger gathering at this year's field day than that of last year because more people are planning to attend.	25/2/2010: Forecast is useful in agriculture decision making (seed selection and planting time) I chose medium variety and planted early. Any form of fertility will bring about change in crop performance. I hope you have learnt something useful for your individual agriculture practices	10/5/2009: A lot of people will come to the field day next year because you mostly discus crop production and rainfall which affects them most.	25/2/2010: I don't miss field days at all. It is a good time for learning more from others. But I don't really understand why men are difficult to attending weather meetings but when it comes to the field day here today they are majority. I think they mainly come to eat meat which is prepared and not to learn.
9. Monitoring and Evaluation	21/11/2008: Some baby field farmers are not committed and are just doing it to please you. Their main interest is yield and not experimental results. Their behaviour proves.	25/2/2010: I have to be frank the project has been successful. It is unfortunate for those who haven't learnt anything over the three years of working together on weather issues.	25/2/2010: I am happy with how the project performed and most people learnt something. Especially the value of forecast in decision making. This was revealed in the way they attended to meetings.	18/12/2008: Come and see my field trials I believe I managed it the way we had agreed and I am very happy with the result. 17/2/2009; May I talk to you (Durton & Prof Sue) privately. I am learning from trials that if I put seed alone it is useless but unless with some form of fertilizer as well. Continue.	My project assessment during the 2007/ 2008 season helped me to make my position clear regarding weather information. I realized it was essential for any successful farming.

Figure 8.5: Malomo radio listening club at Mosley's home on 17/01/2008

Figure 8.6: Edson Malambo (L) on his baby field trial with Durton on 11/12/2008

Figure 8.7: Mosley participating in radio programme design and recording on 8/12/2007

Figure 8.8: Getrude Malambo (r) and her friend during harvesting of mother trial

revealed the seriousness the community attached to the project. Mujika farmers were proactive by designing a plan of action to address their choice, and they monitored it through the CAPEST leadership that involved farmers as well.

The stories of individuals within Mujika community have highlighted the opportunities for capacity building, via a "learning by doing" methodology with climate classes undertaken over three years (table 8.16). The interaction started with a large sector of the community having reservations about the whole project. For example, Clement Mwiinga on 10/9/2007 inquired whether the agrometeorologists were gods to tell them of the coming rains (Table 6.2). This was followed by a change of attitude (E.g 1: on 17/11/2007 Mosley Hamabuyu said *"Had you not come and introduced SCF, I would have never planted the late maturing seed variety MM 709 which I have planted. It is a good variety for a long season")* e.g. 2: appreciating and adopting of climatic learning from Beatrice on 17/2/2009 saying *"I have no field trials but what I am doing in my own field using the climatic information you are teaching us and lessons gained from the field trials is benefiting me more than some farmers with baby field trials";* resulted in improved livelihood (… "*I realize it was essential for any successful farming",* said Clement*)*. There are limitations in the use of some dissemination modes, such as small baby field trials and engaging farmers with different project expectations or of not being fully committed were also revealed (see Mosley's comment in Table 6.2 on monitoring and evaluation). They highlight the fact that the project was successful, with community members learning various lessons such as the value of SCF in agricultural decision making. However they also tell of the remaining challenges of how to get the larger Mujika community into participating in climate learning programmes.

8.4 Analysis of Story Tellers Information and Reactions

The story tellers' information was also analysed under the category of wealthy (status), education and opportunities. This was to explain how they represented the Mujika community by telling their stories. Every story teller had some form of status, form of education and opportunities they could use to improve their livelihood with the introduction of climate learning (Stigter, 2004, Walker, 2004). The analysis of the five story tellers in representing Mujika community did not change with the departure of Mosley as Sharon assumed the role of head of the household. The change was only in the gender situation where there were now two men and three women under study.

8.4.1 Overview of the story tellers

The story tellers were analysed by looking at their status, education and opportunities. This established the farmers' suitability in representing the Mujika community.

Table 8.17: Status of the story tellers

	Category		
Name	**Status**	**Education (# of years)**	**Opportunities**
Mosley Hamabuyu	20 Cattle + chicken	12	Head of Home
Sharon Hamabuyu	20 Cattle + chicken	9	Wife/Head of home
Beatrice Chiluli	8 goats + chicken	7	Daughter of Headman
Owen Hatwiinda	Chicken	7	Son of Headman
Gertrude Malambo	10 cattle + chicken	7	Land occupation
Clement Mwiinga	15 cattle + chicken	7	Head of home, One vehicle & land

Table 8.18: Story tellers by percentage ranking by number of livestock

	Categories					
Wealth	**Zero livestock**	**Only chicken**	**Goats & chicken**	**5 head of cattle**	**20 head of cattle**	**50 head of cattle**
Estimated percentage (%)	5%	10%	20%	30%	35%	5%

The analysis under status for each one of them looked at what they owned in terms of animals which was the symbol of wealthy in southern Zambia amongst the Tonga people. The wealth status of the story tellers was not very high as all fell bellow the category of having less than 50 cattle per family. They effectively represented the Mujika community very well. Table 8.18 shows the use of the livestock as a weath ranking where those with cattle are considered most wealthy and privileged in the community. Those without cattle are considered to be the poorest (eg Owen Hatwiinda).

As the selected farmers were across most of the wealth ranking range, expected at the extremes, effectively they represented the Mujika community well. This community looked forward to developing and improving their livelihood. The project by working with this category of people was addressing the Mujika community and more effectively promoting dissemination of climatic information.

Table 8.19: Education of the story tellers

	Category							
Education level	**Illiterate**	**No education**	**Adult education**	**1 – 4 years**	**5-7 years**	**8-12 years**	**Skills training**	**Formal post education**
Estimated percentage	5%	10%	15%	20%	32%	8%	8%	2%

The education percentage levels of Mujika community are estimated by the researcher. The education levels for Mujika community were categorized in percentages and shown in (Table 8.19). The story tellers were found to be mostly in the 5-7 years and 8-12 years of education categories which is representative of for Mujika communities. The level of education this category probably influenced their decision making and interacting with category was with the right Mujika community that was looking for change.

Table 8.19: Story tellers' opportunities

1	2	3	4	5	6	7	8
No opportunity	Child	Wife	Head of house	Church authority	Son or daughter of Headman	Assistant Headman	Village Headman
0	43%	10%	36%	5%	2%	2%	2%

This categorization of the farmers according to the education the amount of education received illustrated that those that have at least had some basic education will grasp the concepts of climate information easier and quicker than those who are illiterate.

It therefore was justified to acknowledge their stories as being a sorted snap short of the community sections or farmer types. The CAPES worked with the right group of people in Mujika that had the desire to learn and improve their status by use of climate learning and it was successful (Table 6.2).

8.5 Influence of the Project on Individual Story Tellers Lives

8.5.1 Mr Mosley Hamabuyu

From Mosley Hamabuyu's story, represents key informant and farmers with the highest education and wealth rankings. I reason he understood that although the community's major problem was erratic rainfall, there were also other problems such as planting of maize varieties not related to a particular season which was a matter where farmers needed guidance from SCF. He was quick to acknowledge SCF as a decision making tool to improve agriculture productivity and utilize it in his farming practices especially for selection of maize varieties selection (Table 6.2). He openly shared the initial community view of the project (Table 6.2) causing farmers not to use SCF information in 2007 where they said the researcher could not tell them of the coming rains because He was anot a god. However the researcher addressed this matter and usefulness of SCF after the first year of interaction was acknowledged. Mosley represents sfarmers in Mujika who had a broader view of the community problems and insight into possible working solutions to address them. He felt non-climate related problems needed addressing as well. He represents a group of early climate learning innovations adopters, who were influential in the farmer to farmer interaction of SCF.

8.5.2 Mrs Sharon Hamabuyu

Even after Mosley's death, his wife Sharon was still convinced of the use of SCF for selection of appropriate maize varieties for a particular forecast season. She knew that sustainable agricultural practices were also required to improve soil fertility in order to obtain improved agricultural productivity. She started in 20098 and continued to use Sunn Hemp each year, by consistently producing and planted maize crop with the first rains, which she said was sustaining her livelihood with sufficient maize for her household (Archer et al., 2007). Climate learning to Mosley (35 years

old) and Sharon Hamabuyu (31 years old) was vital to enable thewm to change their crop productivity levels and livelihood which they managed to attain and even had surplus food to sell. My findings were that an improved understanding of climate matters contributed to Mosley and Sharon's better crop production. Sharon's food security despite being a widow by the end of the project, was not adversely affected by her husband's death. This particular situation gives the illustration that there were families in Mujika that attended and adopted climate classes together and despite difficult family circumstances, they could continue with the sustainable approaches learnt.

8.5.3 Mrs Beatrice Chiluli

While Beatrice agreed erratic rainfall was her community's number one problem, but she saw laziness as another serious hindrance that affected successful agriculture production amongst some community members. The solution she saw to the current problems lies with farmers attending climate meetings to obtain information that can serve as a guide to improved agricultural production. Her solution to the soil fertility problem as a widow, was the adoption of Sunn Hemp in a rotational cropping system with maize. This particular report reveals the food security limitation in Mujika were not only due climatic factors but also affected by others as well. She finds the solution to something like laziness as participating to climate learning meetings where more climate knowledge and encouragements was given to farmers.

Her desire was to have more people learning and adopting the improved practice. This was fostered by planting her Sunn Hemp field next to the mother field trial where it could be easily seen by more people who were coming to learn during the field days. Her use of drama in presenting lessons learnt from the project was to attract more community attention and focus the climate learning activities and benefits. Her character reveals that there were farmers in Mujika who introduced innovative ideas to disseminate climate information other than those used by the project. They did it in their own time and place like the farmer to farmer interactions (table 6.21). At the age of 46 years, she increased the area planted with Sun Hemp every year over the three year period, showing practical climate learning and attaining a sustainable system despite climate change. Thus she improved her food security which was her primary goal. She also saw the potential of having surplus production to sell to meet the other family requirements such as clothing. This story also reveals the fact that some early adopters in Mujika did not limit the knowledge gained to the experimental field sites alone but expanded them to the management of their whole family cropping lands. Such a result was probable characteristic of those in the Mujika community with a desire to learn about with SCF.

8.5.4 Mr Owen Hatwiinda

Owen attended most of the public and radio listing meetings from which he realized the community problems of erratic rainfall, poor seed selection and soil fertility could be addressed using the newly introduced climate information from 2007-2010. Owen saw the introduction of the project as an opportunity to remind the community that, the current agricultural practices needed evaluating and reviewing, and so he volunteered as a baby field trial farmer. His careful management of the trials provided him the confirmation that the application of climate learning to his own fields was a sustainable solution to the community's poverty situation. He was so enthusiastic and absolutely convinced of the results from the baby trial that he was determined to transfer the information to his neighbours and fellow farmers. He felt that the information gained from the trial was so important that he needed much more time, (such as half a day) to share the benefits of tailored climate forecasts, so he organized his own field day on 3rd March, 2009. He planted his crop the start of the rainy season using appropriate maize varieties. He was food secure for the first time in his life at the age of 24 in 2008 due to using climate forecast information. Thus it was clear that climate learning had contributed to changing his family's livelihood. Owen's story is a model of climate learning changing smallholder farmers' livelihood, especially the fact that he was considered one of the least in community. This particular story tells us we should not judge our fellow farmers by their previous failures but rather that they should be given another opportunity to learn new techniques. Researchers and community members should allow for an equal opportunity for farmers to learn and improve their own livelihood regardless of any previous failure or any other bad experiences. This general community view was however proven incorrect by Owen representing that group of people who were instrumental and successful during the project. Effective interaction with the type of group that Owen represented would develop the community through application of climate learning.

8.5.5 Mrs Gertrude Malambo

In my view, Gertrude understood very well her personal and community problems of lack of animal draft power, erratic rainfall, poor soil fertility and inadequate food supply. She discovered the introduction of CAPES was helpful to improve her agricultural decision making and so was consistently in participated at all levels of meetings. Gertrude contributed to the fruitful farmer to farmer interactions about SCF that led to more farmers participating in CAPES activities. She introduced Edison Malambo to climate classes and later he volunteered as baby field trial farmer.

As a person desiring to learn she reached a turning point and declared her views privately to the researcher and Professor Sue Walker on 17/2/2008 that she would definitely incorporate climatic

information in her practice. She stated she understood SCF was important for crop productivity and also that the use of some form of fertility improved crop yield. Evidence of practicing her belief was being found on 8/9/2008 applying composite manure to her fields before planting maize. It is true to say personal interactions around SCF lead the Mujika community to understanding of SCF and it benefits. One can tell that there were farmers in Mujika who understood SCF and relate it to their own agricultural practices. Gertrude's story reveals climate learning had an influence in changing livelihoods of the women in Mujika.

Being a wise woman, Gertrude also advised researchers not to seek individual opinions on CAPES programmes in public. This especially applies to women in a community where women are not encouraged to speak freely in publicly, but to find other specific opportunities where one-on-one discussion with women could be held. She demonstrated it when she sought a private audience with researchers at the end of the on-farm trials field tour. Gertrude was aware that at times things in projects such as these were difficult for researchers almost to level where they could become disillusioned or give up completely. To avoid beneficiaries from loosing out completely, she encouraged the researchers and reminded them she, and the larger community she was representing, were benefiting from all the activities for dissemination of climatic information. This revealed that some women in Mujika were not free to communicate their views at public meeting therefore, getting their views required additional opportunities than those of the public meeting. Gertrude, at the age of 43, found that climate learning changed community livelihood by including a change of behaviour and attitude towards SCF and implementing better planning of their cropping programmes. It also reveals there were probably many Mujika women who benefited from CAPES but whose views were never heard of.

8.5.6 Mr Clement Mwiinga

Clement saw corridor disease of livestock as the major community problem. He initially received the climatic information, especially that of SCF being given by humans instead of "the gods" with much reservations The accuracy of the ZMD 2007/08 SCF when compared to the actual rainfall performance and the flood impact on his crops which he had been warned of, then increased his desire to find out more about SCF continued reliability. Clement's story reveals that not all smallholder farmers in Mujika acknowledged SCF when it was first introduced. Some of them had reservations and needed to learn more before applying it to their agricultural practices. The field training tour he took with 40 other Mujika farmers on 6th January, 2008 to MFTC marked his turning point, when he realized that those who considered SCF in their practices had fewer risks on their crops (Hansen, 2002). On return he planted a quarter hectare field of Sunn Hemp,

demonstrating his conviction about using climatic information in his agricultural practices. The continued interaction with community in CAPES, helped these farmers to obtain a better understanding and adopted climatic information in their practices. This story teaches us that undertaking climatic information dissemination for only one growing season in a community that depended on IK for planning and management options, may not yield a good enough result, but a commitment to a least 3 or 5 years is needed.

By attending all climate learning meetings over the following two years was proof of Clement's determination to learn and effectively use climate information by integrating it into his own decision making information style. Maximizing crop productivity using climate appears to be his new aim when he increased the Sunn Hemp plot during the 2009/10 season to one hectare. Though he introduced the planting of hybrid maize varieties he also continued planting local maize verities but at appropriate planting times in the ideal planting window for their best tolerance against diseases. He considered both SCF and IK; and followed the response farming approach. Climate learning for Clement changed his attitude towards SCF, farming and improved his decision making regarding when to plant which maize variety according to climate forecast available. His story also tells us that there were other farmers in Mujika who integrated SCF together with IK in the agricultural programme after the first year of interaction. He represents a group of slow adopters but through CAPES they changed in their attitude, to SCF, decision making and management of crops. Their visioning and cropping practices also changed. At 36 years of age Clement, a crop traditionalist like others he represented in Mujika, eventually realized application of both IK and SCF was better that relying on IK alone in crop productivity. He found climate learning through CAPES providing responses to the many questions concerning sustainable agriculture under climate change. It was in the continued regular interactions through CAPES that most Mujika farmers had their many questions SCF and its benefits answered. So Clement's story motivates researchers and disseminators of climatic information to have more than a single research cycle within one community where farmers could plan, implement, reflect and evaluate the process again.

8.6 Summary

The stories of the five smallholder farmers from Mujika' three villages of Nkabika, Bulimo and Malomo effectively represented the climate learning of the whole Mujika community that occurred from 2007 to 2010. Actually each one of the baby trial farmers and many others who attended CAPES activities could tell their own stories of climatic learning and when considered together they could tell of the Mujika community climate learning also. The view of Mujika's climate learning from the particular specific situations of five community members provides evidence of CAPES's

effectiveness in reaching the individual households with climatic information. The community was friendly and open to researchers, willing to learn while key informants assisted researchers. The crop traditionalists selected crop varieties for planting each season based on their suitability while the difficult community members were also instrumental improving to all that given an opportunity they could do better. This approach hence is a useful tool for evaluating climate learning of a community and is recommended as a monitoring and evaluation for other areas. Thus individual learning was useful in determining the effectiveness of CAPES from the community baseline, through design and implementation of community information dissemination plan; to monitoring and evaluation phases.

Each individual farmer's story starts with information that presents a series of problems such as lack of money, poor soil fertility, erratic rainfall etc that were used as baseline to monitor changes related to the individual and community. One could tell every farmer in Mujika area understood their personal problems quite well. The Mujika community members had different views of the priority of community problems and strategies for addressing them but by consensus agreed that erratic rainfall was their number one problem and awareness of climatic information was the best available opportunity to address. The stories reveal the CAPES used the multi-disciplinary climatic information dissemination modes such as public meetings, learning by doing, radio broadcast, radio listening, printed literature etc were effective in regularly reaching the Mujika community with climatic information. The stories further reveal that CAPES was successful in Mujika where both early and late adopters were identified. The large numbers of slow adopters were identified during the period. From the stories the one could tell that community farmers participated in climate meetings, interpreting the forecast, decision making using IK and SCF where crop variety selection and management practices were chosen. Farmers in Mujika were also involved in the farmer to farmer interactions; they participated in field experiments and introduction of Sunn Hemp and they evaluated the project activities at the field days.

These stories also reveal that some Mujika community members adopted a combination of SCF and IK and changed the way they made decisions concerning their cropping system, particularly in the matter of choice of cultivars, planting dates, and crop rotation with legumes. Crop traditionalists like Clement did not totally abandon their local maize varieties after acquiring climate information but planted them along with the hybrid varieties at appropriate times for each specific season due to their generic properties. This was also true for their indigenous knowledge which they used alongside with the seasonal climate forecast for decision making.

The community and researchers are discouraged from considering any community member as not being able to make a significant contribution in the community agrometeorological participatory extension service based on the individual's past failures but rather to encourage them to be given an equal opportunity. Some community norms such as considering women inferior in society hinder effective data collection and information transfer in the community agrometeorological participatory extension service. Special considerations and forums for receiving personal views especially from women should therefore be taken by use of gender sensitive approach or home visits in the community where possible.

Mujika community was made up of members with diverse characteristics that required diversified multi disciplinary dissemination modes for effective dissemination of climatic information. Each group required special attention and accommodation using different approaches to achieve the full benefits of CAPES. Each dissemination mode however, influenced the Mujika community differently.

The print media of cartoons and SCF handbills, meant for easy references to disseminated messages, was not used often but once every year with the release of the seasonal climate forecast. This was mainly due to low literacy levels of the Mujika community. The community however, found it useful in the farmer to farmer interactions as those contacted that could read got the original unaltered message. The cartoon effectively communicated information to both the literate and illiterate, and was a favourite amongst the people but confirmed the low Mujika literacy level.

The vernacular radio broadcasts together with its radio listening groups achieved heightened climatic information awareness. Radio programmes also gave training, and promoted self-learning each week Thursday for three months from November to January for three years. The climatic drama introduced attracted listeners to the programme. The audience over the three years period was consistent indicating farmers were learning something every week. Use of the vernacular radio programmes was effective but requires innovation to use drama to communicate climatic information and maintain a consistent audience over a long time. The experiments with the accompanying its modelling, field days and the social process for training, learning by doing and self-learning were used every season for three years around the mother field trial at Bulimo village. These baby trial farmers documented every activity and learnt by doing from their trials while the neighbouring farmers visited and also learnt from these trials. The annual field day provided for sharing of information by all baby field farmers and researchers with the larger Mujika community. The increased participation by the community in the field days revealed the community was

learning something. Experiments are a practical approach for sharing the benefits of climatic information in agriculture production and in CAPES. Farmers can see, and feel the result and relate it to their own situations at home.

The individual personal contacts were used for interactions and receiving feedback over the three years project period. It happened at any time using the most appropriate manner and with who so ever one met. This mode with its wide usage however, required effective training on climatic information at the beginning to ensure farmers fully understood the message so as to reduce the error that occurs during communication from one person to the next.

Information sharing using large meetings enabled easy distribution of climate information, literature and collection of monitoring and evaluation information. Farmers gathered at agreed place to interpret and discuss the climatic topic of the day. This allowed for community participation in interpreting SCF and making decisions based on the forecast for a particular season. Farmers' contributions enhanced other farmers' interest in SCF. This approach was useful in bringing the larger community's interest to the climatic recommendations made on that particular topic and for their information. However, careful usage when disseminating SCF is required as there were some farmers that could not interpret or remember the forecast correctly even after when it was repeated several times.

From the stories, my view is that climate learning and its dissemination modes made significant positive influence in changing the Mujika community attitude, thinking and vision of climatic information to assist in agricultural production and the necessary agricultural practices. I am convinced a detailed community agrometeorological participatory extension services evaluation where a logical process should followed from the initial stages through implementation to monitoring and evaluation. An alternative evaluation could also be provided by following by selected farmers stories in the community, by researchers documenting throughout the project period. Given the fore going one can say that the qualitative research approach used in this chapter ably evaluated the CAPES project that took place in Mujika from 2007 to 2010. Thus being a complement of the quantitative approach used in the main project. It is hereby recommended that a combination of both qualitative and quantitative approaches in CAPES would provide a better evaluation of benefits of the disseminated climatic information to other community where the CAPES will be used.

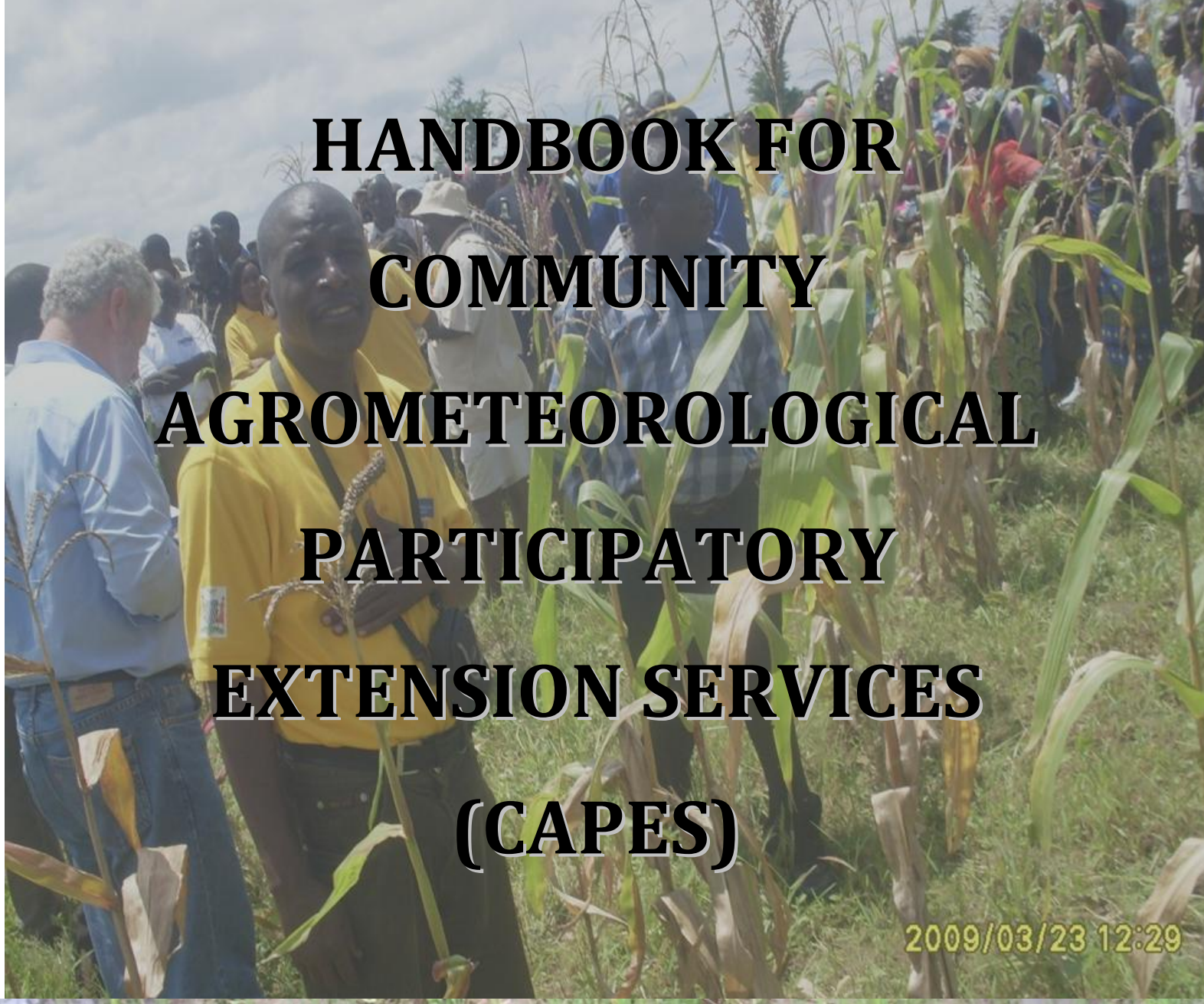
CHAPTER NINE: HANDBOOK FOR COMMUNITY AGROMETEOROLOGICAL PARTICIPATORY EXTENSION

Introduction about Chapter Nine

- This is a separate document showing how in future similar works could be handled
- It can be printed separately with the correct citation
- Can be used in the field by the
    - Department of Meteorology,
    - Department of Agriculture and
    - Non Government Organizations staff with fields related to agriculture

Therefore fonts used and the layout is different to make this distinction.

HANDBOOK FOR COMMUNITY AGROMETEOROLOGICAL PARTICIPATORY EXTENSION SERVICES (CAPES)



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HANDBOOK FOR COMMUNITY AGROMETEOROLOGICAL PARTICIPATORY EXTENSION

Table of Contents

Acknowledgement
Introduction
Section 1: Purpose and Overview of this Guide
1.1 Purpose of this guide
1.2 The overview of the guide
Section 2: **Introduction to Community Agrometeorological Participatory Approach**
2.1 What is participatory approach?
2.2 Who are the participants in the participatory approach?
2.3 Why participatory approach?
2.4 Advantages and disadvantages of participatory approaches
2.5 Participatory structure
Section 3: Implementing PAE
3.1 Self preparation
3.2 Being a facilitator
3.2.1 Managing difficult participants
3.2.2 Recording or documenting outputs
3.3 Creating an appropriate participatory atmosphere
3.3.1 Facilitator as a guide
3.2.2 Be a good listener
3.3.3 Giving instructions
3.4 Material to be used
3.4.1 Applying your tools
Section 4: Managing the Process by Steps
4.1 Step 1: Starting a programme
4.1.1 Community selection
4.1.2 Project introduction
4.1.3 Launching
4.2 Step 2: Data collection
4.2.1 Spatial data
4.2.2 Time related data
4.2.3 Social data
4.3 Step 3: Organization of problems and opportunities
4.3.1 Ranking of problems in order of priority
4.3.2 Ranking of opportunities
4.4 Step 4: Creation of Community Information Dissemination Plan (CIDP)
4.5 Step 5: Formation of the Community Agrometeorological Participatory Extension Services Team (CAPEST)
4.6 Step 6: Implementation OF CAPES
4.6.1 Information dissemination
4.6.2 Experiment: mother-baby field trials
4.6.3 Training
4.6.4 Field and home visits
4.6.5 Farmer to farmer dissemination of information
4.7 Step 7: Participatory Monitoring and Evaluation (PM&E)
4.8 Step 8: Postmortem

List of Abbreviation

CABLAC	Capacity Building, Learning and Activity Centre, Mujika, Monze, Zambia
CAPES	Community Agrometeorological Participatory Extension Service
CAPEST	Community Agrometeorological Participatory Extension Services Team
CCAA	Climate Change for Adaptation Africa
CFU	Conservation Farming Unit, Zambia
CIDP	Community Information Dissemination Plan
CO	Camp Officer, Department of Agriculture and Corporative, Zambia
D	Livestock Diseases noted as a problem
DACO	District Agriculture Coordinating Officer, Department of Agriculture and Corporative, Zambia
DC	District Commissioners of Monze, Provincial Administration, Zambian
ER	Erratic Rainfall
IDRC	International Development Research Centre, Canada
LDP	Lack of animal Draft Power
LSF	Low Soil Fertility
LW	Lack of Water
NGOs	Non Government Organizations
P	Poverty
PM&E	Participatory Monitoring and Evaluation
PRA	Participatory Rural Appraisal
PT	Planting at Wrong Times
SDA	Seventh Day Adventists

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Prospard (l) and Durton (r)
at Bulimo village 2009 field day

This handbook is dedicated to Prospard Gondwe who inspired the authors in the field, a co-researcher on IDRC/CCAA project and PhD student with Durton at UFS from 2007-2010.
Unfortunately he couldn't make it because he "passed on".
This handbook should therefore remind users and beneficiaries
that there are people like Prospard
who God used to improve their livelihood.

Introduction

The climate change challenges in developmental sectors including that of agriculture in Africa have reached levels where individual livelihoods have been seriously affected. However many efforts being rendered especially in most African countries have not borne the expected food security benefits. This has called for rethinking of strategies to use for improvement of adaptation adoption. From about the mid-1980s the participatory approaches in addressing community concerns have been preferred more than the traditional top-down approaches. Participatory Rural Appraisal **(**PRA) was introduced which emphasized ownership, planning, management and analysis of data by rural people, with the role of outsiders being mainly that of facilitation. PRA has been defined as *"a growing family of approaches and methods to enable local people to plan, act, monitor and evaluate"*. The suitability of the PRA to promote sustainable agriculture productivity especially amongst smallholder farmers requires further development.

The Community Agrometeorological Participatory Extension Services (CAPE) has been developed using the participatory techniques and the need for agrometeorological services. The main aim is to promote sustainable agriculture productivity. The IDRC/CCAA project that was conducted in both Zambia and Zimbabwe from 2007-2010, aimed at studying the possibility of developing an effective community agrometeorological participatory extension strategy where attempts were needed to develop agriculture adaptation interventions with the participation of farmers. This was aimed at making agriculture more sustainable by using the available climate forecasts.

Section 1: Purpose and Overview of this Guide

1.1. Purpose of this guide

The aim of this guide is to build the capacity of the agrometeorological extension officers in using community agrometeorological participatory extension strategies. After a formal training the new agrometeorological officers, will still need additional guidance in the field. This guide is meant as their reference. Other extension officers wishing to use this community agrometeorological participatory extension guide could also find it helpful.

1.2. The overview of the guide

This guide is divided into five sections.
Chapter 1: Describes the purpose of this guide and for whom it is meant.
Chapter 2: Discusses aspects of community agrometeorological participatory methods and their relevance.
Chapter 3: Discusses the management qualities for community agrometeorological participatory extension strategies.
Chapter 4: Guidelines for starting up a community agrometeorological participatory extension strategy.
Chapter 5: Approaches used in the community agrometeorological participatory extension.
Appendices: The appendices provide a reference to the guide.

Section 2: Introduction to Community agrometeorological participatory Approach

2.1. What is the participatory approach?

Participation is involvement or making a contribution in undertaking an assignment. Contributions in this case are mainly from those involved in the assignment. An approach is a way of getting close or there (The Free Dictionary). So participatory approach is therefore the ways people are involved in making their contributions.

Agrometeorology combines the two sciences of agriculture and meteorology for sustainable agricultural productivity using weather and climate information. When improved agricultural productivity is approached by way of stakeholders implementing agrometeorological activities it is called a community agrometeorological participatory move. It is the way a community is involved in or contributes to their own agrometeorological programmes. Agrometeorological programmes also have developmental stages such as designing and implementation. A number of considerations such as skills, knowledge, experience and commitments are made during participation. The community may lack agrometeorological or agricultural expertise in their agrometeorological programmes and may require external skills and supports. This also means a sustainable community agrometeorological participatory programme would involve stakeholders and partners from outside that community. The stakeholders share and control the agrometeorological development programme by taking part in all the stages.

2.2. Who are the participants in the participatory approach?

Often participation is taken to mean only for the community as they get involved in a community project,

however this notion requires clarifying. Building on the understanding that contributions are mainly for those whom the assignment is meant for, we can confidently say participation is not only for the community that is directly affected, but also for those indirectly affected. The effect of climate change and climate variability in reducing food security of a community for example, does not only affect that community alone, but a country as a whole. Government and NGOs involvement in an agrometeorological project in a community does not mean they should ***only*** be facilitators or observers since they are also affected in one way or another. In other words, though they do not live in that particular community they are stakeholders and must contribute accordingly. It should be appreciated that a stakeholder can be chosen to be a facilitator of a community agrometeorological participatory programme. It will then require that he or she must undertake the role of facilitator. It must be appreciated that contributions will differ for participants at each agrometeorological developmental stage. However when considering full project participation, segregation should not be made on who has contributed what or more at which stage but rather whether everyone had played the required role.

2.3. Why participatory approach?

Donors and higher learning institutions may notice the food insecurity situation in the world or a country during their monitoring and may want to undertake programmes to address the situation. Previously some programmes were developed without much consultation with the community involved. Many of those programmes in the end had little or no impact at all on community whom they were designed for, because the activities ended at the end of the programme funding. One of the lessons learnt in these previous efforts was the need for community involvement at all stages of the programme with a view of attaining sustainability. It was discovered that programmes that involved the community members and all stakeholders were more successful and sustainable over a longer period of time. Hence, this is the reason for the participatory approach. In participatory approaches, the community more easily adopted ownership of the projects because they had been involved at all levels from formulation to implementation and evaluation. The community by participating gained skills and experience in project management which ultimately supported their individual economical development.

Participatory approaches' working with both genders improves collection of data on community needs and cultural issues. It also helps to solve and manage conflicts in development projects. The inclusion of monitoring and evaluation into agrometeorological projects lead to better project management and a possibility of quick corrective measures being taken. No one individual may be able to address the problem alone, but they could be easily managed as a team of stakeholders. A community, as in the Mujika case, may be able to identify a problem, know the solution to it but lacked the know-how for managing it and therefore needed the involvement of the agrometeorologist for guidance and knowledge dispensation.

The affected communities, by identifying the problems and possible solutions for every notable identified problem were the best change agents for initiating, planning, designing and implementing a community agrometeorological participatory extension strategy. The agrometeorologist, agricultural personnel and other agents outside the local community may also be called in as externals to play their specific roles in the agrometeorological programmes. In the community, external agents will also share their knowledge about in project planning and management as well as help with problems identification and analysis.

2.4. Advantages and disadvantages of participatory approaches

No matter how good an approach may be, it will have some advantages and disadvantages. Documenting the advantages and disadvantages would help future users and the community to better understand and know how best to use participation approaches.

The following are some of the advantages of participatory approaches:-

1. The local communities identify their own problems and the causes;
2. They also identify the opportunities available for solving those problems;
3. Data collection in community is improved and thus also project design;
4. The community plan and design the agrometeorological projects to address problems;
5. The community identifies external developmental supporting agents and institutions for the sake of project sustainability;
6. Community's participation in the agrometeorological projects is enhanced;
7. The success of the project is achievable;
8. Project ownership and adoption of options is more viable;
9. Community contributions to the project are possible;
10. The monitoring and evaluation of the project is improved;
11. Project continuity is possible.

There are also some disadvantages that should be borne in mind when undertaking participatory approaches. The following are some of them:-

1. Participation is not a solution to all community concerns as some perceive.
2. It can take longer for the community and other stakeholders to develop the operational drive needed to manage a participatory project. But if the agrometeorological project has to be sustainable, patience is needed with all participants.
3. Often there are negative assumptions that there are two groups: key players and observers. This notion requires correcting.
4. It is sometimes assumed that agrometeorological projects are for the agrometeorologists alone. Efforts to bring about understanding of real purpose should be made.

2.5. Participatory structure

An example of a participatory process with seven steps for a community agrometeorological participation extension service is given. Each step is briefly described below:

STEP 1: Starting a programme: This step considers the idea of a community agrometeorological participatory extension service (CAPES). It also considers who else may be involved and how they will participate.

STEP 2: Data Collection and Problem Identification: This step uses various approaches and activities in discovering the real limiting factors and gaps. A number of problems may be identified in the process.

STEP 3: Organization of Problems and Opportunities: This will involve prioritizing identified problems. The ensuing analysis should be in a manner that will provide the extent of the problem, impacts and other associated effects as well as opportunities to address them.

STEP 4: Creation of Community Information Dissemination Plan (CIDP): This will involve the creation of a CIDP by participants. Using the opportunities presented and identifying the necessary actions to be undertaken, the stakeholders will also identify who will undertake each assignment and give the time frame for action. The available or developed climatic information or that gained from learning by doing will be disseminated.

STEP 5. Formation of the Community Agrometeorological Participatory Extension Services Team (CAPEST): While participating institutions will be identified in the CIDP, it will require that a special committee of individuals from these institutions agree to participate in the day to day project management. This is the body that will, on behalf of the larger community, be tasked with the day to day management of the community agrometeorological participatory extension service (CAPES) to a certain community and shall be called the Community Agrometeorological Participatory Extension Services Team.

STEP 6: Implementation: The CIDP will require implementing through the involvement of the larger community under the leadership of the CAPEST.

STEP 7: Monitoring and Evaluation: All the developmental stages of the agrometeorological programme require monitoring and evaluating. The developments are monitored by the community as they unfold with timely and appropriate corrections made as the need may arise.

STEP 8: Exit of Development Team and Takeover by Operational Team: During the development stage it would be required to check whether one achieved what was intended. Since it would be a continuous learning process, planning for a continuous operational phase would then be required while building on lessons from the previous engagements. The developmental team by community regulation exit and a new operational team are put in place.

Table 1: The eight part structure of community agrometeorological participation extension

STEP 1: Starting a programme
STEP 2: Data Collection and Problem Identification
STEP 3: Organization of problems and opportunities
STEP 4: Creation of Community Information Dissemination Plan (CIDP)
STEP 5: Formation of the Community agrometeorological participatory Extension Strategy (CAPES)
STEP 6: Implementation
STEP 7: Monitoring and Evaluation
STEP 8: Exit of development team and take over by operational team

This approach views the community as being at the centre of improving their own livelihood. This is a good approach where a community begins by identifying its own problems. However, to do so the community investigates the extent of the problem, supported by available data on the problem, so as to understand it in all contexts including the causes. Then the opportunities must be identified as solutions and or adaptations, by brainstorming ideas to address opportunities and to design a management strategy, so as to make it easier to improve their situation. The effectiveness of the CAPES however has to be tested through the implementation of the CIDP, where the community is involved in its monitoring and evaluation. This data collection process concludes with a postmortem and initiates planning for the next operational phase to address the further climatic challenges.

Section 3: Implementing CAPES

To implement this guide there are three important aspects one needs to consider. These are self preparation, being a good facilitator and knowing the tools you will use.

3.1. Self preparation

To be a successful facilitator of participatory programmes you must start with yourself by being adequately prepared. You have to be prepared at all times as it is essential that you have the required materials. You will need to have a good understanding of the methods you will use, how you will do it and the reasons to use it. Planning on how best you will approach a community is equally vital while ensuring all the tools to be used are available. Use of local examples, where possible, in your tools is encouraged as this will build your integrity with the community. You should remember the objective is to ensure that your community or audience is benefiting fully from the interaction. The self preparation stage is essential especially for new facilitators. Rehearsing the process and trying your tools before-hand would be a good idea.

3.2. Being a facilitator

The successful implementation of this guide will depend on how well you handle your facilitator roles. You may be facilitating an agrometeorological programme in a community where you are a direct stakeholder. It is hence essential to learn the basics of participatory facilitation. In a participatory project the role of each stakeholder is considered as equal to that of the other players. As a result, it is necessary as a facilitator to put or consider yourself as one of the community members for whom the project is intended.

There are some basic factors you should know as a facilitator pertaining to the community and yourself. As a facilitator you should realize your role is as follows:-

1. Facilitating a process and not managing it. Apart from providing guidance to the participation process, you will also have to ensure that:-

- all the participants / community should understand the purpose of the community agrometeorological participatory extension that is to be established and that the project is theirs and for their own benefit;
- everybody must participate or take part in the exploration and identification of problems, analysis and identification of possible adaptations of interventions or solutions;
- all should also take part in the identification of the possible plans for action;
- community should know that the community agrometeorological participatory extension requires their full involvement during implementation for it to succeed;
- Out spoken persons should be placed in a group, that is likely to accommodate his/her ideas in discussion that is only if you are dividing a large group into smaller groups.

2 Guiding the process of problem solving is not:

- a guide to solving a particular problem;
- providing information to a community before you are asked to do so;
- correcting or changing group decisions whether right or wrong in your eyes but helping the group in the participation process;
- to assume group competence or incompetence in addressing the subject at hand.

Working as a facilitator is not a simple process, as it demands certain skills to achieve a viable result. Some of these skills will be expanded and explained in the following sections.

3.2.1. Managing difficult participants

Not all the meetings you will facilitate will be easy ones. Situations with some difficult participants will be common and if not handled properly could lead to poor participation or even closure of a meeting. Examples of certain individuals and how they can be handled:-

- Those who could be indifferent to the whole idea or process
  - You may talk to him/her privately or talk with one of the local leaders to discuss the situation;
  - Request him/her to allow others to have their opinion tabled and also hear;
  - May give the individual a special task during the meeting;
  - It would be advisable to place such a one in an appropriate group with a strong leader if you separate into smaller groups.
- More vocal participants not allowing others to talk
  - Ask specific people to answer questions and contribute to the discussion;
  - Openly encourage everybody to participate freely.
  - Discuss politely and privately with such a one to request them to give others a chance to participate as well.
- Gender balance
  - Some traditions require segregate of men and women and may not allow women to freely participate in public meetings;
  - Split the group into separate sub-groups that of men and women while tactfully trying to explain benefits of teamwork. Gender analysis tools explaining the various roles of men and women could be helpful at this stage.
- Less talkative or shy people
  - Some people, for a variety of reasons, may feel uneasy or afraid to participate in a large group, so

make each and every one feel at easy and accepted.

- It is recommended to divide the group into smaller subgroups.
- Your judgments in doing this should be taken with care to allocate them in groups where they will be able to more easily participate.
- Perhaps go round the groups and ask each to introduce themselves.

3.2.2. Recording or documenting outcomes

A variety of tools and materials should be used in keeping the records of the community agrometeorological participatory developmental process. This is not mainly aimed for you as a facilitator or change agent but for the larger community who have different educational levels. Not all community members are able to read the written notes of the proceedings but can learn from a video or photos for example. While it may be impossible to keep all records in say pictures, it is necessary to preserve as near as possible a complete record of the developmental process for reference purposes. These may be in a book format or documentary which tells the story of the developments of the community agrometeorological participatory extension. It is advisable to store theses copies of records in different places as accidents such as a fire could destroy the infrastructure if only one copy is stored and could lead to the loss of all the records of information.

Although as a facilitator you may be taking records of the development process, it is advisable to have at least two community volunteers to be doing the same. This will help increase the base for recording information as no two people will ever record a story in the same manner and from the same perspective. Your documentation should include all things, even on those aspects which at the time you think you will not require further information.

3.3. Creating an appropriate participatory atmosphere

In cases where the atmosphere may be rather difficult and not very conducive for a participatory process, it is the duty of the facilitator to engender a free atmosphere where all can contribute.

- You may begin by using some funny icebreaker exercises to break the tension and set the people at ease.
- After the usual protocol of starting a public meeting, you can ask the participants to agree on meeting norms (dos and don’ts).
- If the group is large and you have to break into smaller groups, ensure where possible groups of not more than 20 people each are formed though a smaller number can work better.
- Allow each group to take full control of their own meeting so that they are free to ask for clarification where ever necessary.
- Ensure there is full participation of all members in each group where mutual respect for each others’ view is practiced. It is important to emphasize this point at the beginning and one must ensure it is practiced in all groups.
- The group may ask you questions although it appears they already have the answers. Ask for their views on the same matter and they will realize they have the answers and may not bother you again

later.

- Ensure that the whole process is not boring but that you spice it with some relaxing exercises.
- Do not allow an activity to take more than one hour as participants will loose concentration and interest.
- When groups are working in sessions do not make private notes alone but everybody must be aware of what you are recording if you have to record any submissions.
- Do not use exercises with too much writing by participants as some may not be literate enough to do so. If there is much writing to be done by participants, ensure first that all participants are able to read and write or work in pairs with one who is literate.

3.3.1. Facilitator as a guide

Your main objective is to guide the community towards defining their own outcomes through a participatory process. You must therefore develop this skill, of not directing them but guiding them by using open ended participatory tools. In the participatory process they will debate and analyze until they arrive at the solution. Your patience will probably be tested during the process.

3.3.2. Be a good listener

It is important to remember, that you will be working in a community that you do not understand very well, nor do you understand their survival strategies or their adaptation to the environment. To effectively facilitate, you will have to develop an attitude of being a good listener. Regardless of your level of education, the older people may be wiser than you and the younger ones more energetic and vibrant. Listening to them will help to meet their objectives more effectively.

3.3.3. Giving instructions

You may only give instructions at the start of the exercise regarding the methodology or approaches or tools to use, so as to address their problems. You will need to explain clearly in a step by step format so that participants can easily follow the exercise. You will have to be focused to only tell then how they do it and not what to do. You must explain the purpose of the activity, and how long they have to work on each item. Since the whole idea is to come up with their own outcome, it will be necessary to be flexible all the time when they start addressing the concerns, so as to come to a conclusion. Be precise and brief in your instructions and allow for questions if any further clarification may be needed.

3.4. Materials to be used

In cases where participatory engagements may have to do with writing or drawing, you will have to be adequately prepare the necessary tools and materials. You should ensure to have sufficient materials, such as flip charts, large markers or coloured pens, writing pens, pencils, writing pads, Bostick (sticky patty), scissors, plain papers, coloured stickers, drawing pins etc, for all participants and groups, even preferably have surplus materials. You may include any other material you may know from experience is necessary when working with the community. You will need to be well organized to avoid embarrassment. Having additional material is

advisable as some of your materials may not perform as expected during the meeting.

3.4.1 Applying your tools

It is important to ensure that the materials and tools you have organized will be relevant to the community in mind and that you are also familiar with these tools. It is better to consider using tools that you are familiar with, than totally new ones that you are not, as you may be embarrassed during the process. You will have to be careful if you use a video or digital camera during the process as some participants may misunderstand your interventions. Cameras and videos can only be used after introducing their purpose and how they will benefit the community if they are used. Cartoons may also be relevant in the dissemination of information but would require your finding a suitable artist, if you are not able to draw them yourself. Cartoons could be helpful in explaining community activities and their reactions to disseminated climatic information.

Section 4: Managing the Process by Steps

This section discusses the step by step process you must take as a facilitator when working with a community from initiating a PAE programme, through to the participatory monitoring and evaluation (PM&E) of the CIDP. There are seven steps shown below which should be followed. Detailed information for each step including materials and tools to be used at each level are included. The seven-step diagramme showing community agrometeorological participatory extension is in Table 1.

4.1. STEP 1: Starting a Programme

Starting a programme is as important as its purpose. It is therefore important to ensure special care that you start the way you want to proceed throughout the programme to the end.

4.1.1. Community selection

Purpose: The purpose of this activity is to select a specific community or communities in which the community agrometeorological participatory extension can be undertaken.

***Time*:** 1 to 2 hours

Participants: The District Agriculture Coordinating Officer (DACO), and / or initiator and yourself.

The food insecurity in most of Africa's communities especially under climate change scenarios may force a community, individuals, local leader or others to approach your office for agrometeorological services. Your own position may equally cause you to consider an agrometeorological extension service with a particular community that is not effectively supported at present. Whatever the case may be, you will end up with an option of choosing a community to work in. This would lead you to travel to the chosen area to meet with the relevant administrative officers. You will need to meet the local agriculture personnel and perhaps other people to assist you in selecting the specific communities. This is essential because you will need their introduction

and support while serving in those communities. You must also ensure to introduce your intentions to the district commissioner (DC) or the local government administrator or traditional leaders in that area. They will provide you with a better understanding of managing the project in that area.

4.1.2. Project introduction

This stage links you to the local leadership of the project area and is done through a meeting of selected individuals.

Purpose: The purpose of this activity is to have an initial visit to the project area and better understand the potential of the project. The other is to introduce the project to community leaders and get their reactions, support and buy-in.

***Time*:** 1 to 1 hour 30 minutes

Participants: Village Headmen or Headwomen of the targeted community, agricultural extension officer / agricultural camp officer(s), the DACO as your referral and yourself as agrometeorologist.

Ask the DACO to link you to the specific communities where you can make appointment to meet with the respective village Headmen or Headwomen. On the selected day, ensure to arrive on time for the meeting. Remember modern furniture is rare in most rural areas of most developing countries, so you must be ready to find yourself an appropriate place to sit which may even be on the ground as you wait for the meeting. If a seat is provided you should kindly accept and use it. However do not be frustrated when you realize that the meeting does not start on time. In some communities, time management is seen from a different perspective, but despite this, there is a good chance that they will still come to attend the meeting. Even when everyone has come they will still want to spend time to get to know you and learn about your personal details in an informal manner before the start of the meeting. So you will have to exercise patience. This is important for both parties as they start to assess whether they can trust you or not, while from the beginning you also must make an effort to prove to them, beyond any doubt, that you have good intentions. You will have to dress modestly as some communities can be offended by some dress codes. You must not try to change your image but just be yourself, unless you have a hidden agenda. If you cannot speak the local language, try to learn a word or two beforehand especially that used when greeting the elders. You will create a good feeling in them that you have a strong desire to work with them and this could help them to more easily welcome you to their community.

The designated person will then call the meeting to order. After the DACO has introduced you and your intentions, they will allow you an opportunity to provide details of your proposal. Remind them you are there to help them in uplifting and development of the people using available resources including that which you may be able to access. Remember to ask them for feedback and to give their opinion of your proposal, while you listen attentively. When the local leadership accepts your idea, they may openly tell you and inform you of how

they feel it can benefit the community at large. You can then all discuss the launching of the project to the larger community and where it can be held. They will also assist you in identifying other stakeholders whom they feel could be part of the project according to the roles they play. Develop and note or record the stakeholders list immediately it is introduced. You will have to arrange for a full stakeholders meeting and provide detailed project information. Delegated community members and representatives of the stakeholders' organizations are now called the "Team" and must be tasked with the role of implementing and managing the community agrometeorological participatory process.

4.1.3. Launching

This step provides an opportunity for the larger community to learn and approve of the proposed community agrometeorological participatory process.

Purpose: The purpose is to introduce the proposed community agrometeorological participatory extension programme to all members of the broader community to receive their response, and to prepare them for physical engagements and involvement that will to follow.

Time: 2-3 hours depending on the size of community and number of dignitaries attending the occasion.

***Participants*:** All the community members including those from neighbouring areas should be invited and are welcome to attend.

Material: Depending on the size of the group, you may need a large banner if it is a very large gathering and brochures in the community's preferred language, if some of the community members are literate. A public address system would be useful for very large gatherings. A flip chat may be used for smaller gatherings. Refreshments may be required thereafter.

At this stage, you will start to feel whether the project would be able to run or not depending on how the local leadership is involved in the launching exercise. Therefore try to ensure that the community starts to understand that they are managing their own programme as the benefits are for themselves. Ensure the invitations are widely distributed and sufficient time is allowed for people to prepare for the public meeting. This is important since you will be preparing the farmers for some other involvement thereafter. They therefore need to be present, so as to fully understand what their roles will be in the community agrometeorological participatory process.

Ensure protocol is observed and honour given to whom it is supposed to be given. Acknowledge everyone and show them you are happy with their attendance and response and that you look forward to working with them. Some dignitaries get offended when they are not recognized and thereafter may not fully support your efforts in the area. You need everyone's support therefore do your best to ensure they are brought on board.

Be eloquent and as clear as possible when introducing the proposal. Emphasis that the local leaders also

agree that the project is trying to address their situation. Remind the community that they will be the key players while you will play the role of a facilitator and that the project would depend mainly on the available resources including that which you may be able to leverage. You will have to explain the community's role in the community agrometeorological participatory process. Ensure that they fully understand their roles as it will greatly help in influencing their level of participation and commitment. Allow for questions and discussion where possible to ensure everybody is satisfied. Remember to ask what the community view is of the proposed community agrometeorological participatory extension strategy. If agreeable, which in most cases they will, because it will have been designed to address their concerns, thank them for their interest and encourage them to ensure the project succeeds by their full participation throughout all stages. If they happen to refuse, enquire as to what they feel was wrong with the idea. Quickly investigate and see whether their recommendations are feasible or not and can be incorporated. This will help you improve on the project if it has to be considered for application elsewhere or make necessary amendments if requested. You may further enquire whether they could approve of it after their concerns or adjustments were addressed. If you have to consider the recommendations, do it together with the leadership team in the community's view and provide an immediate response thereafter. This will increase community confidence in you, community teamwork and that the process remains a participatory one. Conclude by informing the people of the expected schedule of activities, such as data collection, following their acceptance of the project.

4.2 STEP 2: Data Collection

This step engages you directly with a particular community in the participatory data collection. You need to collect field data which include spatial, time related and social data. Let's assume you decided to collect data village by village, from the selected villages then arrange separate meetings in each of these villages, which will be easier to manage than a very large group of farmers from all villages which may be complicated and cumbersome. You will have to start the data collection process in one village and probably complete before moving to the next selected village. A smaller single village population will enable you to more easily manage the data collection process.

Purpose: To enable both the community and yourself, to full understand the community's social and climatic historical background that is influencing their behaviour and livelihood.

Time: One to two days. This is dependent of the size of the community and number of groups involved in this step, and the amount of information to be collected as well as the true commitment of the people.

Participants: All the members present at the selected village which includes children.

Materials: You may need some of the following materials: - Flip charts, large board markers, coloured pens, writing pens, pencils, writing pads, Bostick (sticky patty), scissors, plain paper, coloured stickers and drawing pins etc.

4.2.1. Spatial data

4.2.1.1. *Community sketch maps*

Purpose: To draw detailed community sketch maps.

Time: 45 minutes

Participants: All the members present of the selected village which includes children.

Materials: Large markers of different colours and flip chat papers.

Ask the community to draw a sketch map of their area showing the natural resources but do not forget to explain why this is needed. The village participants may work as one group or in subgroups. First they should put main geographical features and roads etc. Somebody may be drawing the identified the resources on the provided paper, while the rest mention them aloud. It may be drawn roughly during the provided time but it could be redrawn, if necessary after full consensus is obtained for the whole map. This could also be done on the ground using sticks, stones, other materials etc then transferred to a paper to keep a record. Let one person later present and explain the sketch map in plenary session. The community map will give both the facilitators and community a detailed understanding of the available community resources, their location, size, problems and opportunities available. The Bulimo village sketch map is given as an example.

Figure 1. Example of a community sketch map for Bulimo village drawn on 9th September, 2007 at the marketing board

4.2.1.2. *Transect walk*

Purpose: To walk a transect through the village to confirm the details provided by community members on the sketch map and it will also help to identify any additional information.

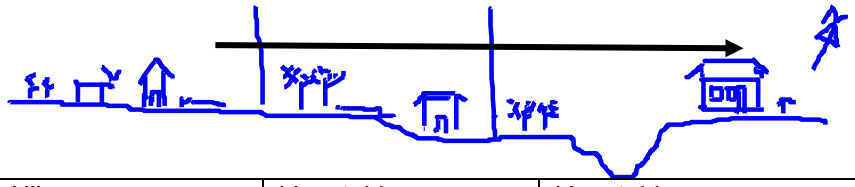
Time: 45 minutes to 1 hour

Participants: The facilitator and three to four community members identified during the meeting.

Materials: Stationary, pens and form for entering the specific details as identified

The identified members will accompany you on a transect walk. It is advisable to rather walk than drive through the village area. Ask your team to start your transect from one corner and walk along a diagonal to the opposite corner. Try to record all identified details along the way as reflected on the transect example for Malomo village (Table 2). Interview a number of people you meet along the way regarding what you have seen and related issues. After the transect, draw a detailed cross section segment by segment showing a summary of the physical features (type of vegetation, buildings, developments etc) identified along the way. Transects will provide and confirm information recorded earlier on the community sketch map; identify other details particularly natural resources and transport routes and other community useful places like schools etc together with a summary of problems and opportunities available to the community.

Table 2: Transect through Malomo village, Mujika area in Monze district conducted on 4th September, 2007.



Crops	*Nil*	*Vegetables*	*Vegetables*
Soil	*Sandy loamy*	*Sandy loamy*	*Sandy loamy*
Vegetation	*Natural bushes*	*Roofing grass, Muunga*	*Bananas, sisal, Acacia, roofing grass*
Water	*Wells (2)*	*Wells (3)*	*Swamps, well*
Social	*Few permanent buildings, grave yard*	*Grocery, few permanent roofed houses,*	*Football ground, CARBLAC school, few permanent roofing building*
Problems	*Animal disease, Lack of clean drinking water, Poor crop yield,*	*Poor crop yield, low soil fertility, animal draft power*	*Livestock disease, low food production, erratic rainfall*
Opportunities	*Boreholes, Use of legumes, fencing farms & dipping animals, old fuel filling station*	*Grazing grounds, use of legumes,*	*Grazing grounds, Building of weir / Damming of stream, Irrigation*

4.2.2. Time related data

Your attention now will be on collecting information about conditions and how the people perceive that they have changed over time. There are at least three time related data sources you can collect including historical time lines, trends, seasonal calendars and daily time lines. In order for the historical data to be meaningful, you

want to have as many older generation present as possible, so that they can give detailed memories from their own childhood situation or circumstances.

4.2.2.1. Historical time lines

Purpose: To record community historical background and what they considered as major events.

Time: 45 minutes

Participants: All the members present of the selected village especially the elderly

Materials: Large markers of different colours and flip charts paper

Ask the community, while working as one group, to provide their historical trend lines. Provide a format for documenting the details. A table with two columns, one for years on the left and another for events on the right would do. While the members are providing the details one or two members may be alternating in writing the details on the provided flip chat. As a facilitator you will continue guiding the data collection through the use of probing questions regarding settlements, diseases, floods, droughts, famine, political or church events etc, to continue encouraging all members to participate. This is necessary so as to widen their search for what they considered as important occasions that may have contributed to their current attitudes. Understanding their history will help you to search for appropriate options of presenting the desired information as some communities may get offended with presentations in certain formats or jokes because of their historical backgrounds. Ask the group to identify someone to present their historical timeline to plenary session. An example of the historical timeline for Malomo is shown as Table 3.

Table 3: Example of a historical time line for Malomo village, Mujika area, Monze district

YEAR	EVENT
1910	The Malomo village established by Seventh Day Adventist (SDA) missionaries under the first headman Philip Malomo
1918	Smallpox breakout in the village
1927	Smallpox breakout in the village again
1930	Savory, a white commercial farmer introduces clothes to the Malomo villagers.
1942	Death of the first headman
1944	First adult education established where both the adults and young pupils could learn together in the same class
1946	The second headman installed
1947	Hunger befalls the village
1952	Disappearance of the wild animals in the area
1953	The first Malomo Seventh Day Adventists (SDA) church built
1956	Break out of polio and whooping cough in the village
1958	Floods engulf the village
1966	The first borehole for water supply was dug
1969	Measles epidemic in the village
1973	Corridor disease breakout and herds of cattle wiped out
1975	The first Malomo community school established and death of the second headman, Dingilizwe Malomo
1976	Job Malomo installed as the third headman of the village
1987	Nkalanga health post established
1988	Outbreak of Corridor disease in the village
1990	Hunger befalls the village
1994	Chicken disease broke out
1995	Hunger befalls the village and yellow maize brought as relief
2001	Death of the third headman
2002	Drought and hunger befalls the village
2003	The fourth headman installed. The first community based organization called Capacity Building, Learning and Activity Center (CABLAC) formed.
2005	CABLAC erects its first building in the village
2006	Occurrence of floods in the village

4.2.2.2 *Trend lines*

You may need to collect trend information on rainfall, population, soil fertility and crop production or other trends of important information over time.

4.2.2.2.1 Rainfall

Purpose: To record the community's perception of rainfall occurrence

Time: 45 minutes

Participants: All the members of the selected present village which includes all generations

Materials: Large markers of different colours and flip chart paper

Using the same community agrometeorological participatory approach and with the community still working in groups, ask the participants to mention the rainfall performance starting from the earliest year any one of them can remember to date. Since they do not have the actual values encourage members to indicate whether the rainfall was low, medium or high. If a particular year was considered high, they should indicate for how long that particular situation had continued. Encourage the participants to be alternating responsibility to document the details on the flip chart. The participatory principle encourages teamwork and handing over the pen. The rainfall trend analysis will improve and provide a visual view of farmer perception of rainfall occurrence. An example of the rainfall trend for Nkabika is shown in Figure 2.

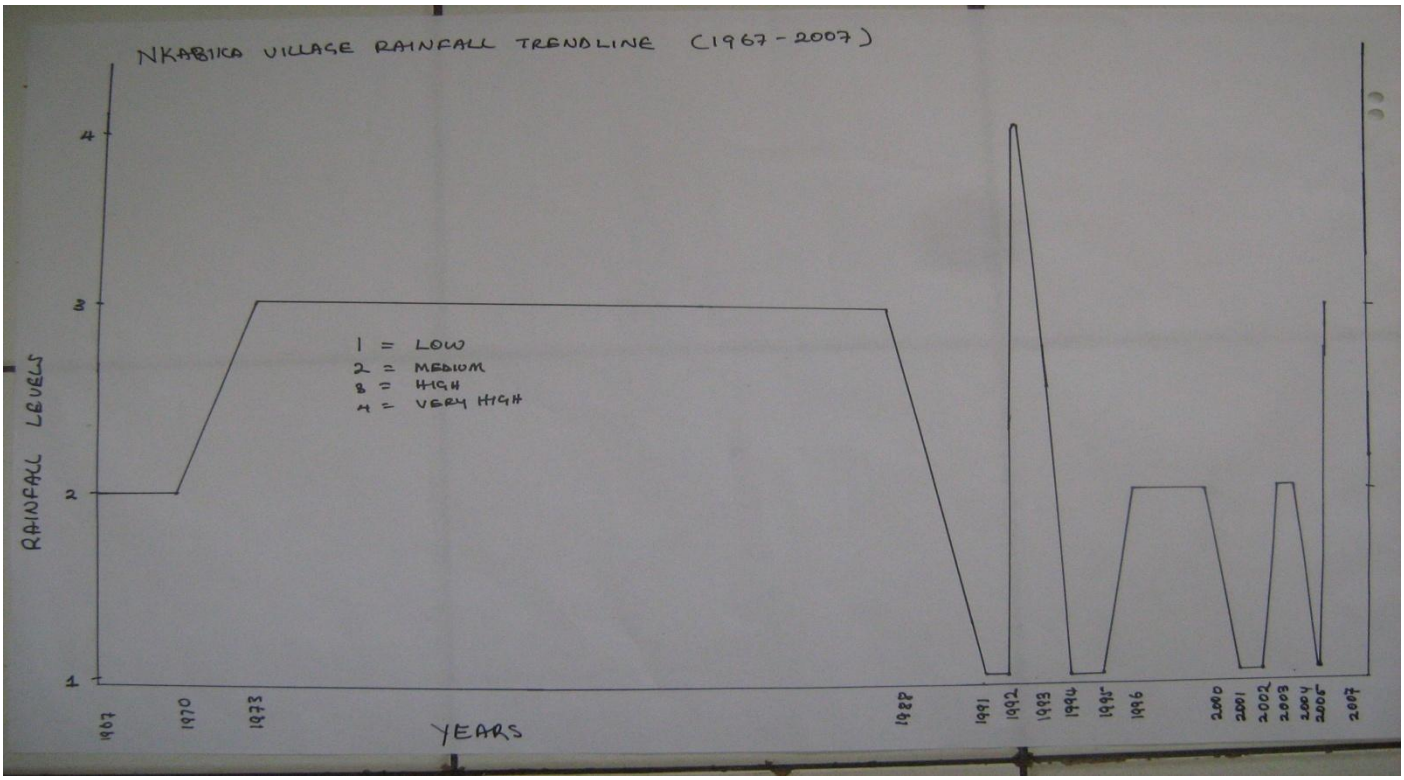


Figure 2. Rainfall trend line for Nkabika village created on 4th September, 2007 by group of farmers

4.2.2.2.2 Population

Purpose: To document the people's perception of the total number of people in the community

Time: 30 minutes

Participants: All the members of the selected village which includes children and the elderly

Materials: Large markers of different colours and flip chart papers

In their same group ask the community to now indicate the population changed over the same period used for rainfall to date. Similar categories of low, medium and high should be used to describe the community population trend. Reasons for changes if any should be given. This information will help you when analyzing relationships between crop production and other elements such as soil fertility. An example of the population trend line for Malomo is shown Figure 3.

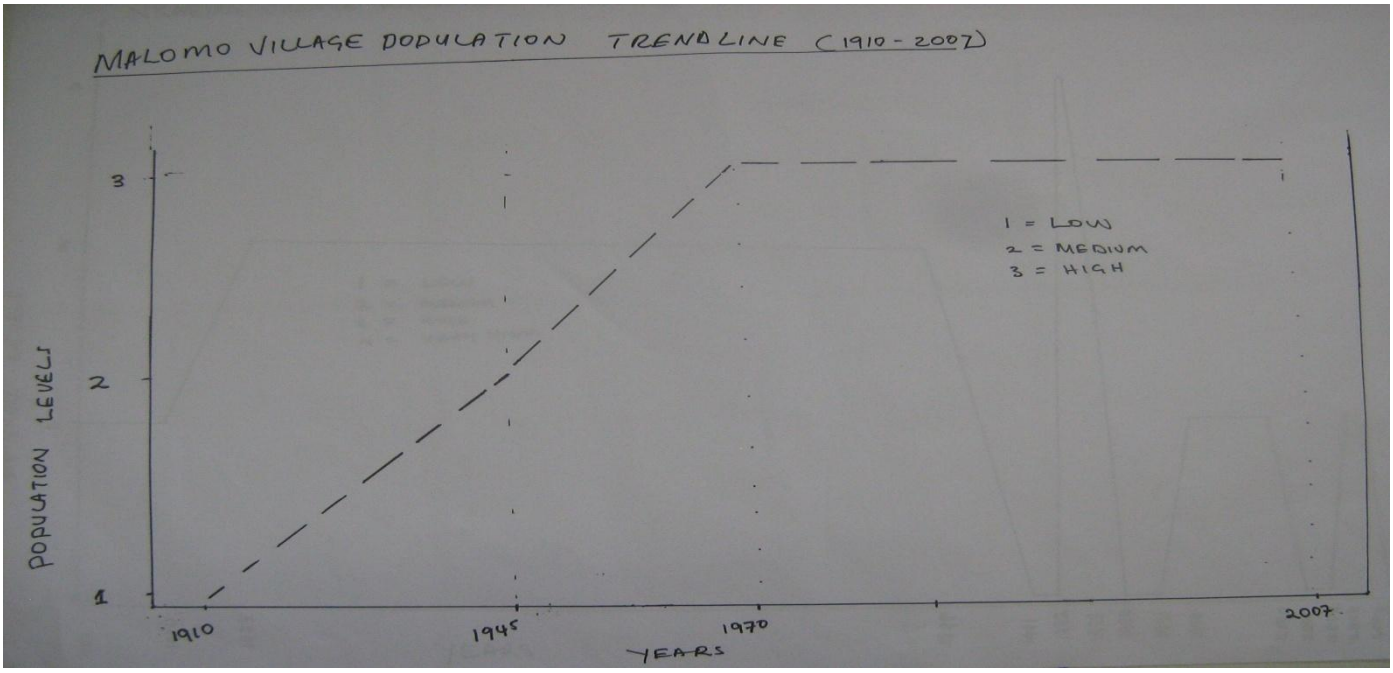


Figure 3: Malomo village population trend line (1910-2007) created on 7th September, 2007 by group of farmers

4.2.2.2.3 Soil fertility

Purpose: To record the people's opinion about the trend in the soil fertility.

Time: 30 minutes

Participants: All the members present of the selected village which includes children and elderly

Materials: Large markers of different colours and flip chart papers

Ask the community to draw trend line for the way they understand the soil and its fertility changes over time just as they did for population. This should be much easier now as they have gained experience on making trends. Keep ensuring the participatory spirit is continuing. Encourage the community not to worry about the exact detail of the exact year(s) for transitions since that is not the main purpose but to record the trends. They should also try to provide reasons for soil fertility changes if any can be identified. This will help you understand the possible contribution soil fertility has made to food productivity. An example of soil fertility trend line for Nkabika village is given in Figure 4.

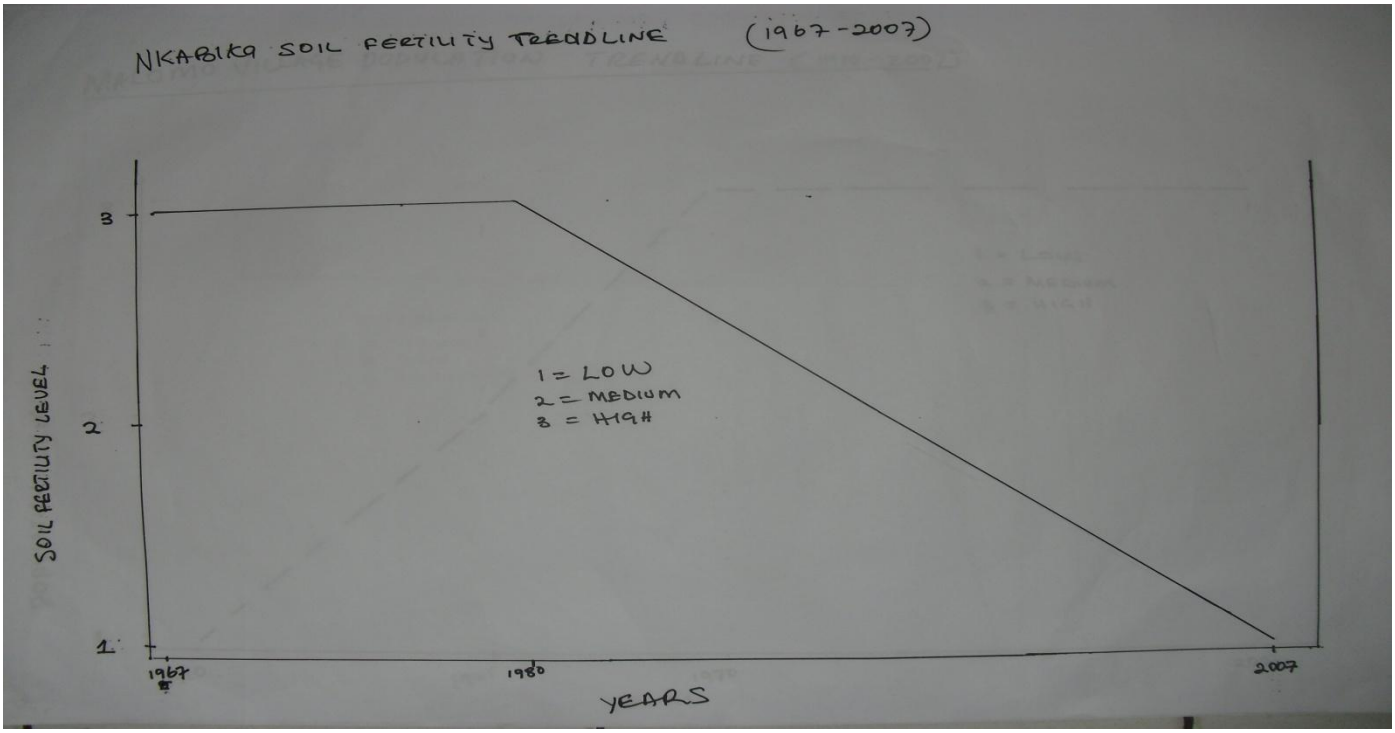


Figure 4. Community perception of soil fertility trend line for Nkabika village (1967-2007) created on 4th September, 2007 by group of farmers

4.2.2.2.4 Crop productivity

Purpose: To document the trend in the crop productivity according to the opinion of the community.

Time: 30 minutes

Participants: All the members present of the selected village which including elderly and children

Materials: Large markers of different colours and flip chart papers

Continuing in the same groups, they should be asked to provide detailed trends of crop productivity. The information will help you to gain a better full understanding of the community perception of crop production. An example of the crop productivity trend line for Nkabika is given below in Figure 5.

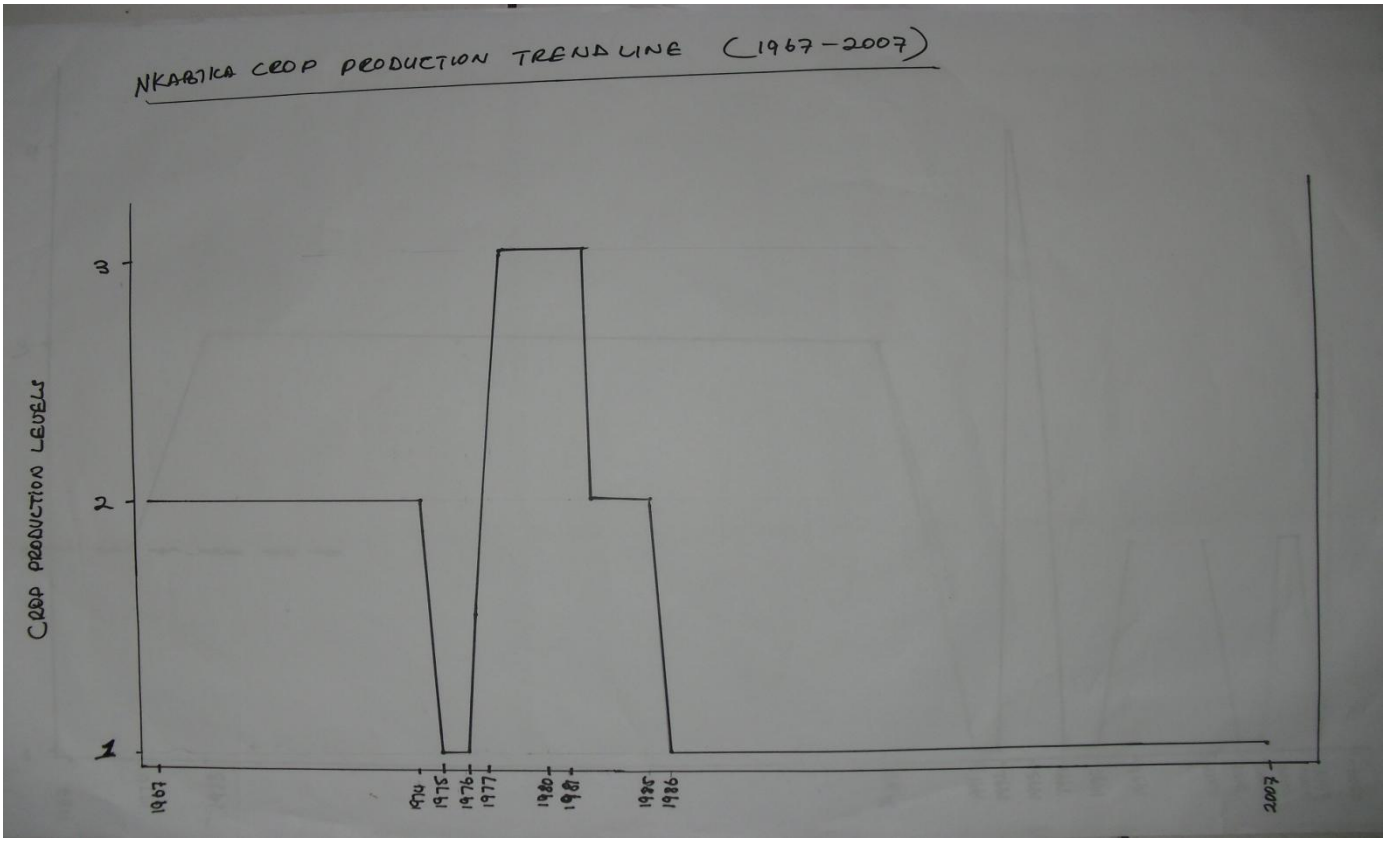


Figure 5. Community perception of crop production trends for Nkabika (1967-2007) according to the community view on 4th September, 2007.

4.2.2.2.5 *Seasonal calendar*

Purpose: To record what activities are undertaken by farmers, at what time of the year and by whom?

Time: 45 minutes

Participants: All the members present of the selected village which including elderly and children

Materials: Large markers of different colours and flip chart papers

Begin as usual by explaining what a "seasonal crop calendar" is required to show, what it is for and how to fill in the required details. An example of a seasonal calendar for Nkabika is shown in Table 4.

Table 4. Example of a seasonal crop calendar for Nkabika village

Activity	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Rainfall												
Maize	land prep (♀+♂)	land prep (♀+♂)	planting +weeding (♀+♂)	planting+ weeding (♀+♂)				harvesting (♀+♂)				land prep (♀+♂)
Groundnuts	land prep (♀)	land prep (♀)	planting (♀)	weeding (♀)			harvesting (♀)					
Sweet potatoes			land prep (♀+♂)	planting (♀)	planting weeding (♀)	weeding (♀)			harvesting (♀)			
Cowpeas			land prep (♀+♂)	planting (♀+♂)	weeding (♀+♂)			harvesting (♀+♂)	harvesting (♀+♂)			
Cotton	land prep (♀+♂)	land prep (♀+♂)	planting+ weeding (♀+♂)	weeding (♀+♂)	weeding (♀+♂)		harvesting (♀+♂)	harvesting (♀+♂)	harvesting (♀+♂)			
Sunflower	land prep (♀+♂)	land prep (♀+♂)	land prep (♀+♂)	planting (♀+♂)				harvesting (♀+♂)				
Labour availability	high	Low	low	Low	Low	medium	medium	low	low	Med	High	high
Labour demand	Low	Medium	high	High	medium	low	medium	high	high	High	Low	low
Food availability	medium	Low	low	Low	Low	medium	High	high	high	High	med	Med
Diseases	coughing diarrhea Malaria bilharzia	malaria (low prevalent)	malaria (low prevalent)	malaria (medium prevalent)	malaria (medium prevalent)	malaria (high prevalent)	Malaria (high prevalent)			sore eyes	coughing + sore eyes	

The left side of the matrix is for the crops and activities while the top right is for the period in months. When farmers fill the matrix in, they provide information or write the details of activities in the corresponding box for activities against a specific month and crops. The crops entered in the activities column should be those that are routinely grown by them. For the labour availability, labour demand, food availability and disease rows, participants should indicate low, medium or high in the corresponding box. The information will help in the even distribution of assignments for the community agrometeorological participatory extension; otherwise some people may end up being over burdened with work without this information. Knowing for example when farmers undertake their planting activities would help you determine when the climatic information is needed so as to maximize crop production.

4.2.3 Social data

Under this section you will have to collect information on institutional analysis, farm sketches, gender daily calendars and household interviews.

4.2.3.1 Institutional analysis

Purpose: To record what other institutions are working in the community, their roles and influence on the community.

Time: 15 minutes

Participants: All the members present of the selected village which including elderly and children

Materials: Large markers of different colours and flip chart papers

While still working together, ask the participants to identify other institutions working in their area. Using the large markers provided they should first write them down and then show using shapes (e.g. circles or squares etc) in the order and size of influence in the community. The one with the most influence should be given the largest circle. It is important to know which other organizations are working in the community, their influence as well as availability to develop the community agrometeorological participatory extension strategy. An example of an institutional analysis for Nkabika village is shown as Figure 6.

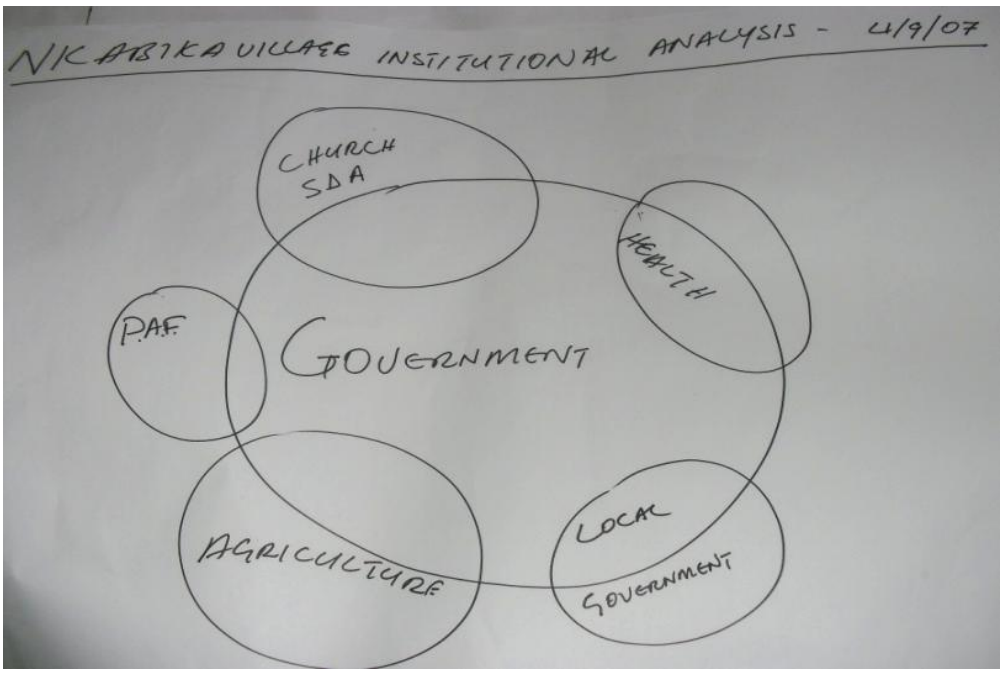


Figure 6. Example of an institutional diagram for Bulimo village as drawn by farmers on 4th September, 2007

4.2.3.2 Farm sketches

Purpose: To identify resources available to the individual farmers and how much of their land is allocated for what purposes.

Time: 30 minutes

Participants: All the members present of the selected village

Materials: Large markers of different colours and plain A4 papers

Request each participant to draw individual farm sketches indicating available resources, land utilization and infrastructure. The participants who cannot draw will have to be assisted by others. This is intended to give them a better understanding of their own individual available resources from a visual point of view. It will also give you an opportunity to understand the extent to which resources are being used by farmers. An example of a farm sketch by Mosley Hamabuyu of Malomo village is shown Figure 7.

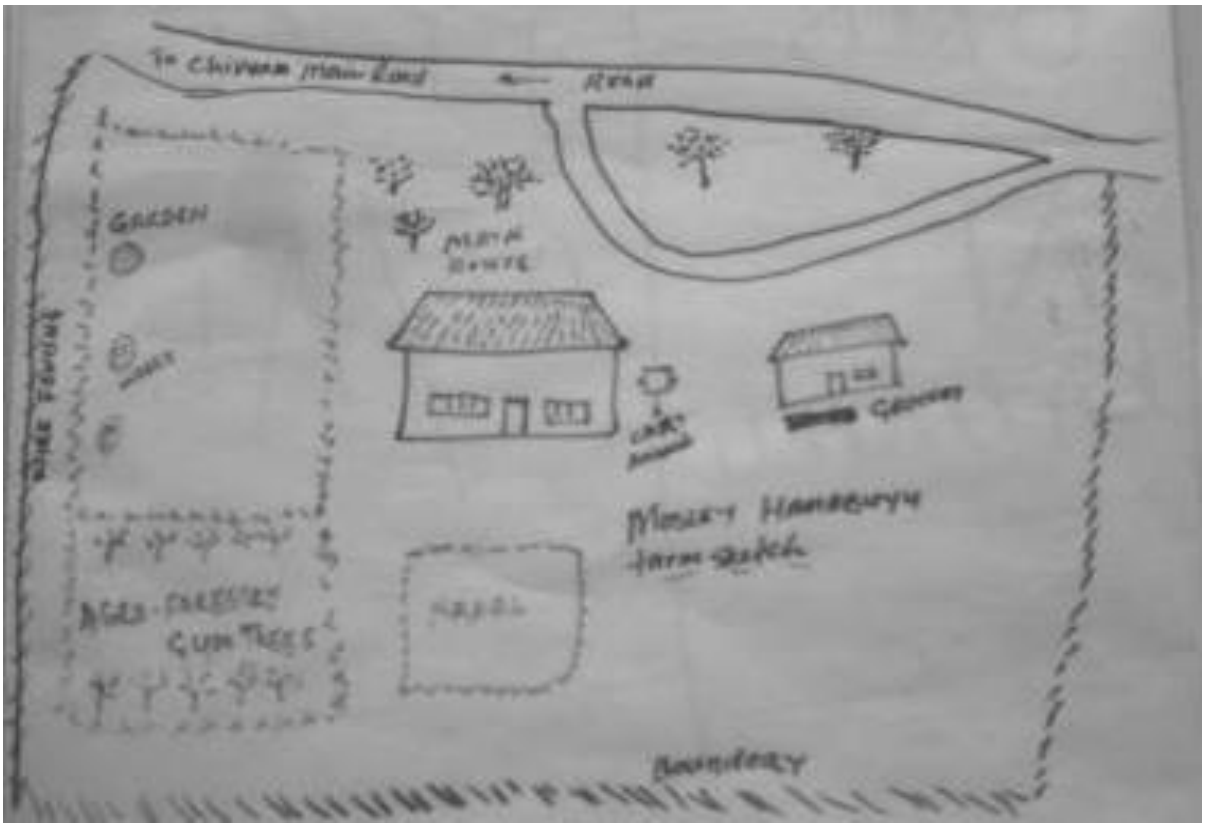


Figure 7. Example of farm sketch by Mosley Hamabuyu, Malomo village, Mujika Monze district drawn on 7th September, 2007

4.2.3.3 Gender daily calendar

Purpose: To record the gender specific daily time line in a family household.

Time: 20 minutes

Participants: All the members present of the selected village which including elderly and children and balanced gender.

Materials: Large markers of different colours and flip charts

Separating in two groups of men alone and women alone is advisable for this exercise in the African context. This will create a more conducive atmosphere especially for women who are usually overlooked by the men folks. Ask them to indicate what they do from the time they wake up until retiring to bed. When the two groups have completed their assignments, ask them to present their calendars in plenary. This will help you and the community to know who does which work on an hourly basis throughout the day in a family and know how the roles in the participatory process may develop. An example of a gender specific daily calendar for Nkabika village is shown Table 5.

Table 5. Gender specific daily calendar for Nkabika village prepared on 4th September, 2007 and recorded

Time	***Male Daily Calendar***	***Female Daily Calendar***
0500 am		*Wakes up, works in personal field digging or weeding*
0600 am	*Wakes up and goes to the field*	
0700 am	*Working in the field*	*Cleans the yard/house, prepares food for the family*
0800 am		*Working in the main field*
1030 am		*Collects firewood and returns home to prepare lunch*
1100 am		*Prepares lunch*
1300 pm	*Lunch break at the field and continues working later*	*Takes lunch to the field*
1530 pm		*Retires from field cleans pots and plates, fetches relish for the evening.*
1600 pm	*Retires from the field and goes for meetings and/or social gatherings*	*Prepares super*
1700 pm	*Rests and waits for dinner*	
1900 pm	*Eats supper*	*Serves supper to the family*
2000 pm		*Cleans plates, tells stories to children around the fire, weaves baskets etc*
2130 pm	*Private family meetings*	*Private family meetings*
2200 pm	*Retires to bed*	*Retires to bed*

4.2.3.4 Household interviews for triangulation of PRA information

Purpose: To understand the household conditions as they relate to the community general view and discover salient issues which may not have been captured during the public meetings.

Time: 30 to 45 minutes per household

Participants: All the members of the selected homestead

Materials: Questionnaire, pen and paper for recording the information provided

With the guidance of the local people, the team will go to selected individual homesteads to conduct semi-structured interviews using a guide questionnaire. You will need someone from the community to support and introduce you further in case the family being visited does still not know you or your project. He/she will translate for you in case you cannot speak the local language. Your questionnaire should already have been prepared but learn to be flexible in its use so as to capture more information. The semi-structured interview will provide you with information on household conditions that relate to the community general view. This data will be used to report and corroborate with the other information collected during the public meetings. This triangulation method helps to provide a fuller picture of the situation by combining information collected with different techniques.

4.3 STEP 3: Organization of Problems and Opportunities

The interactive engagements between community members or groups and the agrometeorologist(s) or team should continue but this time considering community problems and opportunities. This will finally lead to the formation of the community information dissemination plan (CIDP) once the data is organized.

Purpose: To check back and validate the large community data comprehensively into what can easily be accessed and ranked.

Time: 45 minutes to 1 hour

Participants: All the members present from the selected village including elderly and children

Materials: Large markers of different colours and flip chart papers

While working as one group, ask the community to first identify all their problems, then their causes, as well as coping strategies and then opportunities available for addressing these problems. In identifying the problems, the community may be required to undertake a systematic investigation into the extent of the problem. This may involve collecting available data on the problem so as to understand the extent as well as the causes. The problems may be grouped into sectors such as disease, soils, rainfall etc. The community should for each problem then identify the perceived causes, coping strategies and opportunities available. The matrix is a suitable system to collect this data, as one can brainstorm the problems and list them on the left hand side, then address the causes and coping strategies adjacent and specific to each of the problems. In this way, one can return to a section of the matrix if the discussion returns to a problem already addressed. An example developed for Nkabika village is given in Table 6.

4.3.1 Ranking of problems in order of priority

Purpose: To help the community identify which problem to start addressing given the available resources before them.

Time: 30 minutes

Participants: All the members present from the selected village

Materials: Large markers of different colours and flip charts papers

After identification of the problems, the community is advised to reduce them to only six or seven most important ones. With this list at hand, the community would now engage in the ranking of problems using a pairwise ranking matrix. This weighs each problem against another, to come up with the most pressing one. When this is completed you must count the number of times a particular problem was considered more pressing than the other. The one with the highest number of votes will be ranked as their number one problem. An example of the pair-wise ranking matrix for Nkabika is given in Table 7.

Table 6. Problems identified by Nkabika village community in Mujika, Monze made on 4th September, 2007 with 32 present.

Problems	***Possible causes***	***Coping strategies***	***Opportunities***
Lack of animal draft power	Cattle diseases Cattle theft Grabbing of animals from owners by relatives after the husband's death	Conservation agriculture using basins. Seeking employment Selling labour in turn of having your field ploughed Hiring animals from farmers with animals.	Cattle dipping and restocking, Increased police patrol in the area. Community awareness on property grabbing
Poverty	No capital Lack of markets Low prices for their produce. Laziness	Selling of produce Growing vegetables Doing some piecework. Selling Chibwantu (Sweet beer) Keeping poultry Selling goats Selling doormats	Access to money Lending institutions Learning skills
Lack of water	Lack of boreholes and reservoirs Deforestation Low rainfall	Digging of wells/boreholes Planting vetiver grass to control runoff Make basins for water harvesting	Build more water reservoirs Government to sink more boreholes Afforestation
Planting at wrong times	Ignorance	Encouraging each other to attend agriculture meetings	Awareness of climatic information
Low soil fertility	Monocropping Too much use of fertilizers Soil erosion Lack of manure usage Poor soil management	Crop rotations Plant green manures use of kraal manure Use of compost manure planting of vetiver grass and contour banding	Encourage conservation farming
Erratic rainfall	Deforestation Over grazing Erosion	Use of basins and potholing Contour banding	Afforestation Build water reservoirs Contour banding
Livestock diseases	Lack of cattle dip tanks Goats sleeping on wet surfaces Poor water quality Lack of paddocks.	Dipping the animals Building improved goat housing De-worming of the goats Supply good quality water.	Build more dip tanks Build more water points in the village More veterinary services

Organization of problems and opportunities is necessary for ranking purposes and formation of the Community Information Dissemination Plan (CIDP) after the identification of the most pressing problems and coping strategies for each problem.

Table 7. Problems matrix and their ranking for Nkabika village done on 4th September, 2007

Problems	LDP	P	LW	PT	LSF	ER	LD	Total	Rank
Lack of animal draft power (LDP)		P	LW	PT	LDP	ER	LD	1	5
Poverty (P)			P	PT	LSF	ER	LD	2	4
Lack of Water (LW)				LW	LW	ER	LW	4	2
Planting at wrong times (PT)					LSF	ER	PT	3	3
Low soil fertility (LSF)						ER	LSF	3	3
Erratic rainfall (ER)							ER	6	1
Livestock diseases (LD)								2	4

This will help the community identify their number one and most pressing problem, from which they can know which problem to consider addressing first.

4.3.2 Ranking of opportunities

Both the Agrometeorologist and the community have a chance to assess the identified opportunities in light of the pressings needs.

Purpose: This will help both community and the Agrometeorologist to know which projects have a priority to be started, given limited resources.

Time: 30 minutes

Participants: All the members present from the selected village

Materials: Large markers of different colours and flip chart papers

Working in the same groups, ask the community to rank the identified opportunities in light of the problems rating. Advise them to consider the project's cost effectiveness, sustainability, productivity etc. When looking at the cost, the community should look at whether it is affordable or not, while on sustainability how easy it is to maintain even without external support. On productivity they should consider the benefits arising from the project. This will help the community to get the maximum benefit from projects when project implementation follows.

The pairwise matrix could again be used for ranking the opportunities as for the problems. The analysis will lay a foundation for developing a community information dissemination plan. It will also help the community know whether their number one opportunity addresses their number one problem or not.

4.4 STEP 4: Creation of Community Information Dissemination Plan (CIDP)

The community information dissemination plan should include details for addressing the highlighted opportunity, dissemination modes to be used, required information, the provider, start date of programme and facilitator. The community should again be reminded this plan was theirs and that its implementation lies in their own efforts. The continued reminder is aimed at making farmers fully appreciate the project was really theirs and that success depends upon their involvement.

Purpose: To develop an operational strategy for addressing their problems via the opportunities within the limitations of the resources.

Time: 1 hour

Participants: All the members present from the selected village including elderly and children

Materials: Large markers of different colours and flip chart papers

The community should brainstorm ideas addressing the identified opportunities as well as the available dissemination modes. Community should also consider suitability and effectiveness of ideas in meeting the intended objectives. The team should also try to identify a provider of that information, when the activities can start as well as an appropriate facilitator of the particular activities. This is essential for a systematic and sustainable community agrometeorological participatory extension strategy. It is also a basis for the monitoring of its implementation. An example of a community information dissemination plan for Nkabika village is shown below in Table 8.

Table 8. Nkabika Community Information Dissemination Plan (CIDP) made on 4th September, 2007

Opportunity	Dissemination mode	Information needed	Provided by	Start date	Facilitator	Follow up comments
Awareness of climatic information	Farmer to farmer Agriculture extension Local Agro meteorological extension services vernacular radio Farmer weekly meetings	Agricultural practices Seed variety for SCF	Ministry of Agriculture & Meteorology	September	Agrometeorologist	
		Seasonal forecast	Meteorology	September	Agrometeorologist	
		Other crop varieties that can be planted	CFU Agriculture	September	Camp officer	
		Adding nutrients to soil. Appropriate tillage practices	CFU Agriculture	September	Agrometeorologist & CFU	
		Seasonal preparations	Meteorology	September	Agrometeorologist	
		Planting opportunities	Meteorology	September	Agrometeorologist	
		Farmer's view	Mujika Community	September	Community	

Nkabika village is one of the villages in Mujika where the IDRC project developed a Community Information Dissemination Plan. The others are Bulimo and Malomo villages. They addressed the same opportunity of awareness of climatic information as they all had identified the same number one problem of erratic rainfall.

4.5 STEP 5: Formation of the Community Agrometeorological Participatory Eextension Services Team (CAPEST)

While participating institutions can be identified in the CIDP, it will require that a special committee of individuals from these institutions together with farmer representatives be identified for the day to day management of the agrometeorological project. This body shall be called the Community Agrometeorological Participatory Extension Services Team (CAPEST).

Purpose: To transfer coordinating authority to a steering committee for a systematic management and monitoring of the community agrometeorological participatory extension strategy and to manage the community information dissemination plan.

Time: 20 minutes

Participants: All the members present from the selected village

Materials: Large markers of different colours and flip chart papers

You will have to ask the community to identify individuals from the community and stakeholders and institutions who will be tasked with the role of spearheading the community agrometeorological participatory extension strategy (CAPES). It is better to allow community members to take the leadership role while you and others from other institutions could be chosen as members if they so wish. As an Agrometeorologist you don't belong to any particular community but to all communities. This means your commitments can already be too high to take the leadership role in any particular local community. The general feeling that institutions usually play supporting roles only in a participatory engagement is not totally correct for the community agrometeorological participatory extension. You are involved as an Agrometeorologist because you are the main source of climatic information affected directly or indirectly. Hence your involvement is not helping or supporting anybody but working as a team member. As an Agrometeorologist you are therefore a facilitator as well as a stakeholder in this case. The normal portifolios of chairperson, secretary and treasurer (should it involve money) could be used. After formation, the community agrometeorological participatory extension Services Team should be commissioned to undertake its activities by the local community leadership.

4.6 STEP 6: Implementation of CAPES

Since the community agrometeorological participatory engagement is not meant as an academic exercise of only creating a CIDP but to address the community problems, it will have to be implemented to get the overall benefits. This will be through community involvement under the leadership of the community agrometeorological participatory extension Services Team (CAPEST). At this stage each stakeholder should perform specific tasks as expected following the CIDP. This stage will be addressing the overall community problem for improved food security and livelihoods. This is the most active part of CAPES where farmers will be implementing the strategy. This process continues in the community's life as long as it is necessary since community livelihood cannot change overnight. Implementation is important for addressing and testing the suitability of the strategy in addressing climatic related community problems.

4.6.1 Information dissemination

Farmers will participate in the dissemination of climatic information using the multi-disciplinary climatic information dissemination modes such as vernacular radio, radio listening clubs, farmer to farmer, public small and large group meetings, field experiments, field days etc. Farmer participation makes the CAPES special because after receiving climatic in training they engage in information dissemination using different dissemination modes compelling one another to effective participation and utilization of climatic information. The ultimate result is that of an improved livelihood.

4.6.2 Experiment: mother-baby field trials

The current SCF smallholder farmers will make decisions and select crop management options that will fit the season. These choices will then be tested using the mother-baby field trials so as to find their suitability in such a season. Selected or volunteer farmers will manage the baby trials at various locations on their farms while the mother field trial is replicated and will be managed by the researcher. Opportunities such a field day held at the mother field for sharing the gained knowledge from these trials should be accorded at appropriate time. Lessons learnt will improve on future farmers' decisions given the forecast.

4.6.3 Training

Farmers will require training in the use of climate information and may be also for, the crop modelling exercise where after the presentation of the current SCF farmers shall make decisions based on the forecast which they may test during the season.

4.6.4 Field and home visits

The increased interaction with climatic information between researchers and community will be promoted by field and home visits where farmers will receive additional extension service regarding understanding of climatic information and timely on-spot field corrections when ever error would be identified. This will enhance

future farmer decision making for improved crop productivity.

4.6.5 Farmer to farmer dissemination of information

This is the most widely used form of climatic information dissemination by farmers within community. It takes place almost at every time and place given the opportunity. Because climatic information is shared by their fellow farmers that are credible, other farmers easily accept and adopt climatic information.

4.7 STEP 7: Monitoring and Evaluation:

A monitoring process should be in place. It will allow the activities to be monitored on a regular basis and the progress towards the goal evaluated. Thus when progress is not as expected, corrections and remedial actions can take place in a timely fashion. The well planned process should involve a lot more people than those found in the CAPEST. The implementation of the community agrometeorological participatory extension strategy would improve if the implementers were also aware that a special and independent group of project evaluators had been be formed. This monitoring will keep the CIDP on track. Starting from a well analyzed baseline and given the community's full understanding of the project purpose, monitoring and evaluating the process could be much easier. The monitoring and evaluating team members must however agree on how the work will be done. Monitoring and evaluation questions with some indicators to answer may be used.

4.8 STEP 8: Postmortem

Purpose: To document the successes and failures of the CAPES strengths and weaknesses; and plan for the next phase of action.

Time: 2 to 3 hours

Participants: All monitoring and evaluation committee members, and committees, local leadership, policy makers and Agrometeorologist

Materials: Large markers of different colours, flip chart papers, notebooks and writing pens

The strategy for operational PAE engagements must again be in place. This will raise the need for a review and planning meeting to consider lessons, successes and failures of the previous CAPES engagement and make plans for the new challenges. This would allow for improvements in the services provision and attainment of the intended objectives given the similar circumstances as well as reduce the impacts of climate change under different scenarios. Members present at the postmortem meeting, that could be considered as the review and planning committee members, should effectively plan for every situation. Their input was likely to determine the quality of service rendered in the CAPES for the following period of engagements as well as the degree of climate change impact on community. The planning and review committee meeting should always take place to conclude the end the current engagements and prepare for the next phase of the CAPES engagement.

CHAPTER TEN: SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

10.1 Introduction

There is a wide consensus that under climate change sustainable development and livelihoods in Africa will still be one of the greatest problems. The African scenario where poverty is widely spread and it limition to adaptation including coping capabilities make it one of the most vulnerable regions of the world to the current and projected impacts of climate change and climate variability (IPCC, 2007). Projections show that the situation is getting worse, compounded by endemic poverty, disease, HIV/AIDS, complex governance and institutional dimensions; limited access to capital, including markets, ecosystem degradation; and complex disasters and conflicts. Despite the increasing number of case studies undertaken at country level on impacts of climate change on farming systems, major gaps still exist in the understanding of the socio-economic impacts of climate change on smallholder farmers (Jones and Thornton, 2003). While major global efforts were investigating climate change, recent observations have shown that there was a great need to focus on strategies for disseminating climatic information on adaptation and coping with climate variability and change; and development of the relevant policy initiatives (IPCC 2007). The main issue in this study centered on the possibility of developing an appropriate community agrometeorological participatory extension strategy for agrometeorology that would disseminate climatic information for smallholder farmers to enable improved agricultural decision making, crop management and productivity. An engagement therefore with smallholder farmers in the study area of Mujika in southern Zambia was to investigate this possibility by addressing five specific objectives. This chapter draws the main findings and conclusions from this study together and suggests recommendations for future consideration in the context of the objectives of this study.

10.2 Main Findings of the Mujika Study

Baseline data provided researchers (Durton and Prospard) with a better understanding of the Mujika community that their agricultural practices were mainly dependent on indigenous knowledge. The community together with researchers used this information in designing a community information dissemination plan (CIDP) for CAPES. Smallholder farmers' participation in planning the CIDP was relevant as they were the ones directly affected by climate change and variability, and knew the tailored information required for addressing the specific climatic concerns. This also applied to the appropriate dissemination modes namely, local radio, small radio listening groups field days etc that were used for dissemination of climatic information. Mujika farmers equally knew their specific

roles of managing the baby field trials, radio listening at the various clubs, farmer to farmer etc in the dissemination process.

Farmers easily to monitored and evaluated the Mujika community agrometeorological participatory extension strategy by keeping records of most project activities and participating at all project levels such as development and implementation. It gave them a feeling of owning the dissemination of climatic information project. The CAPES was successful in Mujika and its effectiveness depended on all stakeholders playing their full participation and management of their individual roles in the CIDP implementation.

Though Mujika has a history, as far back as 1800, the earliest major event that the community members could remember was the establishment of Malomo village in 1910 with its first Headman Philip Malomo by Seventh Day Adventist (SDA) missionaries. Mujika smallholder farmers had their own perception of climate change and variability regardless of the limited modern climatic analysis information of their environment. This perception was based on their long and detailed time related historical data. The community considered the period from 1910 to late 1970s as a period of high rainfall performance with few extreme drought events after which it became normal with notable and increased number of low performances until 2000 before the seasonal rainfall become more erratic reaching extreme highs and lows. This was also when some vernacular community wide SCF radio programmes started being broadcast from Radio Chikuni in place. Rainfall decline considered to be proportional to soil fertility decline which was considered low at the start of the project and inversely proportional to population development which was considered to be very high at the time of the start of project in 2007. So it was seen that Mujika community experienced climate variability.

Community livelihood and adaptation was shaped by consideration and dependence on indigenous forecast knowledge in developing crop management options for every unfolding season. This community had little access to climatic information and no prior direct contact with meteorological personnel and hence their dependence on indigenous knowledge for coming up with crop management options each season. Understanding their perception influenced the design and quality of the community agrometeorological participatory extension strategy. The periodical English SCF broadcasted before start of the season was never understood and so had no influence on the community's agriculture decision making. At the start of this project, community livelihood was vulnerable to climate change and variability and targeted climatic risk information was needed to reach a sustainable situation.

There are certain social and institutional aspects, which relate to the source of climate information and farmers as users such as understanding the terminologies used in forecasting before farmers' adoption of alternate interventions. The smallholder farmers in Mujika realized understanding SCF were necessary for any changes to be realized in their agricultural practices. Farmers selected a range of interventions such type of crop variety and fertility level from the mother-baby field trials for applications to their main fields.

At the start of the project five dissemination modes were identified, namely radio, letters through Village Headmen, agriculture extension, posters on the road and personal contact with farmers. However, out of five only the radio with English programmes had climatic information at certain times. The other information provided was SCF, although literature reveals that long-term rainfall analysis results for southern province were also available. All the current Mujika community dissemination modes were appropriate for use with weather and climate information with some adjustments. Despite their adoption, the community further identified additional modes to meet project expectations such as agrometeorological extension, public meetings, field days, field experiments, vernacular radio and radio listening clubs.

The Moorings rainfall and Magoye meteorological stations' long-term rainfall data were of little use to smallholder farmers and researchers before its detailed analysis. Mujika annual and seasonal rainfall means differed between La Niña, median - Normal and El Niño years with annual means being between +/- 20% and =/-50% higher than seasonal rainfall means. The fitted trend line shows rainfall performance just above the 20 percentile from the early 1920s rising steadily to the 50 percentile around the 1930s before reaching its maximum around the mid 1950s. The steady decline followed to reach its 20 percentile minimum around the early 1990s before rising rapidly again to reach just above the 50 percentile by 2006.

Mujika is situated 5 Km from Moorings on the opposite side from the Magoye Meteorological station. The researchers thought that the two stations would be able to provide useful information for Mujika but as the long-term rainfall means are 85.7 mm different it is difficult to work with both. One needs to consider other stations across the wider area of Zambia to ascertain where the isohyets are running to get a good estimate for Mujika.

Understanding the average start dates of the rainy season and the risks involved in planting too early could allow for introduction of appropriate management decisions and practices based on the climate analysis. The length of the season for Mujika based on the start of the season dates that are

not really different for the two stations of Moorings and Magoye being 13th and 16th November respectively and end which is about +/- 24th March giving 132.4 days on average. Implementing the CIDP, that showed who was undertaking what role and when, and tested effectiveness of the community agrometeorological participatory extension service at all levels of the project activities from the start in 2007 to the end in 2010.

Smallholder farmers' initial view of the researcher, ZMD and SCF was indifferent to the extent of affecting the acknowledgement and utilization of seasonal climate forecast information by many of them. This was mainly due to researchers and ZMD's lack of credibility with community. Farmers needed more time than just of the first interactions to evaluate the whole process regarding its suitability for addressing their climatic concerns. This could have contributed to some farmers' failure to understand and interpret SCF correctly even when it was repeated three times.

However smallholder farmers' view of researchers, ZMD and SCF improved as credibility and farmers' understanding of SCF did. The usage of the multi-disciplinary climatic information dissemination approach where for example, the Village Headmen availed themselves in mobilizing community to attend climatic information meetings could have contributed to a large degree to this change. This action showed how much value they put into the project activities. Above all smallholder farmers' understanding of SCF as a major factor in rainfed agriculture decision making and effective crop management led to farmers' enquiry on the suitability of digging planting basins before the release of SCF, which was supposed to serve as a guide for doing so. They found the practice inappropriate under above normal rainfall conditions.

Smallholder farmers' interest and participation in climatic information dissemination pathways such as radio, radio listening clubs and SCF public meetings was consistent due to the high level of proactiveness involved in all forums. The activities of the community agrometeorological participatory extension services continued. The SCF terms were explained participants using height difference; and farmers' participation increased over time in interpreting SCF. Creative vernacular climate radio and radio drama programmes with routine recording and broadcasting of radio programs and replaying them at radio listening club meetings continually attracted farmer participation. The effective organization of participatory field days in Mujika, at Bulimo village where farmers shared lessons learnt such as benefits of SCF in planning one's cropping season, selection of low or high ground fields according to forecast and crop management with weather forecast, use of Sunn Hemp for improving soil fertility; and participation of national policy makers, also motivated farmers to attend climatic information dissemination meetings. However, different

smallholder farmers had different meetings preferences as not all smallholder farmers who attended seasonal climate information meetings attended all other climatic forums. With an increase in the understanding of SCF, farmers eventually acknowledged the activities of the CAPES and had a growing interest to climatic information dissemination meetings and other processes such as the mother-baby trials, vernacular radio listening clubs and the crop modeling workshops.

Writing stories about selected farmers provided qualitative information on farmers' response to SCF. These stories provided details on the smallholder farmer's background before interactions, developments from start, during and through to the end of the project period when interacting with seasonal climate forecast. This was valuable information on the individuals' growth and development in understanding the seasonal forecasts and gave insights into how individuals perceived and reacted to and adopted the interventions. The farmer stories were useful in evaluating the community agrometeorological extension strategy in Mujika. They provided the project influence to the particular individuals at the household level as well as giving the broader picture of what happened in Mujika.

10.3 Main Conclusion of the Study

Mujika community through their baseline assessment, where trend lines on rainfall, crop production, soil fertility and population were formulated, identified that their number one problem was erratic rainfall performance. The long-term rainfall data analysis was useful in understanding smallholder farmers' environment in Mujika. The available characterisation was in annual and seasonal rainfall trends. The detailed available intraseasonal information (start and end of rain, dry spell length) used together with seasonal forecasts helped improve agricultural decision making.

Mujika community mainly depended on indigenous forecast knowledge for planning and crop management options for every unfolding season. The community integrated the available climatic knowledge, indigenous knowledge and seasonal climate forecast when it was introduced. The community had a good knowledge of their natural resources such as rainfall performance, coping strategies for dry, normal and wet conditions. The introduction of seasonal climate forecast was additional information for understanding the viability of climate information as an opportunity to improve crop productivity.

The researchers and Zambia Meteorological Department (ZMD) lacked credibility within the community to produce and disseminate seasonal climate forecasts. This situation had a negative influence on farmers' acceptance and usage of climatic information especially seasonal climate

forecasts. Continued interactions however brought about change in attitude, practices and visioning of seasonal forecasts.

Stories of the identified farmers used in the qualitative approach provided the visible evidence of the influence of the CAPES on the farming systems in Mujika. Farmers expressed their personal feelings and attachment to the project. Stories by these farmers were useful in evaluating the community agrometeorological participatory extension service in Mujika.

A new interaction strategy suitable for disseminating climatic information in Mujika called community agrometeorological participatory extension strategy was developed together with community and researchers. Sustainability of the community agrometeorological participatory extension strategy depended on smallholder farmers' contributions during planning regarding the required information for addressing their problems and the identified dissemination modes for effective information utilization. The community agrometeorological participatory extension service in Mujika was successful. It was for this reason concluded that it is possible to develop an effective and appropriate agrometeorological participatory extension service.

10.4 Recommendations

This section outlines recommendations that follow from the implementation, analysis and results of this study. This study builds on previous research conducted by other people on dissemination of climatic information to smallholder farmers in Africa. It takes it beyond that but even with this gained understanding more research is still required for addressing climate change related community concerns. Given the understanding that there has been little research on this subject in the selected study areas, this study may be important in providing recommendations to future efforts dealing with climate change concerns in southern province of Zambia.

Recommendation One

Participatory dissemination of climatic information should be based on a well researched community baseline so as to address actual community expressed problems.

Given their vulnerability, smallholder farmers, at seeing a possible partner to help address community climatic problems may not be sincere with their main problem identification but turn to the donor / government syndrome of demanding handouts which is not sustainable and could misplace resources. Special attention should be paid to the initial PRA interaction that should guide one in understanding community priorities problems and opportunities. It will also provide information on how best to design and manage the community information dissemination plan.

Recommendation Two

The participatory multi-disciplinary climatic information dissemination plan should be develop together with partners and farmers, for an effective information flow in the community.

Given the evidence from the Mujika area, that no single form of information dissemination could be attributed to the change in farmers' attitude towards SCF, but rather due to a multi-disciplinary and multi-mode approach, it is important that development of this approach should include all relevant stakeholders together with partners and smallholder farmers for effectiveness and sustainability. Efforts should be made to remind role players that success is dependent on the collective efforts of all stakeholders and not on any individuals input. Smallholder farmers' involvement brings about ownership of the process leading to sustainability and attainment of the intended objectives.

Recommendation Three

Smallholder farmers' improved rainfed agricultural decision making and crop management options require an effective dissemination of SCF and a detailed long-term rainfall analysis result of their respective area.

There are a number of factors required to be in place for attainment of sustainable agriculture and productivity. Down-scaled SCF and detailed local rainfall analysis results should be amongst those factors. The meteorological department should labour to avail this information to all communities for use in improving their agricultural decision making during that very season.

Recommendation Four

The community agrometeorological extension strategy (CAPES) developed during the dissemination of climatic information to smallholder farmers in Mujika area was a model of success and is recommended for replication to other areas.

Organizations or individuals intending to disseminate climatic risk information to rural communities are encouraged to consider the using the useful approach of the community agrometeorological participatory extension strategy developed in Mujika mentioned in this thesis.

Recommendation Five

Use of stories from selected farmers, which is qualitative approach in evaluating the effectiveness of the community agrometeorological extension strategy (CAPES) is a useful approach and is recommended for use.

The stories of selected farmers whose information is collected with the start of the community agrometeorological extension strategy (CAPES) are able to provide a complete evaluation of the

project as that of the quantitative approach. The use of both the stories and the quantitative approach is recommended for a better project evaluation.

Recommendation Six

The CAPES handbook, developed during this project, is a useful guide and is recommended for use by anyone intending to interact with communities for the dissemination of climatic risk information Dissemination of climatic information to smallholder farmers in a community is complex and requires to be approached with care. The CAPES handbook would serve as a useful guide to all wishing to interact community with seasonal climate forecast.

Recommendation Seven

The community agrometeorological participatory extension strategy should be evaluated in future and should be in five or ten years after it establishment.

Since communities develop every day, the current environment CAPES is developed will have changed. It will therefore be recommended to have it evaluated after five or ten years.

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Appendices

Appendix 1

Display of daily data

Mon	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Day.												
1	1	32	63	93	124	154	185	216	245	276	306	337
2	2	33	64	94	125	155	186	217	246	277	307	338
3	3	34	65	95	126	156	187	218	247	278	308	339
4	4	35	66	96	127	157	188	219	248	279	309	340
5	5	36	67	97	128	158	189	220	249	280	310	341
6	6	37	68	98	129	159	190	221	250	281	311	342
7	7	38	69	99	130	160	191	222	251	282	312	343
8	8	39	70	100	131	161	192	223	252	283	313	344
9	9	40	71	101	132	162	193	224	253	284	314	345
10	10	41	72	102	133	163	194	225	254	285	315	346
11	11	42	73	103	134	164	195	226	255	286	316	347
12	12	43	74	104	135	165	196	227	256	287	317	348
13	13	44	75	105	136	166	197	228	257	288	318	349
14	14	45	76	106	137	167	198	229	258	289	319	350
15	15	46	77	107	138	168	199	230	259	290	320	351
16	16	47	78	108	139	169	200	231	260	291	321	352
17	17	48	79	109	140	170	201	232	261	292	322	353
18	18	49	80	110	141	171	202	233	262	293	323	354
19	19	50	81	111	142	172	203	234	263	294	324	355
20	20	51	82	112	143	173	204	235	264	295	325	356
21	21	52	83	113	144	174	205	236	265	296	326	357
22	22	53	84	114	145	175	206	237	266	297	327	358
23	23	54	85	115	146	176	207	238	267	298	328	359
24	24	55	86	116	147	177	208	239	268	299	329	360
25	25	56	87	117	148	178	209	240	269	300	330	361
26	26	57	88	118	149	179	210	241	270	301	331	362
27	27	58	89	119	150	180	211	242	271	302	332	363
28	28	59	90	120	151	181	212	243	272	303	333	364
29	29	60	91	121	152	182	213	244	273	304	334	365
30	30	61	92	122	153	183	214		274	305	335	366
31	31	62		123		184	215		275		336	

Appendix 2.

Example to creating a community agrometeorological participatory extension (CAPES)

Step 1: STARTING A PROGRAMME

Community selection
Project introduction
Launching

Step 2: DATA COLLECTION

Secondary Data
Field data
- *Spatial Data*
  - *Community Sketch Maps*
  - *Transect*
- *Time Related Data*
  - *Historical Time Lines*
  - *Trend Lines*
  - Seasonal Calendar
- Social Data
  - *Household Interviews*
  - *Farm Sketches*
  - *Institutional Analysis*
  - *Gender Daily Calendar*

Step 3: ORGANIZATION OF PROBLEMS AND OPPORTUNITIES

The Ranking of Problems
The ranking of opportunities

Step 4: CREATION OF A COMMUNITY INFORMATION DISSEMINATION PLAN (CIDP)

Step 5: FORMATION OF A COMMUNITY AGROMETEOROLOGICAL PARTICIPATORY EXTENSION TEAM (CAPEST)

Step 6: IMPLEMENTATION OF THE CIDP (Step 6)

Step 7: PARTICIPATORY MONITORING AND EVALUATION (PM&E)

Monitoring
Evaluation
Project evaluation

Step 8: POSTMORTEM

Reviewing
Planning

QUESTIONNARE

Questionnaire for monitoring special cases

1. **Farmer details**

First Name …… Surname……Sex M/F.
Male/Female headed …… Household size……..Village……. Chief…….
Camp…… Block…… District……

Historical information

2. **Historical rainfall performance**

What trend do you see in the rainfall performance in terms of raising, neutrality or falling?
……
If any state how?
……
Have you noticed any changes in the temperature? Yes or No
What drought years do you remember? ……

Impact on households

What impact did the drought or flood have on your livelihood? ……
……
Floods
……
Did any houses fall? Yes or No
Drought
……
Advantages of drought and floods
……
……

Other factors

What other factors that are none climate related do you find affecting your agriculture productivity?
……

Ranking

Which one do you rank as number one between climate related issues and other factors?
……

Coping strategies

What coping strategies did you use under floods and drought?
……
……
What on farm strategies did you use? ……
…… ……
……

3. **Investment decisions**

Do you have access to Climatic Risk Information (CRI) and Seasonal Climate Forecast (SCF)? Yes/No

If so how did you get it?

…….

Do you have other traditional forecast indicators for SCF? Yes/No

If so give details

……

……

Did you use the CRMI and SCF received? Yes/No

If so how did you use it?

……

If no why didn't you use it?

……

Land

How much land do you have and how much do you use every year?

……

What makes you to increase or reduce the hectorage.

……

……

4. **Household characteristics**

How many children do you have and how many are boys and girls?

……

How old are you? …….

How far did you go with your education? ……

How long have you been in this village? ……

What is your farming experience?

……

Are you a member of any association in the area?

…….…….

Implements: how many ploughs, cultivators, horrors, planters etc do you have?

……

Livestock: How many cattle, goats and chickens do you have?

…….. ……..……

……

……

Appendix 4: Agenda for public project launch

Agenda for the project launch meeting Mujika 4th September, 2007

Prayer
Remarks by the chairman
Introduction of the researchers –Chairman
Welcome remarks by Senior Village Headman
Project introduction- Durton H. Nanja
PRA activities
Wrap Up
Prayer

Appendix 5: Descriptive climatic summary for Moorings station during El Niño and La Niña conditions

Moorings station

El Niño

Column	All Years	Seasonal	Difference Annual and Seasonal	Start	Stdry	End of season	Season length start	Season Length dry
No. of observations	25	25	0	25	25	25	25	25
Minimum	370.7	332.1	38.6	95	0	275	86	76
Maximum	1180.5	1163.6	16.9	189	199	288	180	275
Range	809.8	831.5	-21.7	94	199	13	94	199
Mean	777	745.4	31.6	153.7	155.9	276	122.4	120.1
Std. deviation	220	213.6	6.4	20.5	37.6	2.7	19.6	36.6
20th percentile	568.5	561.6	6.9	133	147	275	106.6	98.2
50th percentile	781	762.7	18.3	157.5	159	275	118	116
80th percentile	983.2	955.6	27.6	173	178	277.4	139.8	128.8

Moorings station

La Niña

Column	All Years	Seasonal	Difference Annual and Seasonal	Start	Stdry	End of season	Season length start	Season Length dry
No. of observations	18	18	18	18	18	18	18	18
Minimum	552.2	544	5.3	128	0	25	74	74
Maximum	1290.1	1176.5	125.3	201	201	298	147	275
Range	737.9	632.5	120	73	201	23	73	201
Mean	802.6	750.4	52.2	150.8	151.4	277.1	126.3	125.7
Std. deviation	196	175	38.4	19.5	43	5.9	19.9	43.2
20th percentile	617	569.2	21.2	132.8	138.4	275	109.6	95
50th percentile	788.3	726.8	39.1	145.5	154.5	275	133	124.5
80th percentile	968.7	901	96.1	165.4	180	275.6	143	143

Appendix 6: Descriptive climatic summary for Magoye station during El Niño and La Niña conditions

Magoye station								
El Niño								
Column	**All Years**	**Seasonal**	**Difference Annual and Seasonal**	**Start**	**Stdry**	**End of season**	**Season length start**	**Season Length dry**
No. of observations	14	14		14	14	14	14	14
Minimum	490.2	431	59.2	95	131	275	96	79
Maximum	916.1	916.1	0	179	196	289	181	151
Range	425.9	485.1	-59.2	84	65	14	85	72
Mean	709.7	695.1	14.6	143.4	160.9	276.9	133.5	116.1
Std. deviation	125.2	135.7	-10.5	24.1	17.1	4.1	24.7	19.3
20th percentile	588.6	562.3	26.3	118	146	275	104	96
50th percentile	729.4	715.9	13.5	146	161	275	131	117
80th percentile	828	814.5	13.5	171	179	280	157	133

Magoye station La Niña								
Column	**All Years**	**Seasonal**	**Annual and seasonal**	**Start**	**Stdry**	**End of season**	**Season length start**	**Season Length dry**
No. of observations	6	6	6	6	6	6	6	6
Minimum	588.6	541.3	12.8	112	112	275	102	102
Maximum	916.1	893.7	87.8	173	173	289	163	163
Range	327.5	352.4	75	61	61	14	61	61
Mean	723.5	684.7	40.2	139	151.3	278.8	139.8	127.5
Std. deviation	132.1	140.4	27.7	22	21.5	5.4	21.5	22.5
20th percentile	599	546.1	16.6	114.4	125.6	275	114.4	105.6
50th percentile	707.5	677	30.6	142.5	156.5	277	142	123
80th percentile	873.4	8402	75.6	162.2	169	285.4	160.6	155

Appendix 7: All of La Niña conditions over Moorings station

Moorings stations								
La Niña								
Years	Annual	Start	stdry	End	Length start	Length dry	Seasonal	Difference annual and seasonal
1952	1180.5	153	156	275	122	119	1163.6	16.9
1954	981.8	130	159	275	145	116	959.5	22.3
1958	819.4	158	158	275	117	117	762.7	56.7
1959	655.6	161	161	275	114	114	617.4	38.2
1964	781	128	128	275	147	147	779.1	1.9
1966	839.5	163	163	278	115	115	797.8	41.7
1969	805.9	157	157	275	118	118	764	41.9
1970	1139.8	133	133	275	142	142	1104.5	35.3
1972	567.2	131	0	275	144	275	544	23.2
1976	566.2	162	162	275	113	113	560.9	5.3
1977	1052.4	149	149	278	129	129	940	112.4
1978	911.3	158	158	275	117	117	896	15.3
1980	926.6	152	152	278	126	126	912.3	14.3
1981	582.33	173	173	278	105	105	573.43	8.9
1983	684.2	173	173	288	115	115	645.5	38.7
1984	539.2	159	197	275	116	78	520.3	18.9
1987	686.1	95	159	275	180	116	634.2	51.9
1990	573.5	178	178	275	97	97	564.6	8.9
1992	829.9	146	172	275	129	103	809.3	20.6
1993	463.7	189	189	275	86	86	434.5	29.2
1994	370.7	179	179	275	96	96	332.1	38.6
1995	758.5	171	199	275	104	76	711.7	46.8
1998	983.5	144	144	275	131	131	983.5	0
2003	615.2	152	152	275	123	123	603.6	11.6
2005	1110	147	147	275	128	128	1021.4	88.6
Average	**729.7**	**154**	**156**	**276**	**122**	**120**	**745.4**	**31.5**

Appendix 7 gives the yearly results for each category considered in 25 years when assessing the La Niña condition as well as the averages for all years at Moorings station.

Appendix 8: All of El Niño conditions over Moorings station

Moorings								
El Niño								
Years	Annual	Seasonal	Difference	start	stdry	End	Length start	Length dry
1951	1290.1	1176.5	113.6	151	151	275	124	124
1955	992.4	898.7	93.7	157	157	287	130	130
1956	707.9	690.5	17.4	128	128	275	147	147
1962	962.8	937.1	25.7	142	142	275	133	133
1963	912.7	875.1	37.6	140	140	275	135	135
1965	648.6	612.6	36	201	201	275	74	74
1967	629.5	571.3	58.2	142	165	275	133	110
1971	715.6	671.5	44.1	140	154	275	135	121
1972	567.2	544	23.2	131	0	275	144	275
1974	892.2	851.5	40.7	149	149	275	126	126
1975	854.6	763.1	91.5	155	155	298	143	143
1976	566.2	560.9	5.3	162	162	275	113	113
1989	787	681.3	105.7	180	180	275	95	95
1997	552.2	545.7	6.5	139	180	275	136	95
1999	1035.4	910.1	125.3	133	198	275	142	77
2000	894.4	871.5	22.9	153	153	278	125	125
2001	647.8	578.3	69.5	132	132	275	143	143
2006	789.6	767.5	22.1	179	179	275	96	96
Average	**802.6**	**750.4**	**52.2**	**150.8**	**151.4**	**277**	**126**	**126**

Appendix 9: All of La Niña conditions over Moorings station

	Magoye station							
	La Niña							
Years	Annual	Start	stdry	End	Length start	Length dry	Seasonal	Difference
1978	786	143	161	280	137	119	783.6	2.4
1980	916.1	118	164	275	157	111	916.1	0
1981	614.7	173	173	275	102	102	608.3	6.4
1983	588.6	146	146	289	143	143	562.3	26.3
1984	748.6	171	196	275	104	79	747.4	1.2
1987	613.8	95	161	276	181	115	612.6	1.2
1990	641.2	179	179	275	96	96	639.2	2
1992	826.6	146	163	275	129	112	814.5	12.1
1993	559.2	150	150	275	125	125	538.3	20.9
1994	490.2	108	180	275	167	95	431	59.2
1995	710.3	142	142	275	133	133	685.6	24.7
1998	840.6	154	154	275	121	121	840.6	0
2003	772.2	152	152	275	123	123	746.3	25.9
2005	828	131	131	282	151	151	806.2	21.8
Average	**709.7**	**143**	**161**	**277**	**133**	**116**	**695.1**	**14.6**

Appendix 10: All of El Niño conditions over Moorings station

	Magoye station							
	El Niño							
Years	Annual	Start	stdry1	End	Length start	Length dry	Seasonal	Difference
1989	786	139	151	280	141	129	759.9	26.1
1997	809.3	112	112	275	163	163	752.1	57.2
1999	916.1	118	164	275	157	111	893.7	22.4
2000	614.7	173	173	275	102	102	601.9	12.8
2001	629.1	146	162	279	133	117	541.3	87.8
2006	588.6	146	146	289	143	143	553.4	35.2
Average	**723.9**	**139**	**151**	**279**	**140**	**127**	**683.7**	**40.2**

Appendix 11: Risk of planting too early over Moorings and Magoye stations

	Moorings station				Magoye station		
Folio	**Years**	**start**	**startdry**	**Years > 0 at risk**	**Stdry1**	**Start**	**Years > 0 at risk**
1	1921	135	135	0	111	111	0
2	1922	107	171	64	153	118	35
3	1923	157	157	0	173	173	0
4	1924	152	152	0	162	110	52
5	1925	71	187	116	145	145	0
6	1926	161	161	0	191	167	24
7	1927	121	136	15	168	126	42
8	1928	154	154	0	108	108	0
9	1929	160	195	35	161	94	67
10	1930	143	143	0	153	153	0
11	1931	135	135	0	182	182	0
12	1932	154	154	0	171	171	0
13	1933	148	148	0	176	141	35
14	1934	116	138	22	163	146	17
15	1935	165	165	0	150	150	0
16	1936	108	134	26	163	107	56
17	1937	139	139	0	142	142	0
18	1938	135	158	23	138	138	0
19	1939	126	126	0	171	171	0
20	1940	134	175	41	153	153	0
21	1941	113	154	41	144	144	0
22	1942	127	176	49	153	136	17
23	1943	133	133	0	132	132	0
24	1944	132	148	16	186	121	65
25	1945	163	181	18	149	149	0
26	1946	140	140	0	238	149	89
27	1947	134	134	0	131	131	0
28	1948	110	132	22	160	135	25
29	1949	143	143	0	125	112	13
30	1950	168	168	0			
31	1951	116	154	38			
32	1952	130	130	0			
33	1953	133	133	0			
34	1954	130	159	29			
35	1955	148	148	0			
36	1956	127	127	0			
37	1957	121	163	42			
38	1958	116	157	41			
39	1959	161	161	0			
40	1960	133	133	0			
41	1961	130	130	0			
42	1962	141	141	0			
43	1963	117	117	0			
44	1964	127	127	0			
45	1965	173	173	0			
46	1966	132	163	31			
47	1967	141	165	24			
48	1968	126	126	0			
49	1969	157	157	0			
50	1970	104	133	29			
51	1971	139	154	15			
52	1972	130	138	8			
53	1973	121	171	50			
54	1974	138	138	0			
55	1975	151	151	0			

56	1976	161	161	0			
57	1977	149	149	0			
58	1978	128	155	27			
59	1979	110	130	20			
60	1980	152	152	0			
61	1981	141	173	32			
62	1982	111	197	86			
63	1983	107	172	65			
64	1984	159	197	38			
65	1985	153	153	0			
66	1986	108	108	0			
67	1987	95	159	64			
68	1988	153	153	0			
69	1989	179	179	0			
70	1990	168	168	0			
71	1991	161	161	0			
72	1992	132	171	39			
73	1993	129	188	59			
74	1994	107	152	45			
75	1995	144	144	0			
76	1996	142	142	0			
77	1997	139	179	40			
78	1998	144	144	0			
79	1999	120	144	24			
80	2000	124	153	29			
81	2001	121	121	0			
82	2002	122	163	41			
83	2003	152	152	0			
84	2004	149	149	0			
85	2005	147	147	0			
86	2006	141	173	32			
	Average	**135.7**	**152.4**	**16.7**	**152.4**	**134.6**	**17.8**

Appendix 12: Names of participating village Headmen and their respective territorial villages to the PPL meeting at Mujika primary school.

S/NO	NAME OF HEADMAN	NAME OF VILLAGES
1	Joshua Moonga	Sikaambo
2	Andrew Mweemba	Nkabika
3	John Cheembo	Muzyamba
4	Cansion Mwiinga	Cheepa
5	Isaac Sintuba	Sintuba
6	Stopie Malomo	Malomo
7	Lazarus Mufu	Nandebe
8	Keelson Chimbali	Namwanze
9	Bornwell Musansi	Habwizu
10	Philip Chilala	Lweendo
11	Simon Hamunsale	Chiyonga
12	abrahamCheelo	Nachona
13	Ephraim Mutwa	Nakakuya
14	Charles Matimba	Sintambo
15	James Nakoonje	Bulimo
16	Moonga Nkumba	Simuumba

Table 13: List of participants to the PPL meeting at Mujika primary school

S/NO	NAME	AGE	VILLAGE
1	Abigal Sibanda	29	Malomo
2	Meridian Habwankuta	22	Bulimo
3	Oliver Neene	35	Nakakunya
4	J.C. Hanseluka	45	Habwizu
5	T.C. Bwato	46	Muzyamba
6	Maxwell Mweene	24	Bulimo
7	Benody Malambo	25	Simuumba
8	Jeremiah Chizeba	77	Simuumba
9	Great Kantemba	45	Simuumba
10	Moses Hakopa	62	Nkabika
11	Chiko Chiinda	27	Muyamba
12	Morris Ng'andu	41	Kayuni
13	Samayuwa Stanley	35	Muzyamba
14	Cliff Neene	39	Cheepa
15	Chileya Moonga	35	Nandobe
16	Stanley Chiinda	34	Sintambo
17	Mwiinga Albin	49	Bulimo
18	Jackie Busiku	32	Nkabika
19	Andrew Mangoye	42	Nkabika
20	Joseph Hampongo	65	Nkabika
21	Benard Chikuni	67	Nkabika
22	Grace Handabile		Situmba
23	Mary Hamuleya		Nkabika
24	Jenipher Mwaka		Nkabika
25	Jeremiah Moonga	67	Simuumba
26	Bornwell Musanzi	30	Habwizu
27	Jonathan Hatwiinda	70	Nkabika
28	Joshua Moonga	67	Sikaambo
29	M. Hanguzu	27	Nkabika
30	F.S. Mudadi	29	Nkabika
31	P.C. Hakalembe	49	Camp Officer
32	L. Chinene		Block Extension Officer – Monze East
33	Joshua Hamilimo	48	Lweendo

Appendix 14: Field day programme at Bulimo village on 27-02-2007

Climate change Capacity building field day program at Mujika Bulimo Village on 27-02-2008			
Folio	**Activity**	**Facilitator**	**Time**
1	Arrival of guests	Chinene	0800-0900
2	Welcoming remarks	Headman Bulimo	
3	Opening remarks	Durton/Prospard	
4	Tour of the Mother/Baby field trials	Durton/Prospard	
5	Drama	Malomo Village	
6	Speech Director	Maurice Muchinda	
7	Speech Deputy Director –ZARI	Moses Mwale	
8	Drama	Bulimo Village	
9	Lessons learnt and summary	Various presenters	
	2008/9 and way forward	Durton	
	Closing remarks	Kanchele	
	Closing remarks	Headman Malomo	
	Lunch		1300

Appendix 15: Field day programme at Bulimo village on 27-02-2007

World Meteorological Day

Theme: "Weather, Climate and the Air we breathe"

Bulimo field day program of events in Mujika, Chief Mwanza, 23rd March, 2009

Time	Event	Facilitator
0730	Briefing at Golden Pillow Lodge	DC- Monze
0800	Depart for Mujika and Bulimo village	
0900	Arrival of Honourable Daniel Munkombwe, Deputy Minister for Southern province	Durton
0900-1200	Tour of field trials	Durton/Prospard
1200	Prayer Entertainment Welcoming remarks: Malomo Village Feed back on lessons learn from the project: Public Role play –Nkabika Village Remarks: Durton H. Nanja PMO southern province Remarks: John Dimes, ICRISAT –Bulawayo, Project representative for Zimbabwe Director of Meteorology: Mr Maurice Muchinda Official address Guest of Honour, Honourable Daniel Munkombwe, Minister for Southern Province. Vote of thanks: P. Mwiinga Prayer:	Sitali/Durton
1400	Lunch	
1500	End of program	

Thank you for having had come.
Please consider the lessons learnt to day.

(Sponsored by the IDRC project & Meteorological Department southern province)

Appendix 16: 2007/2008 seasonal rainfall forecast for Zambia

REPUBLIC OF ZAMBIA

METEOROLOGICAL DEPARTMENT

2007/2008 SEASONAL RAINFALL FORECAST FOR ZAMBIA

Issued by
Maurice R. Muchinda,
Director of Meteorology
19th September 2007

GENERAL SITUATION

The forecast for 2007/2008 rainy season indicates a likelihood of normal to above normal rainfall over Zambia. The main principal factors taken into consideration in the formulation of this forecast are the *current state* of the global oceans, which *indicate*s neutral conditions biased towards a weak La Nina phenomenon.

OUTLOOK

During the period October to December 2007, most parts of Zambia have a likelihood of receiving normal rainfall.

For the period January to March 2008, the whole country has increased chances of receiving normal to above normal rainfall. Flash floods are likely to occur over much of Zambia, especially in the southeast

N.B

ABOVE NORMAL	**-Rainfall greater than 125% of the 30 year average (1971-2000)**
NORMAL	**-Rainfall between 75% and 125% of the 30 year average**
BELOW NORMAL	**-Rainfall less than 75% of the 30 year average**

Zambia Meteorological Department P.O.Box 30200,10101,Lusaka, Zambia
Tel: +260 21 1 251912/252728 Fax: : +260 21 1 252728 E-mail: zmd@coppernet.zm

Please note that this forecast is based on the three monthly averages and not necessarily on monthly basis. It is therefore strongly recommended that users of this forecast contact the Zambia Meteorological Department for interpretation of this forecast.

OCTOBER-DECEMBER 2007 **JANUARY-MARCH 2008**

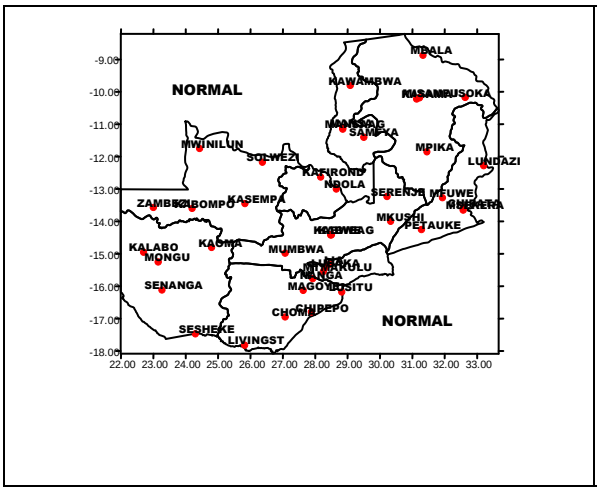

Fig.1

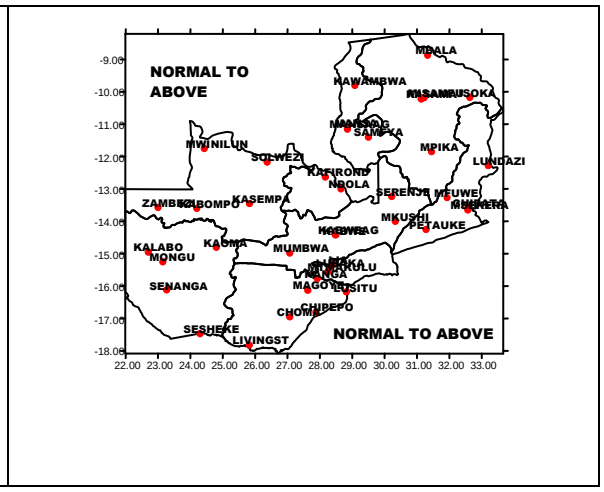

Fig.2

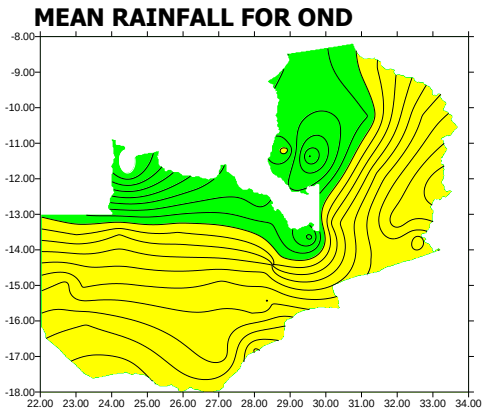

Fig.3

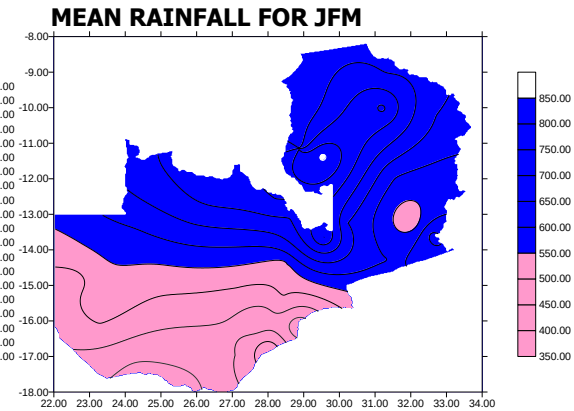

fig.4

Fig.1: Rainfall Forecast for October-November-December 2007
Fig.2: Rainfall Forecast for January-February-March 2008
Fig.3: Mean Rainfall for the period October-November-December (1961-2006)
Fig.4: Mean Rainfall for the period January-February-March (1961-2007)

Appendix 17:

2007/2008 seasonal rainfall forecast for Zambia

REPUBLIC OF ZAMBIA

METEOROLOGICAL DEPARTMENT

BULANGIZI BWA MAINZA A 2007/2008 MU ZAMBIA

Bwa ka zubululwa a ba
Maurice R. Muchinda,
Director of Meteorology
19th September 2007

CIIMINO

Bulangizi bwa mvwula mu mainza a 2007/2008 butondezya kuti kuya kuba mvwula ya katikati ku kuya ku kwiindilila cisi coonse ca Zambia mbocizulwa. Twaambo tupati pati twakalangwa langwa kuku zubulula bwaambilizi oobu, nciimino ca meenda a zingulukide nyika yoonse, citondezya kuliiba kwa kutontola kwa meenda kwa mana kakuli kuyandishisya kwa ku tontola tontola aniini.

CIIMINO

Mu ciindi ca myezi ya Kavumbi kaniini (October) kusika mwezi wa Nalupale (December) 2007, zyi beela zyinji zya Zambia zyilala ngilwa kutambula mvwula yaa katikati.

Ciindi ca kuzwa mu mwezi wa Mukazimaziba (January) kusikila mu mwezi wa Miyoba (March), 2008, cisi coonse cilijisi bulangizi bwiindilide bwa kutambula mvwula yaakatikati ku kuya kwiindinlila.

Meenda apaya alalangilwa muzyibeela zyinji mu Zambia kapati Zambia nkwali kumusanza lyakumbo.

N.B

ABOVE NORMAL	**-Rainfall greater than 125% of the 30 year average (1971-2000)**
NORMAL	**-Rainfall between 75% and 125% of the 30 year average**
BELOW NORMAL	**-Rainfall less than 75% of the 30 year average**

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Zambia Meteorological Department P.O. Box 60004, Livingstone, Zambia
Tel: +260 21 3 321256 Fax: +260 21 3 321256/324235 E-mail: zmds@microlink.zm

Muzyibe kuti buzubuluzi oobi bulanganya ciimino coonse mukwiinda mu kusanganya kwa myezi yotatwe. Ba belesya buzubuluzi oobu bala kulwaizyigwa ku jana bupanduluzi kuzwa kuli ba Zambia Meteorological Department.

Appendix 18: 2008/2009 seasonal rainfall forecast for Zambia

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REPUBLIC OF ZAMBIA
MINISTRY OF COMMUNICATIONS AND TRANSPORT

METEOROLOGICAL DEPARTMENT

P.O. BOX 30200
10101 LUSAKA

2008/2009 SEASONAL RAINFALL FORECAST FOR ZAMBIA

Issued by
Maurice R. Muchinda,
Director of Meteorology
15th September, 2008

GENERAL SITUATION

The 2008/2009 rainy season generally indicates a likelihood of normal rainfall over Zambia. The current state of the sea surface temperatures of the global oceans also indicate neutral conditions (i.e. neither La Niña nor El Niño). However, there is a chance of flash floods in some areas.

OUTLOOK

During the period October to December 2008, most parts of Zambia have a likelihood of receiving normal rainfall, except the extreme north-eastern parts of Zambia where normal to below normal rainfall is expected.

For the period January to March 2009, the whole country is likely to receive normal to above normal rainfall.

N.B.

ABOVE NORMAL - Rainfall greater than 125% of the 30 year average (1971-2000)
NORMAL - Rainfall between 75% and 125% of 30years average
BELOW NORMAL - Rainfall less than 75% of 30 year average

Please note that this forecast is based on three-monthly averages and does not necessarily reflect the monthly distribution. Users of this forecast are therefore strongly urged to contact the Zambia Meteorological Department for interpretation of the forecast.

Zambia Meteorological Department P.O.Box 30200, 10101, Lusaka, Zambia
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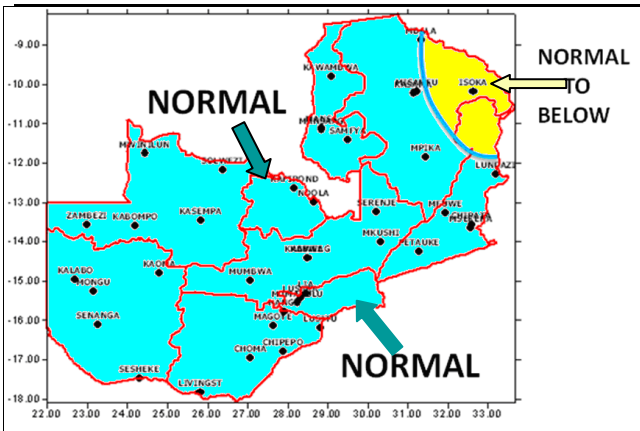

Fig 1. Rainfall Forecast for October-November-December (OND) 2008

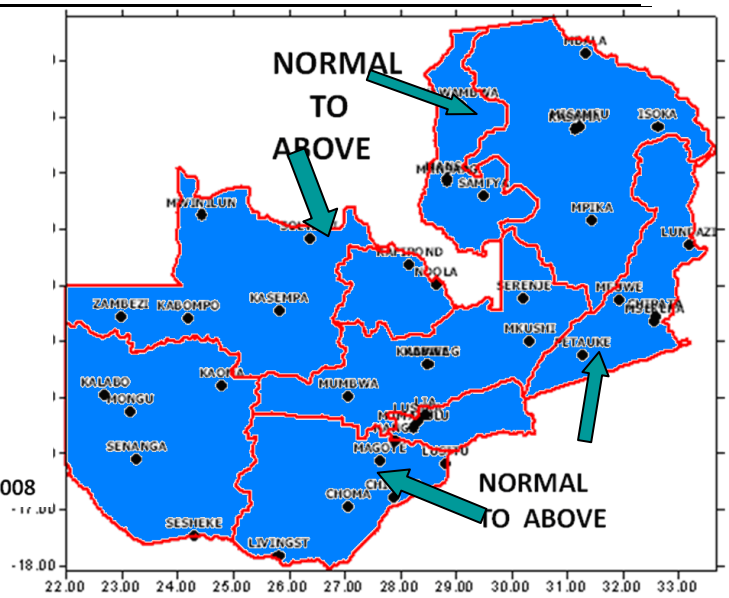

Fig 2. Rainfall Forecast for January –February-March (JFM) 2009

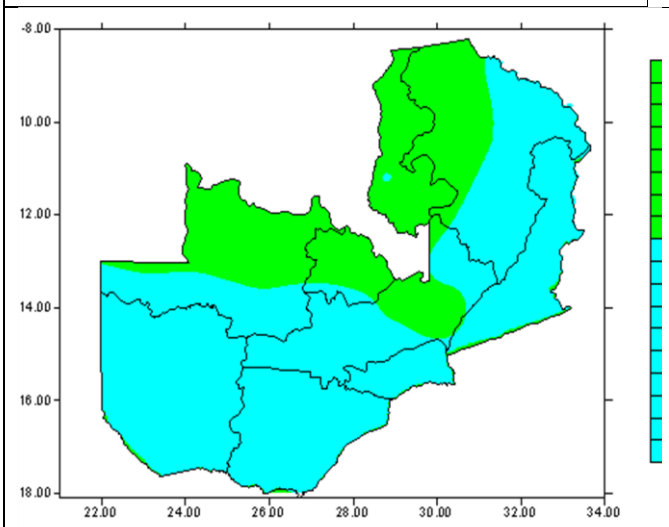

Fig3. Mean Rainfall for OND (1961-2007)

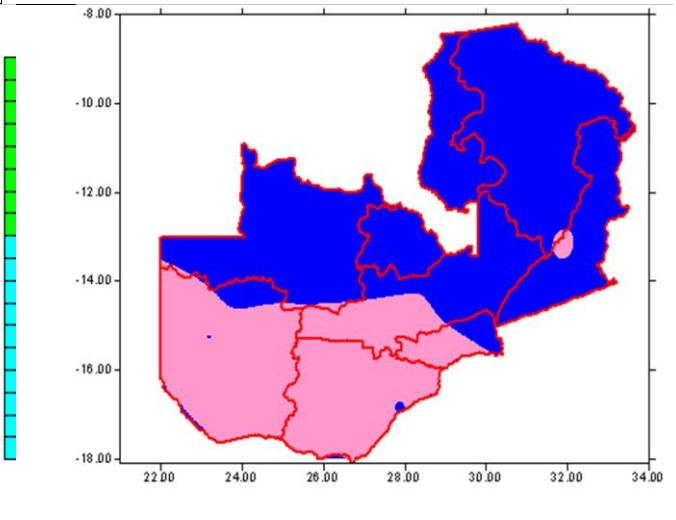

Fig 4. Mean Rainfall for JFM (1961-2008)

Appendix 19: Buzubuluzi bwa mainza a mwaka wa 2008/2009

ZAMBIA METEOROLOGICAL DEPARTMENT

BUZUBULUZI BWA MAINZA A MWAKA WA 2008/2009 MU ZAMBIA

Bwa ka zubululwa a

Maurice R. Muchinda, Director of Meteorology

15th September 2008

CIIMINO

Buzubuluzi bwa mainza a mwaka wa 2008/2009 butondezya kuti imvwula in na kuli yaakatikati mu Zambia. Ku kasaala kwa meenda a zingulukide nyika a kwalo kutondezya kuti kuli akatikati (Ta kuli kwa Cilobe antela cilanga).

BULANGIZI

Kuzwa mu mwezi wa Kavumbi-kaniini (October) kusikila ku mwezi wa Nalupale (December), 2008, zyooko zyinji zya Zambia zyilijisi bulanjizi bwakutambula mvwula ya katikati, pele buyo cisi nkocili ku nyika lya kujwe kukumaninina mvwula nkoilangilwa kuba yaakatikati kukuceya.

Ciindi kuzya mu mwezi wa Mukazimaziba (January) ku sikila wa Miyoba (March) 2009, cisi coonse cilangilwa kutambula mvwula yakatikati ku kwiindilila.

Mwalombwa kuzyiba kuti bulangizi oobu bwiimvwi a kubika buwe bwa mvwula mu myezi yotatwe yotatwe kutali omwe pe. Boonse babelesya bulangizi oobu bala kulwaizyigwa ku buzya cibeela cibona bweende bwa muwo a mvwula (Zambia Meteorological Department) kubupanduluzi.

Meteorological Department, P.O. Box 30200, 10101, Lusaka, Zambia
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Meteorological Department P.O. Box 60004, LIVINGSTONE. zmds@microlink.zm
Tel/Fax: 260 21 3 321 256

Appendix 20: 2009/2010 seasonal rainfall forecast for Zambia

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REPUBLIC OF ZAMBIA

METEOROLOGICAL DEPARTMENT

P.O. BOX 30200,
10101 LUSAKA

2009/2010 SEASONAL RAINFALL FORECAST FOR ZAMBIA

Issued by
Maurice R. Muchinda
Director of Meteorology
11th September, 2009

GENERAL SITUATION

The 2009/2010 rainy season generally indicates a likelihood of normal rainfall over Zambia. The current state of the sea surface temperatures (SSTs) over the Equatorial Pacific Ocean indicate mild El Nino conditions.

OUTLOOK

During the period October, November and December (OND) 2009, most parts of Zambia have an increased chance of receiving normal rainfall except northeastern parts of Zambia where normal to above normal rainfall is expected.

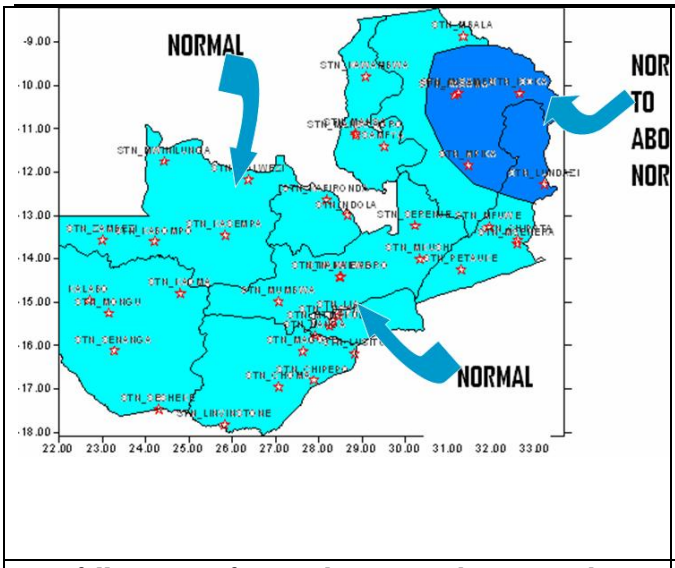
For the period January, February and March (JFM) 2010, Western, Lusaka and Southern Provinces are likely to receive normal rainfall. The rest of the country has a likelihood of receiving normal to above normal rainfall.

N.B.

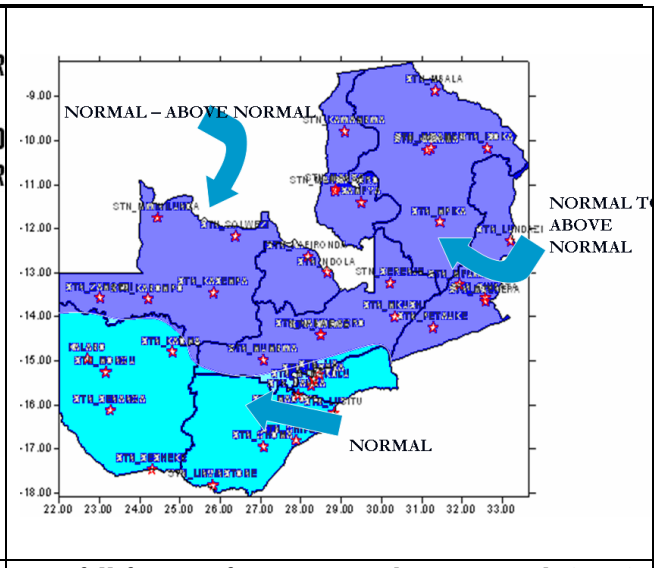
ABOVE NORMAL -Rainfall greater than 125% of the 30 year average
NORMAL -Rainfall between 75% and 125% of 30 year average
BELOW NORMAL -Rainfall less than 75% of 30 year average

Please note that this forecast is based on three monthly averages and does not necessarily reflect the monthly rainfall distribution. Users of this forecast are therefore advised to contact the Director, Zambia Meteorological Department (ZMD) for interpretation and updates of the forecast.

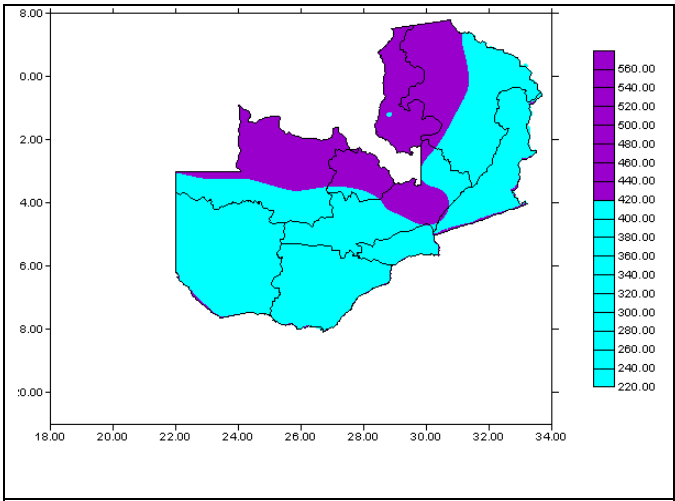
Zambia Meteorological Department P.O Box 30200, 10101 Lusaka, Zambia
Tel: +260 21 1 251912/252728, FAX: +260 21 1 252728.



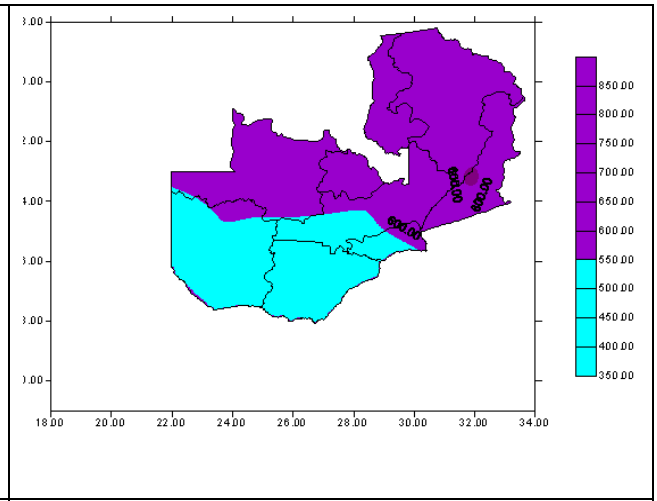
Rainfall Forecast for October-November-December (OND) 2009



Rainfall forecast for January-February-March (JFM) 2010



Mean Rainfall (normal) for OND (1961-2008)



Mean Rainfall (normal) for JFM (1961-2009)