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Vulnerability of Food Production Systems of Small-Scale Farmers to Climate Change in Southern Zambia: A Search for Adaptive Strategies

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Gear M. Kajoba
Department of Geography, University of Zambia

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RIHN Research Project E-04

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Inter-University Research Institute Corporation, National Institutes for the Humanities

大学共同利用機関法人 人間文化研究機構
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ABSTRACT

The overall aim of the research was to assess the vulnerability of the food production system of small-scale farmers in Kafwambila area in Sinazongwe district to climate change; assess their perceptions; impacts and short term coping strategies and search for long term adaptive strategies.

Both qualitative and quantitative data were collected through semi-structured interviews with 32 small-scale farmers including key informants; and two Focus Group Discussions were attended by a total of 44 participants.

The study has shown that although the small-scale farmers are not aware of the concept of climate change, they experience its impacts through frequent droughts and occasional floods. The respondents indicated that climatic variability increasingly impacts negatively on food production, leading to crop failure of their staple cereals of bulrush millet, sorghum and maize.

The major coping strategy (apart from crop combinations or inter cropping) is the establishment of a livelihoods circuit, in which farmers sell some of their livestock to traders, in order to raise cash with which to buy fish from Lake Kariba; then they travel to the plateau to sell the fish, raise money to buy maize grain from farmers on the plateau, or exchange fish with maize grain. Then, the farmers return with grain to the valley, grind it to obtain maize meal, and repeat the cycle when need arises.

Although the farmers stated that they do not know what to do in order to make long term adaptation to climate change, they called for the government and other stakeholders to establish an irrigation scheme to tap water from Lake Kariba; provide micro-credit and improved seed varieties that are drought tolerant, early maturing and high yielding.

Farmers also requested the government to construct passable roads that can link their remote area to the plateau in order to facilitate trade in grain, livestock and fish.

Key words: Vulnerability; Food Production; Climate Change; Adaptation; Coping; Droughts; Perception; Irrigation; Indigenous Knowledge; Scientific Knowledge; Interface; Livelihood

要旨

本研究の目的は、シナゾングェ県カファンビラ地区における、気候変動に対する小規模農家の食料生産システムの脆弱性を評価し、気候変動の影響および短期的対処戦略とともに長期的適応戦略のための農民の知見を評価することである。調査では、３２世帯を対象とした半構造化インタビューと情報提供者を含む計４４人が参加した２回のグループ討論から定性的、定量的データを収集した。小規模農家は気候変動の概念についての理解はないものの、度重なる旱ばつや時折生じる洪水からその影響を経験していた。回答者によれば、気候変動は急激に食料生産に大きな負の影響を与えており、トウジンビエ、ソルガム、メイズ等主食作物の不作をもたらしている。主な対処戦略（作物の組合せや間作の他）として以下のような生業活動があげられる。まず、家畜を売却した現金でカリバ湖畔で魚を購入する。購入した魚は、高地へ運ばれ、メイズを購入するために現金化されたり、メイズと交換されたりする。持ち帰ったメイズは製粉され食糧となる。農民は必要に応じてこのような生業活動を繰り返している。地域の農民は気候変動に対する長期的な対策は知らないと回答したものの、カリバ湖から灌漑用水を引く事業を設立し、小規模金融と旱ばつ耐性がある早生の高収量改良品種を供与してもらうために政府と関係者に働きかけた。また、農民達は政府に対して穀物、家畜、魚の交易を容易にするために、彼らが居住する遠隔地と高地をつなぐ道路の建設を要求した。

キーワード：脆弱性、食料生産、気候変動、適応、対処、旱ばつ、認識、灌漑、伝統的知識、科学的知識、調和、生業

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1.0 INTRODUCTION

This research report contains findings from the field work that was undertaken in the Kafwambila Village and its catchment area in Sinazongwe District in Gwembe Valley, in Chief Mweemba's area of the Southern Province, (Fig.1 and 2), on vulnerability of food production systems of small-scale farmers to climate change.

It is being predicted by scientists that Africa will be seriously affected by climate change especially through increasing and more severe droughts and floods; and that to some extent this situation is already being experienced in Zambia (Sichingabula and Sikazwe, 1999).

These extreme climatic conditions are expected to negatively impact rain fed food production systems of small-scale farmers. This state of affairs necessitated the conducting of empirical research in order to assess the vulnerability and resilience of the food production systems; consider the perceptions of the local farmers about climate change; establish the impacts of variable climate; find out how the people are coping with the impacts and also search for adaptive strategies that small-scale farmers need to adopt (ZVAC, 2005, ZVAC, 2007), as responses to climate change.

The field work was conducted from 20th June to 27th June, 2009, with the help of a University of Zambia undergraduate research assistant from the village where the field work was conducted.

1.1 Statement of the Research Problem

According to the Intergovernmental Panel on Climate Change (IPCC), it is predicted that in Africa, climate change will lead to the reduction in area suitable for agriculture, length of growing season and yield potentials; that yields from rain – fed agriculture could reduce by up to 50% by 2020; and that local food supplies will be negatively affected (IUCN, 2007).

In view of the above, it became necessary to conduct an empirical study in order to assess the perceptions of small-scale farmers as to whether environmental shocks from droughts and floods
are already being experienced in the study area; what the impacts are; what their short-term coping strategies are at the moment; and then find out what long term adaptation strategies should be devised and implemented.

1.2 Aim of the Study

The overall aim of the study was to assess vulnerability of food production systems in Kafwambila to climate change; assess perceptions of small-scale farmers on the impacts of climate change on their food production systems; find out their coping strategies; and search for adaptive measures that can be undertaken by the small-scale farmers themselves, with possible assistance from stakeholders such as the extension wings of the Ministry Agriculture and Cooperatives, the private sector, cooperating partners and Non Governmental Organisations (NGOs).

1.3 Objectives of the Study

The specific objectives of the research were as follows:-

(i) To assess perceptions of small-scale farmers on the impact of climate change on their food production system;

(ii) To assess their short term coping strategies; and

(iii) To search for long term adaptive strategies to climate change.

1.4 The Conceptual Framework

The research was undertaken in the context of a framework in which it was assumed that long term responses to climate change would require interfacing indigenous and scientific knowledge systems. In such a framework, it would require starting to search for adaptive strategies from what is known by the local people, such as different seed varieties and crop combinations which are currently being grown under existing climatic conditions; and then propagating them using modern scientific methods in order to adapt to the stressful climatic conditions that are being predicted.

Such an interface could take place in the context of emerging rural markets as well as selective interventions by different stakeholders including the Ministry of Agriculture and Cooperatives, the private Sector, NGOs, and Cooperating Partners, in order to promote sustainable small-holder agriculture.

1.5 Significance of the Study

This study is significant because it attempts to search for long term adaptive strategies to climate change in which there is an interface of indigenous and scientific knowledge systems. Such an interface could become the basis for a sustainable approach or framework upon which interventions to help small-holder farmers' deal with the impacts of climate change in the rest of the country and probably even beyond, can be established.

Furthermore, the study is significant because it is a contribution to knowledge on the impacts of climate change on food production since the findings are based on empirical research in a particular area, where probably no such study has been done before.

1.6 The Study Area

Kafwambila Village and its catchment area (Fig.2) is located in Region I of Zambia's three Agro-ecological Regions (Fig.3). This Region (I) which covers about 42% of the total land in Zambia comprises of Luangwa, Lunsemfwa and Zambezi or Gwembe Valleys and experiences unpredictable rainfall of less than 800mm per annum, and recurrent droughts.

It is further indicated by the National Adaptation Programme of Action to Climate change that Region I has become increasingly prone to droughts and that this trend is projected to continue (IUCN, 2007).

Region I has shallow escarpment sandy loams, and have a short growing season of between 80 and 120 days. According to Chipungu and Kunda (1994), these soils are of marginal agricultural value, and are cultivated for sorghum and millet on a subsistence basis.

As a semi-arid region or zone, the area is grown with secondary miombo woodland and scanty thorn bushes with little grass cover and is stalked with cattle, goats and donkeys. Goats and donkeys are probably more adapted to this dry and drought prone region than cattle.

Thus, according to a geography teacher at Kafwambila Upper Basic School, Kafwambila is located in the Gwembe Valley, which is considered a "rain shadow." The moist Congo air deposits its rain on the plateau (of the Southern Province) and is dry by the time the air mass flows over the valley.

The village and its catchment area or hinter land has a large, youthful and growing population of about 4,705 people, according to information from the Registered Nurse at the clinic in the village near the school. The Ward Councilor put the population at about 4,835 people. The Kafwambila Upper Basic School has an enrollment of 663 pupils, according to the Acting Deputy Headmaster.

It is therefore necessary for the community to find ways of responding to climate change so that the relatively high population is provided with the staple cereals on a sustainable basis.

Figure 1: Location of Sinazongwe District, Southern Province, Zambia

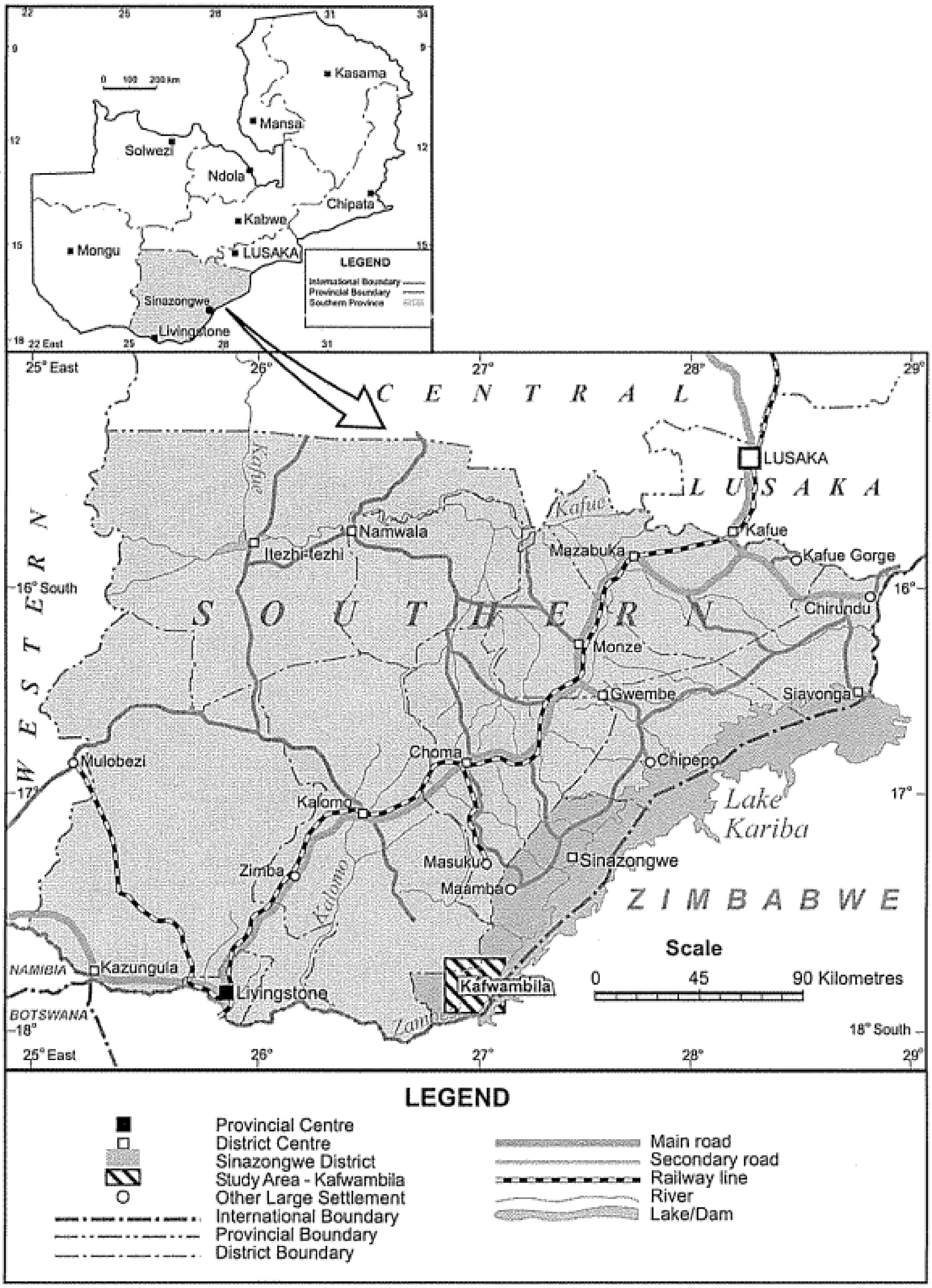


Figure 2: Kafwambila Village and Catchment Area, Sinazongwe District

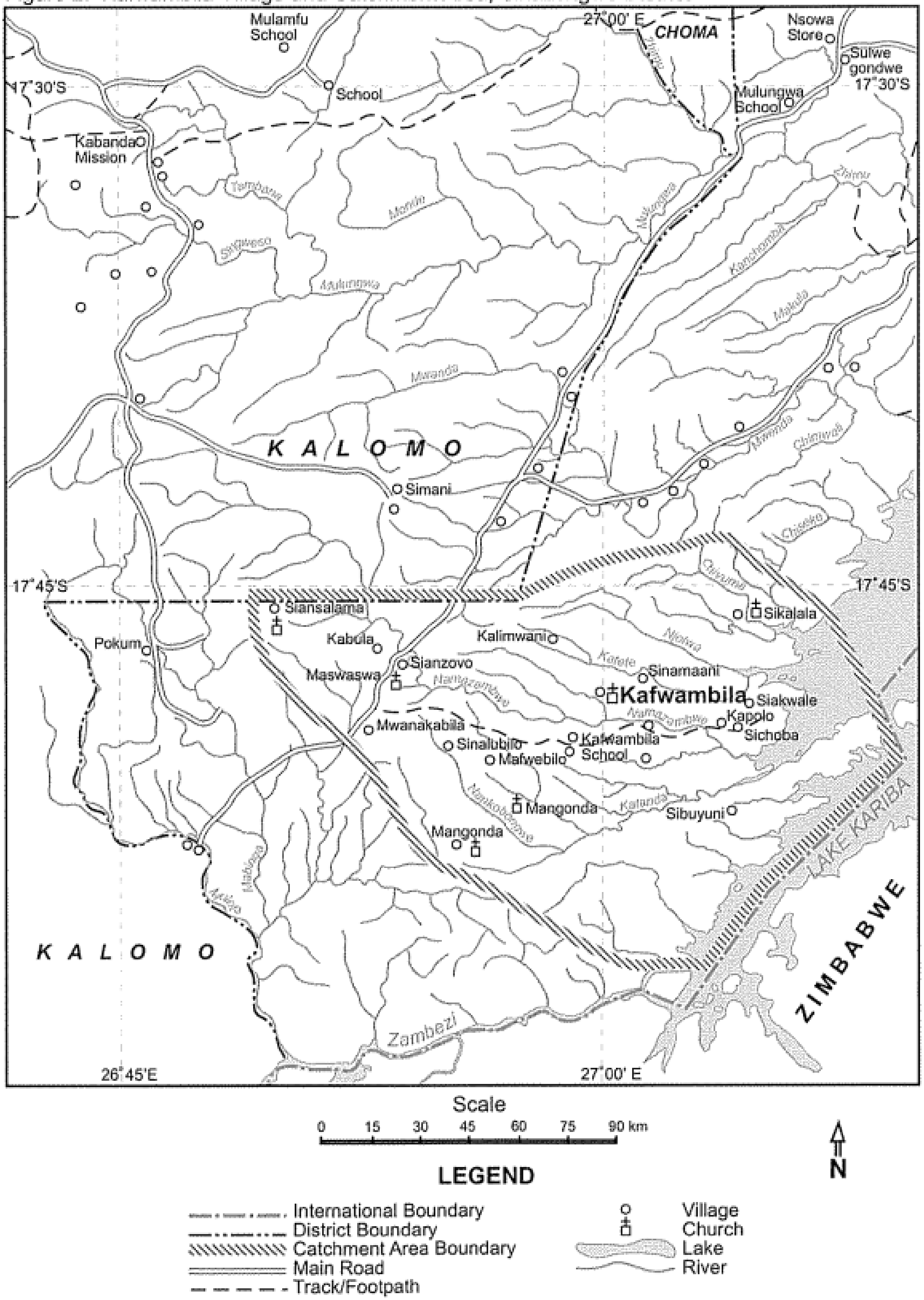
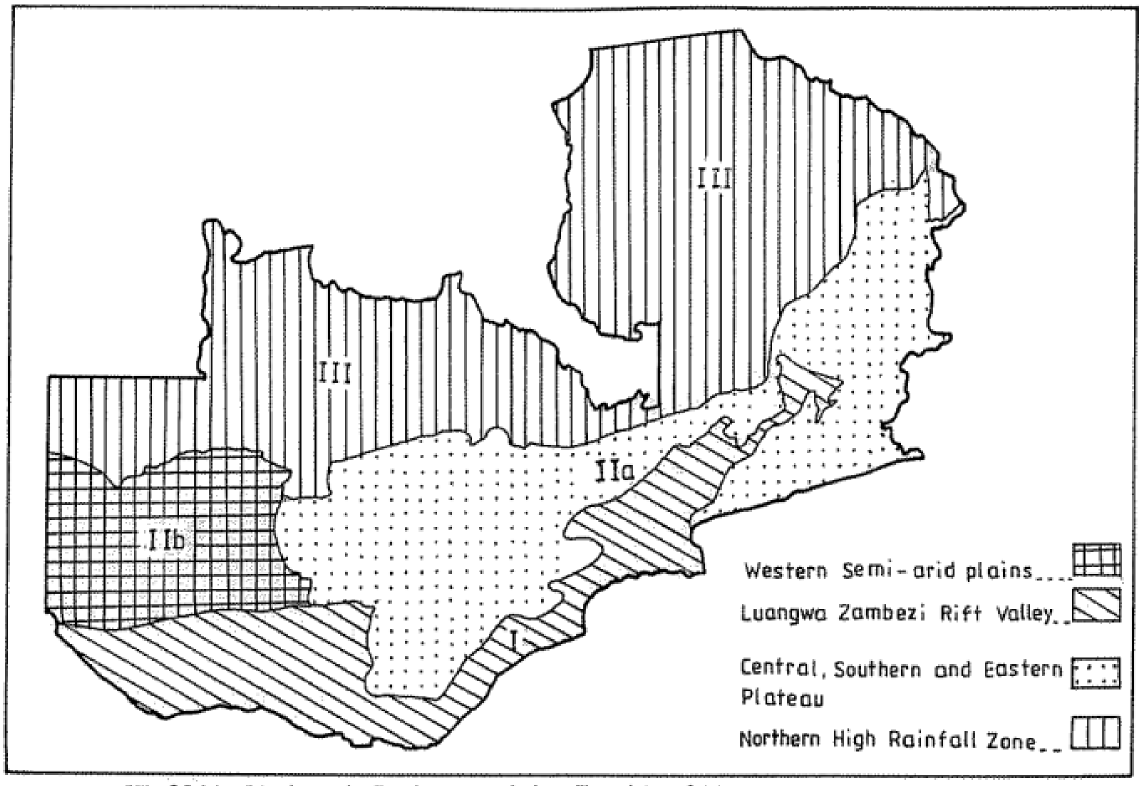


Figure 3: Agro-Ecological Regions of Zambia



Source: ECZ, 2001, State of Environment in Zambia 2000.

2.0 LITERATURE REVIEW

In making the review of literature an attempt has been made to first describe what climate change is; consider its impacts on the food system (in Africa), and then refer to measures that need to be undertaken as a response to the phenomenon.

According to Staff Writer (2008), the earth is surrounded by greenhouse gases such as water vapour and carbon dioxide which act as a natural blanket to retain some of the solar radiation. This keeps the earth warm within the context of the Earth's energy balance. Climate change therefore, is about the fact that this energy balance is being altered due to the increase in greenhouse gases, resulting from the burning of fossil fuels and emissions of carbon dioxide, methane, hydro-fluorocarbons (HFCs), and other gases over a long period of time since the Industrial Revolution that started in Europe around 1750.

Thus, the accumulation or concentration of these green house gases in the atmosphere is making the earth warmer. In the sub-tropics such as in Southern Africa, the warming of the climate system is likely to cause a significant decrease in precipitation, but an increase in temperature, leading to frequent and more severe droughts (Staff Writer, 2008, p.6).

It is therefore being predicted in the assessment reports by the IPCC that in Africa, between 75 and 250 million people could be exposed to increased water stress by 2020; and that in some counties, yields from rain-fed agriculture could be reduced by up to 50% by 2020; and that agricultural production (and access to food) in many African countries will be severely compromised, resulting in food insecurity that will exacerbate malnutrition.

According to Hachileka (2007), climate variability is not new to Zambia, as the country has a history of droughts and floods. These extreme events are expected to become more frequent and severe due to the impacts of climate change.

A study by Sichingabula and Sikazwe (1999) on Kafue and Zambezi river droughts shows that there is persistent occurrence of droughts. These events are taking place under increasing water demands for agriculture (and other uses), and also under increasing threat of global warming. They go on to contend that in Zambia droughts go back as early as 1908 and since then drought years have been more frequent than wet years.

It should be noted that climatic variability due to climate change is probably already undermining the resilience of food production systems. Torok (2008) defines resilience as "the capacity of a social-ecological system both to withstand perturbations from climate or economic shocks and to rebuild and renew itself afterwards" (Torok, 2008, p. 48). He continues to contend that resilience focuses on the ability to manage change resulting from the shocks and continue to develop.

In this regard it may be argued that aspects of food production system resilience among small-scale farmers may be found in the coping strategies that they resort to in order to manage the shocks emanating from climate change.

According to Global Environmental Change and Food Systems(GECAFS ,2005), a Food System is "a set of dynamic interactions between and within the bio-geophysical and human environments that result in the production, processing, distribution, preparation and consumption of food "(GECAFS, 2005, p. 9). Thus the system encompasses food availability (in the community and at household level); food access (in markets if individuals can afford to purchase the food) and food utilization or consumption.

With respect to the need for small-scale farmers to adapt their food production systems to climate change, Staff Writer (2008a) is of the view that the capacity to adapt is not evenly distributed in the communities. This ability is unevenly distributed within societies, and the poor and marginalized groups are likely to be more adversely affected by climate change, since these groups usually have the lowest capacity to cope.

Staff Writer (2008a) continues to point out that adaptation may be used in different contexts, and adaptation practices can be local, regional or national. Furthermore, adaptation may take place in a given sector, such as in small-holder agricultural production, and there may be different actors.

It is further stated that short-term mitigation measures or coping strategies may increase the long-term resilience or adaptation strategies.

Staff Writer (2008a) points out that the IPCC provides examples of adaptation practices that enhance adaptive capacity of food production or livelihood systems. These include crop and livelihood diversification; alternative crops (or crop types and crop combinations); diversification of incomes; changes in livelihood practices and migration.

In order to reduce vulnerability to climate change, it is suggested by the IPCC that food production/livelihoods systems should promote among other things, adjustment of planting dates, and crop varieties, drought tolerant crops, water storage, irrigation, rainwater harvesting and water conservation (Staff Writer, 2008a, p. 18).

Thus, it is stated that while adaptation mainly involves private actions of the people who are affected, mitigation or public intervention aims at reducing community impact. However, adaptation and mitigation are interrelated, and there could be synergies between the two (Staff Writer, 2008a, p.20).

In an attempt to improve food security/rural livelihoods and their adaptive capacities to climate change or global environmental change hazards, Quaye (2009) states that an interdisciplinary research team in Ghana, is attempting to create an interface between indigenous knowledge and food science technology development.

This is being done in order to strengthen local food (production) networks and enhance ‘food sovereignty’ or the ability of small-scale farmers to produce and process food, while taking into account local consumer preference and perceptions (Quaye, 2009).

Cesano et al (2009), show that in the semi arid region of North – Eastern Brazil where the rural economy is based on subsistence agriculture and pastoralism, a structured partnership has been established between local leaders, providers of a micro-credit scheme, technological providers, private, public and NGOs. This partnership has established a water efficient irrigation project aimed at improving agricultural yields and helping about 15,000 small-scale farmers to adapt to climate change impacts such as drought.

It is indicated that the irrigation project has been running for four years now and it is likely to become a self-replicable programme, not only in Brazil, but also in many parts of Asia and Africa where social, economic and environmental conditions may be similar.

With respect to the impacts of climate change on agricultural activities in Zambia, the Environmental Council of Zambia (ECZ, 2001) reports that studies were conducted, and it was shown that production of maize varieties would reduce "under a scenario that would double the amount of carbon dioxide that is currently present in the atmosphere" (ECZ, 2001, p. 134). This state of affairs would occur in Agro-ecological Regions I and II. On the other hand, it was shown that sorghum production would increase.

In terms of adaptation measures, it was reported that the following were being done:- (ECZ, 2001, p. 134).

- Development of drought tolerant and early maturing crop varieties;
- Promotion of crop diversification;
- Improvement in crop management or crop husbandry, techniques; and
- The construction of support infrastructure like dams for irrigation.

Kasali (2007) contends that although Zambia has experienced climatic hazards, especially droughts and floods, "the resilience of communities is still very low", and communities depend on "outside interventions to save them from the associated socio-economic hardships" (Kasali, 2007, p.29-29).

Kasali (2007) continues to argue that while mitigation measures address the short-term needs of affected populations, Zambia needs "longer – term reduction of risks and vulnerability" (Kasali, 2007, p.29). In other words, the country needs to enhance the adaptive capacities of the communities in order to promote sustainable agricultural development, in the context of the changing climate.

Thus, one of the key adaptive strategies that has been identified and proposed by the Ministry of Agriculture and Cooperatives (MACO) which is contained in the National Agricultural Policy (2004 – 2015), is the supplementing of rainfall to meet crop water requirements in times of drought, and the planting of crops during the dry season, through irrigation (Kasali, 2007, p. 29).

In this regard, Kasali (2007) states further that "irrigation is one of those adaptation options that should address the long – term vulnerability of Zambians to rainfall deficits" (Kasali. 2007, p, 29).

He goes on to propose that in addition to irrigation, adaptation measures should include the development of drought tolerant, early maturing and high yielding crop varieties through agricultural research and development; and the diffusion of drought tolerant root crops like cassava, and also sorghum, in the traditionally maize growing communities especially in the drought prone Agro-ecological Region I.

Kasali (2007) also hopes that the government and other stakeholders should train the communities in the processing and utilization of the introduced crops (like cassava); restock cattle and fish; introduce perennial grasses as cattle fodder; promote drought tolerant goats and conservation (organic) farming.

Thus, according to Hachileka (2007), consultations with the Zambia National Farmers Union (ZNFU); Environmental Conversation Association of Zambia and various government ministries, reveal that a number of coping and adaptation strategies to climate change that are being implemented by some farmers include the following:- (Hachileka, 2007, p. 3 and p. 4).

- Seed multiplication
- Introduction of early maturing crop varieties
- Introduction of drought tolerant crops
- Crop diversification
- Introduction of crops requiring low external input support such as cassava and sweet potatoes.
- Promotion of irrigation through the construction of small dams
- Promotion of drought tolerant small livestock especially goats and poultry
- Food relief distribution programmes with the support of the World Food Programme and faith based organizations, and
- Awareness rising on climate change.

3.0 METHODOLOGY

The data which are presented in this research report were obtained through the use of Secondary and Primary Sources.

3.1 Secondary Sources of Data

Secondary data were collected through the review of literature. This has been done in section 2.0, and touches on the concepts of climate change and food system; the impacts and the need for both short and long-term adaptation strategies and awareness rising on climate change.

3.2 Primary Sources of Data

Primary data were collected through field work that was undertaken between 20th June to 27th June, 2009, as follows:-

3.2.1 Semi-Structured Interviews with Farmers

Semi-structured interviews using an Interview Schedule (appendix 1) were held with 32 small-scale farmers from Kafwambila Village, and from seven other villages within the hinterland of Kafwambila. The sample was purposively chosen on the basis of availability sampling, as shown in table 1.

Table 1: Villages of the Respondents

Name of Village	No. Sampled	Percent (%)
Kafwambila	17	53.1
Kabula	01	03.1
Kalimwani	02	06.3
Kapolo	02	06.3
Mangonda	01	03.1
Sichooba	05	15.6
Sinalubilo	03	09.4
Sinamaani	01	03.1
Total	**32**	**100.0**

Source: Field Data (2009)

The number of households per sampled village is shown in table 2.

Table 2: Households per Sampled Village

Name of Village	No. of Households
Kafwambila	86
Kabula	66
Kalimwani	30
Kapolo	48
Mangonda	62
Sichooba	74
Sinalubilo	56
Sinamaani	81
Total	**503**

Source: Ward Councilor (2009)

Since 32 heads of households, or their spouses were interviewed out of the 503 households from the eight villages that were captured in the Kafwambila catchment area or hinterland, it follows that the sample represents 6.4 percent of the total number of households as compiled by the Ward Councilor.

3.2.2 Interviews with Key Informants

Interviews were held with the following Key Informants:-

(a) The Ward Councilor – in his double capacity as a small-scale farmer and also as a Councilor;
(b) The Agricultural Block Extension Officer;
(c) The Community Agricultural Worker (CAW) – in his double capacity as a small-scale farmer as well as an officer in the community who acts as a link with the Block Extension Officer;
(d) The Acting Deputy Head Teacher – in his double capacity as a part time farmer and teacher at the local Kafwambila High Basic School; and
(e) The Registered Nurse at the Kafwambila Clinic – in order to obtain some information on child malnutrition and HIV/AIDS situation in the community.

3.2.3 Focus Group Discussions (FGDs)

Two FGDs were held. The first was held in Kafwambila Village and was attended by 23 men from five different villages from the catchment area. However, no woman attended the discussions, probably because the notice of the meeting was only shared with the Headmen and their colleagues in the village communities in which women are not represented. This first meeting was held on 23rd June, 2009.

The second FGD meeting was held on 25th June 2009, in Sinalubilo Village - a distance from the Basic School and the clinic. It was attended by 21 men, again, no woman was in attendance, probably because the local culture does not encourage women to be nominated or elected to be members in the village committees, as those in attendance were mostly headmen with their committee members.

3.2.4 Research Questions

The following questions guided the research:-

(i) Are small-scale farmers aware of climate change and its impacts on their food production systems in the local area?
(ii) What are their short term coping strategies?

(iii) What are their long term adaptation measures or strategies in terms of food production?
(iv) What crop types are cultivated in the village or the area?
(v) What are the crop combinations that are practiced?
(vi) Is food production, area planted and yield increasing or reducing due to climatic variability or climate change?
(vii) What should small-scale farmers do to withstand climate change in terms of production?
(viii) What can stakeholders do to help farmers deal with climate change?

4.0 RESEARCH FINDINGS

This section presents the research findings from the field work that was undertaken to consider or assess food production systems; perception of climate change by the small-scale farmers; Impacts of climate change; coping and adaptive strategies.

4.1 Characteristics of the Sample

A total of 32 small-scale farmers were interviewed. Of these, 19 or 59.4% were men while 13 or 40.6% were women.

In terms of marital status, 16 or 50.0% of the respondents were married to one spouse; 10 or 31.3% were in polygamous marriages; and 6 or 18.7% were widowed. Of all those that were interviewed, none was single, divorced or separated. All the widowed spouses were women, and they indicated that they were rather vulnerable because of this status.

With respect to age, one respondent or 3.1% was below the age of 21 years; 23 or 71.9% were in the productive age group between 22 to 50 years; two or 6.3% fell in the 51 to 60 years age group, while 6 or 18.7% were in the 61 and above age group. The respondents in the last age group especially women, were also rather vulnerable, as they tended to be widowed at the same time.

In terms of the level of education attained, 9 or 28.1% reported that they had no education at all or had not been to school; 20 or 62.5% had attained primary education, while 3 or 9.4% had reached secondary level. None of the respondents had attained any tertiary or post secondary education.

Thus, it would seem that the majority of the respondents (29 or 90.6%) had very little education, and this state of affairs could have an influence on their perception of climate change.

The occupations of the 32 respondents are show in table 3.

Table 3: Occupation of Respondents

Category	No.	Percent
Farmer	21	65.63
Farmer and Fisherman	8	25.00
Farmer and government Job	1	3.13
Farmer and Business	1	3.13
Other (Farmer and Teacher)	1	3.13
Total	32	100.00

Source: Field Data (2009)

Table 3 shows that the majority of the respondents (21 or 65.63%) classify themselves as small-scale farmers; while 8 or 25% combine farming and fishing as the bases for their livelihood; while the remainder combine farming with non-farming income generating activities.

The length of stay of the respondents in Kafwambila village and its catchment area or hinter land is shown in table 4.

Table 4: Length of Stay in Village

Category	No.	Percent
Recently settled (5 yrs)	1	3.1
Since relocation from Kariba (1955)	2	6.3
Stayed a long time (15 yrs +)	10	31.2
Born in village (over 40 yrs)	19	59.2
Total	32	100.0

Source: Field Data (2009)

The data in table 4 show that the majority of the respondents (29 or 90.4%), have stayed for a long time (15 yrs +) and many were born in the study area, and have therefore lived in the area for over 40 years.

It would seem that individuals have stayed in the Kafwambila area for a long time, and the community is probably adapted to the semi – arid conditions. Furthermore, it could also be assumed that the majority of the small-scale farmers have stayed long enough to notice a trend towards frequent droughts and its consequent impact on agricultural production.

4.2 Food Production System

The food production system in the Kafwambila area is described in the context of crop types; estimates of what is harvested in an average good agricultural season; size of fields; livestock assets and crop combinations. The system is based on rain fed agriculture.

4.2.1 Crop Types

It was found during the research that the main staple cereals that are grown by the small-scale farmers are Bulrush Millet (*Nzembwe*); Sorghum (*Maila*) and Maize (*Mapopwe*).

All those that were interviewed (32 or 100%) indicated that they cultivate both millet and sorghum. A total of 23 respondents or 71.9% indicated that they also grow maize as their third cereal and staple. Those who stated that they do not grow maize were 9 or 28% of the sample, and they explained that they did not grow the crop because of low rainfall which made the cereal unsuitable in the area that is characterized by drought conditions.

In, other words, both millet and sorghum are seen to be relatively more suited to this low rainfall area, than maize.

4.2.2 Estimates of Crop Harvests

Estimates by farmers of how much they are able to harvest in a normal or good rainy season are shown in tables 5a and 5b.

Table 5a: Estimates of Crop Harvests (In Good Season) x 90 Kg Bags

Respondent	Millet X 90 Kg Bags	Sorghum X 90Kg Bags	Maize X 90Kg Bags
No. 2	**7**	4	-
No. 4	5	-	-
No. 5	2	-	-
No. 7	3	1	-
No. 8	5	-	-
No. 10	10	-	5
No. 11	11	-	-
No. 12	4	-	-
No. 13	6	8	21
No. 14	4	4	10
No. 15	1	1	-
No. 16	5	2	4
No. 17	8	3	4

Respondent	Millet X 90 Kg Bags	Sorghum X 90Kg Bags	Maize X 90Kg Bags
No. 18	6	5	4
No. 19	5	-	-
No. 20	6	-	-
No. 21	6	-	-
No. 22	2	-	-
No. 25	1.5	-	-
No. 26	4	1	-
No. 27	20	-	-
No. 28	-	25	-
No. 29	9	12	47
No. 30	5	3.5	-
No. 31	9	5	3
Total	**144.5**	**74.5**	**97**

Source: Field Data (2009)

Table 5a shows estimates of how many 90 Kg bags were harvested in an average good agricultural season with normal rainfall. A total of 24 farmers indicated the amounts they harvested or produced which totaled 144.5 x 90 Kg bags of millet. This gives an average of 6 bags per farmer.

For sorghum, a total of 13 farmers produced 74.5 x 90 Kg bags, giving an average of 5.7 bags per farmer; while the 97 x 90 Kg bags of maize were produced by only eight farmers and production was dominated by two farmers (respondent No. 29 and No. 13). Respondent No. 29 indicated that he was able to produce many bags of maize because he uses cattle to plough a large field of about 4 ha.

Another set of farmers gave crop production estimates measured in 50 Kg bags in a good season. These estimates are show in Table 5b.

Table 5b: **Estimates of Crop Harvests (in good season) X 50 Kg Bags**

Respondent	Millet X 50 Kg bags	Sorghum X 50 Kg bags	Maize X 50 Kg bags
No. 23	9	-	-
No. 24	6	8	4
No. 26	-	-	1
No. 28	1	-	40
No. 30	-	-	6
Total	16	8	51

Source: Field Data (2009)

Table 5b. shows that three farmers produced 16 X 50 Kg bags of millet and had an average of 5.3 x 50 Kg bags per person, while only one farmer produced the 8 x 50 Kg bags of sorghum. It is also interesting to note that respondent No. 28 was able to produce 40 x 50 Kg bags of maize in a good season. He explained that he was able to do well because he uses cattle manure and chemical fertilizers to produce the crop.

Estimates were also made by some farmers to show what they produce in a bad season with drought. These are shown in table 5c.

Table 5c: Estimates of Crop Harvests (in bad season) X 90 Kg Bags

Respondent	Millet X 90 Kg bags	Sorghum X 90 Kg bags	Maize X 90 Kg bags
No. 2	3	-	-
No. 8	3	-	-
No. 11	3	-	-
No. 27	1	-	-
No. 29	3	-	7
Total	13	0	7

Source: Field Data (2009)

Table 5c shows that respondents who did 'well' in a good season as shown in table 5a, especially with respect to millet production, suffer big losses in a bad season or year. For instance, respondent No. 2 who harvested 7 x 90 Kg bags of millet and 4 x 90 Kg bags of sorghum in a good year produced only 3 x 90 Kg bags in a bad season, experiencing a reduction of 57% and 100% for millet and sorghum, respectively. Also, respondent No. 27 who produced 20 x 90 Kg bags of millet in a good year, harvested only 1 x 90 Kg bag of millet in a bad season, suffering a big loss of 95%. In other words crop production is declining rather than increasing in the study area due to climatic variability or climate change.

It should be noted that tables 5a and 5c show that millet or *Nzembwe* is the major cereal that farmers depend on, as both sorghum and maize are adversely affected by climatic variation, especially during drought. Furthermore, the few bags that are harvested go to suggest that production of crops is basically for subsistence rather than for the market, and does not fully ensure household food security. Information from the Health Centre indicated that the village and its hinterland have cases of under-five child malnutrition, and these are increasing. By the time of the research, the World food Programme was providing High Energy Protein Supplements (HEPS) to 293 children – an increase of 173 children or 144% from 2007, when there were 120 cases.

4.2.3 <u>Size of Fields</u>

A total of nine respondents or 28% of the sample were able to give estimates of the sizes of their fields. These estimates are shown in table 6.

Table 6: Estimates of Size of Fields in Hectares

Respondent	Size of Field
No. 7	1.5 (on average about 2 ha)
No. 12	0.25 (one Lima)
No. 13	3.0
No. 14	3.0
No. 18	2.0
No. 9	0.25 (one Lima
No. 20	1.5
No. 28	5.0
No. 29	4.0
Total	**28.5**

Source: Field Data (2009)

Table 6 shows that the nine farmers had a total of 28.5 ha. of land, giving an average of 2.3 ha per farmer or household. This figure compares favourably with the mean for smallholder landholding size per household in Southern Province, which is 2.64 ha. by 2002/2003, according to the Food Security Research Project (Jayne, et al, 2008, p 9, table1).

From the responses in table 6, three types of field sizes were categorized as follows:-

Small fields = 0.25 ha (Lima) (2 respondents)
Medium size fields = 1.5 to 2 ha. (3 respondents)
Large fields = 3 – 5 ha (4 respondents)

Thus, out of the nine respondents, seven or 77.8% had medium to large size fields, which they used to cultivate the three staple cereals. The Community Agricultural Worker (CAW), who was respondent number 18, stated that the average field size was about 1.5 ha., although the farmers who have access to draft power are able to cultivate about 3 ha.

4.2.4 <u>Livestock Assets</u>

The types and numbers of livestock assets that respondents own are given in table 7.

Table 7: Livestock Assets Owned by Respondents

Respondent	Cattle	Goats	Sheep	Pigs	Donkey	Guinea Fowls	Chickens
No.1	5	-	-	-	-	-	-
No.2	-	45	38	-	-	-	-
No.3	15	-	-	-	-	-	-
No.4	-	-	-	-	-	-	-
No.5	3	-	-	-	-	4	5
No.6	3	6	-	-	-	-	-
No.7	2	-	3	-	-	-	-
No.8	-	-	-	-	-	-	-
No.9	-	10	-	-	-	16	6
No.10	2	6	-	-	-	-	30
No.11	1	-	-	-	-	-	-
No.12	9	15	-	-	-	-	6
No.13	18	26	-	-	6	-	6
No.14	3	-	-	-	-	8	4
No.15	-	3	-	-	-	-	-
No.16	-	5	-	-	-	-	5
No.17	7	25	10	-		-	6
No.18	6	21	-	-		-	10
No.19	10	5	-	-		-	4
No.20	11	7	-	-	2	-	20
No.21	2		-	-	-	-	-
No.22	2	4	-	4	-	-	-
No.23	-	3	-	-	-	-	-
No.24	-	5	-	-	-	-	6
No.25	3	-	-	-	-	-	-
No.26	-	2	-	-	-	-	10
No.27	-	-	-	-	-	-	1
No.28	15	20	-	-	-	-	-
No.29	9	Stolen	-	-	-	-	19
No.30	10	16	32	-	-	-	12
No.31	40h	30h	20h	-	15h	-	-
No.32	5h	8h	-	-	-	-	18h, 2w
Total	181	262	103	4	23	28	170

Note: h = Owned by husband; w = Owned by wife; Stolen = 28 Goats

Table 7 shows that a total of 30 or 93.8% of the respondents (plus the two husbands), had one type of livestock or another; or a combination of livestock assets, as shown below:-

- A total of 181 herds of cattle were owned by 22 or 68.8% of the interviewed farmers. The animals are used for ploughing by those who have them; as well as by those who don't have but are able to hire them. The use of cattle for ploughing was given as a contributing factor to the ability by some farmers to cultivate what they referred to as 'large fields'. In addition, cattle provide meat and milk and are a source of income if sold.
- Goats numbering 262, and were more numerous than cattle, were owned by 20 or 62.5% of the respondents. It was observed that goats which are also a source of meat and income if sold, were more adapted than cattle to this semi – arid area, as they are able to feed on shrub since there is no grass.
- Sheep were also available in the study area. There were 103 sheep owned by 5 or 15.6% of the respondents. They are also a source of meat and income if sold.
- Twenty three (23) donkeys were owned by 3 or 9.4% of the respondents. It was indicated that these animals were also adapted to the area, and were used for carrying or transporting goods such as maize meal from the grinding mills.
- A total of 170 chickens were owned by 17 or 53.1% of the respondents; plus 28 guinea fowls owned by 3 or 9.4% of those interviewed. The birds are a major source of relish and also of income, since they are readily sold.
- Only one respondent indicated that he owned the four pigs, which are also a source of meat and income.

4.2.5 <u>Crop Combinations</u>

When the research was conceived, it was assumed that under crop combinations, it would require obtaining qualitative data on whether inter – cropping land usage systems were still being practiced or not. Such systems in the past, allowed a wide variety of crops such as cereals, tubers, legumes and cucurbits to be grown on the same piece of land or field. The variety of crops grown was a useful risk management strategy, aimed at avoiding total crop failure under adverse weather conditions.

Thus, the statements which follow, captured the responses and summarized the narratives of some small-scale farmers: two men and seven women (or 28% of the sample); four of whom were elderly widows, who were able to recollect what transpired when they were younger women. The responses suggest that crop combinations or inter cropping is to some extent still a surviving land usage practice which is part of indigenous knowledge systems.

The two men were respondents No.2 and No. 18. Number 2 explained that he is aware of inter-cropping and is able to mix millet, sorghum and pumpkins. Number 18, the Community Agricultural Worker (CAW), was of the view that inter-cropping (which he practices) also "help to provide food, since some crop may fail but others may reach maturity".

With respect to the views of women, respondent number five stated that some farmers still practice inter-cropping cereals and cucurbits; adding that "this helps us to some extent. But, we need seed for grain."

Respondent No. 6, an elderly widow, stated that inter-cropping is (still) done. Maize is inter-cropped with pumpkins and water melons; adding that this practice improves household food security because different crops mature at different times. So, "we can feed children with pumpkins when these mature before the maize crop."

Another elderly widow, respondent No. 8, stated that when she was younger and able to cultivate the land, she used to practice inter-cropping-mixing millet with cucurbits like water melons and pumpkins. She indicated further that crop combination was a good strategy especially if one did not have enough land; and added that her recommendation was that small-scale farmers should continue to use this strategy.

A 74 year old widow (respondent No. 11) also stated that when she was much younger and even now, she practices inter-cropping in one field. She added that "this strategy is good because if one crop fails, then you can depend on the other that may survive."

Another elderly widow, responded No. 27, also stated that she used to inter crop when she was younger. She explained that this was a risk management strategy in that if one crop failed, she could harvest the other that survived.

However, she rather exposed her limited appreciation of indigenous knowledge by concluding that "we inter cropped on a trial and error basis", and wondered whether the practice should be continued even now!

Two younger women, both in polygamous marriages, also indicated that they practice inter cropping. The youngest woman who was interviewed, aged 19 was respondent No. 32. She stated that "we intercrop; it helps with food security". The other 34 year old respondent No. 31, also indicated that she practices inter-cropping. However, she qualified her practice of inter-cropping by stating that "it helps only to provide early food; while waiting for the cereals to ripen."

The statements recorded above suggest that knowledge about the practice of and the advantages of inter cropping or crop combinations, is not only confined to elderly people, especially women, but can also be passed on to the younger generation as well. Furthermore, crop combinations enhance household food security and the resilience of the food production systems of small-scale farmers, in view of the climatic variability in the study area.

4.3 Impact of Droughts and Floods or Climate Change

When the researcher asked farmers to state the impact of extreme weather conditions, especially drought, on crop production, a total of 16 or 50% of the respondents indicated that droughts lead to crop failure, as cereals wilt before reaching maturity; and when asked about production, another 21 or 65.6% responded that crop production or harvests are reducing instead of increasing.

For instance, respondent No. 23, a 31 year old male disclosed that "crops die at flowering stage due to lack of rain"; while respondent No. 22, a 36 year old female stated that "crops wilt before maturity; when crops are about to flower, the rains stop; so, crops don't mature." On the whole, the scenario was summarized by respondent No. 15, a 29 year old male who remarked that "droughts are causing hunger". Participants in the first focus group discussion (FGD) also remarked that "droughts bring hunger".

With respect to the impact of droughts on livestock, respondent No. 2, a 40 year old male stated that "when there is drought, there is no water and therefore no grass for livestock – so, animals become thin and eventually die."

Respondent No. 5, a 46 year old female, indicated that in times of droughts, "animals are adversely affected in that there is no pasture for grazing." In the same vein, participants in the first FGD also observed that during drought, "there is no grass for animals, so they die."

Although floods are rarely experienced in the area, respondent No. 2 explained that in the 2007/08 season, he lost 21 goats and sheep due to floods. Respondent No. 10, a 38 year old male even remarked that "drought is better than flooding because floods wash away everything – but during drought, some crops survive"!

4.4 Perception of Climate Change

In attempting to assess if farmers were aware of climate change, the researcher did it indirectly, by asking questions on whether they had experienced droughts and floods.

So, when the question, have you experienced drought as a farmer was posed, the responses were affirmative. All those that were interviewed individually said: "Yes, I have experienced drought."

Then, a follow up question was posed: How often have you experiences droughts? In answering the question, a total of 28 or 87.5% of the sampled farmers stated that "droughts are quite often or droughts are frequent". Only 4 or 12.5% of the farmers responded that "droughts come in a while."

Farmers were then asked the question: why are droughts frequent? A total of 29 or 90.63% of the sample responded that they were not aware of the causes of frequent droughts in their area. However, 3 or 9.37% of the sample attempted to give an explanation. Respondent No. 9, a 41 year old male teacher explained that droughts were frequent because the Gwembe Valley is a rain shadow; while the other one said that wind causes the droughts and the third said that he had heard something on radio about climatic variability.

The farmers were then asked the question: have you experienced floods in the area? In answering the question, 28 or 87.5% of the sample said "yes"; and they went on to explain that they had experienced it in the 2007/08 agricultural season. Another 2 or 6.25% responded that they had experienced "part drought, part flood" in the 2008/09 season; while another 2 or 6.25% responded in the negative that "there are no floods here"; or "floods were not common".

Thus, the small-scale farmers unanimously stated that droughts were more frequent in their occurrence, in comparison to floods, although they were not aware of the causes of the extreme weather conditions. This lack of awareness could be due to low levels of education in the community as shown in section 4.1 above, and also probably due to the remoteness of the area.

In other words, the respondents were not aware of the concept of "climate change". Hence, the researcher attempted to sensitize the farmers individually and in the FGDs about the concept; and about the worst scenario predictions as indicated by the IPCC as shown in section 2.0 above.

When the concept was simplified and explained, the respondents were very anxious about the state of the environment and even asked: "how are we going to survive"? One female respondent asked the question: "when is climate change going to start"? Furthermore, another male participant in the second FGD posed a question in anger that "why should we suffer from the effects of the predicted scenarios when the major causes of climate change lie elsewhere outside Africa"?

4.5 Coping Strategies

After assessing the impact of droughts and floods on their agricultural/food production, small-scale farmers were then asked to explain their coping/livelihood strategies. The respondents gave their coping/ livelihood strategies as shown in table 8.

Table 8: Coping/Livelihood Strategies

	Livelihood Type	No.	%
1	Selling Livestock to raise cash	17	53.10
2	Catch and sell fish	8	25.00
3	Sell baskets and help from well wishers	2	6.30
4	Work for food	1	3.12
5	Look for piece work	1	3.12
6	Work as a Teacher	1	3.12
7	Husband has a grocery	1	3.12
8	God feeds me through my children	1	3.12
	Total	32	100.00

Source: Field Data (2009)

Table 8 shows that the major coping or livelihood strategy given by the respondents was their ability to sell one or two of their animals – whether cattle, goats or chickens, in order to buy fish from Lake Kariba; and then travel to the plateau (Maamba Coal Mine or Mapatizya and even Kalomo) to look for maize grain which was bought after selling the fish or bartered or exchanged with fish. Then, the farmers would return to the valley with maize grain which they took to the grinding mills to obtain maize mealie meal for food. The majority of the respondents (17 or 53.1%) indicated that this was their strategy of coping with climatic variation, especially drought.

Those who indicated that they combine farming with fishing (i.e. 8 or 25% of the sample) also exchanged their fish with maize grain or sold the fish to buy grain at the plateau, before returning to the valley.

Thus, if we combine the first and second livelihood types, a total of 25 or 78.1% of the respondents rely on the relationship between farming and livestock raising in the valley; catching and selling/buying of fish from the lake; and exchanging fish with grain at the plateau or selling fish and then buying grain – then making the return journey to the valley with maize grain; and then repeat the cycle when necessary. Figure 4 shows the stages that constitute this livelihoods circuit or pattern and coping strategies.

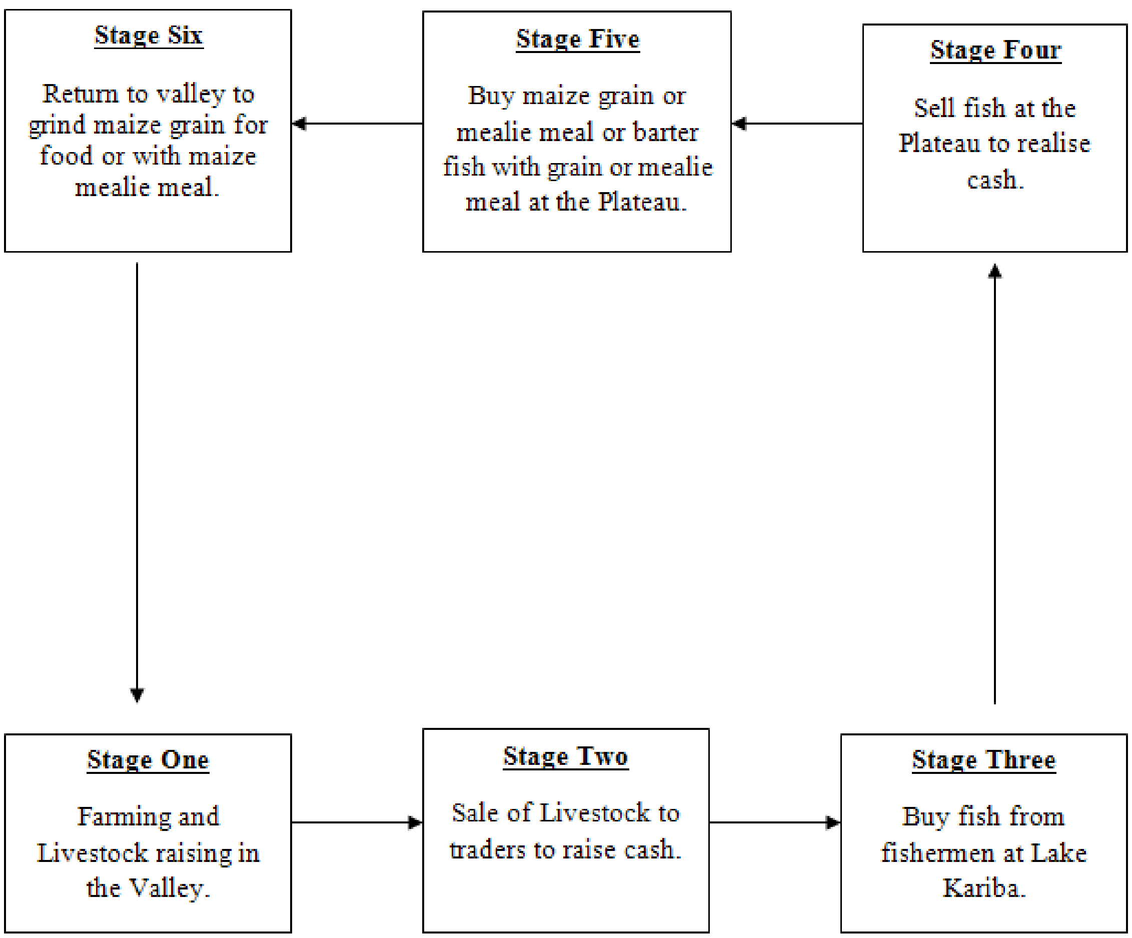
One key informant, respondent No. 13 (the Ward Councilor) indicated that he sold six animals at K1.2 million Kwacha per animal, in order to raise cash to buy grain from the plateau in different areas of Kalomo District. Another farmer, respondent No. 20, a village headman, stated that he sold 5 cattle in 2008, at K350,000 per animal as they were small, but the bigger ones were sold at K600,000 each. In the same year, he sold 3 goats at K35,000 – K40,000 per animal.

However, respondent No. 20 also indicated that when there is a drought, the price of livestock on the rural market comes down and therefore, farmers are made to sell their animals at depressed prices.

In the case of fishermen, respondent No. 23 stated that if he has a good catch of fish, he can raise about K1.5 million – K2.0 million per month if he goes to sell the fish at the mine on the plateau. If he sells within the valley, he can raise about K600,000 per month.

The two respondents, who indicated that they cope with the effects of drought by making and selling baskets, were elderly widows. They seemed very vulnerable as they raised very little, about K10,000 per basket. Respondent No. 4 stated that she is able to make only 2 baskets per month. She lamented that in the past the government brought relief food, but this was not the case now. So, she depends on well wishers! The other widow, respondent No. 11 summed it up when she said that "God feeds me through my children".

Figure 4*:* Livelihoods Circuit and Coping Strategies



Source: Field Data (2009)

4.6 Adaptive Strategies and Interface

After sharing with the farmers, in which effort was made to simplify the meaning of climate change, the researcher then asked them to state what they thought they could do in order to adapt to climate change. The responses are shown in table 9.

Table 9: Adaptation Strategies

	Response	No.	%
1	We don't know what to do if extremes of droughts (and floods) come in future	10	31.25
2	We need irrigation	9	28.12
3	We need new seed varieties	1	3.13
4	Emigrate to the plateau	2	6.25
5	The government should teach us new farming methods	1	3.13
6	We need good roads to facilitate trading (in food and fish)	1	3.13
7	The government should help us; otherwise we will be in serious trouble.	2	6.25
8	We will start/continue fishing as a livelihood.	3	9.37
9	We need to intercrop as was the case in the past.	3	9.37
	Total	32	100.00

Source: Field Data (2009)

The data in table 9 show that 10 or 31.25% of the farmers stated that they did not know what to do in trying to adapt to climate change and the worst scenarios that scientists are predicting.

However, 9 or 28.12% of the respondents suggested that what is needed is that government should intervene to provide an irrigation scheme(s), so that farmers do not continue to depend on rainfall for agricultural activities. Participants in the FGDs also emphasized the need for irrigation as a more sustainable adaptation strategy to climate change that was causing frequent droughts. Furthermore, it was suggested that farmers in the area need to access new seed varieties that are early maturing, tolerant to drought and high yielding.

In this regard, respondent No. 4, a widow from Kafwambila Village recalled that in the past, the local people had different types of local/traditional or indigenous varieties of seeds. One such type was a bull rush millet called *Katokoloshi.* It was early maturing. However, the variety was short and had very small grains. As a result, the yield per planted area was very low. So, farmers did not like it despite the fact that is was early maturing.

Thus, when farmers were asked to indicate whether they had different seed varieties, 28 or 87.5% responded that "no, we need seed"; and 3 or 9.5% indicated that they had seed in the past, but not now.

It is apparent that the indigenous knowledge which the farmers have accumulated over the decades needs to be interfaced with modern knowledge from the scientific community including government experts, in order to help farmers adapt to climate change. So, when farmers were asked to indicate what stakeholders should do to help them, the following responses were given:-

- Stakeholders should come to help small-scale farmers find solutions to this problem of climate change, especially by teaching new methods of farming that are adapted to the changing environment.
- Interventions should include the introduction of early maturing and high yielding varieties of seeds that are suitable to the changing rain pattern. These hybrids should include seed for millet, sorghum and maize, and cassava sticks (at the right time for planting).
- Stakeholders should establish an Irrigation Scheme to tap water from Lake Kariba. This should include the promotion of Traddle Pumps (through a loan scheme) that farmers can use to engage in small-scale irrigation of maize and vegetable gardens by the lake shore.
- The government and other relevant stakeholders should provide information (especially weather forecasting) to help farmers strategise in agriculture.
- Stakeholders should (continue to) provide relief food in order to mitigate the impacts of climate change that will manifest in terms of more frequent and severe droughts and floods.

It was therefore reassuring to learn from the Block Extension Officer that the Scientific Community with the support of the Japanese International Cooperation Agency (JICA) was currently working on improving seed varieties of millet and sorghum at Mt. Makulu Agricultural Research Station; and that these early maturing and high yielding varieties would be introduced in the 2009/2010 agricultural season.

5.0 DISCUSSION

The aim of the research was to assess the perceptions of small-scale farmers on the impacts of climate change on their food production systems; assess their coping strategies; and search for adaptive measures.

It has been noted that Kafwambila (the study area) is located within Agro-Ecological Region I which is characterized by low rainfall, and is a semi-arid area in a rain shadow. Because of this, small-scale farmers are engaged in subsistence rain fed agricultural production of traditional cereals – Bulrush millet (*Nzembwe*), sorghum (*Maila*) and to some extent maize (*Mapopwe*). They also raise cattle, goats, sheep, donkeys and chickens.

The study area experiences frequent droughts and occassionary floods which have severe impacts on production of staple crops. Although the study shows that the small-scale farmers are not aware of the concept of 'climate change', they nonetheless experience its effects indirectly through variable climate, especially low rainfall that leads to frequent droughts. These droughts lead to crop failure that makes the food production system very vulnerable.

Thus farmers expressed the view that because of frequent droughts, their production of cereals has been declining despite the use of cattle to plough more land. Such decline in food production that is supposed to support a youthful and growing population, makes the community very vulnerable, and has many cases of under-five child malnutrition.
However, the study shows that the farmers have devised an interesting coping strategy. When the crops fail, they sell some of their animals (especially cattle, goats and chickens) in order to raise money to buy fish from fishermen at Lake Kariba; then, they travel to the plateau to sell the fish in order to raise cash to buy maize grain on the rural market, or exchange (barter) the fish with maize grain. After this, they make a return journey to the valley where they take the grain to hammer mills in order to obtain maize mealie meal. The process is repeated as required.

This process creates a pattern that has been referred to in this report as a livelihoods circuit and coping strategy (Fig.4). The pattern seems to be sustainable and resilient as the farmers in the valley are able to raise money from the sale of livestock; then relate to the lake as a source of fish; and then relate to the farmers or traders at the plateau before returning to the Gwembe Valley.

However, the participants in the FGDs did not accept this circuit as being sustainable. They were of the view that if the droughts become more frequent and severe (as per the worst scenarios being predicted by the scientific community in the IPCC), the fishing industry on Lake Kariba will also suffer. They argued that reduced volume of water in the lake affects the fish, and fishermen cannot catch enough fish to sell to the farmers in the valley. Furthermore, the participants also argued that extreme climatic conditions, especially drought, is also likely to affect the farmers on the plateau, and these will not have enough maize grain to sell to them or exchange with fish.

It was further pointed out in the FGDs that the traders or buyers of fish at the plateau do not practice fair exchange, as they demand for large quantities of fish for the grain that the farmers from the valley need to access.

In the same vein, farmers lamented that in times of drought, the price of livestock decreases substantially, probably because the rural markets become glutted with animals due to the fact that many livestock keepers become desperate to raise cash by selling more animals so that they participate in the livelihoods circuit, in order to access maize grain.

So, when the researcher explained in a simplified way the causes and possible consequences of climate change; and asked the farmers to state how they hope to adapt to this global environmental change, they responded that “we don’t know what to do”; “we have no idea”; “we have no solution”; “we are not sure”; and they added that “we need external support”.
However, the generative theme that emerged from the interviews and FGDs was that adaptation could probably be achieved, if the government and other stakeholders (like the NGOs and Cooperating Partners) intervened by introducing an irrigation scheme that could tap water from Lake Kariba that is nearby within walking distance from Kafwambila Village and its hinterland.

In this regard, the Block Extension Officer commented that there was need for an NGO that could work with the Ministry of Agriculture and Cooperatives to introduce irrigation technology into the area. He added that such a scheme could be viable since the flat topography is suitable to constructing an irrigation canal to bring water from the lake to farmers.

The officer added that if such a scheme was introduced, there would be need to train the farmers in irrigation techniques as was the case with another scheme at Sinamalima within Sinazongwe District. At this place, the scheme that was introduced by the government is still operating and the local people are growing citrus fruits and vegetables like tomatoes and okra.

He observed that what was required was for the institutional representatives like the Member of Parliament; the Ward Councilor and others, to initiate moves so that the government and other stakeholders can intervene to introduce the scheme as there is demand in the area.

The local farmers also emphasised that there was need for the Scientific Community through government and other stakeholders (especially NGOs) to provide a wide variety of improved and certified seeds, for all the staple cereals that they grow. It was emphasized that such seeds should be suitable to the changing rain pattern. In other words, the varieties should be drought tolerant, early maturing and high yielding.

If the scientific community intervenes in this way, then there could be an interface between what the small-scale farmers know in terms of crop types and crop combinations in the context of indigenous knowledge, and the scientific knowledge systems. In this regard, the Block Officer acknowledged that currently, there is a seed development programme aimed at producing hybrids of millets, sorghum and maize, at Mt. Makulu Research Station, supported by the Japanese International Cooperation Agency (JICA).

Although participants in the FGDs seemed to under estimate the positive roles played by their coping strategies which have been referred to as the livelihoods circuit in section 4.5, it can be argued that this livelihoods circuit could enhance adaptation to climate change. Staff Writer (2008a) expressed the view that short-term mitigation and long-term adaptation are interrelated and there could be synergies between the two.

Thus, trading activities within the livelihoods circuit could re-enforce the long term adaptation measures involving the introduction of new seed varieties of the staple cereals; while farmers are trained to assimilate irrigation techniques and technological practices. This is similar to the point raised by Quaye (2009) who indicated that efforts are being made in Northern Ghana to create an interface between indigenous knowledge and food science technology; and also the point stated by Cesano et al, (2009), that the introduction of an irrigation scheme plus provision of micro-credit by stakeholders, is helping small-scale farmers to improve agricultural yields, and adapt to climate change in North-eastern Brazil.

The partnership between different stakeholders, which is referred to in Zambia as Public Private Partnership (PPPs), could be instrumental in making the required interventions to meet the suggestions made by small-scale farmers in the Kafwambila area, with respect to the need to provide an irrigation scheme, a micro-credit scheme and the improvement of seed (and livestock) varieties.

These interventions could facilitate adaptation to climate change, as farmers have observed that they are experiencing more bad seasons than good ones due to frequent droughts; hence, there is increasing vulnerability due to declining production of existing local varieties of staple cereals, under rain fed agricultural production.

It should also be added that interventions by stake holders should include the construction and maintenance of passable feeder roads, which can link this remote part of the Southern Province, to the plateau, in order to facilitate more trade in fish, cattle, goats, chicken and grain, as these are the bases for sustainable livelihoods in the Gwembe Valley.

6.0 CONCLUSION

The study has shown that although the small-scale farmers in the Kafwambila area are not aware of the concept of climate change, they experience its impacts (indirectly) through frequent droughts and occasional floods. The local people indicated that climatic variability, especially low rainfall, had an increasing negative impact on their rain fed agricultural production system, in which they experienced frequent crop failure of their staple cereals of bulrush millet, sorghum and maize, resulting in food insecurity with increasing cases of under five child malnutrition as reported at the Health Centre.

The research has further shown that the small-scale farmers have been coping with these effects of climate change through the practice of crop combinations (or inter cropping) to some extent, but mainly through the establishment of a livelihoods circuit, in which farmers sell some of their livestock to (traders who come to the valley), in order to raise cash with which they buy fish from Lake Kariba, and then travel to the plateau to sell the fish to raise money with which to purchase maize grain from farmers on the plateau; or exchange fish with maize grain. Then, the farmers return with the grain to the valley and repeat the cycle when need arises.

Although the small-scale farmers seem to under estimate the positive role of this livelihood circuit/coping strategy, it could be argued that it has the potential of contributing significantly to long term adaptation measures which farmers need the government and other stakeholders like NGOs, Cooperating Partners and the Private Sector, to undertake.

The generative theme that arose from interviews and FGDs was that stakeholders should intervene by establishing an irrigation scheme; provide micro-credit to help farmers purchase pumps to facilitate small-scale irrigation, purchase fish nets, boats, implements and inputs.

Apart from the need for irrigation technology, farmers also expressed interest in accessing improved varieties of seeds of their staple cereals (bulrush millet, sorghum and maize), and emphasized that these were the bases on which to secure adaptation to climate change in this low rainfall, drought prone, semi arid zone. These seed varieties should be drought tolerant, early maturing and high yielding.

Thus, the research has shown that in order to help the small-scale farmers adapt to climate change, it will require establishing an interface between the ongoing agronomic practices based on indigenous knowledge (of crop types and crop combinations), with interventions by the scientific community, using scientific knowledge to produce, propagate and distribute (through rural markets and grants), hybrid seeds of all he staple cereals.

Furthermore, efforts must be made to ensure that synergies between short term mitigation and coping strategies based on the existing livelihoods circuit and the long term adaptation strategies (requiring irrigation and improved hybrid seeds), are synchronized and fused to promote adaptation of the food production systems to climate change.

7.0 RECOMMENDATIONS

In view of the research findings, discussion and conclusions made above, the following recommendations with policy implications are made:

(a) Efforts must be made by the government and other stake holders to sensitize the rural populations about the impacts of climate change and its implications for rain fed food production systems, as per the predictions of the Scientific Community in the IPCC reports.

(b) Institutional leaders in rural areas like members of Parliament, Ward Councilors, Church leaders etc should engage government and draw the attention of its institutions to the need to make targeted interventions to help small-scale farmers enhance their coping strategies with long term adaptation strategies – such as the establishment of irrigation schemes in order to lessen dependence on rain fed agricultural production given the increasing occurrence and severity of droughts (and floods) due to climate change.

(c) Concerted efforts must be made by the government and other stakeholders, to promote adaptation by small-scale farmers through inter facing indigenous knowledge in agricultural practices, with scientific knowledge by propagating improved hybrid varieties of seeds (of all staple cereals and tubers), and diffusing them through rural markets and grants.

(d) Adaptation to climate change could also be promoted if government ensures that remote parts of the country (like Kafwambila in Sinazongwe) are linked to the rest of the country through the provision and maintenance of passable feeder roads. These roads can stimulate market oriented agricultural production and trade in grain, livestock and fish, and contribute to spatial integration and national unity that is needed for promoting sustainable rural development in the country as a whole.

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Appendix 1

INTERVIEW SCHEDULE

A. PERSONAL INFORMATION

1. (a) Name: ……………………………………….(b) Village: ….…………………….

   (c) Chief: ………………………………….

2. Age: ……………………………………………

3. Marital Status: …………………………………

4. Education: (i) Primary: ………………………. (ii) Secondary: ……………………..
   (iii) Tertiary: ………………… (iv) None: ……………...…………

5. Length of stay in the village: …………………………………………………………

6. Occupation:….………………………………………………………………………….

7. Sex: (a) Male ( ) (b) Female ( )

B. PERCEPTION OF CLIMATE CHANGE

1. (a) Have you experienced droughts? ………………………………………………

   (b) How often? ……………………………………………………………………..

2. (a) Have you experienced floods? …………………………………………………

   (b) How often? ………………………………………………………………….….

3. Why droughts and floods? ……………………………………………………………..

4. Probe and share on changing climate ……………………………………………….……

C. IMPACTS OF DROUGHTS AND FLOODS

1. How do droughts affect food production?

    (a) Crop failure

    (b) Reduced yield/production?

2. How do floods affect food production?

    (a) Crop damage

    (b) Reduce yield / production?

3. How do these extreme events affect livestock?

    (a) Increased livestock diseases?

    (b) Increased livestock loses?

4. How does livestock loses affect food production?

    (a) Reduced draft power?

    (b) Reduced area cultivated?

    (c) Reduced livestock sales?

    (d) Reduced milk and meat sources?

D. COPING STRATEGIES

1. How do you cope with droughts?

2. How do you cope with floods?

E. ADAPTATION STRATEGIES

1. What crops do you grow? (i.e. crop types)

   - Names of crops

(a) Any early maturing varieties?

(b) Any drought tolerant crops?

(c) Any late maturing crops?

(d) Any flood tolerant (e.g. tall varieties of Sorghum or Bulrush Millet?)

2. Crop Combinations

(a) Co you practice intercropping? (Mixing Crops in the field).

(b) Do you practice under cropping?

F. INTERFACING ADAPTIVE STRATEGIES

1. Do you recall any strategies that were used in the past to reduce risk of total crop failure?

2. What can stakeholders do to help reduce risk of crop failure? (Any role by government, NGOs, Business people, the Church, donors, etc?).

3. Do you have different seeds that can help to withstand the extremes of weather indicated above?

4. What should small-scale farmers do to withstand climate change in the local area in terms of agricultural production?

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