

THE UNIVERSITY OF ZAMBIA
SCHOOL OF NATUEAL SCIENCES
DEPARTMENT OD GEOGRAPHY



**RESPONSES TO DROUGHT AMONG SMALL SCALE
FARMERS IN CHIEF NYAWA'S AREA, KAZUNGULA
DISTICT, SOUTHERN PROVINCE.**

BY VALENTINE K. MICHELO
(94102368)

SUPERVISOR: DR H.M. SICHINGABULA

GEO 474.

Project report saubmitted in partial fulfilment of requirements for the Bachelor of Science
Degree in Natural Resources

April, 2000

DEDICATION

This project is dedicated to my mother Elizaberth Munsanda; my young sisters Beeni and Maurine; and my young brother Evaristo Michelo who all live in Nakambala Township, Mazabuka. Southern Province.

DECLARATION

I VALENTINE KAWAMBWA MICHELO, declare that this project has been composed by me and that the work recorded is my own. All maps were drawn by me, and all quotations have been distinguished by quotation marks. The sources of all materials have been specially acknowledged.

Signature: *Michelelo*

Date:

ACKNOWLEDGEMENTS

Firstly, I wish to thank Dr. H.M. Sichingabula for Supervising the writing up of the final project report. I also thank Mr. G. Kajoba for supervising this project until Dr. H.M. Sichingabula took over. Their Technical guidance has been very valuable.

I also thank Zambia Meteorological Department, Central Statistical Office and the Cartographic Office of Geography Department of the University of Zambia for the necessary data they provided.

I am also indebted to Mr. Dominic Haanyanga for accommodating and helping me in various ways during the study. I am grateful to all the people of Chief Nyawa's area for their hospitality and co-operation which made this study possible.

TABLE OF CONTENT

Dedication	i
Declaration.....	ii
Acknowledgement	iii
Table of Contents	iv
List of Figures.....	v
List of Abbreviations.....	vi
Abstarct	1

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND.....	3
1.2 PROBLEM STATEMENT	3
1.3 RATIONALE.....	4
1.4 OBJECTIVES	4
1.4.1 Specific Objectives.....	4
1.5 Hypothese.....	5
1.6 Definations of key words.....	5

CHAPTEER TWO: LITERATURE REVIEW

2.1 WHAT IS DROUGHT.....	6
2.2 CAUSES OF DROUGHT	6
2.3 RAINFALL DISTRIBUTION IN ZAMBIA	7
2.4 IMPACTS AND EFFECTS OF DROUGHT	7
2.5 PERCEPTION OF DROUGHT	8
2.6 HUMAN RESPONSES.....	8

CHAPTER THREE: DESCRIPTION OF THE STUDY

3.1 LOCATION.....	10
3.2 CLIMATE.....	10
3.3 VEGETATION.....	10
3.4 SOILS AND DRAINAGE.....	10
3.5 SOCIO-ECONOMIC CONDITIONS.....	11

CHAPTER FOUR: METHODOLOGY

4.1 INTRODUCTION.....	12
4.2 SOURECES AND TYPES OF DATA.....	12
4.2.1 Secondary Sources.....	12
4.2.2 Primary Sources	12
4.3 SAMPLING METHOD	13
4.4 DATA ANALYSIS	14
4.5 CHOICE OF STUDY AREA	14
4.6 LIMITATIONS OF STUDY	15

CHAPTER FIVE: ANALYSIS AND RESEARCH FINDINGS

5.1 INTRODUCTION.....	16
5.2 FARMERS BACKGROUND INFORMATION.....	16
5.2.1 Age Structure.....	16
5.2.2 Sex.....	17
5.2.3 Marital Status.....	17
5.2.4 Education Status of Farmers.....	17
5.3 ACCESS TO AGRICULTURAL INFORMATION.....	18
5.4 HOUSEHOLD SOURCES OF INCOME.....	18
5.5 CLIMATOLOGICAL ANALYSIS.....	19
5.6 IMPACTS OF DROUGHTS ON CROP PRODUCTION.....	21
5.7 AID TO FARMERS.....	26
5.8 DROUGHT PERCEPTION AND ADOPTION OF ON-FARM APPLICABLE PRACTICES.....	26
5.8.1 DROUGHT AS PERCEIVED BY FARMERS AND ATTITUDES.....	26
5.8.2 Crop devesfication.....	28
5.8.3 Attitude towards adapted crops.....	28
5.8.4 Attitude towards early planting and other on-farm and off-farm adjustments.....	29

CHAPTER SIX: DISCUSSION OF FINDINGS AND INTERPRETATIONS

6.1 DROUGHT OCCURRENCE AND IMPLICATIONS.....	32
6.2 DROUGHT IMPACT ON MAIZE PRODUCTION.....	32
6.3 DROUGHT PERCEPTION AND ADOPTION OF APPLICABLE PRACTICES ..	33
6.4 GOVERNMENT AND NGO'S AID TO FARMERS.....	36

CHAPTER SEVEN: SUMMARY, CONCLUSION AND RECOMMENDATIONS

7.1 SUMMARY.....37
7.2 CONCLUSIONS37
7.3 RECOMMENDATIONS38
7.3.1 Recommendations to Farmers38
7.3.2 Recommendations to Government38

APPENDIX 1.: THE QUESTIONNAIRE 40

**APPENDIX2.: HISTORICAL RAINFALL FIGURES AND THEIR DEPARTHURE
FROM NORMAL (780.4MM).43**

REFERENCES45

LIST OF FIGURES

- Figure 1 Locational map of Chief Nyawa's area
- Figure 2 Age Structure of farmers
- Figure 4 Rainfall trend in Livingstone
- Figure 5 Maize yield and total Rainfall in Nyawa
1991 – 1998
- Figure 6 Correlation of maize yield and Rainfall in Chief Nyawa's
Area, 1991 – 1998

LIST OF TABLES

Table 4.1	Distribution of respondents in sampled villages
Table 5.1	Sex composition of farmers
Table 5.2	Education status of farmers in Chief Nyawa's area
Table 5.3	Household means of earning a living in Chief Nyawa's area
Table 5.4	Total maize yield and rainfall for 1990/91, 1991/92, 1993/94 and 1994/95 seasons
Table 5.5.	Drought perception Among Farmers
Table 5.6	Farmers' view on strip cropping
Table 5.7	Attitude towards diversification
Table 5.8	Off-farm Drought coping strategies
Table 5.9	Cultivation practices in Chief Nyawa's area
Table 5.10	Farmer's Difficulties in Adapting crop cultivation to drought.

ABSTRACT

This study investigated drought perception and responses to drought by small-scale farmers in chief Nyawa's area in Kazungula District, Southern Province. It assessed the occurrence of drought, impact of drought on maize production and the assistance given to farmers by Government and NGOs. The following were the objectives of the study;

- a) To identify the impacts of drought on maize production
- b) To assess drought perception and adjustments among small-scale farmers.
- c) To assess the responses to drought and the assistance rendered to the farmers by Government and NGOs.

A Survey questionnaire containing structured, semi-structured and open ended questions was used to collect primary data from small-scale farmers. Secondary data were obtained from existing literature and unpublished sources. Data were coded and analysed using statistical tests and the results were mainly presented in tabular and graphical forms.

Analysis of results revealed that droughts in chief Nyawa's area occur more frequently than wet years and that it was widely believed by farmers that droughts were becoming more frequent in occurrence. It was also revealed that droughts of 1991/92 and 1994/95 seasons had significant adverse effects on maize yields.

Due to the persistence of drought in the area, a wide range of both ^{on-farm} and off-farm drought mitigation adjustments were carried out by small-scale farmers as responses to drought. However, the adoption of effective practices need to be supported. The main adjustments to minimise the risk of crop failure due to drought included early planting, using early maturing maize varieties, mixed cropping and crop diversification. Off-farm drought mitigation strategies included selling livestock to towns, selling second-hand cloths and operating small shops. Most farmers became Anti-loan due to little or no income realised after repaying loans to some private input dealers especially in drought situations.

Government assistance to farmers included agricultural extension services and the provision of food for work. The assistance given by NGOS involve the ~~construction~~^{Provision} of inputs on loan basis.

Recommendations to farmers included placing of more emphasis on diversification to drought tolerant food and cash crops, full utilization of available sources of information in implementing drought mitigation adjustments, and farmers' involvement in other off-farm income generating activities to prevent hunger during drought. Recommendations made to Government included the provision of vital infrastructure to support irrigation, provision of Government regulated credits for agricultural inputs and other capital-intensive drought mitigation adjustments and the empowerment of farmers through the provision of title deeds.

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Southern Africa, of late, has been adversely hit by persistent droughts which have occurred in most parts of the African continent. During the 1991-92 season, a severe drought hit southern Africa and countries involved included Zambia, Zimbabwe, Botswana, Malawi, Tanzania, Swaziland and Mozambique (CSO 1992, Tiffen and Mulele 1994).

In Zambia, the 1991-92 drought saw the intensification of suffering amongst peasant farmers who were and are still suffering as a result of micro-economic policy problems that the country is facing. The drought hit the country in the midst of an economic transition from a high dependency on government subsidised maize production to a more liberalised economy. The economic transition coupled with subsequent occurrence of more frequent droughts has led to increased suffering of the peasantry characterised by decreased food stocks, water shortages especially for livestock and increased livestock diseases and deaths (CSO 1992). The 1991-92 drought led to decreases in crop production of 93%, 85%, 80.1%, 79.3% and 57% in Southern province, Lusaka, Western, Eastern and Central Provinces respectively, and this called for an estimated National cereal import of 970,000 tones of which 820,000 was required as food aid (CSO 1992). Droughts cause persistent suffering to man especially peasant farmers who depend on the adequacy of rainfall in each growing season for their survival. Crop failures, human and livestock deaths could be reduced or alleviated if peasant farmers were adequately fed with reliable information to help them in their perception and adjustments with a view to producing more food. This study, hence, investigated the impacts of drought on maize production in chief Nyawa's area and the farmers' perception and responses to drought.

1.2 PROBLEM STATEMENT

Chief Nyawa's area is characterised by critical food shortages in drought periods. The main crop grown is maize. Others include Millet, Sorghum, Groundnuts, Cotton, Sunflower and Tobacco. Maize is planted as first priority and other crops are planted later in the season. Despite this multiple cropping system dominated by maize, the study area is characterised by hunger in drought periods. The suffering of the peasantry is reflected in depleted food stocks,

depleted incomes, death of animals and humans due to lack of water and food (Tiffen and Mulele 1994; CSO,1992). On these grounds, this study investigated the impacts of drought in chief Nyawa's area, farmers' perception and adjustments or responses to persistent droughts.

1.3 RATIONALE

Most of the people in chief Nyawa's area are peasant farmers who obtain their food and other material needs through farming. Thus, the availability of food and the general wellbeing of the local people in the study area is highly dependent on the amount and distribution of rainfall for crop growth in each rain season. In times of drought, the poor peasant farmers are left with no food to eat before the next rain season. The food security of this country lies in the productivity of the agricultural sector. Since the peasantry makes more than 75% of the total number of farmers in the country (Tiffen and Mulele 1994). It is of primary importance that they are helped to perceive drought as a positive challenge and to be able to adjust towards continued agricultural production.

It is for the above reason that this study was proposed such that the research findings may be of use to farmers (in their adoption of drought coping strategies) and decision makers when making farming related decisions with or without drought. The project facilitates the identification of effective drought coping strategies that could be reinforced by government in order to reduce expenditure on the needed relief food in times of crop failure. It is also hoped that this study will contribute to increased knowledge on impacts of drought on small-scale farming in Zambia.

1.4 OBJECTIVES

The main objectives of this study is to assess drought perception and adjustments and/or responses to drought by small-scale farmers in chief Nyawa's area, Kazungula District of Southern province.

1.4.1 Specific Objectives

The Specific objectives of the study are threefold;

- a) To identify the impact of drought on maize production
- b) To assess drought perception and adjustments among small-scale farmers

b) To assess the responses to drought and the assistance rendered to the farmers by Government, Donors and NGOs

1.5 HYPOTHESES

- a) Ho: Maize production is not adversely affected by drought in Chief Nyawa's area.
- b) Ho: The small-scale farmers in Chief Nyawa's area are not able to respond to and adjust positively to persistent drought by continued agricultural production.
- c) Ho: Peasant farmers do not receive aid from Government, Donors and NGOs in order to cushion the adverse effects of drought.

1.6 DEFINITION OF SOME KEY WORDS USED IN THIS PAPER

1. Household - A group of human individuals who normally eat and live together, make common provisions for food or other essentials for living and they have one person whom they all regard as the head (CSO, 1993)
2. Food Security - Access by all people at all times to enough food for an active healthy life (World Bank 1986)
3. Coping Strategies/Adjustments - adaptive responses to maximise the survival of peasant households when faced with drought and shortage of food.
4. Drought - As used in this study, occurs when rainfall is below the expected (normal) in any area for an extended period. Normal rainfall in this study is defined as the long-term mean rainfall calculated from total annual rainfall figures (history)

CHAPTER TWO: LITERATURE REVIEW

2.1 WHAT IS DROUGHT

It is difficult to give one clear definition of drought as it is relative in nature and it is used to describe a wide range of conditions. Thus, there are multiple definitions of drought relating to different types of droughts in Agriculture, Meteorology and Hydrology among others. Agricultural drought is defined as a shortage of moisture such that plant growth is affected (Tiffen and Mulele, 1994; WMO, 1975). Hydrologically, drought occurs when there is a sustained deficit in surface runoff below normal conditions (WMO 1975; Sichingabula, 1975). Sichingabula (1999) defined drought as deficit in the mean discharge below the long-term mean. Meteorologically, drought occurs when there is a below average natural precipitation in a given period of time (WMO 1975). Most definitions of drought based solely on rainfall also refer to short period drought within the rain season (WMO 1975). The Southern part of Zambia suffers not only low rainfall but also poorly distributed rainfall within season (Tiffen and Mulele, 1994; Hutchinson, 1974)

Drought as used in this study occurs when rainfall is below the normal (long-term average natural precipitation) in any area for an extended period.

2.2 CAUSES OF DROUGHT

There are physical and anthropogenic factors leading to the occurrence of drought. Anthropogenic factors include deforestation, which leads to reduction in amounts of rainfall.

Physical variables that determine the amount and distribute of rainfall in different parts of the world include the effects of the sun, atmosphere, continents and own causes of rainfall and therefore it's own causes of rainfall deficiency-drought (Tannehill 1947). In Zambia, rainfall is highly affected by the movements of the Intertropical Convergence Zone (ITCZ). Due to the movements of the ITCZ rainfall decreases with increasing distance from the equator (Hutchinson, 1974). In Zambia, areas south west of the country are drier than those on the north eastern part (Sichingabula,1998). Chief Nyawa's area lies in the south western part of Zambia.

2.3 RAINFALL DISTRIBUTION IN ZAMBIA

Zambia has a distinct rain season lasting roughly from November to April (Hutchinson, 1974). The distribution of rainfall tends to be variable and invariable just as it is over most parts of southern Africa. The most notable feature of the distribution of the mean annual rainfall is the general decrease in the amount from north to south. This is due to the Southern movement of the ITCZ. Rainfall in Zambia decreases from an average of 1400mm in the wettest upper North to 600mm in the driest lower South (Sichingabula, 1998; Tiffen and Mulele, 1994). Chief Nyawa's area lies in the dry parts of the country where the probability of drought occurrence is 55% (Sichingabula, 1999). According to Sichingabula, drought occurs with a probability of 66% and 34% in the driest and wettest parts of the country respectively. Thus the Southern parts of the country are more prone to droughts than the North.

2.4 IMPACTS AND EFFECTS OF DROUGHT

Droughts have been known to be the major causes of famine, starvation and massive crop failures leading to outbreaks of disease and death of wild and domesticated animals. Lack of water affects all aspects of environmental health and human activities necessary for human survival and development.

Failure of rains in China and India is said to be the principle cause of famine although sometimes it is caused by heavy rains and flooding (Tannehill, 1947).

The 1969-73 drought in Nigeria greatly affected the country's economy. This was characterised by out-migration into towns in search of jobs, sale of cattle at very cheap prices, rise in prices of staple foods by 200-300% and a complete halt in groundnut export following an approximated 115,000 tonne loss in groundnut crop (Dalby, 1977).

The 1991-92 drought which hit large parts of Southern Africa caused critical food shortages in a number of countries including Botswana, Zimbabwe, Lesotho, Malawi, Mozambique, Swaziland and Zambia. In Zambia, particularly the southern province, the problem was so pronounced that people in some areas resorted to eating wild roots and grass due to depleted food stocks (Tiffen and Mulele, 1994; CSO, 1992). Drought has a negative effect on the production of food due to reduced crop yields when soil moisture is limiting. Tiffen and Mulele reported in 1994 that lack of water due to the 1991-92 drought entailed that domesticated animals trekked to far areas in search of water. The decline of the quality of

grazing areas caused stress and left animals more susceptible to disease such as Theileriosis, a tick borne disease usually called Corridor disease in Zambia [Tiffen and Mutele, 1994). The 1991/92 drought was also followed by an increase in Downer cow syndrome which is a disease characterised by cows failing to stand after giving birth and eventually die. The drought also forced some farmers to sell their animals due to urgent need of cash and/or (Tiffen and Mutele, 1994). Persistent droughts in the years 1991-97 have had negative impacts on many factors of the Zambian economy. These include: decreased annual rates of storage capacity in reservoirs such as Lake Kariba and Itzhi tezhi Dam (thus reducing power generation in the country), widespread failure of crops, loss of livestock and disruption of urban life styles due to water rationing and reduced forex earnings from water based recreation activities and Tourism (Sichingabula, 1998, 99, Banda et al, 1997, kajoba, 1993).

2.5 PERCEPTION OF DROUGHT

Drought brings to minds of many a people withering crops , parched fields, excessively high temperatures (in Africa and others) and failing water supplies. In its extremes in some countries , it means hunger, famine, starvation, human emenciation and death , and mass migration of peoples. It seems likely that the way in which people deal natural catastrophe of floods may be similar to their behaviour vis-a-vis droughts. Some studies in drought perception have revealed that experience is the major factor influencing drought perception among people (Saarinen, 1966). Therefore, perception varies with a degree of personal experience one to area differences in the frequency and nature of drought occurrence, there is also variation in the perception from area to area.

Perceptions of drought are complex and responses are often unpredictable. People do not view drought in a simple unified way, but usually have multiple adjustments.

2.6 HUMAN RESPONSES TO DROUGHT

As the need to continue living exist even after a drought, people always find ways of continuing to live by either improved methods of farming, completely abandoning farming for other economic activities or supplementing the reduced crop yields with other income generating activities. Tiffen and Mutele (1994) reported an increase in charcoal burning as a response to crop failure due to the 1991-92 drought. Following years of bad harvest due to

drought in 1973-74 season, the hause men resorted to rope and mat making in the drought prone rural areas of the semi-arid northern Nigeria(Mortimore,1989).

The Central Statistical Office in 1992 reported an increase in the consumption of wildfruits, roots and grass in Southern province of Zambia in response to the 1991-92 drought.The drought also led to an increase in the number of livestock transported from Southern Province to the Copperbelt markets for sale in local Butcheries(CSO,1992).

Other human responses to drought include, accepting losses(thus doing nothing but wait for relief provided by governments), improving irrigation and discharge by building dams and canals, and change to drought tolerant crops and adopt agricultural practices which conserve soil moisture(Sichingabula,1998).

This study sought to assess drought perception, impact of drought on maize production and farmers on-farm and off-farm adjustments as responses to persistent droughts in chief Nyawa's area.

CHAPTER THREE: DESCRIPTION OF THE STUDY AREA

3.1 LOCATION

Chief Nyawa's area is located between latitudes 17⁰S and 18⁰S, and Longitudes 26⁰E and 27⁰E. It is situated in Kazungula District about forty kilometers from Zimba in Southern Province (figure1). Zimba is about forty nine kilometers south west of Kalomo.

3.2 CLIMATE

Nyawa's area experiences a subtropical climate. The area receives annual rainfall ranging between 800 and 900mm. The rain season lasts from late November to mid April although this varies from year to year. The variation in the rainfall makes planning difficult for farmers.

October(hottest month) mean temperatures range between 15⁰C and 17⁰C (Meteorological Department, Lusaka;Resources Atlas of Zambia,1970).

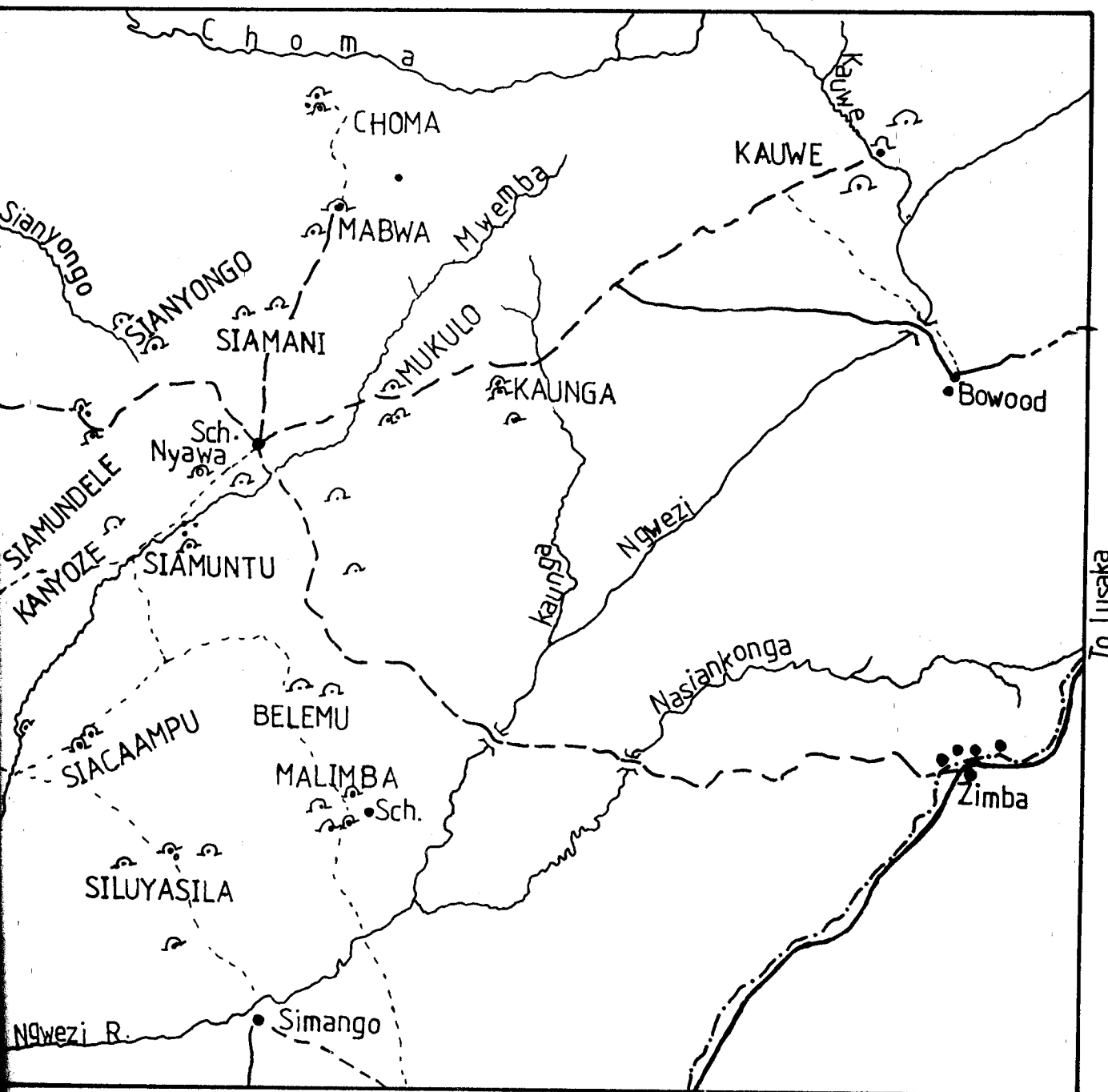
3.3 VEGETATION

Miombo woodland dominates the vegetation type in Nyawa's area. This is dominated by leguminous trees of genera *Brachystegia*, *Isoberlima* and *julbarnardia* (chidumoyo,1997). According to Chidumoyo, these trees are well adapted to fires and water stress, and are slow-growing. Other tree species found in the study area include pericopsis Angorensis ("Mubanga"), Andogensis ("Musime") and Colophospermaun Mopane (Mupani).

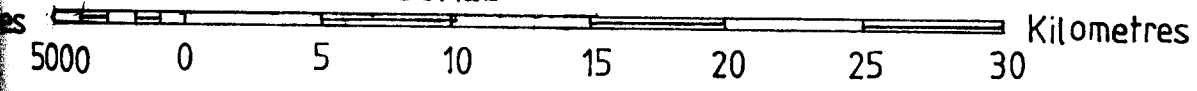
3.4 SOILS AND DRAINAGE

The soils in chief Nyawa's area are typically sandveldtely soils. Sandveldt soils are mainly well to moderately well drained. They are usually dark grey to brown in the top soils,depending on the content of organic matter. Soils in chief Nyawa's area are moderately leached sandveldt soils and are only medium acidic and hold nutrients fairly well under moderate rainfall conditions (Bramer,1993). These soils generally provide good agricultural soils and especially suitable for Virginia tobacco, maize, cotton, Cassava, Millet and Sunflower(Bramer,1993, Shultz,1976, Chief Nyawa's area is drained by six major streams, Choma, Sianyongo, Mwemba, Kaunga, Malimba and Kauwe. These are tributaries of Ngweszi river which joins the Zambezi river up stream of Victoria Falls (figure1).

FIGURE 1: LOCAL MAP OF CHIEF NYAWA'S AREA

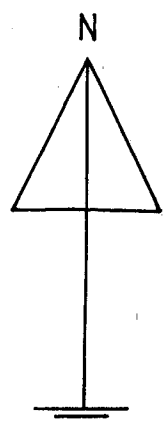


SCALE:



KEY

Im tared road		Bridge	
il line		Village	
er tared roads			
intained roads			
torable tracks			
ter course			



3.5 SOCIO-ECONOMIC CONDITONS

Chief Nyawa's area is located in a typical Toka Leya society and as such Toka Leya is the main language spoken, partly because of this location and partly because the local Toka Layas are the majority.

The villages in chief Nyawa's area include; Nyawa Central, Sianyongo, Siamundele, Siamani, Siamuntu, Mulamfu, Siaachampu, Belemu, Malimba, Siluyasila, Mabwa, Choma, Kauwe, Kaunga, Mufana, Muzumbwe, Kanchele, and Kanyoze. Administratively, all villages are under the aegis of chief Nyawa.

The people are generally small-scale farmers who grow Cotton, Cassava, groundnuts, sunflower, millet, sorghum, vegetable, and maize which is the dominant crop. Chief Nyawa's area has about seven primary schools and these are: Nyawa, Siamundele, Malimba, Simango, Choma, Mabwa, and Kaunwe primary schools. There is no secondary school in the area. The nearest Secondary schools are in Zimba. The aera has only one clinic at Nyawa Central.

CHAPTER FOUR: METHODOLOGY

4.1 INTRODUCTION

It is important in any study to present the methods and procedures of investigation used as this ensures the appreciation of the validity and the reliability of information obtained. This chapter gives the description of the types of data and sources, where the data was collected. The chapter also outlines the techniques that were used to analyse the data.

4.2 SOURCE AND TYPES OF DATA

The information was collected through three major sources as listed below:

- a) Secondary sources
- b) Primary sources
- c) Field observation

4.2.1 Secondary Sources

Daily point measurements of rainfall at Livingstone Meteorological Station for the period 1947-1998 were collected from the Meteorological Department in Lusaka. Only data from Livingstone Meteorology Station was collected and analysed because of lack of other Meteorology Stations near Nyawa. The nearest Station was in Kalomo but the data had many gaps and thus was not considered in this study.

The other secondary information included in the literature review was obtained by desk research at the University of Zambia main Library and Geography Departmental Library. Base maps were obtained from the Cartographic Office of the Geography Department, University of Zambia.

4.2.2 Primary Sources

Interviews were conducted to people with knowledge and are able to keep records of what happens in the area especially during drought. These included village headmen and Nyawa ward Councilar (MMD). An interview schedule in form of a questionnaire was administered to obtain information from the farmers. A total of 39 farmers (Household heads) were interviewed.

Due to the fact that many peasant farmers have a problem with the official language (English), the researcher asked the questions (from the questionnaires) in the local language (Toka Leya) and ticking the responses given by each respondent, the household head.

Field observations were used to identify some of the adjustments to drought by peasant farmers in the area.

4.3 Sampling Method

A stratified sampling technique was used to interview 39 heads of households out of the total of 1081 households in the sampled villages. The distribution of respondents in the 9 sampled villages is shown in table 4.1.

Table 4.1 Distribution of respondents in sampled villages

Village	Number of households	Number of respondents
Nyawa Central	278	10
Siamundele	222	8
Mukulo	139	5
Mabwa	111	4
Siamani	83	3
Kaunga	83	3
Choma	54	2
Siamuntu	56	2
Kanyoze	55	2
Totals	1081	39

Source: Field Research

4.4 DATA ANALYSIS

The data obtained was statistically analysed using appropriate statistical tests. The student "t" test was used to test the significance of the observed maize yield differences from year to year in the period 1991-98. The product - moment Correlation were used to test if there were any significant relationship between maize harvest and drought. the analysis of socio-economic and general farmers information involved manual coding and summerising. Description methods of means and percentages were used to assess the range of adjustments to drought and the adoption of applicable on-form practices by farmers in Chief Nyawa's area. The data has also been presented by statisatical tables, charts and graphs to make it easier to understand.

For climatical data, means, percentage frequencies and product - moment corrections were used. Drought frequency was determined as the number of drought occurences in a 51-year period (1947 - 1998) expressed as a percentage of the total number of periods.

The simple run test (WALD-WOLFOWITZ test) was used to determine the nature of sequences of occurrence of drought and wet periods for 51-year period.

Mean duration of drought periods was computed for the period between 1947 and 1998 using the following formular:-

$$\text{Mean duration of drought} = \frac{\text{Sum of drought of years}}{\text{Number of drought intervals}}$$

4.5 CHOICE OF STUDY AREA

The study area was chosen for the following reasons:-

- a) The area is prone todrought and it is one of the areas mostly hit by droughts
- b) Despite the vulnerability of the area to drought most people obtain food by own production which is highly affected by adequacy of rainfall during each growing season
- c) It is the reseacher's home area and so the researcher is familiar with the local language (Toka Leya). This made it easier for communication between the researcher and the locals.

4.6 LIMITATIONS OF THE STUDY

There was inadequate raingauge density to represent the study area as only one raingauge was used to obtain the rainfall data used in this research. An assumption was made, therefore, that rainfall distribution was uniform over Chief Nyawa's area. In the determination of the influence of drought on maize production in Chief Nyawa's area, it was not possible to isolate the effects of other physical, economic and managerial factors that affect crop production apart from climatic factors - rainfall. These factors were thus held constant.

One to luck of meteorological station in Chief Nyawa's area, rainfall data was obtained from the nearest Livingstone Meteorological Station. This could have affected the true portrayal of the picture of rainfall variability in the study area. Furthermore, the nature of the Socio-economic data obtained could not allow statistical tests which are applicable to the interval scale of management. Lastly, villagers in the study area have a spatial distribution pattern requiring transport for long distance travelling. Thus only areas accesible by walking were included in the sample. As a result a small sample was selected. The study area is about 1645km² in size. Results and their analysis are represented in the next chapter.

CHAPTER FIVE: ANALYSIS AND RESEARCH FINDINGS.

5.1 INTRODUCTION

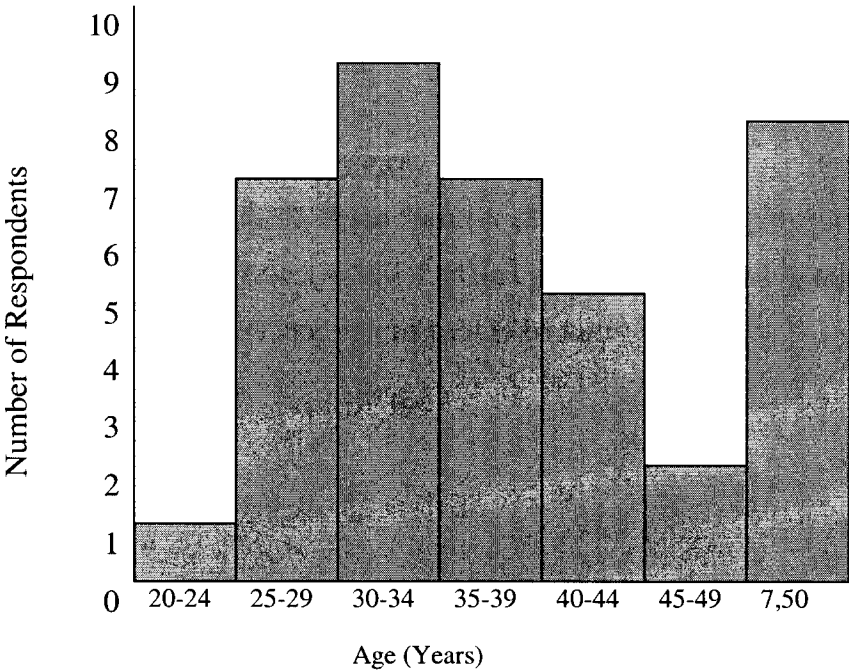
This chapter presents and analyses the research findings on the household background information, impacts of drought on maize production, responses to drought and adoption of applicable coping strategies and the aid received by farmers from government and non-governmental organisations.

5.2 FARMERS' BACKGROUND INFORMATION

5.2.1 Age Structure

The age of the farmers interviewed has been presented in figure 2 below. The majority of the farmers (38%) were above 39 years of age while only 2.6% were aged between 20 and 24 years and 17.9% were aged between 25 and 29 years. The average age of farmers was 40.3 years while the median was 36 and mode was 28 years. A comparison of the three measures of centrality (mean, median and mode) showed that there was positive skewness in age of farmers in Chief Nyawa's area, that there were more farmers below the age of 40 (mean) than above it.

Figure 2. Age Structure of Farmers



5.2.2 Sex

The sex composition of the farmers in Chief Nyawa's area is shown by Table 5.1

Table 5.1 Sex Composition of farmers

Sex	Number of Respondents	Percentage
Male	37	94.9
Female	2	5.1
Total	39	100.0

Source: Field research

As shown in Table 5.1, there are males than female farmers in Chief Nyawa's area. The only two females interviewed were widows. The lower percent of women farmers in the area shows the fact that men are the heads of most households.

5.2.3 Marital Status

Most of the farmers in the area (94.9%) were married and only 5.1% were single. All of the single famrmers were widows.

The research did not identify any widower. This may be due to the fact that most male farmers have more than one wives and hence the death of one wife does not necessarily make a husband a widower.

5.2.4 Education Status of Farmers

Table 5.2 shows that 46.2% of the farmers attained secondary level of education. Only 5.1% had tertiary education. About 87.2% had had primary and higher levels of education. Thus the farmers in Chief Nyawa's area can be said to be fairly literate.

Table 5.2 Education Status of Farmers in Chief Nyawa's area

Level of Education	Number of Respondents	Percentage
Nil	5	12.8
Primary	14	35.9
Secondary	18	46.2
Tertiary	2	5.1
Totals	39	100.0

Source: Field Survey

5.3 ACCESS TO AGRICULTURAL INFORMATION

The farmers in the study area have access to agricultural information. The sources of information include radios, neighbours and friends, Ministry of Agriculture Extension Services, and family relatives. The other sources of information are Non-Governmental Organisations, PAM and CARE International who advise and provide agricultural loans in terms of seeds, fertilizers and other chemicals.

About (89.7%) farmers get agriculture information mainly from Radio, 31 respondents (79.5%) share information with neighbours and friends, 4 respondents (10.3%) share information with family and relatives while 25 respondents (64.0%) are visited by MAFF extension officers.

5.4 HOUSEHOLD SOURCES OF INCOME

All the respondents (100%) were farmers among which 41% practiced farming only. About 59% had other off-farm sources of income Table 5.3).

Table 5.3: Household Means of earning a Living in Chief Nyawa's Area

Sources of Income	Number of Respondents	Percentage
Farming only	16	41.0
Farming plus wage employment	3	7.7
Farming plus other business	20	51.3
Totals	39	100.0

Source: Field research

5.5 CLIMATOLOGICAL ANALYSIS

The runs test for the period 1947 - 1998 yielded a calculated value of the Zrun (0.282) which is outside the critical range (-0.1103 - 0.1103). In this test drought years were labeled 'D' and wet years were labeled 'W'. The test led to the establishment that droughts in the study area do not occur in random sequence with wet years.

Drought frequency in the period 1947 - 1998 was found to be 52.2%. This means that drought occur more frequently than high rainfall in the area because there is a higher chance of drought occurrence (52.2%) than the occurrence of high rainfall (47.8%). The mean duration of droughts in the period 1947 to 1998 was found to 3 years. Rainfall variations about the normal value (780.4mm) are shown in Figure 4.

TOTAL RAINFALL (mm)

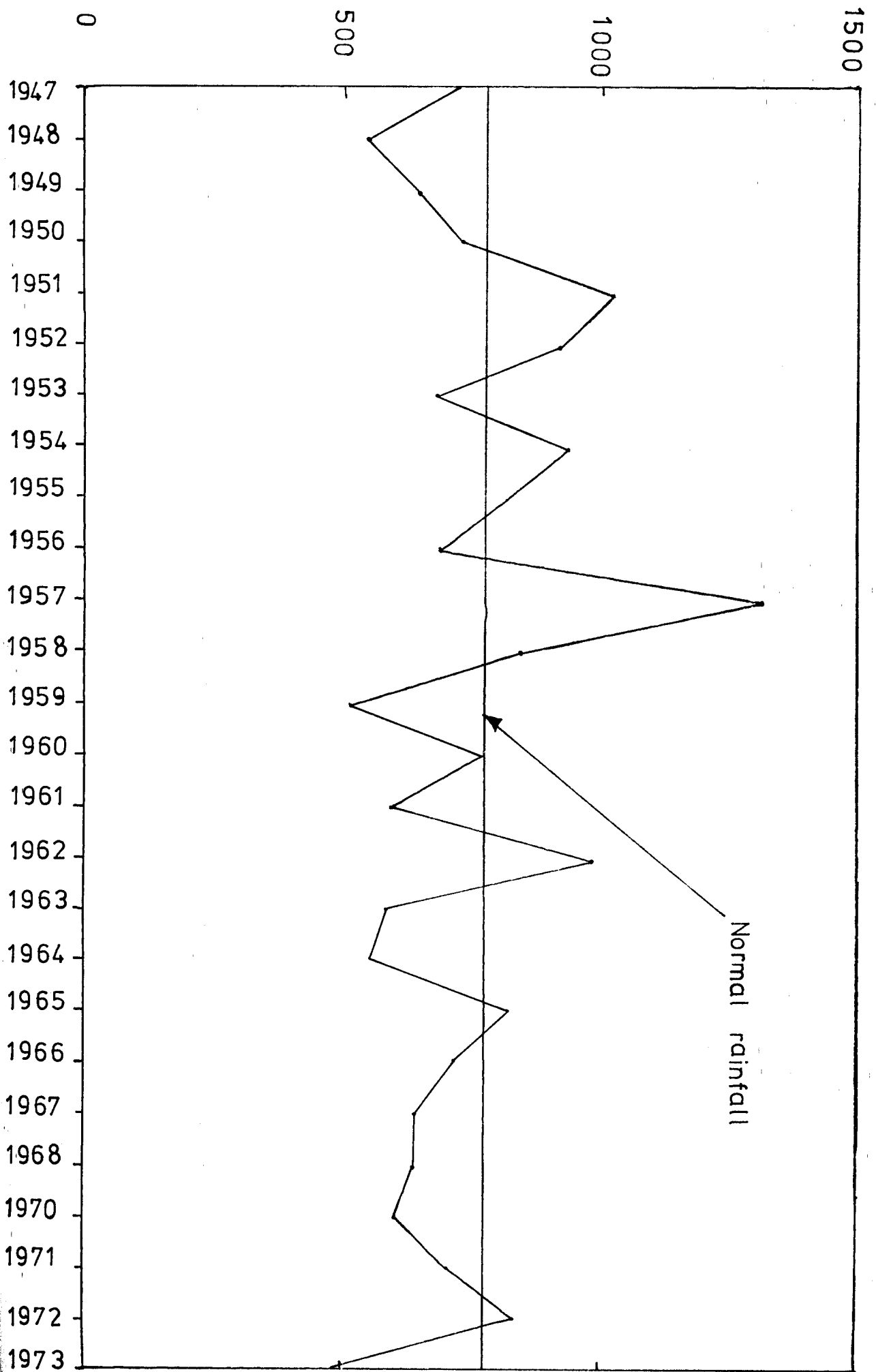


FIGURE 4 RAINFALL TREND IN LIVINGSTONE (1947 - 1998)

TOTAL RAINFALL (mm)

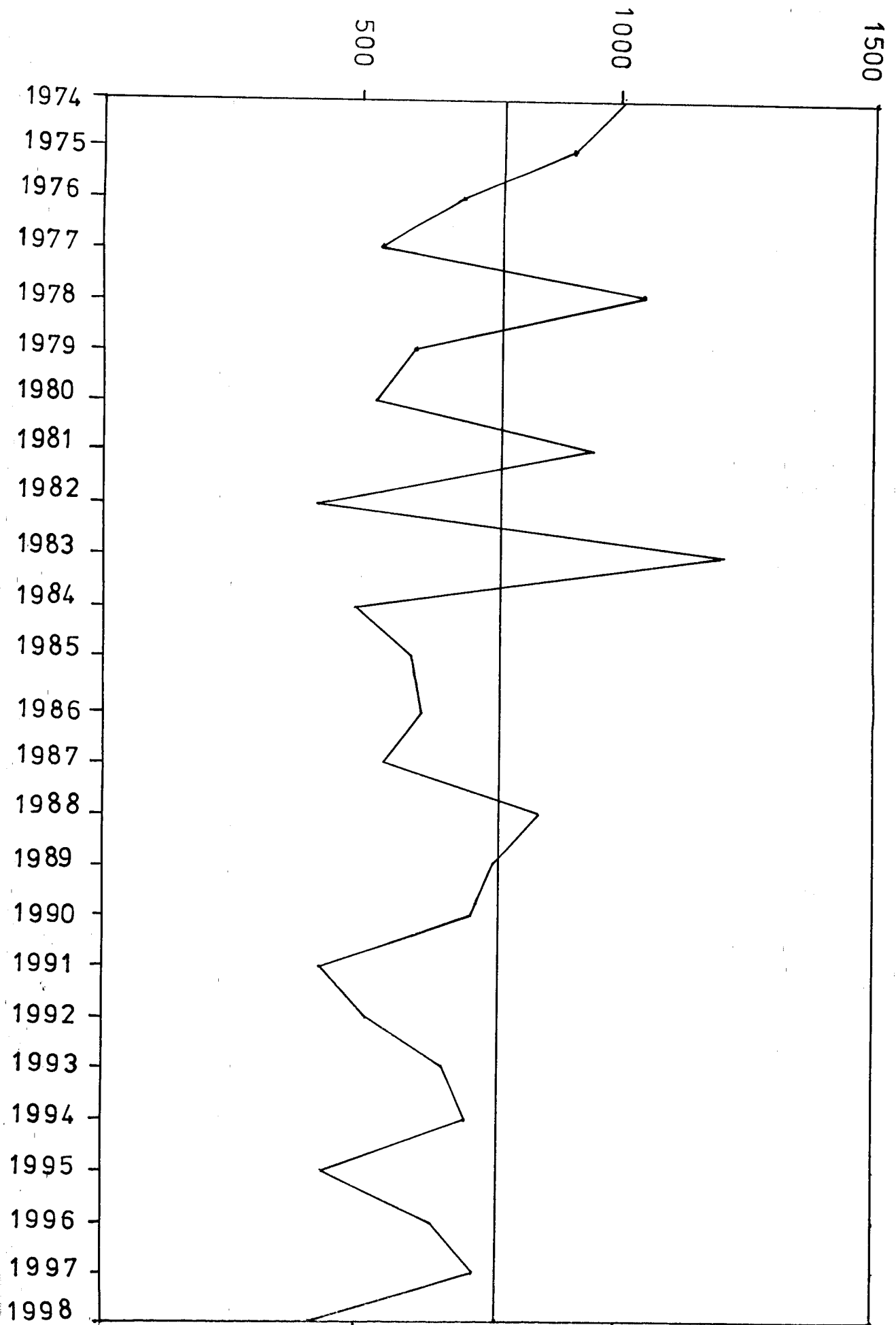


FIGURE 4

CONTINUED :

5.6 IMPACTS OF DROUGHT ON CROP PRODUCTION

Before the 1990s Zambia as a whole was self sustainable in staple maize (Fiffen Mulele 1994). Southern province was commonly referred to as the "Maize Basket of Zambia". Kajoba (1993) reported that Zambia had a bumper harvest of 15 million 90kg bags of the staple maize in the 1987/1988 season due to a combination of attractive producer prices (K80.00 per 90kg bag), and good rainfall. The study area received rainfall amounting to 845mm in the 1987/1988 seasons and this is above the normal rainfall in the area (780.4mm). Despite the bumper harvests, the country still needed to import grain (especially wheat for bread and other wheat products) because of high dependency on government subsidized maize production and maize exportation to neighbouring countries mainly through smuggling.

The occurrence of drought in the 1990s and the liberalization of the economy brought more suffering to the people many of whom had not recovered by 1997. Droughts and the Liberalization of the agriculture sector led to decrease in maize yields and increased cases of hunger.

In Chief Nyawa's area, about 56% of the farmers have been able to expand their cultivated areas while 44% have either ploughed the same size of land or a reduced size of land in the nineties.

Maize production was used as a parameter for determining the impact of drought on food production levels. Two major reasons affected this choice: firstly maize is the staple food grown by all the households in Chief Nyawa's area. Secondly, Maize is highly susceptible to drought (MAFF, 1994).

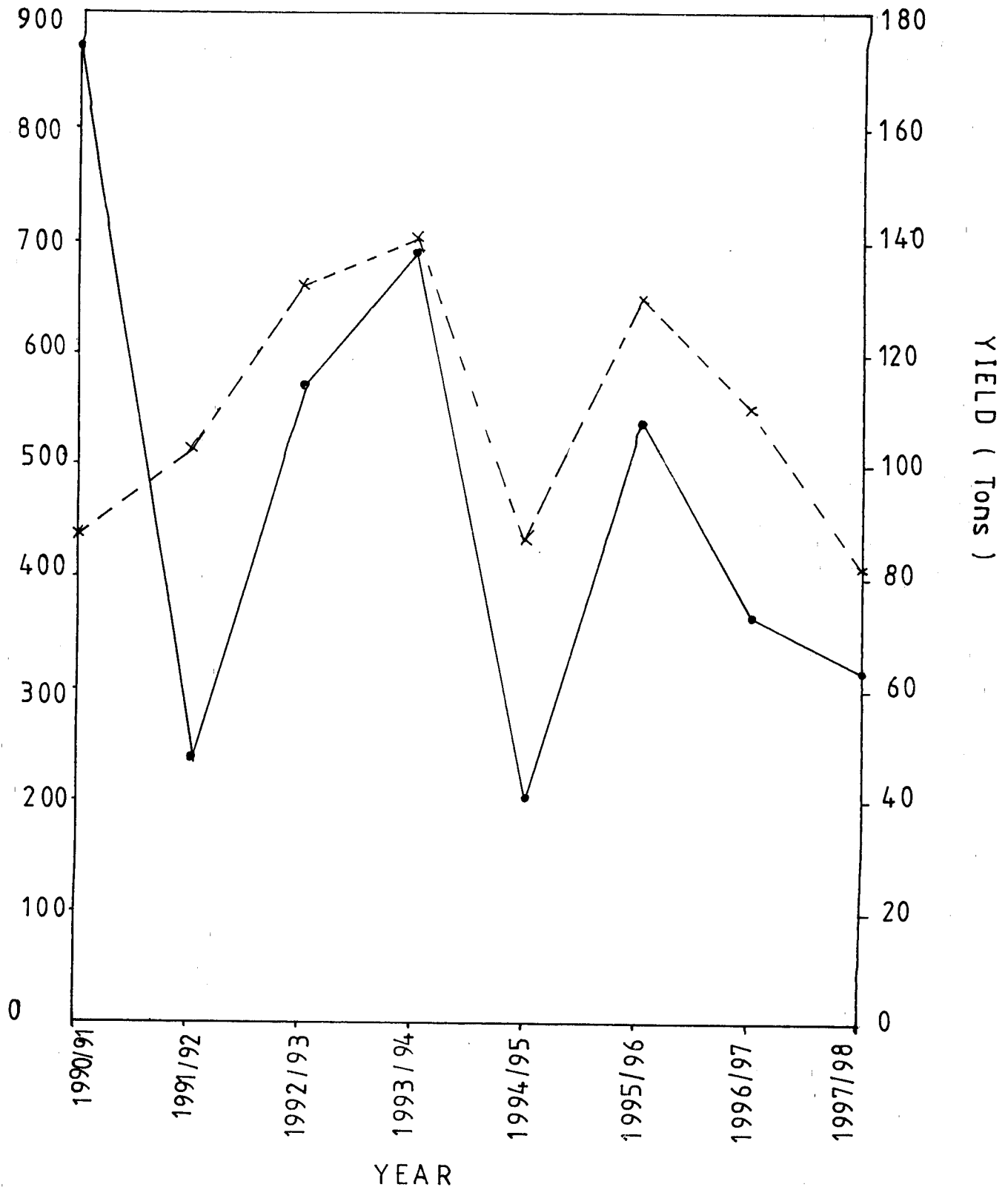
The evaluation of maize production was based on the variables of rainfall, number of households and total yields. The amount of fertilizers used was not a significant factor as the soils are generally good for maize production even without application of fertilizers. Furthermore, fertilizers and other inputs are provided by non-governmental organisation like OMNIA, on loan basis. Thus, the amount of fertilizers and other variables were held constant. Total maize yields and not yields per hectare were used as it was not possible to establish

reliable data from farmers on hectarrage devoted to maize production from 1990 to 1998 since many of the famrmers do not measure and keep such records.

Total maize yields in Chief Nyawa's area varied directly with rainfall in the years 1990 - 1998 (Figure 5). Inspection of Figure 5 reveals the fact that drops and increases in rainfall were followed by reductions and increases in maize yields respectively.

Correlation of precipitation (independent variable) with maize yield (dependent variable) yielded correlation coefficient $r = 0.187$ (df. = 6, n=8, level of significance = 0.05) indicating a positive and significantly weak correlation (Figure 6).

Figure 5 : MAIZE YIELD AND TOTAL RAINFALL IN NYAWA, 1991 - 1998.

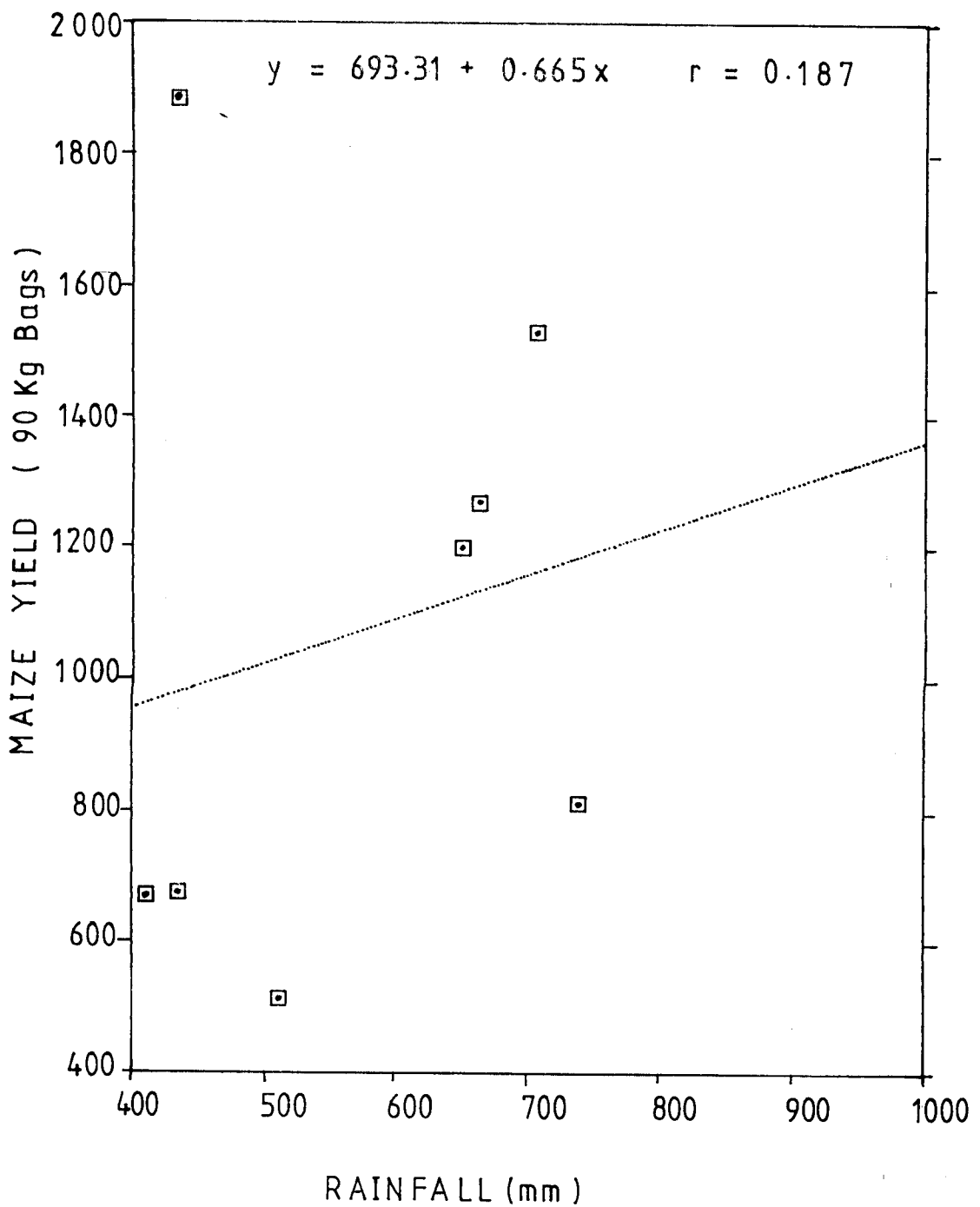


Key: Maize yield —●—
 Rainfall (mm) - - - x

Source: Yields: Field survey

Rainfall data: Meteorological Department

FIGURE 6 : CORRELATION OF MAIZE YIELD (90 Kg Bags) AND RAINFALL (mm) IN CHIEF NYAWA'S AREA, 1991 - 1998.



Data for correlation of Rainfall and maize yields

No.	(mm)	90kg bags
1.	431.7	1884
2.	511.3	508
3.	661.6	1271
4.	705.9	1538
5.	434.6	679.7
6.	649.9	1200.7
7.	739.1	811
8.	408.7	675

Maize yield reduced by 72.3% from 1991 to 1992 (Table 5.4). This followed a 14.4% reduction in rainfall. The mean production per household also dropped by 74.0%. Following a 38.5% reduction in rainfall in 1995 from 1994, a 70.5% reduction in maize yield was experienced.

Table 5.4: Total Maize Output and rainfall for 1990/91, 1991/92, 1993/94 and 1994/95 Seasons

Season	Rainfall (mm)	No. of Households Involved	Total Yields (90kg Bags)	Main Production Per Household
1990/91	596.9	29	1884	65
1991/92	511.2	31	521	17
Change	-85.7	2	-1363	-48
% Change	-14.4	6.9	-72.3	-74.0
1993/94	705.7	37	1538	41.6
1994/95	433.8	38	453	11.9
Change	-271.9	1	-1085	-29.7
% Change	-38.5	2.7	-70.5	-71.4

Source: Field Research

Maize yields from 1990/91 to 1991/92 seasons and from 1993/94 to 1994/95 seasons were analysed using the student 't' test at significant level of 0.05 and d.f. = 76. Maize yield reductions were significant in the drought seasons 1991/92 and 1994/95. This finding strengthens the observation that decreases in rainfall in 1991/92 and 1994/95 seasons is the main factor which contributed to decreased yields of maize in years following the two seasons. Hence, maize had an adverse effect on maize yields.

5.7 AID TO FARMERS

The Government and NGOs provide assistance to farmers. The study revealed that all the farmers interviewed get help from the Government and NGOs - OMNIA, CARE International and PAM.

After a season of drought, the government provides relief food to hunger stricken villages. The Government assists the villages through its food-for-work programmes. The Government, through the MAFF Extension Services, provide extension to farmers with or without drought, OMNIA provides fertilizers, seeds and sprays on loan basis to farmers. The loans are usually paid in harvest form. For instance farmers in 1999 paid 80kg of sunflower per 10kg of sunflower seed provided (Stali - OMNIA area representative, personal comm)

Other NGOs like PAM and CARE International are also involved in community based development activities. These include building dams, schools, installation of water hand pumps. By 1998, 3 dams had been constructed along the three streams; Kaunga, Mweemba and Sianyanggo. The work is done with the full participation of the locals. For instance, the foundation must be laid and bricks made by locals before financial assistance is given to finish the building of a school.

5.8 DROUGHT PERCEPTION AND ADOPTION OF ON-FARM APPLIAGE PRACTICES

5.8.1 Drought as Perceived by Farmers and Attitudes

The farmers interviewed defined drought as either a lack of water or an inadequacy of water during the rain season to support the normal growth and lives of plants and animals. Most farmers interviewed (87.2%) thought that droughts in the area were becoming more frequent

(Table 5.5). Analysis of climatic data revealed that droughts in the area occur frequently (52.2%) than wet years.

Table 5.5: Drought Perception Among Farmers

Response	Number of Respondents	Percentage (%)
More frequent	34	87.2
Les frequent	3	7.7
No difference	1	2.6
Don't know	1	2.6
Totals	39	100.0

Source: Field Research

On drought impact reduction, about 71.8% of the farmers interviewed felt that the impacts of drought could be reduced through applicable practices, while 23.1% believed that the drought impacts could not be reduced, and 5.1% did not know if drought effects could be reduced.

Only 10.3% of the farmers interviewed felt that it was necessary to practice strip cropping as a measure of reducing the impacts of drought on crop production (Table 5.6).

Table 5.6: Farmers' View on Strip Cropping

Response	Number of Respondents	Percentage
Yes	4	10.3
No	35	89.7
Totals	39	100.0

Source: Field Research

Strip cropping is not known by most farmers (89.7%) as a means of reducing drought impacts on crop production.

About 53.8% of the farmers felt that, with the availability of boreholes and pumps, pump irrigation can significantly reduce the the adverse effects of drought. But, 46.2% did not favour the idea of using pumps as it was practically impossible, without external assistance, for them to sink boreholes and erect pumps to water the the fields in times of drought. Irrigation is only done near deeper stream portions to water vegetable gardens.

5.8.2 Crop Diversification

Crop diversification is widely practical by farmers (84.6%) in Chief Nyawa's area as an on farm drought coping strategy (Table 5.7). The main crops grown are Maize, Sorghum, Tobacco, Groundnuts, Sunflower, Beans and Cassava.

Table 5.7 Attitude Towards Diversification

Response	Number of Respondents	Percentage (%)
Yes	33	84.6
No	6	15.4
Totals	39	100.0

Source: Field Research

5.8.3 Attitude Towards Adapted Crops

Most of the farmers interviewed (94.9%) believed that it was necessary to plant drought resistant or drought tolerant seeds to reduce the occurrence of reduced or zero harvest caused by drought. But 5.1% were not for the idea adapted crops due to lack of knowledge of the existence and the availability of such seeds on the market. Furthermore, the concept of "drought - resistant" was repulsive to households who had experienced severe crop failures in the 1991/92 and 1994/95 seasons due to drought in spite of having used "drought - resistant" maize seeds.

5.8.4 Attitude Towards Early Planting and Other On-form and off-form adjustments.

About 64.1% of farmers in chief Nyawa's area plant their crops early in the season (around October and November) but 35.9% plant later in the season.

Late planting is affected by the unavailability of farm implements like ploughs and unavailability of cattle and late delivery of inputs such as fertilizers, seeds and chemical sprays.

Only 38.5 % of the farmers use fertilizers in their fields. About 58.9% of the farmers burn the stubble after harvesting to control pest while 41.1% do not, to retain moisture and protect the soils from soil erosion.

In response to drought situations in chief Nyawa's area, many households (59%) have resorted to investing in other income generating activities in order to have additional on-farm and off-farm source of income (Table 5.8).

Table 5.8: Off-Farm Drought Coping Strategies

Off-Farm drought coping strategies	Number of Respondents	Percentage (%)
None	16	41.0
Selling Livestock to Town	8	20.5
Selling Second-hand clothes	6	15.4
Own Shop/"Kantemba"	7	17.9
Other Strategies	2	5.1
Totals	39	100.0

Source: Field Research

Table 5.8 shows that 41% of the farmers had no Off-farm activities. These farmers are the most hit by drought and usually respond to crop failure by begging, stealing, selling household property etc. The farmers who have other activities apart from farming are able to buy food even after crop failure due to drought.

Table 5.9 shows cultivation practices in chief Nyawa's area. The adoption of appropriate practices by farmers need to be supported. Inspection of Table 5.9 reveals that some practices, proved ineffective and drop by some farmers, have been adopted by other farmers. This may mean that some farmers do not know what to do and thus rely on trial and error methods.

Table 5.9: Cultivation Practices in Chief Nyawa,s area

	OLD	CURRENT PRACTICES
1.	No fertilizers	Use of fertilizers
2.	Maize monoculture	Crop diversification
3.	Mixed cropping	Mixed cropping
4.	Late application of fertilizer	Early application of fertilizer
5.	Strip cropping	Strip cropping
6.	Irrigation in vegetable gardens	Irrigation in gardens
7.	Late maturing seed varieties	Early maturing seed varieties
8.	Free range seed varieties	Drought toleratnt seed varieties
9.	Winter ploughing	Minimum tillage
10.	Use of fertilizers	Use of fertilizers
11.	Early planting	Early planting, Late planting

Source: Field Research

The persistent drought occurrence inthe 1990s have left most farmers so bankrupt that they do not have enough money to adopt effective capital-intensive drought coping strategies like irrigation. Failure to pay agriculturalloans indrought situations has considerably reduced borrowing by farmers for fear of loss of property to Baillifs. Lack of knowledge on the wide range of appropriate practices and seed varieties suited to drought has consoderably increased farmers resistance to changing their agriculturalpractices to effective drought mitigation measures and practices.The difficulties faced by farmers in adopting effective cultivation practices are listed in Table 5.10

Table 5.10: Famers' Difficulties in Adapting Crop cultivation to Drought.

	DIFFICULTIES
1.	Persistence to changing agricultural practices
2	Ignorance of seed varieties
3.	Late delivery of agricultural inputs
4.	Poverty
5.	Lack of Technology to effect change
6.	Unpredictability of weather
7.	Failure to pay previous agricultural loans
8.	Lack of farming implements like ploughs and cattle
9.	Lack money (capital) to sink boreholes and erect pumps
10.	Lack of Knowledge on the wide range of applicable practices available

Source: Field Research

CHAPTER SIX: DISCUSSION OF FINDINGS AND INTERPRETATION

The discussion and interpretation of the research findings are offered in this chapter.

6.1 DROUGHT OCCURENCE AND IMPLICATIONS

This research found that dry years in Chief Nyawa's area occur more frequently than wet years (52.2%). Almost similar findings (55%) were arrived at by Sichingabula (1998). The difference can be attributed to the longer period used in this analysis. Chief Nyawa's area can thus be said to be a drought prone area.

The study established that droughts in the area do not occur in a random sequence with high rainfall. Thus a one year period of drought may be followed by many years of high rainfall, and vice versa. For instance, the study area received below long term mean rainfall from 1989 to 1998 following high rainfall in 1987/88 season (Appendix 2). This scenario increases the uncertainty of drought making it difficult for farmers to plan. The occurrence of drought in the 1990s have resulted in increased poverty among small-scale farmers due to their inability to pay back loans and thus lost property to bailiffs.

6.2 DROUGHT IMPACT ON MAIZE PRODUCTION

Total maize yields in Chief Nyawa's area varied directly with rainfall in the years 1990-98 (figure 5.8). The correlation of precipitation (independent variable) and maize yields (dependent variable) yielded a correlation coefficient $r=0.187$. Although the value of the coefficient indicates a positive relationship between the two variables, the relationship is not statistically significant. The insignificance of the correlation may thus entail the existence of other variables acting simultaneously with drought in lowering maize yields. The other factors (independent) may include the availability of animal power which is known to have been reduced by drought in Southern Province (Tiffen and Mulele, 1994).

Maize yields from the 1993/94 and 1994/95 seasons were found to be significantly different. Maize yields between the seasons reduced by 70.5% following a 38.5% reduction in rainfall. Significant reductions in maize yields were also observed in 1992 (72.3%) following a 14.4% decrease in rainfall (Table 5.4). Although there was an increase in the number of households growing maize in 1992 and 1995 from previous years, mean production per household also

dropped by 74.1% and 71.3% respectively. Agronomically, it is logical to attribute the 70.5% and 72.3% decreases in maize yields to the 38.5% and 14.4% decreases in rainfall in the two seasons respectively. Since the optimum rainfall requirement for maize ranges between 700mm and 1000mm depending on its distribution (MAFF, 1994), the 433.8mm in the 1994/95 season was too low and so contributed to lower yields whereas the 705.7mm in 1993/94 season was within the requirement range and likewise contributed to higher maize yields.

Maize yield reductions were significant in the drought years 1991/92 and 1994/95. This finding strengthens the observation that the decreases in rainfall in 1991/92 and 1994/95 seasons (Figure 5) are the main factors which contributed to decreased yields of maize in the two seasons.

Going by the fact that there was less rainfall (433.8mm) and less maize yield (453x90 kg bags) in 1994/95 season; and more rainfall (705.7mm) and more maize yield (1538x90 kg bags) in the 1993/94 season (Table 5.4) it is probably correct to assert that the 1994/95 drought had an adverse impact on maize yields and lowered household food security in the area. Overall, persistent drought occurrence in the 1990s have had an adverse impact on maize yields.

6.3 DROUGHT PERCEPTION AND ADOPTION OF APPLICABLE PRACTICES

The farmers generally defined drought as either a lack of water or an inadequacy of water during the rain season. It was widely believed that the shortage of water negatively affects crop yield and this causes food shortages.

Most of the farmers (71.8%), however, believed that negative effects of drought could be significantly reduced with successful implementation of appropriate farming practices. About 23% strongly felt that droughts are natural phenomena whose occurrences are highly unpredictable and because of this, some practices like early planting need full information on seasonal weather conditions and this information is lacking in chief Nyawa's area. Most people interviewed (87.2%) felt that droughts were occurring more frequently and persistent in the 1990s. This view is in conformity with the findings in the analysis of climatic

data(52.2%). Figure 4 shows persistent drought in the 1990s as all the years between 1989 and 1999 received below-normal rainfall (780.4mm)

The most practiced drought mitigation measure by farmers in chief Nyawa's area is crop diversification (84.6%). These farmers grow Maize, Groundnuts, Cotton, Sorghum, Millet, Tobacco, Sunflower, and on a small scale Beans.

Although Pump irrigation can help alleviate losses in agriculture production it is not practiced by farmers in chief Nyawa's area due to lack of funds to sink boreholes and erect pipes to water the fields. Due to the inability to sink boreholes, about 53.8% of the farmers opted for loans for irrigation project.

Although farmers (94.9%) believed that drought resistant and early maturing seed varieties provided to them by OMNIA and other NGOs can help to prevent crop losses during drought, these seed varieties are not widely used by farmers for three reasons; firstly, the farmers usually find it difficult to pay back the loans and, as a consequence, have had their household property grabbed from them as payment of loan. Secondly the farmers shun loans due to the existence of local early maturing seed varieties locally known as "kafwamba" which simply means "early-maturing. Thirdly, farmers feel it is expensive to get loans for seeds since the tenders usually demand too much as loan payment per given weight of seed. OMNIA, in 1998, demanded 80kg of produce per 10kg of seed provided.

Early planting is practiced by farmers (64.1%) in chief Nyawa's area. Those farmers who do not keep seed have to rely on NGOs who usually provide them on loan basis. But these seeds are sometimes brought in late. Planting late is also influenced by lack of cattle to till the land and farmers have to wait until those who have can lend them out. As a consequence some farmers(35%) plant late. This considerably reduces crop yields especially in times of drought. The growing of many crops on the same piece of land (mixed cropping) is done by some farmers.

However, this is not done as a response/adjustment to drought situations although these farmers also feel that total crop failure can be prevented by mixed cropping or intercropping. Only 10.3% practice mixed cropping.

About 38.5% of the farmers use fertilizers in their fields. This stems from the fact that some soils are naturally good for the growth of such crops as maize (Bramer 1973). Also farmers can not afford the purchase of fertilizers and the persistence of drought has discouraged farmers from borrowing for fear of crop failure due to drought.

Apart from on-farm adjustments to droughts some farmers (59%) have engaged themselves to other off-farm activities as responses to drought situations (Table 5.8). Among these, 20.5% sell livestock (Cattle, goats, chickens etc) to towns including those on the copperbelt, 15.4% deal in second hand clothes in exchange for cash, chickens and maize, and 17.9% own shops or make-shift shops commonly known as "tuntemba". About 5.1% are involved in other activities including carpentry, hunting, and wage employment.

There are basically two ways in which a household obtains food. The first way is by own production and the second is by purchasing or receiving it from other sources. This study revealed that some households (41%) derive their food from own agriculture production. These farmers are more vulnerable to drought than those who have other off-farm sources of income. The study revealed that farmers who rely on agricultural production to obtain food and other requirements usually respond to severe drought situations like those of 1991/92 and 1994/95 by begging, stealing, selling household property and merely working on other farmers' field for food.

Going by the fact that all the people interviewed (100%) actually practiced farming and given the range of both on-farm and off-farm adjustments in response to drought situations with a view to continued crop production, it can be said that farmers have responded positively to drought. This proves the second hypothesis wrong, and thus farmers are able to respond positively to drought but with difficulty. The peasant farmers have to be supported or helped in appropriate agricultural practices. It must be pointed out here that some practices which have been proven to be ineffective in the area, have however, been taken up by the other farmers. This may mean that some Farmers do not know what to do.

6.4 GOVERNMENT AND NGOs AID TO FARMERS

In drought situations, the Government provides food to starving villages. The distribution of food is done by NGOs like CARE international. The government also provides food through its Food-For-Work programmes. The villagers work in their communities and they are given food in turn. However, this kind of help does not really solve the long-term existence of hunger due to persistent droughts. The major problem facing farmers is lack of capital (money and equipment) to implement some of the practices which, at present do not make sense due to lack of the means.

Irrigation in chief Nyawa's area is only confined to vegetable gardens because farmers have no means of using pump irrigation to water their fields when rainfall fails. The Ministry of Agriculture extension services reaches to 64% of the farmers in the area. But irregular visits by extension officers leads to inadequate dissemination of information.

Due to lack of money for fertilizer, seeds and sprays, farmers have to either borrow from NGOs like OMNIA or do away with fertilizer and drought tolerant seed varieties and sprays. Consequently the result is low crop yield. When those farmers who have to borrow fail to pay back loans they lose their property by selling in order to pay back loans in terms of crop failure.

Some NGOs fund community based development programmes like building dams, schools, installation of water hand pumps. These are done with full participation of the local people. The NGOs include PAM and CARE international.

Given the various types of assistance given by government and NGOs, the third hypothesis is rejected. Thus, farmers receive aid from government and NGOs in times of drought. But the occurrence of hunger during drought means more needs to be done by farmers with the help of Government and other NGOs so that long term solutions to the problem could be implemented. The huge expenditure on food relief could go on forever as long as there is drought. This needs to be checked.

CHAPTER SEVEN: SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter summarises the major highlights of the project. It gives conclusions drawn from the findings and finally offers recommendations to farmers and Government for the prevention of and mitigation of drought - induced crop losses and other impacts.

7.1 SUMMARY

The objectives of this study were to investigate drought perception and farmers' responses to drought, impacts of drought on maize production and help given to farmers by government and NGOs. It was found that dry years occur more frequently than wet years in chief Nyawa's area. Droughts have had a negative impact on maize yields. Farmers in the area (71.8%) felt that droughts were becoming more frequent in occurrence and farmers have responded positively with a view to continued agricultural production through appropriate agricultural practices though with difficulties. In addition to on-farm adjustments farmers in chief Nyawa's area (59%) have other off-farm sources of income to help mitigate negative drought effects. Farmers also receive help from Government and NGOs, but despite this help and both on-farm and off-farm adjustments, low crop yields and widespread hunger are still a common feature of chief Nyawa's area, especially in times of drought.

7.2 CONCLUSIONS

The following conclusions have been drawn:

- i) Chief Nyawa's area is a drought prone area and droughts occur 52% of the time. It is also difficult to predict drought in this area since they occur in a random sequence with wet years.
- ii) Maize yields are influenced by total rainfall received. The occurrence of drought is one factor among others which reduce maize yields in chief Nyawa's area.
- iii) Due to pressing need to survive by own production the farmers have responded to drought by both on-farm and off-farm mitigation adjustments but with difficulty. Thus low crop yields especially in maize are common.
- iv) Farmers receive help from Government and NGOs. This includes provision of relief food to starving villages and provision of fertilizer and seed on loan basis by Omnia and other

NGOs. Despite this help low crop yields, hunger and death of domesticated animals are a common feature of chief Nyawa's area.

Thus farmers need to be helped in their adoption of appropriate adjustments in coping with drought.

7.3 RECOMENDATION

In view of the foregoing conclusions the following recommendations are proposed to farmers and government in the quest for solutions to the negative effects of drought.

7.3.1 Recommendations to Farmers

i) Due to the vulnerability of the area to drought, farmers should place more emphasis on diversification to drought tolerant food and cash crops like Millet, Sorghum and Cotton. These crops are more resistant to drought than maize.

ii) Farmers should make full use of all the available sources of information to help them in their implementation of the right adjustments in drought mitigation. The implementation of effective applicable measures would minimise losses caused by inappropriate cultivation practices.

iii) Farmers should also engage themselves in other off-farm income generating activities to prevent hunger due to crop failure in times of drought.

7.3.2 Recommendations for Government

To supplement farmers' effort, the role of government is important in finding long-term solutions to negative impact of drought. The following solutions are recommended;

i) Government should engage in the provision of such infrastructure as boreholes, water pumps, dams and electricity to support irrigation in chief Nyawa's area.

ii) Government should also provide loan facilities to enable farmers adopt effective capital-intensive cultivation practices aimed at reducing negative effects of drought.

iii) Government should empower the farmers in chief Nyawa's area by the provision of title deeds to the land they occupy. This would foster investment in land improvements and enhance accessibility of farmers to bank loans.

iv) Government should provide credits for agricultural inputs.

Although this study was done with special reference to chief Nyawa's area, it is hoped that farmers (small-scale) in many other parts of Zambia with similar climatic conditions could learn from this case and consider these recommendation in dealin^g_g with their problems caused by drought.

APPENDIX 1. THE QUESTIONNAIRE

GENERAL INFORMATION

1. Age:
2. Sex:.....
3. Education level: None/Primary/ Scondary/Tertiary
4. How long have you been farming in this area?
5. What is the exact nature of you operation?
 - Grain only
 - Diversified (grain emphasis)
 - Diversified (cattle emphasis)
 - Others (specify)
6. What is the exact nature of you operation?
 - Grain only
 - Diversified (grain emphasis)
 - Diversified (cattle emphasis)
 - Others (specify)
7. How much land do you have?
8. How many animals do you own?
 - Cattle
 - Goats
 - Pigs
 - Others specify
9. What crops do you grow?
 - Maize
 - Sunflower
 - Cotton
 - Others specify
10. How much maize did you harvest in the years:

1991	1995
1992	1996
1993	1997
1994	1998
11. Have you increased the size of the farm in the past?
 - Yes
 - No if no,why? Explain

12. What are the main merits and demerits of this area?

- | | |
|---------------|---------------|
| Advanges | Disadvantages |
| Good soil | Too dry |
| Level terrain | Insects |
| Good climate | Isolation |
| Others | |

13. When was the last drought in this area?

14. Have you experienced any other? Yes or No if years what years?

15. What do you think of as a drought?

16. Do you think droughts are becoming more less or frequent?
More less no difference dont know

PERCEPTION OF DROUGHT AND ADOPTION OF APPLICABLE PRACTICES

1. Is there any way to reduce or overcome droughts?

2. Yes No Dont know

3. If asked to give suggestions for reducing drought losses, what would you say?

4. Stubble murch

5. Pump irrigation

6. Strip cropping

7. Diversification

8. Adapted crops

9. Strip farming

10. Others specify

11. Which of the agricultural practices in Q16 have you adopted to reduce the adverse effects of drought?

12. What difficulties do you face in the adoption of new agricultural practices?

13. What were your old practices?

14. Do you have any off-farm sources of income?

Yes/No

15. What are the main sources of information about new practices in farming?

Neighbours or friends

Family or relatives

Radio

Ministry of Agriculture extension officers

Others specify

16. Do you get help from government or NGOs?

Yes/No If Yes specify the name of organisation(s) and the kind of help.

Name

Help

.....

.....

.....

.....

APPENDIX 2. Historical Rainfall Figures and their Departure from Normal (780.4) - 1947-98

Year	Rainfall (mm)	Departure from normal (mm)
1947-48	727.6	-52.8
1948-49	544.3	-356.1
1949-50	641.3	139.1
1950-51	728.4	-52.0
1951-52	1191	410.6
1952-53	911.3	130.9
1953-54	680	-100.4
1954-55	929.4	149.0
1955-56	818.4	37.6
1956-57	686.3	-94.1
1957-58	1396.5	616.1
1958-59	843.6	63.2
1959-60	510.5	-269.9
1960-61	778.4	-2.0
1961-62	598.7	-181.7
1962-63	985.2	204.8
1963-64	585.5	-1949
1964-65	552.2	-228.2
1965-66	820.1	39.1
1966-67	715.3	-65.1
1967-68	642.6	-137.8
1968-69	653.9	-126.5
1969-70	604.1	-176.3
1970-71	703.5	-76.9
1971-72	835.1	54.7
1972-73	493.2	-287.2
1973-74	1006.6	226.2
1974-75	911.8	131.4
1975-76	701.4	-79.0
1976-77	544.5	-235.9
1977-78	1050.8	270.4
1978-79	608.4	-172.0
1979-80	531.8	-248.6
1980-81	952.7	172.3
1981-82	420.0	-360.4
1982-83	1207.0	426.6
1983-84	494.4	-286.0
1984-85	602.2	-178.2
1985-86	636.2	-144.2
1986-87	542.6	-237.8
1987-88	845	64.6
1988-89	778.8	-1.6

1989-90	715.2	-65.2
1990-91	431.7	-348.7
1991-92	511.3	-269.1
1992-93	661.6	-118.8
1993-94	705.9	-74.5
1994-95	434.6	-345.8
1995-96	650.1	-130.3
1996-97	739.1	-41.3
1997-98	408.7	-371.7

REFERENCES;

1. Banda, G.P.A. , Mutoti N. , Mwiinga B. , Sichingabula H.M. and Phiri J.K. (1997) . An Assessment of the 1995/96 Programme Against Malnutrition (PAM) Drought Food Relief Programme. Social Recovery Project, Lusaka
2. Brammer H. (1973) Soils of Zambia. Soil survey unit Mount Makulu, Lusaka.
3. CSO (1993) Social Dimensions of Adjustments;
4. Priority Survey 11 1993- Tabulation Report, CSO Lusaka.
5. CSO (1992) drought Impact Monitoring system in Zambia. Report of a Pilot Survey in Kalomo , Luangwa and Senanga Districts.
6. Dalby D.C. and Harrison R. J. (1977) Drought in Africa London: IAI
7. Glants, M.N. (1988) Drought and Hunger in Africa . Denying famine a future, Cambridge University press Cambridge, uk.
8. Hutchinson p(1974) The climate of Zambia; Lusaka Geographical Association of Zambia.
9. Kajoba a.m (1993) Food crisis in Zambia, zpc publications, Lusaka.
10. MAFF (1994) Proceedings of the crop Diversification workshop for crop Husbandry officers, Department of Agriculture (extension) Mulungushi House, Lusaka.
11. Mortmore. M. (1989) Adapting to drought ; farmers, famine and deserfication in West Africa. Cambridge University press, Cambridge.
12. Saarinen, T.F. (1966) Perception of the drought harzard on the Great Plains, Chicago; Dept. Of Geography university of Chicago.
13. Sichingabula, H.M. (1995) The Climate System and Climate Change; Global warming, drought and Desertification in Zambia. Paper presented at Zambia's National Awareness Workshop on the Convention to Combat Deserfication, Intercontinental Hotel , Lusaka.
14. Sichingabula, H.M. (1998) Rainfall variability drought and implications of its impacts on Zambia , 1886-1996. In; Int. Conf. On Water resources variability in Africa during the xxth Century (ED. By E . servat, D. Hughles, J.M. Fritsch and M. Hume) (Proc. Abidjan Cof. (D) Voire , November 1998) 125 134 . IAHS publ. No 252.
14. Sichingabula H.M. and Sikazwe H. (1999) Occurrence, Severity and magnitude of Hydrological Drought in Zambia; Impact and implications. In Hydrological extremes: understanding , prediciting and mitigating (proceedings of IUGG 199 Symposium HSI< Birmingham, july 1999) IAHS Publ. NO 255,1999.
15. Tannehill I.R. (1947) Drought: It causes and effects . Princeton University press.

16. Tiffen M. And Mulele M.R. (1994) . The Enviromental Impacts of the 1991-92 Drought in Zambia . IUCN, Gland, Switzerland and Lusaka, Zambia.
17. World Bank -1980-1994. World Bank Development Reports; New York , Oxford university press.
18. World Meteorological Organization (WMO) 1975, Drought and Agriculture. Technical Note No 138, Geneva, Switzerland.