# EFFECT OF DROUGHT ON CROP PRODUCTION, A CASE STUDY RAFI LOCAL GOVERNMENT, KAGARA.

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PGD/GEO/2005/336

DEPARTMENT OF GEOGRAPHY,
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BEING A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF POSTGRADUATE DIPLOMA IN ENVIRONMENTAL MANAGEMENT.

## CERTIFICATION

This thesis titled: 'Effect of Drought on Crop Production; A case study of Rafi local government,Kagara.' by Mohammad Aliyu Ibrahim (PGD/GEO/2005/336) meets the regulations governing the award of Post – Graduate Diploma (PGD) of the Federal University of Technology, Minna and is approved for its contributions to scientific knowledge and literal presentation.

**Prof G. N. Nsofor**
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**Signature & Date**

# DECLARATION

I Mohammad Aliyu Ibrahim of the Department of Geography, School of Science and Science Education Federal University do hereby declare that this thesis "Effects of drought on crop production" A case study of Rafi Local Government Kagara" is an authentic research work conducted by me under the supervision of Prof. G. N. Nsofor. This work has not been presented either wholly or partly for any degree else where. All references to previously published materials are fully acknowledged.

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Signature Date

## DEDICATION

This project is dedicated to my father and mother.

## ACKNOWLEDGEMENT

Glory be to Allah. I am indebted to Professor G. N. Nsofor for both as my Academic and research project supervisor and for his guidance and constructive criticism in this project work.

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## ABSTRACTS

The people of Rafi Local Government Area are exposed to a wide range of disasters that seriously have aggravated the environment's economic situation. Droughts are one of the dominant disasters that the people in Rafi Local Government Area face, and have rendered the population utterly vulnerable. The effect of droughts incl1;lde death, mounting food bills, health hazards, environmental degradation, loss of property, backward economic development and climate change are projected to increase the risk of drought over, much 0 f southern Rafi in the 21st century. Therefore, Environmental problems including deforestation, desertification, drought, flood and erosion, industrial pollution, municipal waste and transboundry traffic in banned chemicals and hazardous wastes still manifest themselves not only in our country but also the most threatening ones are the growing global problem of ozone depletion, global warming and consequent climate change. Above all, there should be research into drought resistant and short-term varieties of crops. The development of early maturing species of crop such as beans, maize and millet etc will alleviate the effect of drought. As long term solution to the effect of drought, the following ate recommended. The, State government or Federal government should embark on massive sinking of borehole, canalization schemes for irrigation and drilling purposes in the area prone to drought. Dams should be constructed in the areas where possible. It is suggested that dams construction, establishment of standing drought relief committee and more agricultural loan schemes should be undertaken to minimize the physical and amelierate the socio-economic effect of drought in the area. The main aim of this research is to determine the extent to which different drought years have affected crop production of the peasant farmers in the study area. The research work has established, that drought occurred in Rafi and its environs in 1973 and 1983, which adversely affected crop production through late planting, forced harvesting and crop failure.

# CHAPTER ONE

# 1.0. INTRODUCTION

## 1.1. BACKGROUND

Rafi Local Government has a total Land area of 4,250 square kilometers and is richly endowed with abundant and diverse natural resources both renewable and non-renewable. Rafi is blessed with physical, Biological and energy resources. The mineral resources is vast and should enable it to establish a firm industrial base for rapid economic development e.g. Kagara talc processing industry.

It is richly endowed with fishery resources, wildlife, timber, medicinal plants, mineral resources, water, ornamental and food crops. Today, Rafi Local Government environment is faced with many environmental problems across the length and breath of the area. These environmental problems include:

- Destruction of watersheds
- Uncontrolled logging with inherent problems of destruction of biodiversity.
- Inappropriate agricultural practices.
- Soil-crust formation caused by loss of water
- Destruction of Vast agricultural land.
- Population pressure and the continuous exploitation of marginal land aggravating the process of drought and desertification in the northern part of the area.
- Illegal-mining practices and road work.

Human activities in Africa, particularly in my area (Rafi Local Government of Niger State), in particular, the farming are usually dependent on the climate. If this changes, the effects can be

devastating. Drought, crop failures and starvation can lead to human suffering on a massive scale Natural Disaster, Reader Digest, (1996). A drought is a long period of abnormally dry weather when the average rain for a region drops far below the normal amount for the time, higher than normal temperature usually occurs during drought periods. The severity of drought depends upon the degree of moisture deficiency, duration and size of the affected area.

Therefore, drought impact can be economic, social and environmental. Lack of rain and increase in temperature cause stress on both rural and agricultural and urban metropolitan areas. Usual period of rain-free week can spread panic and shrivel crops. Wells, lakes and streams begin to dry up. Plant and farm crops eventually wither and die. Animals suffer and may even die because of extreme drought.

It is envisaged that models which emerge from this research will not only be useful tools in agricultural and land-use planning, but will also find significant application in the area of water resource management for sustainable development in drought-prone countries of West Africa.

There are recent studies and research in relation to aspects of hydrology and meteorology in Nigeria since the period of the sahellian drought which began in 1969. Concentrated on the socio-economic aspect of environmental degradation, such studies focused on drought, desertification, desert encroachment.

Droughts in parts of Africa can be lethal as certain important crops grow in a strip 100km wide and nearly 4000km long. Studies have shown that, more than any other event, the sahellian drought of

1968 to 1973 called public attention by the reality of climate variability and its significance for humanity. Indeed the case of the Sahel is so recent, so well documented, and offers so many pointer for the future that it merits special attention. However, drought is a natural disaster of immense consequences, being disruptive of the economy, society and the environment. Drought may occur over a wide range of time-scale from a season to years to decade.

Therefore, due to lack of strict index for drought, one can summarise that a drought condition is basically a derivation from a rainfall regime whose effects are adverse on people, animals and plants of a particular climate zone.

However, in our particular climate, what determines whether or not we have a drought in any one year is the sum of how dry or wet the preceding year was, how late this year's rain is established, how early it ceases, how early the rain received is distributed in addition to how large the amount of rainfall is. The severity depends on the extent to which the rainfall anomalies adversely affect human and livestock and water supply.

## 1.2. CAUSES OF DROUGHT IN KAGARA

Drought as an inevitable part of climate even in regions with copious rainfall, has been a scourge on mankind since antiquity. Historically speaking drought are not uncommon, nor are severe droughts unique to the Sahelian region alone. Drought accordingly to many authors are recurrent phenomena in Africa particularly in Sudan – Sahelian zone. Most peasant farmers and herdsmen can recount tales of lean years due to local droughts and even disaster, years such as the early 1970's when animals and crops perished.

Historical records suggest that drought have occurred frequently in the past and some of the more severe ones have been accompanied by famine. Many authors Allan, (1923, Grove 1973, etc) have shown the occurrence of drought conditions in this zone several times within this century alone.

The establishment of many meteorological stations towards the end of 19th century provided a climatic record to more adequately described the intensity and area/coverage of drought conditions. Nicholson (1982), provided a good summary of the recent droughts. According to him, the sub-Saharan regions suffered a tremendous drought in the 1910s, 1940s, 1968 and 1973.

Also using rainfall data from various well established stations – Fisher (1975) summarized historical evidence indicating that drought and famine conditions prevailed in different parts of present day Northern Nigeria in the year 1989 and 1990.

Similarly, according to Bovill (1971), drought conditions appear to have prevailed during the early part of the century in western part of Nigeria.

According to them this is due to the fact that since 1972 only two years 1974 and 1975 yielded higher rainfall than normal in many areas in the continent Abdumumin (1984).

## 1.3. THE CAUSES OF DROUGHT

Just as in the case of the definition of drought, the causes of drought is not clearly known. However there are many theories on the causes of drought in Sudan – Sahelian zone of Africa. Some of these theories attributed the causes of the Sahelian drought to the global changes in air pressure belts dating back to twenty to forty years Lamb (1973).

According to these people, Sahelian rainfall has been predicted to decline by a change in global pressure belts. The argument is based on the theory that a reduced pressure gradient from the Equator has resulted in the tropical maritime air masses which bring moisture to the northern part of Nigeria, sweeping less far north and consequently disposing a higher proportion of its rain near the equator. According to Allan (1973), this is evident in the claimed rise in the Equatorial East African lakes parallel to Savanna drought.

In addition, a study of the global distribution of rainfall anomalies of the period (1961 – 1964) showed the pattern, with increased rainfall in the Mediterranean and elsewhere in the lower middle latitude as well as just near the equator while rainfall was reduced over much of the desert zone, particularly in Southern fringes.

However, the importance of desertification as the direct cause of drought is debatable for various reasons Abdulmumin (1984). For example many areas affected by these droughts are not necessarily on desert fringes and sub-tropical deserts are more as a result of a large scale of atmospheric subsidence in the descending air of the tropical air masses than to human vegetation clearing.

Therefore, if the atmosphere circulation system changes such an area normally under ascending convictive systems comes under descending stable system, it will experience reduced rainfall no matter what the surface vegetation cover is. Although, according to Abdulmumin (1984), desertification does not under estimate the importance of large scale vegetation clearing in changing the micro – climate of an area.

## 1.4. EFFECTS OF DROUGHT

Irrespective of the causes of drought, drought have had a tremendous effect on the society, both on human, livestock and Agricultural production.

Environmental effects compounded by certain human activities are so serious that only with massive effort and a return of normal rainfall, will the agricultural lands ever recover their desired level of productivity. According to Apeldoorn (1978), the soil of most of the drought affected area has become so hardened and eroded that young plants even if sprouted, cannot survive, as the land has become increasingly parched and subject to erosion.

Hydrologically, many streams either failed to flow or flow at highly decreased rate. For instance, Niger River was reported as being at its lowest for 30 years in 1972, Thomas and Boune (1973), and at its lowest for 60 years in 1973 Aid (1973). Thus the drought severely hindered dry season farming along streams.

Demographically, drought has devastating consequences on the people. A large number of people suffer from malnutrition and diseases which leads to a famine in most of the drought affected areas in Northern Nigeria. According to Mortimore (1973), the most serious drought induced famine was that of 1913 and 1973.

## 1.5. DROUGHT AND RAINFALL

Three components of droughts are; meteorological, Agricultural and hydrological drought. The only aspect to which most establishments in Africa pay any serious attention is meteorological drought, being a mere diminution in total rainfall amount normally received over specific periods yearly. It is the simple and most

inconsequential in relation to plant life. Inadequacy of soil moisture or water below soil surface for nutrient intake by plants is not a function of rainfall, but its spread, distribution and reliability (seasonality). Thus, the form in which data is presented is very important in drought research.

## 1.6. TYPES OF DROUGHT

Three major types of drought are recognized namely meteorological, Agricultural and hydrological, usually associated with environmental degradation. This classification is based on the different uses made of precipitating water by man.

## 1.7. METEOROLOGICAL DROUGHT

This is regarded as dryness due to lack of precipitation.

This infers lower than normal rainfall amount over a specified period of time. This refers to the temporal cycles of negative fluctuations from the mean annual precipitation over an area. Meteorological drought has been experienced in West Africa in the Sahel Region. It was the main cause of the sahelian drought of (1968 – 1973) and that of (1982 – 1984). Meteorologists recognize two types of drought namely absolute and partial drought.

An absolute drought is defined as a period of at least 20 days consecutive, none of which is credited with 0.2mm or more of rainfall; while partial drought is a period of at least 29 consecutive days, the mean daily rainfall of which does not exceed 0.2mm.

Climatologist usually define drought in terms of rainfall departures from the long-term means called the normal. This drought is said to occur when the rain received in a year of season is less than a specified percentage of long term annual or seasonal average.

Various percentage deviation from the mean are used to denote different intensities of drought.

**Table 1.1: Climatic definition of drought of various intensities**

| Types of drought | % deviation from mean |
|---|---|
| Slight drought | 11 – 25% |
| Moderate drought | 26 – 45% |
| Sever drought | 46 – 60% |
| Disastrous drought | More than 60% |

Source: World Metrology

## 1.8. AGRICULTURAL DROUGHT

This refers to the shortage of water in the soil for plant growth, development and maturity. It normally results from either late onset of rains or earlier than normal cessation dates of rains (form seasonal climate as in West Africa). This results in shorter than usual length of rainy season.

Agricultural drought is most marked in areas experiencing high seasonality of rainfall. These are areas within continental interiors such as Northern Nigeria and other Sahelian regions of West Africa. The only planning strategy to combat such drought in those areas is to provide a standby irrigation facility.

Thorthwaite (1944) identified three types agricultural drought.

(i) Permanent drought – found in arid environment where in no season is precipitation enough to satisfy the water needs of plant e.g. Sahara and Kalahari deserts.

(ii) Seasonal drought occurs in areas with well-defined wet and try season e.g. savanna and Sahelian zones of Nigeria. It is expected every year as a result of atmospheric circulation pattern.

(iii) Contingent drought is due to rainfall availability. They occur anywhere but not in humid and sub-humid area.

## 1.9. HYDROLOGICAL DROUGHT

This is a period during which stream-flow are inadequate to supply established uses under a given system of underground water which takes time to replenish. Hydrological drought relates to declining amount of surface/ground water and hence lowering of water table as a result of prolonged tapping of underground water by man, together with the additional effects of both meteorological and agricultural drought, reduced infiltration due to compaction of soils at the surface by man and animals. Increased cases of meteorological droughts have resulted in the decreased volumes of underground water. This has resulted specifically to the new experienced water table lowering in Northern Nigeria, resulting in well deepening annually.

## 1.10. HOW TO TACKLE THE PROBLEM OF DROUGHT

(i) Drought hazard and vulnerability monitoring risk assessment and early warning of drought.

(ii) Water supply management: include improving storage, processing and distribution of preserved normal off-take from water resources during period of deficient precipitation. Here water harvesting and other low-cost storage mechanism are relevant.

(iii) Sound planning for prevention and mitigation measures including in non – drought years, given the strong role of preparedness in reducing drought risks.

(iv) Improving effectiveness of water use, such as through improving soil moisture management often by means of existing traditional practices and mechanisms.

(v) Protecting and enhancing water sources through sound environmental management and effective compliance with regulatory measures.

## 1.11. STATEMENT OF RESEARCH PROBLEM

Adefolalu (1976a, 1983a) Lecture series in agrometeorology in a paper titled; Precipitation effectiveness and predictability for sustainable development, the inadequacies of relief effort apart, there is also a definite shortfall in documented studies on both atmospheric circulation patterns and geo-environmental indication of drought and desertification in the entire Sahel sub-region. This is due partly to insufficient database even if there is the will or desire to tackle the problem in principle.

However, in Niger State there have been problems of water shortage as a result of drought, pollution, land wasting and declining agricultural productivity, government instead of addressing the root cause of the problem and finding solutions resorted to ceremonial tree planting exercise, grains and fertilizer importation and distribution to every local government area.

Most of the crops grown in the study area, which include cereal and root crops, it was observed that the year 1983 was short of the normal requirement of such crop. Therefore, cereal crops e.g. guinea corn, maize and rice wilted before reaching maturity and yam crop

failed to germinate due to intense heat. Nomadic Fulani lost their animals due to shortage of water fodder.

Therefore, it is for these reasons that the present study is to be important in generating, emphirical data which will quantify some of the enumerated effects. For the purpose of the study, it is being asserted that different drought years has adversely affected crop production in the study area.

## 1.12. OBJECTIVES OF THE RESEARCH

The main object of this research is to determine the extent to which different drought years have affected crop production of the peasant farmer in Rafi Local Government area. To be specific, the main objective are as follows:

(i) To compare crop yields of different drought years.

(ii) To determine the production in 1973 and 1983.

(iii) To make constructive recommendation for the future amelionation of drought.

## 1.13. JUSTIFICATION

The problem of drought in Nigeria is no more an illusion, while man tries to take advantage of Natural resources particularly Land and water resources in Agriculture, there is a tendency to disturb the fragile ecological balance in the drought prone Sudan sahel – belt of Nigeria.

However, in the past, Government did their best in the area of tree planting and development of shelter belts. To complement this practical approach to conservation and preservation of the Landscape a multi-purpose initiative of this nature is necessary.

Globally, it has been stated that Billions of Dollar worth of agricultural products would be lost if current rate of desert encroachment and drought was not stopped. To stop this, it is a function of fundamental research, while the imminent threat of desertification of the semi arid, sudan-sahel of Minna has necessitated very bold tree-planting campaign and construction of large-scale dams on the other hand.

The area of research which is Rafi Local Government Area of Niger State is purely an agricultural area. The farmers of the area have been contributing immensely toward self sufficiency in food production in Niger State and Nigeria in general. The area is suitable for the type of investigation pursued in this study.

## 1.14. SCOPE AND LIMITATION OF THE STUDY

The amount of rainfall and onset, cessation dates of rains and length of the rainy season (LRS) will be estimated for Rafi Local Government. (1980 to 1984) 5 years using the data which will be given quality control check from the Minna meteorological station of years records. Due to limited resources available for the research and time constraints, the study shall be limited to Rafi Local Government area and its environs.

## 1.15. THE STUDY AREA

The study area shall include, Rafi Local Government and its environs. It comprises of Kagara, Makangara, Karaya and Kabitu makaranta

**Fig. 1.1:** A MAP OF NIGER STATE SHOWING STUDY AREA

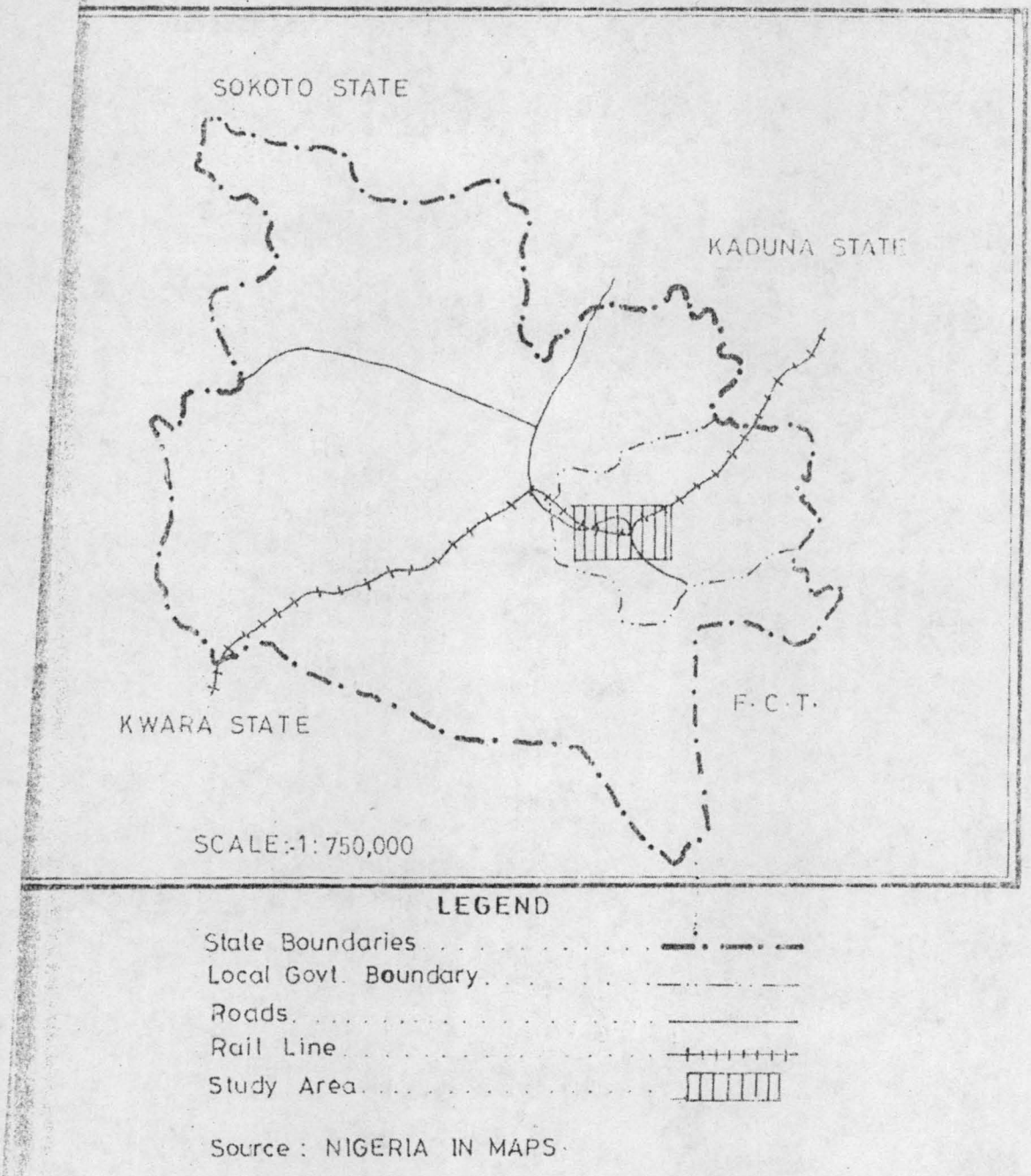
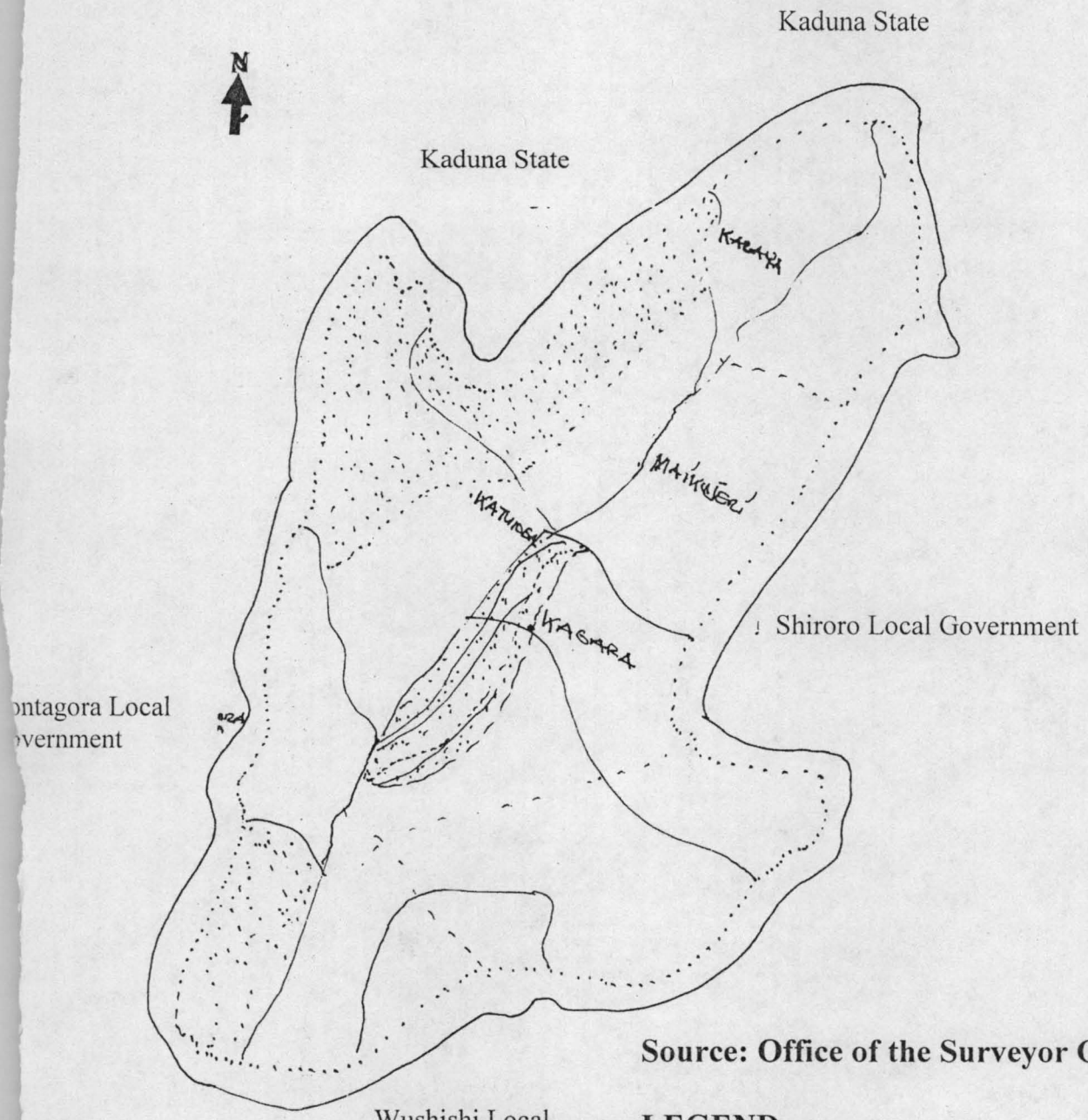


**Figure 1.2. RAFI LOCAL GOVERNMENT, NIGER STATE, NIGERIA.**




**Source: Office of the Surveyor General**

**LEGEND**

Roads ……_____

Local boundaries …… _·_·_

Prone to drought ……..

# CHAPTER TWO

## 2.0. LITERATURE REVIEW

Drought is an abstract phenomenon – a non event in sharp to a distinct recognizable event like a flood. Different disciplines have different notions as to what constitutes a drought, be it agricultural, hydrological or meteorological. Though drought is a physical phenomenon, it is very difficult to define or quantify.

Studies on environmental hydrology and meteorology concentrated on socio – economic effects of environmental degradation, such studies were directed to drought, desertification, desert encroachment and other related fields.

There are a lot of empirical studies in Nigeria and West Africa aimed at estimating some meteorological parameters which are not commonly measured. These include water balance and assessment of evaporation and evapotraspiration.

Basically, drought is composed of three types: meteorological, agricultural and hydrological droughts. Meteorological drought refers significantly to lower than normal rainfall amounts over a specific period of time. Agricultural drought deals with insufficient soil moisture surplus at time of maximum demand due to either late onset of the rain or earlier than normal, cessation dates of the rains or both, thus resulting in a shorter than usual length of the rainy seasons.

It has been found that these characteristics, of the rainy season may be more "stressful" for plants than shortage of absolute amount of recorded rainfall Adefolalu (1986b). They are more injurious to seasonal plants with short (or near – surface) tap roots.

Hydrological drought relate more to declining underground water amounts and hence lowering of the water table. A drawn – down as its effect is often called is postulated to be due to a combination of prolonged tapping by man with simultaneous aggravating effects of meteorological and agricultural droughts. This "aggravation" as recorded in the case of lake Chad in the heart of the sahel which according to Sircoulon (1984) is now a mere shadow of its old size at 2,300 – 2,500km as compared to its pre 1963 surface area of about 23 – 25,000km$^2$. It is worthy to note that about a quarter of a million years ago, Lake Chad occupied over 200,000km2 Grove (1967). As at 1990, the lake is less than 8 metres at the deepest parts and a mere shadow of the 1984 estimated surface area Sircoulon (1990).

Thus a cycle of extreme dry weather conditions is to be linked with drought in Africa.

Meteorological drought is concerned with a period of well below normal precipitation. The commonly used meteorological drought arises from Palmer (1965) who described drought as an interval of time, generally of the order of months or years in duration, during which the actual moisture supply at a given place rather consistently falls short of climatically appropriate moisture supply. Some other definition based only on precipitation includes:-

(i) a year having less than 85% of normal precipitation, and

(ii) a period of at least 15 consecutive days non of which received as 0.25mm Houmam et al., (1975).

Closely related to meteorological drought are the climatological and atmospheric drought. Climatological drought is defined in terms

of precipitation deficiency not in specific quantities but as ratio to mean or normal value. While atmospheric but possible temperature, humidity or wind speed and is used to indicate the dryness of air.

In the agronomic sense according to Kowal and Adeoye (1973), drought can occur only in areas which normally receive appreciable amounts of rainfall sufficient to raise crops and it implies a deficit of precipitation or an abnormal distribution of rain different from the expected pattern of distribution.

Therefore, when such areas suffer from shortage or abnormal distribution of rains, resulting in partial or total crop failure, the condition is described as an occurrence of drought.

However, the economists see drought from an entirely different point of view that of the areas of human perspective induced shortage of some economic goods brought about by inadequate or badly timed rainfall Sandford (1978).

Hydrological drought on the other hand refers to period of below normal stream flow and depleted reservoir storage. It refers to a period of one year during which the average discharge for each year falls consistently below the long – term mean annual flow. Other definition of hydrological drought includes a prolonged period of runoff averaging less than the long term mean Whipple (1966).

This aspect is thought to be related to significant drop in agricultural yield which was a function of spatial and temporal variations of precipitation patterns during the 1973 monsoon season. At other times this could also occur due to long break during the course of a particular growing season. Furthermore, shortened rainy season may damage plant development and consequently affect yield when onset

of rains is delayed or there is premature cessation occurring simultaneously in a single rainy season, thus leading to abnormally short hydrological growing season, spatial aberrations of either rainfall onset or cessation as was the cause in 1972 – 1973 are equally catastrophic Kowal (1973).

The least problem is meteorological drought, but unfortunately, it has been blamed for the large scale destruction of plant and animal life in the drought prone areas of West Africa sequel to the 1972 to 1973 drought. As a weather event, meteorological drought, usually defined as a diminution in rainfall amount Davy (1974), is repetitive in nature, wet and dry spells are to be expected anywhere in West Africa Adefolalu (1983) and although the rainfall deficiency in (1972 to 1973) at the peak of the (1969 to 1973) drought was the worst in most parts of Nigeria since instrumental records Ayoade (1977) this is only relative, as the lowest rainfall deficiency of 20% – 50% recorded in 1973 was within climatological expectations in semi – arid sahel Odingo (1976). However various land-use activities have "confused" the situation in the sahel to the extent that all problems of precipitation ineffectiveness are blamed on lack of adequate rainfall amounts. This is unfortunate certainly, the condition in this sub – region between the drought years of 1969 to 1973 and 1979 to 1983 showed that the vegetal cover never recovered despite the surplus rainfall of 1974 to 1976, Nicholson (1981).

The implication is that an irreversible change is taking place in the sahel. Obviously the last of the drought components – hydrological drought has stepped in but this is not due to dwindling rainfall amounts alone. As noted by Charney et al (1977) and

confirmed by Adefolalu (1983, 1990) the sahelian zone has suffered (and still suffering from a combination of drought effects and human interference which conform with the postulation of Lamb (1979) that interference by man through various land use activities especially in drought prone areas adjacent to existing deserts may usher in desertification.

Drought is a function of weather-producing system in West Africa. In the tropics anomalous pattern of precipitation (annual amounts seasonally variable distribution in time and space etc) between 1970 and 1990 have aroused much interest. Various studies have given the causes of such anomalies in West Africa as ranging from the failure of the monsoon and atmospheric synoptic scale features to the increasing albedo effects due to denuded surface vegetation which will result in lower thermal heating needed for convection Adefolalu (1984b). The important point that becomes obvious is that the convective clouds on which tropical precipitation depends has continued to suffer some reverses since 1950 Lamb (1979) and the role of the monsoon in this regard – be it in the supply of moisture or in enhancing sub-regional instability – needs further clarification. In relation to the global monsoon, three dynamics in West Africa, being a seasonal wind system, the climatological features of the monsoon suggest that there are two rainfall seasons – dry and wet in general, it is dry from mid – October to mid – April, while, the wet season covers the other half of the year. Secondly, although the bulk of the rains (80 percent of the annual total) is received during the later season when monsoon – trough – included waves (the African waves) are dominant in the rain forest and sudan –

savanna zones ($4^0$ – $12^0$ N Latitude). The remaining 20 percent is nonetheless significant, especially in the double – cropping belt south of about latitude $10^0$ N.

These waves need further diagnosis. Thirdly, the monsoon basic synoptic current is unstable Hassan (1971). However, the seasonality of West African rainfall as a function of the migratory monsoon made the climatological weather forecasting method very popular approach to weather forecasting. Then was "Yesterday" method as it was called Schove (1948), which was based on the weather zones as an indicator of the dominant weather changes to be expected Hamitton and Archbold, (1945), Adejokun (1966) since the most important phenomena then were precipitation types, the occurrence was linked with each weather zone. Adefolalu (1976).

The obvious consequences of this arrangement is the creation of a surface discontinuity which is now called the inter tropical discontinuity in West Africa (LTD). As confirmed by Lamb (1979) there has been continuing South ward decline of the monsoon influence to an over all equator ward treat from about $22.5^0$N in 1950 to about $20^0$N in three decades.

## 2.1. DROUGHT SITUATION IN AFRICA'S PERSPECTIVE

A drought is a long period of very dry weather. It is a long time with little or no rain. It is a period of abnormally dry weather when the average rainfall for a region drops far below the normal amount for a long time. Higher than normal temperatures usually occur during drought periods. The severity of the drought depends upon the degree of moisture deficiency, the duration and the size of the affected area. Drought impacts can be economic, social, and environmental.

Lack of rain and increased temperatures cause stress on both rural agricultural and urban metropolitan areas. Unusual periods of rain- free weeks can spread panic and shrivel crops. Wells, lakes, and streams begin to dry up. Plants and farm crops eventually wither and then die. Animals suffer and may even die because of extreme drought. Forest and grass fires occur more frequently and can spread quickly if dry, arid conditions continue. Absence of moisture and plant life reduction can lead to increased wind erosion. More weeks and months without sufficient rainfall coupled with and sunshine can begin to turn a forest into desert.

Most African countries also experience extremes of rainfall (periodic flooding or drought). There is some evidence that both droughts and floods have increased in frequency and severity over the past 30 years. In particular, the sahelian zone has experienced a continued decline in rainfall compared to pre- 1960s averages, and Lake Chad has shrunk to 5 percent of its size 35 years ago. NASA Global Earth Observing System (2001).

Several million people in the horn of Africa and the sahelian zone, and in southern Africa, were affected.

Since the last 1960's droughts have caused much suffering in Africa. Millions of Africans have died of starvation and related causes. The hardest-hit areas include Ethiopia and the sahel region on the southern edge of the sahara World Book, Inc., (2003).

Drought is the most deadly naturally caused disaster. Of all natural disasters, drought accounts for over three – quarters of those affected (Table 2.1) and 98% of mortality. During the past ten years, three-quarters of the droughts in the world have occurred in Africa.

Drought is a condition of life for many residents of Africa, especially those of the Greater Horn region.

The countries in Africa reporting the highest frequency of drought include: Ethiopia, Chad, Botswana, Burkina Faso, Kenya, Mozambique and Mauritania.

Drought causes crop failures, resulting in weakened food security conditions for millions among varied complex natural and anthropogenic factors that are yet to be fully understood. It is the third most common disaster by occurrence in Africa, accounting for 31% of all natural disaster events in Africa during 1975 to 2002 (Vordzogbe, 2003). Droughts differ from other natural hazards because they are slow-onset phenomena, their occurrence and effects cover wide spatial areas, and their impacts are largely environmental and human but non-structural. Droughts exert the environment in Africa.

The single worst drought disaster killed 300,000 people in Ethiopia in 1984 (Table 2.1) and affected 14.3 million people in 2002 in the same country. In economic terms, the cost of droughts in Africa is enormous.

**Table 2.1: PEOPLE AFFECTED BY NATIONAL DISASTERS**

| Country | Year | Disaster | Region | Continent | Killed |
|---|---|---|---|---|---|
| Ethiopia | 1972 | Famine | E. Africa | Africa | 600,000 |
| Ethiopia | 1984 | Drought | E. Africa | Africa | 300,000 |
| Ethiopia | 1974 | Drought | E. Africa | Africa | 200,000 |
| Uganda | 1901 | Drought | E. Africa | Africa | 150,000 |
| Ethiopia | 1973 | Drought | E. Africa | Africa | 100,000 |

| | | | | | |
|---|---|---|---|---|---|
| Mozambique | 1985 | Drought | E. Africa | Africa | 100,000 |
| Niger | 1923 | Drought | W. Africa | Africa | 100,000 |
| NA | 1972 | Drought | W. Africa | Africa | 62,500 |
| Niger | 1913 | Drought | W. Africa | Africa | 21,250 |
| Somalia | 1974 | Drought | E. Africa | Africa | 19,00 |
| Morocco | 1960 | Drought | N. Africa | Africa | 12,000 |
| Cape Verde Is | 1900 | Drought | W. Africa | Africa | 11,000 |
| Nigeria | 1991 | Ethiopia | W. Africa | Africa | 10,391 |

Source: International Disaster Database

## 2.2. POTENTIAL HAZARDS FROM DROUGHT IN AFRICA

The people of Africa are exposed to a wide range of disasters that seriously have aggravated the continent's economic situation. Droughts are one of the dominant disasters that the people in the African countries face, and have rendered the population utterly vulnerable. Droughts have aggravated Africa's economic situation. The effects of droughts include death, mounting food import bills, health hazards, environmental degradation, loss of property, backward economic development, displaced people, refugees, and nutritional deficiency. Today, 175 million Africans out of a total population of 744 million people (23.5%) are suffering from chronic hunger; this is an increase of 50% from 25 years ago. More than 50 million Africans have been affected by disasters such as drought, floods fire, war, epidemics, industrial and transport accidents during the last decade. The main natural disasters, Africa-wide, are related to climatic extremes. As Table 2 shows, droughts are endemic in both southern African and the sahelian region of western and northern Africa. They

are party linked to the El Nino climate phenomenon. In some cases droughts are exacerbated by human-induced changes in land cover. "Climate change is projected to increased the risk of drought over much of southern Africa in the 21st century, party through altering the frequency of El Nino events.

A natural disaster such as drought is often aggravated b y certain food policies, or alternatively, a human-made disaster such as armed conflict could again weak havoc on.

**Table 2.2. Potential Natural Hazards in Africa**

| COUNTRY | | POTENTIAL NATURAL DISASTERS |
|---|---|---|
| 1. | Ghana | Dry, dusty, northern harmattan winds occurs from January to march; droughts |
| 2. | Sudan | Dust storm and periodic persistent droughts |
| 3. | Tanzania | Flooding on the central plateau during the rainy season; drought |
| 4. | Burundi | Flooding, landslides, drought |
| 5. | Togo | Hot, d ry h ammatan wind c an r educe visibility i n n orth during winter; periodic droughts |
| 6. | Mali | Hot, dust-laen harmattan haze common during dry season; recurring droughts; occasional Niger flooding |
| 7. | Nigeria | Periodic droughts; flooding |
| 8. | Egypt | Periodic droughts; frequent earthquakes, flash floods, landslides; hot, diving windstorm called kh: occurs, spring; dust storms, sandstorms |
| 9. | Niger | Recurring droughts |
| 10. | Cameroon | Volcanic activity with periodic releases of poisonous gases from Lake Nyos and Lake Monounvo |

Source: CIA World Factbook 2002 www.nationmaster.com

## 2.3. RAINFALL PATTERNS, TRENDS AND ANOMALIES IN AFRICA

Most of Africa has a warm or hot climate, but the humidity and amount of rainfall vary dramatically from area to area. Rainfall is distributed very unevenly in Africa. Most areas receive either too much rain or too little. In parts of the west coast, for example, annual rainfall averages more than 250 centimetres. In Monrovia, Liberia, an average of more than 100 centimeters of rain falls during the month of June alone. In contrast, more than half of Africa receives less than 50 centimetres of rainfall yearly. The Sahara and the Namibia Desert receive an average of less than 25 centimetres a year. In parts of the deserts, rain may not fall for six or seven years in a row. Then when it does rain, many children are startled because they have never seen rain before World Book, Inc., (2003).

While rain falls the year around in the forests of the Congo Basin and the coastal regions of western Africa, almost all the rest of Africa has one or two seasons of heavy rainfall separated by dry periods. In some regions of Africa, the amount of rainfall varies sharply from year to year rather than from season to season. Inter-annual variations can be extremely high, and drought is common in most African countries. The cost of such extreme events runs to millions of dollars every year, a price that many African countries cannot afford either to incur or to prevent.

The general characterization of the variability of the climatic flux over the continent has been based on the continental air mass circulation controlled by the Inter Tropical Convergence Zone (ITCZ), accentuated by local physiographic and orographic conditions

Kraus (1977); Zahran (1986). However, due to the erratic nature of the climate variations, it would be more opportune to include other studies directed toward analysis of large-scale climatic anomalies over the continent and their possible tel-connections Nicholson (1986).

Based on the movement of the ITCZ, rainfall is expected in the areas below 10°N around March-April, while the regions upon lat. 20°N receive rain in June through September. Nicholson (1986), however, points out that variations in Sahel rainfall are generally related to changes in the intensity of the rainy season rather than to its onset or length as the ITCZ hypothesis would require.

## 2.4. ENVIRONMENTAL PROBLEM IN RAFI KAGARA

Adefolau (2006), described drought as a long period of dry weather and that it is a long time with little or no rain which he said also it is described as a period of abnormal dry weather when the average rainfall for a region drops far below the normal amount for a long time. Higher than normal temperatures usually occur during drought period.

According to Halilu (2006), drought impacts can be economic, social and environmental. He stated also that lack of rain and increase in temperatures cause stress on both rural agricultural and urban metropolitan areas (e.g. Borno State). Usual periods of rain free weeks can spread panic and shrivel crops. Wells, lakes and streams begin to dry up, plants and farm crop eventually wither and then die. Animals suffer and may even die because of extreme drought. Madu ( 1988) stated that forest and grass fires occur more frequently and can spread quickly. Dry and absence of moisture and plant life reduction can lead

to increased wind and sunshine which can begin to turn a forest into desert (Desertification).

Drought, crops failure and starvation can lead to human suffering on a massive scale. My region, have been experience extremes of rainfall (periodic flooding or drought). NASA Global Earth observing system (2001), stated that there is evidence that both drought and floods have increased in frequency and severity over the past 30years. Particularly Borno and other Sahelian zones have experienced a continued decline in rainfall compared to pre- 1960s, and Lake Chad has shrunk to 5percent of its size 35years ago.

According to Adefolalu (2006), severe drought was experienced in 1973 and 1984 when the area suffered reduced rainfall and several areas and villages were affected. e.g. Kagara, Kontagora, and Mariga.

## 2.5. CAUSES OF DROUGHT IN THE STUDY AREA

According to world Book Inc (2003), since the late 1960s, droughts have caused much suffering in Africa including my area (Niger State and its environs) Several people have died of starvation and related causes. UNEP (2005), also stated that Drought is the most deadly natural disasters of all natural disasters in this areas of ours, which also causes crop failures, resulting in weakened food security for thousands of households.

Vordzorgbe (2003), stated that Drought is the resultant outcome of the interrelationships among varied complex natural and anthropogenic factors (human factors) that are yet to be fully understood. He also said that drought differs from other natural hazards because they show – onset phenomena and their occurrence

and effects cover wide spatial areas, and their impacts are largely environmental and human but non structural. Drought exerts environmental, economic and social impacts that retard sustainable development in most sahelian zones.

Drought is an inevitable part of the climate of the arid areas in which I come from. However, overgrazing, over cultivation, deforestation, bush burning and general environmental misuse have helped to increase desert like conditions. Moreover, whether or not a drought becomes an environmental disaster depends on how people have been managing the environment before it occurs. According to Deleeuw (1977) as far back as 1969, when there was an increase in population of livestock in the northern Nigeria which was estimated to be about 8million, the pasturelands in these mean annual rainfall of 500 – 700mm, were over stocked and therefore, heavily overgrazed and thus the consequences of over stocking became very evidence during the catastrophic – drought of early 1970s. Overgrazing is commonly attributed to selective grazing, premature grazing and trampling the expansion of cultivated area in years with good rainfall, is also another human cause of land degradation. The extensions of agricultural activities to the marginally productive areas also have a heavy negative impact on the highly sensitive ecosystem of this area. The current massive expansion of heat production in the highly vulnerable areas in this area is an example of ploughing and irrigation of such lands; which may produce a few good harvest in the short term, while in the long term, it leads to ecological degradation. Deforestation, resulting from uncontrolled cutting or felling of wood

for firewood and charcoal, for construction, and for other domestic and industrial uses, it is also now a very serious problem.

Umeh (1986), estimated the total annual consumption of wood in Nigeria at about 50 – 55 million cubic meters of which about 90% is firewood and also an annual deficit of fuel wood in the northern part is about 5 to 8million cubic metres. Gornitz (1983), identify that the fuel wood extraction rate in the country is estimated to be about 3.85% times the rate of re-growth and almost ten times the rate of regeneration.

These figures give a drought estimate of the magnitude of the problem and the degree of severe population pressure on woody species in many parts of our regions. As population increases, wood will become scarce. Once nearby wood resources have been exhausted, firewood dealers might travel further, thereby encroaching on rare species. Pressure on wood resources becomes more severe during a drought because it can, paradoxically, increase supplies of fuel wood. As fuel wood consumption have not been successful, because of frequent shortages of cooking gas and kerosene that could be used as energy source alternatives. These fossils – fuels, besides their supply irregularities, are now definitely priced out of the reach of most Nigerians and are therefore no longer available as alternatives to fuel wood.

There is a saying "when trees go, desert come" remain a real and grim reminder of the predicament of people in Nigeria's dry belt,

caught between the need to use wood as fuel and the need to conserve it in order to preserve their environment.

In general, land use in our arid and semi – arid areas appears to have entered upon a vicious cycle of misuse. Soil and vegetation resources are over–exploited resulting in the depletion of soil fertility and tree cover. Loss of soil fertility means that more land has to be used to make up for falling yields and gets over exploited in turn because of increasing human and cattle populations. The land gets progressively worse until desertification sets in. Compounding the consequences of man's bad management of his land resources is periodic drought which, now and again, intervenes negatively in the cycle of attempts to extract more and more from a deteriorating environment. The consequence is a looming disaster for man and his environment.

## CHAPTER THREE

# 3.0. RESEARCH METHODOLOGY AND TECHNIQUES

## 3.1. PROBLEMS

There are several factors responsible for environmental problems in Rafi Local Government Area. These are:-

(a) Inappropriate agricultural practices and the destruction of watershed.

(b) Bush burning for farming and over-increasing depletion of young forest for fuel wood.

(c) Mining waste land and mining pits without addressing reclamation-as provided for in the miners act.

(d) Poverty as a cause and consequence of environmental degradation, with the poor scavenging marginal land to earn out a living.

(e) Uncontrolled use of agro – chemicals and the resultant problem of chemical persistence in the soil in humid areas and soil – crust formation leading to destruction of vast agricultural hands.

## 3.2. OBJECTIVES

In view of the foregoing, the main aim of this research is to determine the extent to which different drought years have affected crop production of the peasant farmers in the study area.

The specific objectives, apart from the determination of 1973 and 1983 as drought years are:-

i. To determine the level of crop production in the normal years proceeding 1973 and 1983.

ii. To determine the production in 1973 and 1983.

iii. To compare crop yields of different drought years.

iv. To make constructive recommendation for the future amelioration of drought.

## 3.4. ONSET CESSATION AND LENGTH OF THE RAINY SEASON (LRS)

In general, these parameters, if based on daily rainfall data through the plotting of pentacle rainfall values (Ogives), give the effective period which determines the rainy season for particular years. It is unlike the practice of defining certain threshold values for monthly rainfall such as that of Griffith (1972) giving the value of 60mm or more.

Apart from the uncertainty of the actual date during a particular month when the commencement of the rainy season is supposed to start, there is also ambiguity relating to the distribution within the month. Suppose all the 60mm or more occurred in the first ten days of that month, how effective will that be? Furthermore, identification of false onset which are critically injurious to young plant cannot be determined from monthly data which gives amount and not the spread of precipitation.

As its name connotes, cessation means the effective termination date of the rainy season. It does not imply the last rain fall, but rainfall can no more be assured. Again, values estimated from monthly rainfall data as the month when less than 60mm of rain was received is most in-appropriate. Daily data is more relevant. From the estimates of realistic onset (Ø) and cessation (Ø) dates, the effective length of the rainy season (LRS) may be written as LRS = (@ - Ø).

The hypotheses are formulated so that, if null hypothesis is rejected as a result of the statistical test to be applied, it will then be

logical to adopt the alternatives, meaning that chances alone yielded the changes in crop yield. The rejection level is put at 0.05 probability level or 5%.

## 3.5. FIELD OBSERVATION

The student personally studied the farms to see things for himself. Such observation gave the student first – hand information on the sizes of the farm – land affected by drought. Some of the farmers also estimated the area of their farm land in 1973 and 1983 drought years. This gave room for comparison in terms of crops yields of these drought years.

The statistical tools used and data (actual period, from) are:- Pearson's product moment of correlation ®, standard deviations and coefficient of variation. These statistical tools were used to compare crop yields of 1983 and 1984. However, data on crop yields were collected through questionnaire survey during the field work which covered a period of a year.

The climatic data is also collected for a period of 5 years (1980 – 1985). It was used to show the average rainfall amount of the study area, prior to the global Sahelian drought.

Furthermore, the result of the research was in the form of rainfall graphs and tables.

Therefore rainfall graphs for Minna meteorological station were shown for a period of 5 years (1980 – 1985) to show the monthly and annual rainfall of the study area.

# CHAPTER FOUR

## 4.0 DATA ANALYSIS

This chapter is devoted to the analysis and presentation of data collected from the meteorological stations and also those collected through the use of questionnaire survey and field work.

This chapter deals with how drought affected crop production in Rafi and its environs.

## 4.1 DROUGHT AND CROP PRODUCTION

The availability of rain fall and its distribution throughout the year is the most important single characteristic of climate determining the potential for plant growth, unless irrigation is used. The effect rain fall has on crops is very tremendous, because the length of the growing season is determined by the onset and end of rains.

Where rainfall is perennial, it allows triple or double cropping where as when rain is seasonal it permits single cropping as in this part of the country.

However, it is not the total amount that matters but its equitable distribution over the growing season. In order to be of use to the crops, the rain must be well distributed without long breaks and must allow the ground to retain enough water for the plants to grow to maturity without interruption.

Apart from the general clearing of bush which is normally done in dry season, the first rain here marks the beginning of the farming activities.

These activities include tilling or ploughing, planting, weeding and in the end harvesting. Tilling commences with the first rain. Any delay

of the first rain therefore affects the tilling and subsequent farming activities either in a drought year or not. The delay caused in planting is the most critical here. This is aggravated when agronomic drought occurs, i.e. a deficit of precipitation or an abnormal distribution of rainfall different from the expected pattern of distribution.

This does not only limit the length of farming period during its occurrence. That is why in most drought affected regions, population migration is very evident.

The people's major economic activities are farming and rearing of livestocks by Gwari and Fulani, while the Hausa migrants are petty traders.

The most dominant crops grown here include:- Yam, Maize, guineacorn, millet, rice, beans, cassava and sweet – potatoes. These crops are grown on subsistence bases, although a varying proportion is devoted for cash cropping.

However, recently, many co-operative societies have been formed aimed at commercializing agriculture. Some of these co-operative associations include:- Maikano co-operative association, Samaarri co-operative association of Lambu, farmers association of Garatu and others.

These associations aim at high scale farming where machines are intensively used.

The most dominant agricultural system is the fallow system of cultivation, whereby a land is cultivated for some years, usually three years and is then left alone to regain its fertility for about 6 years, depending on the availability of fertile land.

However, around Kagara and Karaya, Maikujeri, Madaka and Mariga, where the population is a little bit dense, some kind of rotational cropping is practiced. The fallow system is partially responsible for the disappearance and degradation of forest in the area, since it involves annual slashing and burning.

## 4.2 CLIMATE

General Climate.

The climate of the study area is a sub-humid type classified as the tropical wet and dry (AW) by Koppen (1971).

These two seasons are very dependent on the two prevailing air masses over the country at different times of the year: the dry tropical continental air mass of Saharan origin and humid maritime air mass originating from the Atlantic Ocean.

The two air masses, nearly opposite in direction meet at a zone of discontinuity stretching East – West across West Africa known as the inter-tropical Discontinuity (ITD). It migrates northwards and southwards, following the Earth Revolution.

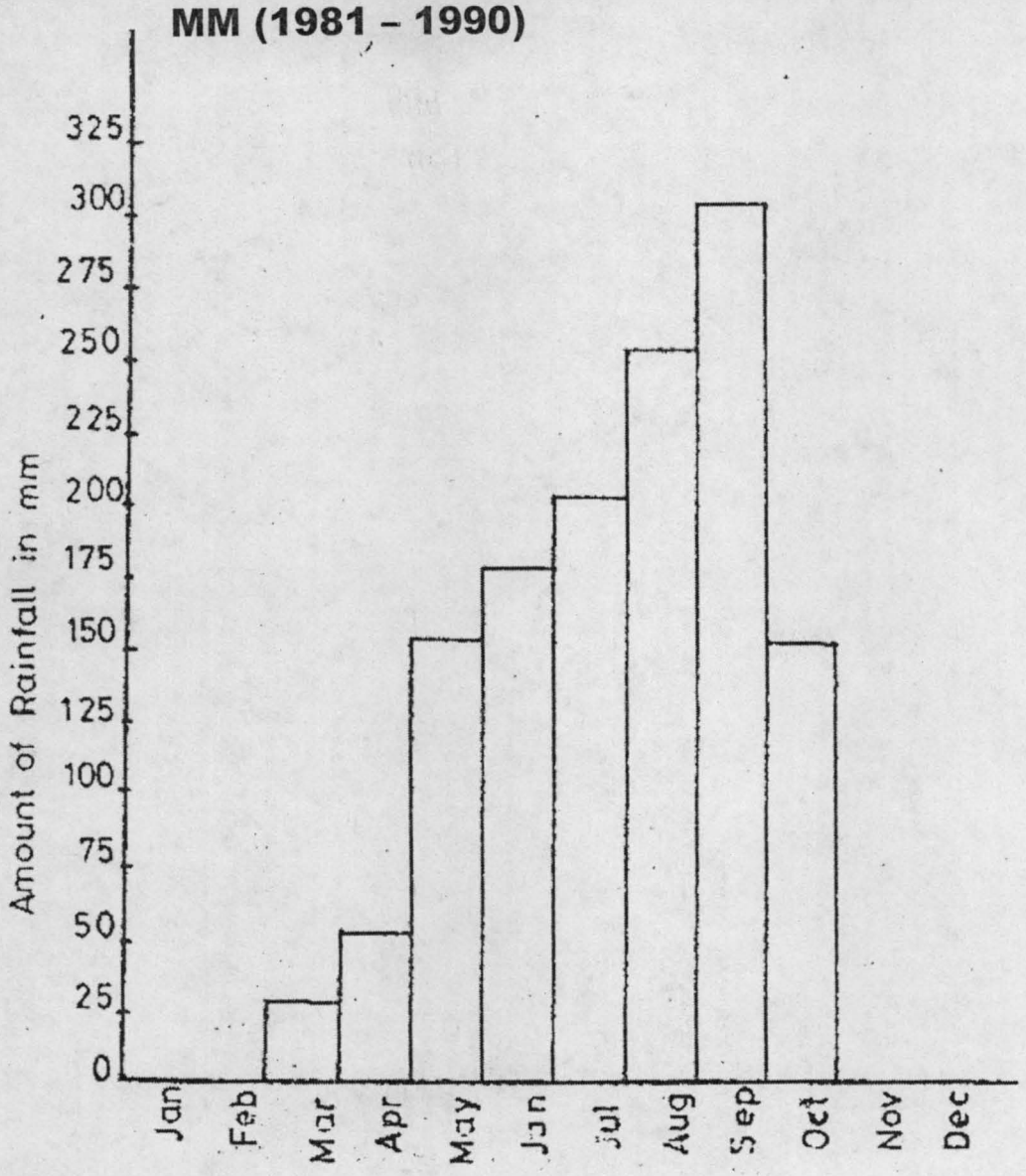
It reaches the southern limit at latitude $5^0$ N in January, and its northern limit is in the vicinity of latitude $20^0 - 24^0$ N in August. The ITD as explained above reaches the study area (lat. $9^0$ 35'N) between March and April and it recedes in October.

The climatic parameters of significance to crops include rainfall, temperature and evapotranspiration, as well as the spatial and temporal variations of these elements within the region. However, rainfall amount and its temporal variations constitute the most significant sets of climatic variables which directly affect the amount,

reliability and timing of available water for agricultural crops in the study area; Udo (1970).

Generally, in the study area, temperature does not constitute the major constraint to agriculture, hence it is suitable for the growth of most tropical crops. The highest temperature is usually recorded in April ($31^0$ C) and the lowest in August ($25^0$ C).

**FIG. 4.1: AVERAGE RAINFALL OF RAFI FOR 10 YEARS IN MM (1981 – 1990)**




**Source: Minna meteorological station**

## 4.3 RAINFALL CHARACTERISTICS

(a) Mean Annual Rainfall and its Duration.

Figure 4.1 shows the mean monthly rainfall for 5 years recorded at Rafi Meteorological station from (1981 to 1990).

From the figure it can be seen that the rainfall of this area is concentrated in a short wet season. For instance, if we consider a humid month to be that when the total rainfall is 75mm (Olofin, 1984), or more, then the number of humid months for the 10 years period in each year was 6 months. On the other hand, if we consider months with less than 25mm of rainfall as critically dry, then the number of critically dry months for the same period was 5 months, while 1month was sub – humid i.e. April with 50.5mm of rainfall. The Wettest month for the period was September, as shown on figure 4.1.

(b) Temporal variations in rainfall.

The amount of rainfall as shown by the mean condition does not make room for temporal variation.

That is why I said earlier in my introductory chapter that a normal climate value is of less value than information concerning the occurrence and magnitudes of climate extreme. For the 10years period there had been both temporal and normal variation in rainfall. Jackson (1977), believes that a variation of about +- 30% is normal for the tropical wet and dry climate. Thus a mean rainfall of 1346.20mm for the study area implies a range of any values between 942.34mm and 1750mm, while the average duration of 6 wet months means any length between 5 and 7 months.

The normal variations in the amount and duration of rainfall according to Olofin (1984) result in three rainfall regimes as follows.

(i) A wet regime when the amount of rainfall is larger than normal, the duration is longer and the rainfall pattern is also steady.

(ii) A moderate regime when the amount and the duration of rainfall are approximately the same as the mean value, and the rainfall pattern is fairly steady, and

(iii) A dry regime when either the amount and the duration of rainfall is less than the mean value with erratic rainfall pattern or both the amount and duration of rainfall are less than the mean value.

Normal variations have been noticed in this area in the past. However, the variation is mostly negative and for each season there is condition of uncertainty as regards to which regime may occur.

Apart from the normal variation, there are short-term variations, which are greater than the -+30% as stated above. It becomes disastrous when two or more extremely dry years follow each other consecutively. When this does happen, a condition of drought is said to exist.

Many Authors have shown the occurrence of drought condition in this part of the country, as highlighted in the literature review.

However, during the 1972/73 drought, the area received 1373.4mm in 1972 and 995.68mm in 1973. The drought has a serious effect on the start of the rainy season as shown in table 4.1.

**Table 4.1: Growing Season, Average Year 1972 and 1973**

| | Amount of Rainfall | Start of Rain | End of Rain | Duration Days |
|---|---|---|---|---|
| Average | 1328.9mm | 20-30 April | 20-31 Oct | 190 |
| 1972 | 1373.4mm | 20-30 April | 20-31Oct | 190 |
| 1973 | 995.68mm | 20-30 May | 20-30 May | 160 |

SOURCE: After Apeldorn (1978)

As could be seen in table 4.1, during the 1972 season, the rain started late in April and ended in October, which signifies five months for normal years. As for 1973 rainy season, the rain started late in May and ended in October. This was more disastrous because of the cumulative effect of the preceding year. The rainy days were shorter which was 160 days as compared to 190 days for 1972.

Thus, these two years, the number of critically dry months increased to 7 therefore, shows a dry regime because the duration is far shorter compared with the long term mean.

## 4.4 FIVE YEARS CLIMATIC PERIOD IN RAFI (1980-1984)

Table 4.2 shows the monthly and annual rainfall for year's period i.e. from 1980 – 1984 at Minna meteorological station.

From Table 4.2; it could be seen that the annual rainfall ranges from 1087.1mm in 1980 to 1001.3mm in 1984. From table 4.2 and figure 4.1, it could also be seen that the rainfall was concentrated in a short wet season. Thus the period of humid months is usually five to six months, but in 1983, it was four months as shown in table 4.2.

(Note Tr = Trace when Rainfall recorded is less than 0.3mm).

Table 4.2 **CHARACTERISTIC OF RAINFALL FROM 1980-1984 (MM)**

| YEARS | > 75MM | BETWEEN 75MM & 25MM | < 25MM |
|---|---|---|---|
| 1980 | 6 | 0 | 6 |
| 1981 | 5 | 1 | 6 |

| | | | |
|---|---|---|---|
| 1982 | 6 | 1 | 5 |
| 1983 | 4 | 2 | 6 |
| 1984 | 5 | 2 | 5 |

Source: Minna Meteorological Station.

The number of critically dry months was 6 months while 2 months i.e. May and October were sub-humid. Therefore, on the average for the year 1983, three quarters of the year was critically dry. The year recorded the lowest annual rainfall. The amount and duration of rainfall was less than the mean value.

**Table 4.3 RAINFALL CHARACTERISTIC IN 1973 AND 1983 COMPARED WITH NORMAL YEAR (FARMERS PERSPECTIVE)**

| **Comparison of 1973 and 1983** Rainfall with normal year | No of Respondents (%) 1973 | " 1983 |
|---|---|---|
| Very much less than normal | 40 | 50 |
| Slightly less than normal | 30 | 20 |
| Like normal | 20 | 10 |
| More than normal | 10 | 20 |
| Total | 100 | 100 |

Source: Questionnaire Survey, 1994

The criteria employed by the respondents to determine normal and abnormal year depend on total rainfall and their farm out put.

## 4.5 EFFECT ON PLANTING

In 1973 and 1983 cropping season, rainfall did not only start late, but it also ceased earlier than normal. From the meteorological data on rainfall of Minna, it was discovered that rainfall started towards the end of April and ended early in October in 1983. Farming activities could not start until May. However about 5% of farmers normally plant in April/May but 26% of the farmers and 5% planted their crops in 1973 and 1983 respectively while 60% and 79% of the farmers planted their crops in June and July. This imply that majority of the farmers planted their crops late in 1973 and 1983 drought years.

Furthermore, in 1983 rainfall started in April, planting did not commence until June, due to break between the first rain and the subsequent ones. The first rain only caused premature Germination and Sprouting of vegetation, which later on wilted away due to lack of sufficient soil moisture. Thus most farmers planted two or more times before their crops could survive. Even though rainfall was generally on the increase in 1984, it was marked by alternate wet and dry periods.

However, the trend of the rainfall for that year in Minna was too far from normal as can be seen from the table 4.4.

**Table 4.4: PLANTING TIME**

| TIME | NORMAL YEARS | 1973 | 1983 |
|---|---|---|---|
| FEB/MARCH | 20 | 14 | 16 |
| APRIL/MAY | 75 | 26 | 5 |
| JUNE/JULY | 5 | 60 | 79 |
| TOTAL | 100 | 100 | 100 |

Source: Field Survey 1994

## 4.6 CROP FAILURE

Generally, the degree of failure of the crops varies. The point is illustrated in table 4.5.

**Table 4. 5: EFFECT OF THE DROUGHT ON CROPS**

| CROPS | FAILED MOST % 1973 | FAILED MOST % 1983 | THRIVED MOST % 1973 | THRIVED MOST % 1983 |
|---|---|---|---|---|
| Yam | 25 | 19 | 19 | 20 |
| G/Corn (Sorghun) | 50 | 46 | 15 | 16 |
| Maize | 10 | 6 | 63 | 60 |
| Rice | 15 | 29 | 3 | 4 |
| **Total** | **100** | **100** | **100** | **100** |

Source: Field Survey 1994

During the 1973 and 1983 drought, crops with long growing cycles, usually late maturing and deep rooted crops suffered most. Out of the hundred responding farmers, 50% and 46% were of the opinion that crop with the highest rate of failure was guineacorn 1973 and 1983 drought year, while 25% and 19% of the farmers maintained, that it was yam that failed most. Another 10% and 6% said that it was maize that failed in 1973 and 1983 respectively.

The remaining 15% and 29% of the farmers believed that it was rice that failed most during the drought period.

On the whole, 63% and 60% believed that maize thrived most in 1973 and 1983. This is not surprising because it matures within a short

period. About 19% of the farmers in 1973 and 20% in 1983 agreed that yam thrived most during the drought period.

Another 15% and 16% of the respondents stated that Guinea corn (Sorghum) thrived most in 1973 and 1983 respectively. It is not surprising that 3% and 4% were of the opinion that rice was worst affected in 973 and 1983.

Thus rice and Guinea corn were the most adversely affected, while maize seems not to have been adversely affected at all.

## 4.7. DROUGHT AND CROP YIELDS

Due to some failure in crops in 1973 and 1983 drought, one might expect the farmers to increase their farm sizes. Therefore, to find out whether the drought had affected crop yield of the 1973 and 1983, the researcher carried out a field investigation through questionnaire survey where by he interviewed a number of hundred farmers on their farm outputs in 1973 and 1983.

The mean for crop yield in 1973 is 0.455 ton/ha with deviation from the mean 0.60 while the mean of 1983 is 0.5304 ton/ha with its standard deviation at 0.62. A casual look at these figure shows that there is not much difference between the crop yields of 1973 and 1983.

These were subjected to a test for significant difference. To this end, the researcher postulated two working hypothesis. The rejection level is put at 5% significant level or 0.05 probability level. The working hypothesis were:-

(i) There is no significant differences between the data sets. i.e. there is no difference in crops yields between the two years. This

is to demonstrate that chance alone might yield the difference in given data.

(ii) Alternative hypothesis:- there is a difference between crop yields in the two sets of data. This will indicate that chance alone cannot yield the result in the two data sets.

**TABLE 4.6. DROUGHTS AND CROP YIELD**

| Parameter | 1973 | 1983 |
|---|---|---|
| Crop yield ten ( --) | 0.455 | 0.530r |
| Standard Deviation | 0.60 | 0.62 |
| CV% | 131.86 | 1/6. 89 |

r..... +006

t (r)..... +0.60

Source:- Field Summary 1994

The result shows a high internal variation in crop yield which is characteristics of peasant holdings. Both variations are similar but the 1973 set of data has a higher value (131.86%) than 1983 set with (116.89%).

## 4.8. THE SEARCH FOR AN ALTERNATIVE SOURCE OF FOOD

The first socio-economic response by an individual farmer to the drought was a drastic reduction in selling and consumption of food. The respondents drastically cut the quantity of food stuffs earmarked for sale because of the drought. The immediate effects of this was the rise in food prices. The prices of some crops like guinea corn, rice, beans and even gari rose by 100%.

**Table 4. 7. PRICES OF SOME COMMODITIES AFFECTED BY THE 1983 DROUGHT.**

| CROPS | PRICE ORIGINAL 1973 | PRICE DURING THE DROUGHT 1983 | % INCREASE | UNIT OF MEASUREMENT |
|---|---|---|---|---|
| G/corns | 50k | N1.80 | 260% | 1Mudu |
| Rice | N1.20k | N3.50 | 191% | 1Mudu |
| Maize | 30k | N1.00 | 233% | 1Mudu |
| Millet | 30k | N1.00 | 233% | 1Mudu |
| Gari | 70k | N1.50 | 114% | 1Mudu |
| Beans | N1.00 | N3.00 | 200% | 1Mudu |

Source: Ministry of Commerce and Industry, Minna 1994.

Due to this sky-rocketing prices of food stuffs, all the respondents were of the opinion that they reduced their eating habit and tried other types of staple foods. For instance, the principal staple food before drought used to be g/corn, rice and yam. However, since most of these crops failed most of the respondents therefore, substituted these foods with millet, cassava, maize, beans and any other edible food available for the staples.

## 4.9. CHARACTERISTIC OF RAINFALL IN 1973 AND 1983 RAINY SEASON WITH THOSE OF A NORMAL YEAR.

When one observed the characteristic of rainfall in1973 and 1983 rainy season, with those of normal year one can ascertain that about

40% and 50% of the respondents indicated that 1973 and 1983 rainfall was very much less than normal.

Another 30% and 20% of the farmers believed it was slightly less than normal in 1973 and 1983 respectively. Although 20% and 10% of the respondents maintained that the rainfall characteristics and growing seasons was just normal while 10% and 20% of the respondents described 1973 and 1983 growing season as more than normal and were those who took the risk of planting with early rainfall and particularly those who cultivated Fadama area. Generally, rainfall started late in 1983 and it ceased earlier than normal.

**Table 4.8 RAINFALL CHARACTERISTICS IN 1973 AND 1983 COMPARED WITH NORMAL YEAR (FARMERS PERSPECTIVE)**

| Comparison of 1973 and 1983 rainfall with normal | No. of respondents | 1983 |
|---|---|---|
| Very much less than normal | 40 | 50 |
| Slightly less than normal | 30 | 20 |
| Like normal | 20 | 10 |
| More than normal | 10 | 20 |
| TOTAL | 100 | 100 |

Source: questionnaire survey, 1994.

The criteria employed by the respondents to determined normal and abnormal year depend on total rainfall and their farm output.

## 4.10. EFFECT ON PLANTING

In 1973 and 1983 cropping season, rainfall did not only start late, but it also ceased earlier than normal. From the meteotological data on rainfall of Minna, it was discovered that rainfall started towards the end of April ad ended early October in 1983. Farming activities could not start in October in 1983. Farming activities could not start until in May. However about 5% farmers normally plant in April/May but 26% of the farmers and 5% planted their crops in1973 and 1983 respectively while 60% and79% of the farmers planted their crops in June and July. This imply that majority of the farmers planted their crops late in 1973 and 1983 drought years.

Furthermore, in 1983 rainfall started in April, planting did not commence until June, due to a break between the first rain and the subsequent ones. The first rain only caused premature germination and sprouting of vegetation, which later on wilted away due to lack of sufficient soil moisture. Thus most farmers planted two or more times before their crops could survive. Even though rainfall was generally on the increase in 1984, it was marked by alternate wet and dry periods.

However, the trend of the rainfall for that year in Rafi was too far from normal as can be seen from the table 4.9.

**TABLE 4.9. PLANTING TIME**

| TIME | NORMAL YEARS | 1973 | 1983 |
|---|---|---|---|
| FEB/MARCH | 20 | 14 | 16 |
| APRIL/MAY | 75 | 26 | 5 |
| JUNE/JULY | 5 | 60 | 79 |
| TOTAL | 100 | 100 | 100 |

Source: Field Survey 1994

## 4.11. CROP FAILURE

Generally, the degree of failure of the crops varies. This point is illustrated in the table 4.10.

**TABLE 4. 10: EFFECT OF THE DROUGHT ON CROPS**

| CROPS | FAILED MOST % 1973 | FAILED MOST % 1983 | THRIVED MOST % 1973 | THRIVED MOST % 1983 |
|---|---|---|---|---|
| Yam | 25 | 19 | 19 | 20 |
| G/Corn (Sorghum) | 50 | 46 | 15 | 16 |
| Maize | 10 | 6 | 63 | 60 |
| Rice | 15 | 29 | 3 | 4 |
| Total | 100 | 100 | 100 | 100 |

Source: Field Survey 1994

During the 1973 and 1983 drought, crops with long growing cycles, usually late maturing and deep rooted crops suffered most. Out of the

hundred responding farmers, 50% and 46% were of the opinion that the crop with the highest rate of failure was guinea corn in 1973 and 1983 drought year, while 25% and 19% of the farmers maintained, that it was yam that failed most. Another 10% and 6% said that it was maize that failed in 1973 and 1983 respectively.

The remaining 15% and 29% of the farmers believed that it was rice that failed most during the drought period.

On the whole, 63% and 60% believed that maize thrived most in 1973 and 1983. This is not surprising because it matures within a short period. About 19% of the farmers in 1973 and 20% in 1983 agreed that yam thrived most during the drought period.

Another 15% and 16% of the respondents stated that Guinea corn (Sorghum) thrived most in 1973 and 1983 respectively. It is not surprising that 3% and 4% were of the opinion that rice was worst affected in 1973 and 1983.

Thus, rice and guinea corn were the most adversely affected, while maize seems not to have been adversely affected at all.

## 4.12. DROUGHT AND CROP YIELDS

Due to some failure in crops in 1973 and 1983 drought, one might expect the farmers to increase their farm sizes. Therefore, to find out whether the drought had affected crop yield of the 1973 and 1983, the researcher carried out a field investigation through questionnaire survey where by he interviewed a number of hundred farmers on their farm outputs in 1973 and 1983.

The mean for crop yield in 1973 is 0.455 ton/ha with deviation from the mean 0.60 while the mean of 1983 is 0.5304 ton/ha with its

standard deviation at 0.62. A casual look at these figure shows that there is not much difference between the crop yields of 1973 and 1983. These were subjected to a test for significant difference. To this end, the researcher postulated two working hypothesis. The rejection level is put at 5% significant level or 0.05 probability level. The working hypothesis are:-

(i) There is no significant differences between the data sets. i.e. there is no differences in the proportions of crops yields between the two years. This is to demonstrate that chance alone might yield the difference in given data.

(ii) Alternative hypothesis:- There is a difference between crop yields in the two sets of data. This will indicate that chance alone cannot yield the result in the two data sets.

In order to test the strength of the association a measure of relationship was undertaken. For this purpose the person's product moment coefficient is suitable because (r) techniques is used. The measure is suitable because it shows the degree of association between two sets of the paired variable.

As relationship could occur by chance between two variable the results from the correlation tests are not taken at first value but are subjected to another rigorous test. This is the student t-test for r (see Appendix 3)

The correlation (r) between the two sets of data was found to be + 0.06 which signifies a positive relationship, between the two sets of crop yields.

Therefore, there is positive degree of association between them.

To further rule out chance occurrence as stated earlier, student t-test for (r) was carried out. The value obtained is (0.60) and is less than the table value at 0.001 probability level.

Therefore, there is a significant relationship between the two sets of data, i.e. the association observed could not have occurred by chance.

Finally a test of internal variation for such years was undertaken using the co-efficient of variation percent (Cv%) as can be seen in the table 4.11.

Agricultural system of inter - cropping and other kinds of alternative strategies (e. g mulching that are open to the farmer during the course of the year are very relevant here).

The pattern of rainfall also affected harvesting in 1973 and 1983, for example the normal period of harvest in this area is November/ December, whereby crops like Guinea corn, millet, Rice, Yam, Maize are all harvested. But in 1973/74 and 1983 / 84 drought period, this pattern of harvesting changed. Based on the data collected from questionnaire survey in 1973 and 1983 only 26% and 3% of the farmers were forced to harvest their crops during this period while more than three quarters (70%) and (89%) of the farmers were forced to harvest their crops between October and November which was earlier than normal time in 1973 and 1983 respectively. This early harvest during the i.e. 1973/74 and 1983/84 farming season was due to the early stoppage of rainfall, force ripening and wilting of crops. Thus 4% and 8% of farmers had to harvest the few crops that withstood drought quickly in order to avoid further damage.

**Table 4.11. HARVEST TIME (FARMERS IN %)**

| TIME | NORMAL | 1973 | 1983 |
|---|---|---|---|
| June / July | - | - | - |
| Aug/September | 10 | 4 | 8 |
| October/November | 31 | 70 | 89 |
| November/December | 59 | 26 | 3 |
| TOTAL | 100 | 100 | 100 |

Source: Field Survey 1994

## 4.13. AGRICULTURAL ADAPTATION

There have been some innovations in agriculture in response to the drought, but these are limited and localized. This is in form of the cultivation of low lying fadama land. But this choice is only open to those with access to such land. Most of the farmers adopted this method because Fadama Soil which is clay retain more moisture than upland Soil.

New crops were adopted by a large number of farmers. The crops that Survived in the drought such as millet, beans, Cassava and maize were substituted in some area for sorghum and Rice, provided that the farmer could obtain the seeds. Infact, the most widely cultivated crops during the succeeding year was cassava and maize, which almost all the farmers cultivated.

Ploughing at the end of the wet season was another form of adaptation by the farmers. This allowed early planting as the farmer needed to till with the first rain but straight planting was done. However, this is dangerous, because the first rain may not necessarily

mark the beginning of the rain season. There may be a break between the first rain and the subsequent ones.

## 4.14. FARMERS SOCIO-ECONOMIC RESPONSES TO THE DROUGHT

We have seen in the preceding chapter the extent of the drought and how it affected the agricultural practice of people of Rafi in Niger State.

The drought had a detrimental effect on agriculture and the state of our economy. It is the most serious problem which is crucial to cropping in the area since there is uncertainties about the onset and cessation of rainfall. Of the hundred farmers serve with questionnaires, all considered drought as one of the serious problem to farming activities.

The effects drought has on people range from malnutrition to semi – starvation, and even death.

However in the study area, the effect was not so severe to warrant death, although people suffered either from a lack of sufficient food or a lack of good drinking water, since most rivers dried up. Thus it goes without saying, that the drought has affected farmers resources as a result of low and poor yield of crops. It has led to serious escalation of prices of food stuff in the markets and placed majority of the farmers in a difficult position as regards repayment of agricultural loans because of crop failure.

Therefore, under these conditions one does not expect the people to fold their arms looking at the forces of nature. Consequently, the people and Government in general respond to droughts in one form or the other.

These responses varies from one individual or government to the other, including international aid scheme.

However, the drought in this area as discussed in the preceding chapters did not warrant international aid scheme since it was not so serious compared with droughts in parts of the country where there were total failure of crops.

The mechanisms used by the farmers to cope with the drought conditions could be categorized into four groups:- The search for an alternative source of food; ways to make money in order to buy food; agricultural adaptations; and dependence on others.

## 4.15. WAYS TO MAKE INCOME

About 30% of the respondents were contemplating migrating into an urban centre for an alternative job. To them farming was discouraging and coupled with low rainfall and the precarious method of production, the benefit accruing to them was significant compared with other sectors of the economy.

Others took to fire wood cutting for sale. This was intensified by the women since it fetched money easily. Another form of generating money to buy food was through casual work. This led to the widespread form of casual farm labourers and labourers ready to take on any sort of paid job. This was limited to the youths.

Unfortunately a few jobless farmers and farm-hands took to stealing in their search for money to buy food. Stealing actually reached such an alarming stage, particularly the theft of food stuff, that made some farmers to guide their farms daily. Even yam that were planted, were removed from heaps by thieves.

## 4.16. RESPONSE BY THE GOVERNMENT

The response by the state government according to most farmers consisted of mere promises. 100 people of the respondents did not receive any aid from the government while 37% claimed to have received such aid sometimes in the past. However, in 1973 and 1983 drought, only 16% claimed to have received government aid. About 44% received such aid in the form of fertilizers, while the remaining 56% received aid in the form of food subsidies and other essential commodities.

The quantity of food stuffs given as aid was however too small compared with the number of people living in a household. Most of the farmers complained bitterly about the method for distributing the food stuffs and about the quantity given.

## 4.17. MITIGATING THE RISK OF DROUGHT AND DESERTIFICATION IN THE STUDY AREA

Alleviating the impact of drought and combating desertification require data on their occurrence and severity. Thus the monitoring of these environmental hazards is an absolute necessity.

The development of an early warning system for drought occurrence for example would help the planning of relief measures.

Long term measures include minimum tillage, large scale irrigation, weather and micro-climatic modification, alternate crops, improved cultural and agricultural practices, water harvesting, soil evaporation reduction, selective plant breeding for drought tolerance, water impoundments and transfer of water from areas of surplus to areas of persistent drought.

Finally, what is required in order to tackle the problem of drought effectively in a coherent, systematic, coordinated and sustainable programme of development which takes into account the vagaries of climate, the fragile nature of the ecosystems, and the needs, aspirations and perception of the people is a programme which must have built into it both short term strategies for coping with drought and must involve the local population from its conception through its planning stage to its implementation.

A comprehensive programme to arrest desertification where it already exists and to prevent it in areas that are prone should include:

(i) A desertification mounting programme.

(ii) A national settlement and land policy which will rationalize the distribution of population.

(iii) Land capability studies.

(iv) Preparation of fuel wood consumption through more efficient fuel wood use and the use of alternatives and renewable resources of energy, such as wind and solar energy.

(v) Control of overgrazing.

(vi) Agro-forestry.

(vii) Measures ensuring a certain amount of plant cover on the land at all times; and

(viii) Public education on the causes of desertification and what people can do to prevent it.

# CHAPTER FIVE

## 5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 5.1 SUMMARY

It is now believed, that basically drought is composed of three types:- Meteorological, agricultural and hydrological droughts. Meteorological drought refers significantly to lower than normal rainfall amounts over a specific time. Agricultural drought is insufficient soil moisture surplus at the time of maximum demand due to either late onset of the rain or earlier than normal, cessation dates of the rains or both, thus resulting in a shorter than usual length of the rainy seasons. It has been found that these characteristics of the rainy season may be more 'stressful' for plants than shortage of absolute amount of recorded rainfall Adefolalu (1986b). They are more injurious to seasonal plants with short (our near surface) tap roots.

On the other hand, Hydrological droughts relate more to declining underground water amounts and hence lowering of the water table.

A drawn-down as its effect is often called is postulated to be due to a combination of prolonged tapping by man with simultaneous aggravating effects of meteorological and agricultural droughts.

This "aggravation" has been recorded in the case of lake Chad in the heart of the sahel which according to Sir Coulon (1984) is now a mere shadow of its old size at 2,300-2,500Km$^2$ as compared to its pre-1963 surface area of about 25,000km$^2$.

It is worthy to note that about a quarter of a million years ago, lake Chad occupied over 200,000km$^2$ (Grove, 1967). As at 1990, the

lake is less than 8 meters at the deepest parts and mere shadow of 1984 estimated surface area (Sir Coulon, 1990).

Therefore, it is believed that agricultural drought is never new in this part of the country since the 1969-1973 global drought of the sahelian regions.

The region has suffered a number of exceptionally dry years, particularly since the early 1970s and the occurrence of drought is becoming more frequent than in the past.

The annual rainfall has been decreasing gradually during the different drought years.

However, in 1983 the decrease was so drastic that most crops failed to reach maturity.

Furthermore, drought is difficult to define. It may be a period of continuous dry weather or the absence of significant precipitation for a period long enough to cause moisture deficits in the soil due to evapotranspiration. For the agriculturist, drought may be defined according to the type of crops concerned. For example, certain types of weather conditions may be called dry spells for sorghum, but may be a drought for sweet corn. An agricultural drought may therefore be defined as a period of dry weather sufficiently prolonged for lack of water to cause a serious hydrologic imbalance (i.e. Crop damage, water supply shortage etc) in the affected area.

Drought severity depends upon the kinds of crops, degree of plant wilting, duration of drought and the size of the areas affected.

Therefore drought designates the period between rainfalls. The longer the interval the greater the severity of the drought such as has been the case in the sudan – sahelian zone, where a 300Km by 700Km zone

stretching along the southern edge of the sahara from Mauritania to Chad suffered a protracted drought from 1969 to 1973.

It is believed therefore that drought may be caused by meteorological or human factors or combination of both. From the meteorological point of view, it has been established that increases in area and persistence of the sub-tropical high pressure cells in the late 1960s and early 1970s led to a south ward expansion of the A zones anticyclone. Such a phenomenon prevented the maritime air mass from penetrating far enough inland to bring rain to the desert margins during successive years between 1969 and 1973.

The processes of over cultivation and over-grazing have increased the exposure of land on desert margins to high surface reflectivity (albedo).

The increase in surface albedo, it has been suggested, may lead to a mechanism which suppressed convective rainfall derived from local evapotranspiration. Thus the processes of over-cultivation and over-grazing help perpetual desertification.

The drought had a detrimental effect on agriculture and the state of our economy. It is the most serious problem which is crucial to cropping in the area since there are uncertainties about the onset and cessation of rainfall.

The effects drought has on people range from malnutrition to semi-starvation, and even death. However, in the study area, the effect has not been so severe to warrant death, although people suffered either from a lack of sufficient food or a lack of good drinking water, since most rivers dried up.

Thus it is important to note, that the drought has affected resources as a result of low and poor yield of crops.

It has led to serious escalation of prices of food stuff in the markets and placed majority of the farmers in a difficult position as regards repayment of agricultural loans because of crop failure.

It was found that most of the farmers responded to the drought by adopting new techniques of production including the cultivation of early maturing crops, changing of staple food, and managing the available food more economically.

## 5.2 CONCLUSION AND RECOMMENDATIONS

The conclusion one may draw from the research work are presented as follows:-

(i) Drought is an inherent characteristic of sudan sahelian zone of Nigeria including Minna and its environs in Niger State. The situation only worsened in 1983 when the variation of rainfall was -+ 37 which is greater than the normal variation - +30 in that area.

(ii) The effect of the drought was not very serious as compared with other parts of the country, although some crops failed to mature.

(iii) A drought year affects farming activities in the following year. Hence there was no significant difference between crops yields of 1973 and 1983.

(iv) In general Drought will continue to affect the region and the northern part of Nigeria, unless something remarkable is done by the government to check the Situation.

## 5.3 SUGGESTIONS FOR THE AMELIORATION OF DROUGHT IN RAFI AND ITS ENVIRONS

The unchecked ravages of drought in this part and over the country in general, over the years testify to the inability of the people affected to take concrete actions to be masters of our environment.

Drought scourges have been left to assume a permanent character and needed permanent solutions. It has already caused terrible human sufferings, hunger, malnutrition and starvation.

To make losses arising from agriculture to be more bearable in the study area in particular and in the country in general the Government must plan for the amelioration of drought.

In the past our fore-fathers adopted strategies against drought in their own way. For examples, each farmer cultivated more land than was actually required to feed his family. They also adopted mixed cropping as a safeguard against total failure of crops etc.

However, under present prevailing conditions such strategies will not be sufficient to guarantee adequate food supply due to rapid population growth.

Some recommendations categorized into short and long term types are hereby put forward.

The short-term recommendations are to cater for immediate need of the farmers and the whole populace affected in order to survive.

The long-term recommendations are to eliminate the effect of drought by being combat ready for it.

## 5.4 SHORT-TERM RECOMMENDATIONS

As short-term solutions, the following are recommended:-

(a) Food aid:- there should be a nationally organized response to drought affected areas in form of food Aid Agency. The agency will distribute food among affected people anytime, there is a major drought. The function of food aid agency would include among others the supply of seeds to farmers for the planting seasons. This is due to the fact that most farmers consume or sell most of their meager production that it will be very difficult for them to have enough reserved for planting. However, food aid will only succeed in helping people to barely survive any drought, because food so supplied is easily exhausted. For instance, the sahelian countries that received food in 1974 are today stretching out their arms for the same assistance.

(b) Drought relief fund committee should be reactivated at the national and local levels, where philanthropic individuals and organizations can contribute to emergency relief funds. However, people of high integrity should be selected as members and these should co-ordinate their efforts with the food aid agency.

(c) The Government should make provisions for agricultural loan/credit to the farmers to sustain them over the difficult period and aid them in production. This loan should be given in a good time i.e. before the beginning of the rainy season and it should be interest free.

## 5.5 LONG-TERM RECOMMENDATION

As a long-term solution to the effect of drought, the following are recommended.

(a) The state Government or federal Government should embark on massive sinking of boreholes and canalization schemes for irrigation

and drilling purpose in the areas prone to drought. Networks of earth dams should be constructed in areas where possible.

(b) There should be research into drought resistant and short-term varieties of crops. The development of early maturity species of crops such as cassava, maize, beans, millet etc will alleviate the effects of drought.

(c) Proper storage facilities: Most of the country's agricultural products is lost to the menace of insects, birds, rodents, etc, both in the field and during the post harvest stages. It is therefore imperative to adopt a strategy of reducing food losses as a means of increasing food availability in case of drought.

(d) There should be an early warning system by meteorologist to detect a meteorological drought and provide input to determine agricultural drought. The early warning of impending drought would give individuals as well as the various governments and agricultural agencies in the country sometime to plan and take action designed to reduce the hunger and starvation associated with each drought year.

(e) Desertification should be checked.

A component approach towards this, is aggressive tree planting campaign to stop desert encroachment. In addition to this, there should be a regional policy to check overgrazing. This will be achieved by the introduction of more scientific ranching, the sedentary settlement of pastoral normands and of a symbiosis of pastoralist and agriculturist particularly the moves towards mixed farming.

(f) The Government should embark upon desalination programme where by the ocean water will be pumped through pipelines to the northern part of the country where drought is a perennial problem. Although

this is expensive, we could afford it by sacrificing our effort and money. If this is done the adverse effect of drought will be reduce.

(g) F inally, it is therefore suggested that as a permanent solution to the perennial drought problems in the region, drought escape and drought resistant plants are to be re-introduced while highly demanding plants (in terms of waters) are to be re-appraised in relation to the available sources of water for irrigation in the area. This is where the application of space-based observation platforms becomes most pertinent.

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## APPENDIX 1

## QUESTIONNAIRE

1. What is your occupation?

   (a) Farming (b) Trader (c) Livestock Rearing

2. What is your age?

   (a) Below 15 (b) 15 – 21 (c) 21 – 35 (d) 35 and above

3. For how long have you been farming

   (a) Less than 5 years (b) 6 – 10 years (c) 11 – 15 years

   (d) more than 15 years

4. What types of crops do you cultivate?

   (a) Root (Specify).....

   (b) Cereal (specify).....

   (c) If both in what proportion (root to cereal)?

   (d) 20:50 (b) 40: 60 (c) 50:50 (d) 60:40

   (e) 80:20

5. When do you normally plant crops 1972?

   (a) Feb – March (b) April – May (c) June – July

   (d) other time (specify).....

6. When did you plant in 1972?

   (a) Feb – March (b) April – May (c) June – July

   (d) Other time (specify)

7. When did you plant in 1972?

(a) Feb – March (b) April – May (c) June – July

(d) Other time (specify)

8. When did you plant in 1973?

(a) Feb – March (b) April – May (c) June – July

(d) Other time (specify)

9. When did you plant in 1974?

(a) Feb – March (b) April – May (c) June – July

(d) Other time (specify)

10. When did you plant in 1981?

(a) Feb – March (b) April – May (c) June – July

(d) Other time (specify)

11. When did you plant in 1982?

(a) Feb – March (b) April – May (c) June – July

(d) Other time (specify)

12. When did you plant in 1983?

(a) Feb – March (b) April – May (c) June – July

(d) Other time (specify)

13. When did you plant in 1984?

(a) Feb – March (b) April – May (c) June – July

(d) Other time (specify)

14. How does the rainfall of the 1972/73 compare with normal years?

(a) Very much less than normal

(b) Slightly less than normal

(c) More than normal

15. What were the main characteristics of the rainfall pattern of 1972/73? Pick as many as relevant.

(a) The rains started late/early

(b) The rains stopped late/early

(c) The rainfall fell steadily throughout the rainy season

(d) The rains were erratic during the season

(e) There were enough rains for these crops

(f) There were no enough rains for these crops

16. How does the rainfall of the 1983/84 compare with normal years?

(a) Very much less than normal

(b) Slightly less than normal

(c) More than normal

17. What were the main characteristics of the rainfall pattern of 1983/84? Pick as many as relevant.

(a) The rains started late/early

(b) The rains stopped late/early

(c) The rainfall fell steadily throughout the rainy season

(d) The rains were erratic during the season

(e) There were enough rains for these crops

(f) There were no enough rains for these crops

18. When do you normally harvest your crops?

(a) June – July (b) August – September

(c) October – November (d) other time (specify)

19. When did you harvest in 1972/73?

(a) June – July (b) August – September

(c) October – November (d) other time (specify)

20. When did you harvest in 1983/84?

(a) June – July (b) August – September

(c) October – November (d) other time (specify)

21. What was your yield in Ton per hectare in 1972/73?

(a) 0.01 (b) 0.02 (c) 0.04 (d) 0.13 (e) 1.32

(f) Other (specify)

22. What was your yield in Ton per hectare in 1983/84?

(a) 0.01 (b) 0.02 (c) 0.04 (d) 0.13 (e) 1.32

(f) Other (specify)

23. How does yield of 1972/73 compare with your usual yield?

(a) very much smaller than normal

(b) slightly smaller than normal

(c) same as normal

(d) larger than normal

24. How does yield of 1983/84 compare with your usual yield?

(a) very much smaller than normal

(b) slightly smaller than normal

(c) same as normal

(d) larger than normal

25. Which of your crop (s) thrived most in 1972/73?

(a) Yam (b) guinea-corn (c) Maize (d) Rice

(e) Millet (f) Others (specify)

26. Which of your crop (s) thrived most in 1983/84?

(a) Yam (b) guinea-corn (c) Maize (d) Rice

(e) Millet (f) Others (specify)

27. Which of your crop (s) failed most in 1972/73?

(a) Yam (b) guinea-corn (c) Maize (d) Rice

(e) Millet (f) Others (specify)

28. Which of your crop (s) failed most in 1983/84?

(a) Yam (b) guinea-corn (c) Maize (d) Rice

(e) Millet (f) Others (specify)

29. How many drought year(s) have you experienced in your life time?

(a) 5 or more (b) 4 (c) 3 (d) 2 (e) 1

30. How will you rate 1972/73 drought?

(a) very severe (b) moderate (c) insignificant

31. How will you rate 1983/84 drought?

(a) very severe (b) moderate (c) insignificant

32. What is your attitude towards farming?

(a) encouraging (b) discouraging

33. What were your principal staple food before different drought years?

.....

.....

34. What is your principal staple food now? .....

.....

35. Whenever there is drought what do you do?

(a) look for alternative job (b) stopped selling of the remaining stuff

(c) abandoning of farming as a whole (d) others (specify)

36. Whenever, there is a drought, do you receive any aid from the government?

(a) always (b) sometimes (c) never

37. If yes, In what form is such aid?

(a) cash (b) fertilizers (c) improved seeds (d) foodstuff

(e) any other (specify)

38. Did you receive such aid in 1972/73

(a) Yes (b) No

39. Did you receive such aid in 1983/84

(a) Yes (b) No

40. If yes in what form?

(a) cash (b) fertilizers (c) improved seeds (d) foodstuff

(e) any other (specify)

41. In what do you store your foodstuff?

(a) silos (b) barn (c) huts (d) any other (specify)

42. How long can such stored foodstuff last?

(a) below 2 years (b) between 1 – 4 years

(c) between 5 – 10 years (d) over 10 years

43. How will you prepare for future drought if at all there will be any?

.....

.....

44. How would you rate drought among the problems you encounter as a farmer?

(a) the most serious problems (b) one of the serious problems

(c) one of the medium problems (d) One of the slight problems

## APPENDIX II

## FORMULAE FOR FINDING PEARSON'S PRODUCT MOMENT COEFFICIENT OF CORRELATION (R), T – TEST OF R, STANDARD DEVIATION AND COEFFICIENT OF VARIATION.

a. The formulae for calculating r, is :-

$$r \frac{\frac{1}{n}\sum\left(x-\bar{x}\right)\left(y-\bar{y}\right)}{Ox}$$

Where r = co-efficient of correlation

n = Total number of pairs of values

e = The Total sum (sigma)

xy = Value of variables

x, y = mean of y and x variables

b. Student t – test of r is given as

$$t = \sqrt{\frac{r^2(n-2)}{1-r^2}}$$

Where t = student's test of r

r = Correlation Co-efficient

n = Number of pairs of values

(Source, monkhouse and Wilkison, values)

c. The standard deviation is calculated as :-

## CROP YIELDS (YAMS, RICE, MAIZE, GUNEA CORN)

| S/No | 1973 | 1983 |
|---|---|---|
| 1. | 0.13 | 0.13 |
| 2. | 0.04 | 0.13 |
| 3. | 0.04 | 1.40 |
| 4 | 0.02 | 0.13 |
| 5. | 1.32 | 1.40 |
| 6. | 0.13 | 0.04 |
| 7. | 1.13 | 1.40 |
| 8 | 0.02 | 0.40 |
| 9 | 0.02 | 0.13 |
| 10 | 0.04 | 1.40 |
| 11 | 0.13 | 1.40 |
| 12 | 0.04 | 0.02 |
| 13 | 1.32 | 0.13 |
| 14 | 0.13 | 1.40 |
| 15 | 0.02 | 0.13 |
| 16 | 0.04 | 1.40 |
| 17 | 1.13 | 0.13 |
| 18 | 0.04 | 0.02 |
| 19 | 0.04 | 0.04 |
| 20 | 0.02 | 0.13 |
| 21 | 1.32 | 0.02 |
| 22 | 1.40 | 1.40 |
| 23 | 0.040 | 0.13 |

| | | |
|---|---|---|
| 24 | 0.02 | 0.02 |
| 25 | 0.13 | 0.04 |
| 26 | 0.04 | 1.40 |
| 27 | 0.02 | 0.13 |
| 28 | 0.13 | 0.02 |
| 29 | 1.32 | 0.04 |
| 30 | 0.02 | 1.40 |
| 31 | 1.04 | 0.13 |
| 32 | 0.02 | 0.02 |
| 33 | 0.04 | 0.04 |
| 34 | 1.132 | 0.13 |
| 35 | 1.40 | 0.13 |
| 36 | 0.02 | 0.13 |
| 37 | 0.04 | 0.02 |
| 38 | 0.13 | 0.02 |
| 39 | 1.32 | 0.13 |
| 40 | 1.40 | 0.04 |
| 41 | 1.32 | 0.02 |
| 42 | 1.40 | 0.04 |
| 43 | 0.13 | 0.13 |
| 44 | 0.02 | 1.40 |
| 45 | 0.04 | 1.32 |
| 46. | 1.32 | 0.04 |
| 47. | 0.04 | 0.02 |
| 48. | 0.04 | 0.02 |
| 49. | 0.02 | 1.40 |

| | | |
|---|---|---|
| 50. | 0.13 | 1.32 |
| 51. | 0.04 | 1.40 |
| 52. | 1.32 | 0.13 |
| 53. | 0.13 | 0.04 |
| 54. | 0.02 | 1.40 |
| 55. | 0.02 | 0.02 |
| 56. | 0.04 | 0.13 |
| 57. | 0.13 | 1.40 |
| 58. | 0.04 | 0.32 |
| 59. | 0.02 | 0.02 |
| 60. | 1.32 | 1.40 |
| 61. | 1.32 | 0.13 |
| 62. | 0.02 | 0.13 |
| 63. | 0.04 | 1.40 |
| 64. | 0.02 | 1.32 |
| 65. | 1.32 | 0.02 |
| 66. | 1.40 | 0.04 |
| 67. | 0.13 | 1.40 |
| 68. | 0.13 | 1.32 |
| 69. | 0.04 | 0.02 |
| 70. | 0.02 | 0.04 |
| 71. | 1.40 | 0.02 |
| 72. | 0.04 | 0.04 |
| 73. | 0.02 | 0.13 |
| 74. | 0.13 | 0.02 |
| 75. | 0.13 | 0.04 |

| | | |
|---|---|---|
| 76. | 0.04 | 0.13 |
| 77. | 0.04 | 1.32 |
| 78. | 1.32 | 1.40 |
| 79. | 1.40 | 1.40 |
| 80. | 0.02 | 0.13 |
| 81. | 0.02 | 1.40 |
| 82. | 0.04 | 1.32 |
| 83. | 0.13 | 0.04 |
| 84. | 0.13 | 0.02 |
| 85. | 0.04 | 0.13 |
| 86. | 1.40 | 0.02 |
| 87. | 1.32 | 0.04 |
| 88. | 0.02 | 0.13 |
| 89. | 0.04 | 1.40 |
| 90. | 1.40 | 1.32 |
| 91. | 1.32 | 1.32 |
| 92. | 0.04 | 0.04 |
| 93. | 0.02 | 0.02 |
| 94. | 0.13 | 0.13 |
| 95. | 1.02 | 1.40 |
| 96. | 1.40 | 1.32 |
| 97. | 1.32 | 1.02 |
| 98. | 1.40 | 1.04 |
| 99. | 1.40 | 1.32 |
| 100. | 0.04 | 0.04 |
| TOTAL | 45.5 TONS/HA | 53.04 TONS/HA |
| MEAN | 0.455 TONS/HA | 0.5304 TONS/HA |