INFLUENCE OF RAINFALL ON RICE PRODUCTION IN KATCHA AND ITS ENVIRONS

BY

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A THESIS

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CERTIFICATION

This is to certify that the research work title "Influence of rainfall on rice Production – Katcha and its environ" was carried out by Mohammed Ahmed Emigilati (M. Tech/SSSE/546) of the department of Geography, Federal University of Technology, Minna. Under my supervisor and it is here by approved.

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DEDICATION

This project is dedicated to my father (may his soul rest in peace Amin), My Mother, Children, Relatives and Friends.

ACKNOWLEDGEMENT

I am mostly obligated to express my indebtedness to Dr. P.S. Akinyeye both as my academic and research thesis supervisor. For his patience to guide and offer constructive criticism in this write up. I will always appreciate that courage.

My acknowledgement also goes to my friends and relatives who devoted much of their precious time in assisting me in the arrangement and computing of the data during the course of my research.

I also like to thank the member of staff ADP, Bida, Minna, NCRI Badeggi in Niger State, for their permission to use their climatic and farm produce data.

Finally, must not fail to acknowledge these relatives of mine especially, Mal Usufu Tswaida, Deputy Director M.O.E. HQ, Minna, whose moral support I enjoyed.

TABLE OF CONTENT

PAGE

LIST OF FIGURES.

LIST OF TABLES

ABSTRACT

This research attempts to describe the relationship between rainfall and Rice yield in Katcha and its environs, with some suggestions for controlling effect of flood and drought in the area of study.

The main aim of this work is to determine the extent of which rainfall have contributed to affect rice production of these present farmers in the study area.

The sources of this data were mostly collected from (ADP-Bida) Agricultural Development Project Bida.

As along term solution to the effects of the following above, this research work recommended that Government should embark on massive irrigation farming as dry season farming through sinking of bone holes particularly areas prone to floods and drought.

CHAPTER ONE.

1.0 INTRODUCTION.

1.1 BACKGROUND.

The secret of plant growth lies in the balance between heat and rainfall. The value of rains depends not only on seasonal amount, but also distribution and reliability. If the season average is low, rainfall is usually less dependable.

Plants differ enormously in their ability to withstand water shortage. There are three groups infact, i) the camels of the plants world (the xerophates) the average citizens (mesophates) and the ducks of the plant world (hydrophate). Their rainfall needs depend on the heat of the sun in the stage of their growth. If the rain have failed, the plant must rely on the soil for moisture.

Source: (UMO 1977 Geneva 1967)

With regards to rice, a large part of rice in sub-Sahara Africa is rain fed. (Moorman and Van Breemen (1978), For example it is commonly grown in uplands of Seirraleone and Guinea and Liberia where rainfall is substantial and evenly distributed. Rain fed rice is widely cultivated over West Africa, particularly Nigeria (Ayotade 1980 and Faqade 1982 and Wards 1980).

This wet land rain fed rice depends solemnly on rainfall and some moisture contents. Therefore only where irrigation is possible can rice be planted at a date which will result in repening period of high global solar rendition during the dry season. (De Datta and Zorotes 1970).

One of the most original features of rice is the fact that can grow under vary different environment condition, particularly from the point view of its water supply. It can be grown either as an upland crop, supplied solely rain water, or at the other end at the scale, as floating crop.

Deficiency in soil moisture is a feature of rainfall variability, that requires continuos investigation through meteorological Data. This is because, inspite of technological and scientific advancement weather is still the important variable in agricultural production.

Resent studies and research in relation to aspect of hydrology and meteorology in Nigeria, since the period of the sahehian drought which began in 1969 concentrated upon socio-economic aspects of environmental degradation, such studies as on drought, desertification, desert encroachment and meteorological aspects. Their causative mechanisms and factors and possible methods of abatement and control. (Ojo 1985 and Adefolalu D.O. (1986,1990). On the other hand, studies on aspects of environmental

hydrogy in Nigeria have not been widely documented. (Ayoade and Oyebande 1982).

However, climate variability and subsequent rainfall deficiency has negative consequence which disrupt economy, society and the environment. This may occur over a wide range of time scale from a season to year's or decades. This is could be associated to drought, which is the direct cause of famine, that can kill hundreds or thousand of people and disrupt the society and live hood of valuable of world's inhabitant.

Rainfall variability is more pronounced in areas with well defined wet and dry seasons as in most part of Nigeria in particular and in the tropic in general. This can be expected every year owing to seasonal changes in atmospheric circulation pattern. Lower than normal rainfall results in drought conditions which when aggravated lead to dry conditions and when temperatures are extreamely high severe desertification occurs which lead to wilting of crops. Such exceptional dry weather dominates the northern Sahel belt of Nigeria to which (Katcha) in Niger State belongs.

Of all climatic fluctuations the short-term variability is becoming increasingly important. The high degree of precipitation variability that has plagued different parts of Nigeria particularly, the Northern Sudan Sahara region has been of great public concern where precipitation in their area has

become unreliable. The consequence of precipitation deficiency is injurious to Agriculture, when periods with lower than normal rainfall are prolonged. Thus sensitivity to precipitation variation for agricultural and pastoral farming, animal rearing in this section of Nigeria has major socio-economic impact because seasonal and monthly precipitation are sharply reflected in the total crops yield each year.

The term rain fall is associated with sustained period of abnormal and normal water or moisture supply, which translated the different amount of rain fall recorded in a region that is not consistent over successive period.

Plant response to moisture requirements and even drought situation has shown that sometimes the amount of recorded rainfall is quiet irrelevant. A year with perhaps normal or abnormal total annual rainfall, but characterised by delayed on set or premature cessation (or both) of the rain season is worse for plant than one with definite short fall in total amount.

1.2 STATEMENT OF RESEARCH PROBLEM.

Inspite of recent technology and scientific advancement, weather record is still the most important in agricultural production (Ayoade 1977).

Problems of ecological disaster such as drought, desertification, flood and erosion have been on the increase in Nigeria. (Adefolalu 1976A, 1983A, 1993). In Niger State there have been problem of water shortage as a result of deficiency and variability in normal year rainfall, drought, pollution, land wasting and declining agricultural productivity. Government instead of addressing the root causes of the problem and finding solutions, resulted into ceremonial tree planting exercise and award of various degree of contracts water provision that wide spread and abandoned throughout the state.

There is a definite shortfall in documentation of studies on both atmospheric circulation patterns and geo-environmental indicators of deficiency and variability of rainfall in the entire sahel sub region.

(Obasi 1987) the abundant knowledge and tested theory on the role of atmospheric circulation and its variability in relation to climate and its anomalities e.g. drought and flood, government do concentrated on exploitative natural resources, monitoring with respect to capital investment.

(Bourn et al 1991) for example, in Nigeria which has been expatiated upon by Adefolalu (1986) poor exclusion of well defined programme to

rehabilitate, the deforested and the degraded of the geo-environment even when reliable data are available.

(Berry 1984) the years' 1973 and 1983, widely accepted as years in Nigeria, rain started late and ended earlier than usual especially in the northern part of the country. And the situation where most of the people depend on agriculture for their livelihood, and where there are other resources on which fall back the variability in rainfall might constitute an economic disaster in the area under study.

For example, most of the crops in the study area, which include cereal and leguminous especial rice required moderate of 700-1000mm of rainfall.

For the purpose of this it has been ascertained and believed some years before and subsequently now, rainfall variability has and may adversely effect on crop production and yield in the study area, if remedies are not put forward. It is for these reasons that the present research is thought to be relevant in generating empirical relationship, which will quantify some of the enumerated effects.

1.3 AIM AND OBJECTIVES.

The aim is to look into fluctuation in rice production in Katcha and its environs as result of influence of rainfall.

Within this broad aim the specific objectives are:-

a) To determine how rainfall influences rice production in the study area.

b) To offer suggestions for lasting solution.

1.4 JUSTIFICATION OF THE STUDY.

The deficiency in rainfall could be attributed to both the natural and general circulation of the atmospheric motion thropogenic factors. This aggravates the green effect. (global warning) and fragile ecological balance in the drought prone sudan-sahallain belt of Nigeria.

Adefolalu (1986) confirmed that, while sahel-type of vegetation was non exist up to 1950.it has now spread south latitude 10^0N in Nigeria with trends in desertification of sahel proper, suggesting increase in areas to recovered by "tree less" desert conditions in sahel.

The possible way to control this tree planting. Therefore an intensification of a practical approach to conservation of the landscape and water in a multipurpose initiative is necessary.

Because of importation bills on subsidy for rice importation at the wake of the 1983 drought and 1997/88, inflation run into billion of naira in hard cumency.

The area of the research which is a farming community in Niger State, is purely agricultural area. The farmers of the area have been contributing

immensely towards self-sufficiency in food production in Niger State and Nigeria at large.

It is now believed that the type of investigation pursued in this study is a justification to highlight, the degree of the contribution of this farmers. And the degree of problems in the study area particularly that associated to rainfall fluctuations.

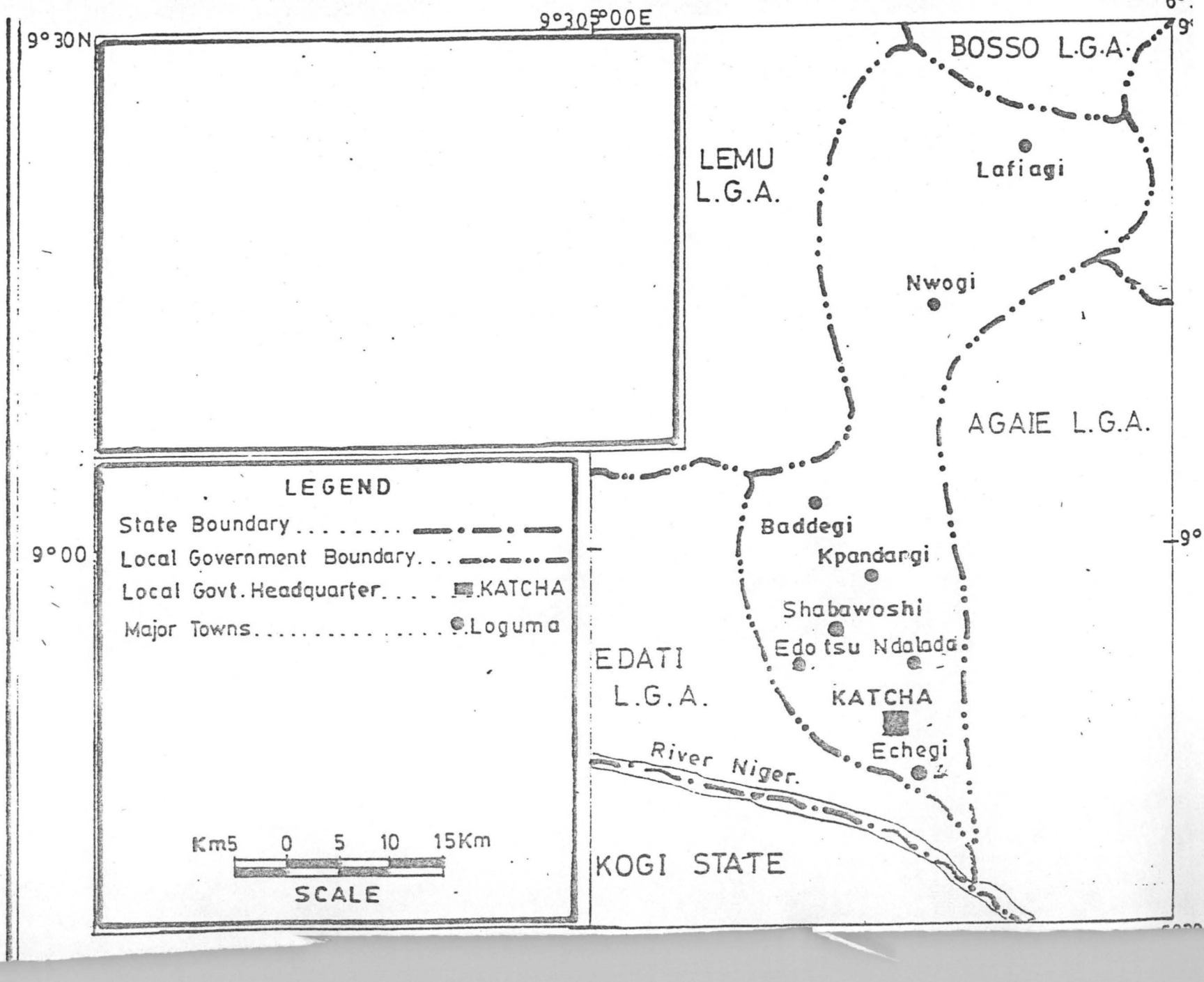
1.5 SCOPE AND LIMITATION OF THE STUDY.

As the topic suggest the will limits its only on the influence of rainfall on rice production in Katcha and its environs. This study is covered with both fadam and upland rice farming lands, not on other cereal crops.

It covered the duration of ten years rainfall characteristics of the area data, from Niger State Agriculture Project Bida, and airport Minna.

Furthermore, because it is difficult to release data by government agencies that is why we relied greate deal on responses generated from my questionnaire rather than much depend on government agencies, (Airport and Agriculture project Bida).

We however are involved that our analysis is a close representation of true position of influence of rain fall on the rice production in this farming community.


9°30N
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BOSSO L.G.A.
LEMU L.G.A.
Lafiagi
Nwogi
AGAIE L.G.A.
Baddegi
Kpandargi
Shabawoshi
Edo tsu Ndalada
EDATI L.G.A.
KATCHA
Echegi
River Niger.
KOGI STATE
9°00
9°
LEGEND
State Boundary
Local Government Boundary
Local Govt. Headquarter ... KATCHA
Major Towns ... Loguma
Km5 0 5 10 15Km
SCALE

1.6 LOCATION OF STUDY AREA.

Katcha and its environs is located in Katcha local government area of Niger State. It lies between 8^0N and 12^0N and longitude 4E and 8^0E. the western part of this community, situated on a marshy land area, found around or along river banks. The marshy areas are most used for growing of sugar cane and rice, palm oil trees and vegetables.

The north and west eastern part of this farming community is situated on grass land, which forms the best land for growing groundnut, Cotton, up and land rice and guinea corn etc. these districts have distinct seasons, wet and dry season.

A wet season which starts in April and last to november, and rainfall in heaviest in July and August.

Temperature is constant with an annual mean of 27^0C and maximum of 31^0C.

1.7 RELIEF.

Katcha with four districts is situated on flat land. There are a few riverine areas, across the districts in both north and west and southwest. These rivers dry up during the dry season, but are full to capacity during the season. They are characterised by flooding and rapids, as such therefore,

they are not navigable. There're some few scattered hills on to the north and east of the districts.

1.8 VEGETATION AND SOIL.

Katcha District fall exactly within the southern guineas Savannah. There are grasses such as northern gambber and trees like shea-nutes trees and some few economic trees. Many of such trees were planted by individuals in their villages around their houses and on their farms. Creaping root cro[ps and grains are commonly grown. The Katcha has mostly loaning soil.

1.9 THE OUTLINE HISTORY OF KATCHA DISTRICTS.

The two district that formed area of study, consists of tribes. The Nupes, Hausa, Yoruba and Fulani. The Nupe form a major tribe. They are said to be the first settlers into the area. The two districts consists of morw than 160 villages with total population of about 80,000 people (Local Government source). This district have four wards these are for political administrative convenience, are together, answerable to the traditional ruler called Emir of Bida (ETSU NUPE).

The density shows that the areas is relatively sparsely peopled. Some villages are scattered within the area. Oral records from elders point to the

fact that both the Nupe and other tribes like Fulani migrated into the area at the different times. The other tribes or clan were assimilated the Nupes who form the major tribes.

However the influence of the fulani and the Hausas on the area, is that through inter marriages, they have led to the different dialects in the area. The major religion is that is Islam. There are a few Christians and Pocket of traditional religion.

1.10 SOCIO-ECONOMIC CHARACTERISTICS.

There are a few public institutions or structures, and no large private organisations. There exist a few established Niger State own public offices, like accounts of law, dispensing and one modern health centre at Katcha town and few secondary school and three junior secondary schools. There are also few local government primary schools.

Also there are few colonial offices located at the railway station, and few dispensaries scattered in the few villages within the area. The dominant occupations are farming and fishing. The relief and climates of the area of these locality have made it possible to grow rice and others like palm oil tree, G/nuts melon.

The most disappointed issue in the district due to luck of local manufacturing industries, many villages are not assessable enough during rainy season. The roads are not quite motorable throughout the year. They are either seasonal or the bridges across then can only be used seasonally.

CHPATER TWO

2.1 LITERATURE REVIEW.

Many articles have been written on the effect of climate change and the production of crop in several part of the world. The change in rainfall pattern with time may be explained in terms of changes in the general at mospheric circulation, which cause southward and north ward movement of climatic zones. According to (Lamb 1968, 1972) will effect the growing season or the length of the growing period of crop which will in turn affect crop yield.

Some studies on environmental hydrology and meteorology concentrated on soci-economic effects of environment degradation, such studies was directed to drought desertification, desert encroachment, and other related fields. (Have 1945 Lam 1972, 1974 and 1982, Miles and Folland 1974, Charney 1975, Oguntoyimbo and Richerds 1977, Nicholson 1979, Gregory 1982, Ojo 1985, Nicholson and Entabesi 1985, Adefolalu 1983, 1986, 1988 and 1990). The most serious drought occurred in Sudan. Growing season rainfall as little as half of famine. In some farming areas of northern Sudan the drought was severe as in 1984, when thousands of people died. Dryness also affected the marginal growing areas of the Sudan's eastern neighbour.

There are lots of emperical studies in Nigeria aimed at estimating some meteorological parameters, which are not commonly measured. These include water balance (Ojo 1969, Obasi 1972) and assessment of evaporation. (Genier 1956, Daviel 1966, Ojo 1969, Adefalalu 1988).

A lot of studies have been done to relate crop yields to weather parameters. The technique, for rice yield in India is a common one (Robertson in UMO. Technical Notes No. 144). The technique was multiple regression analysis and long term records of yield and weather data just to establish relation ships between yields and certain weather factors at specific time in the life cycle of the rice crop. He there fore suggested that, this techniques provides encouraging results because similar techniques were used in developing equation for other rice growing area sin India with positive result.

Ekpo (1989) noted that regression models have been extensively used by different people provided that the data are base range for climatic variables only. But for this research study the choice of data for each analysis depends relationship between the crop being investigated and the prevailing climatic element with regards to the environmental setting where the analysis is concluded.

Among the first of such models was the one constructed by Thompson in 1960s to assess the influence of selected weather factors and technology in the production of the specific grain crops in mid-west of the United State of America. (Thompson 1962, 1969, 1975). For example his 1962 wheat model was based on data from six states in mid-west U.S.A involving two climatic variable i.e rainfall and temperature various results from several people who modified his model showed that about half of the residual variegate were explained by the climatic components alone.

In another development, Warrick (1984) observed that these regression techniques carry the advantages of involving weather predictors such as monthly or weekly precipitation (rainfall). He stressed that the statistical emperical methods drown upon historical climate and yields data series for the determination of model parameter.

In addition to that, Perm and Carta (1988) observed the relationship (between climatic variable and yield) may vary from region to region and from crop to crop. But they also asserted that emperical statistical models related a sample of seasonal crop productively data to weather data for the same period using statistical techniques such as corredetion coefficient ® and or regression analysis these relationship could be quantified.

2.2 VARIABILITY OF RAINFALL DISTRIBUTION.

Variability of rainfall distribution one areas has been a scourge of mankind even i.e. areas or region with copies rainfall. Historically speaking even drought are not uncommon, nor variability becomes a unique phenomena to the sahalian region. Because according to many authors it is a recurrent climatic phenomena in Africa particularly in sudano sahelian zone. Most peasant farmers and herds men can recount tales of lean years due to deficiency in rainfall of local droughts and even disaster e.g. farming and floods, years such as the early 1970s when animals and crops perished.

According to (Kowal Adeoye 1973) areas which normally receive appreciable amounts or rainfall sufficient to raise crops do suffer some times from shortage or abnormal distribution of rains resulting in a partial or total crop failure. Sanford (1978) desire such areas as areas of induced shortage of some economic goods brought abound by inadequate or badly timed rainfall.

Therefore due to luck of strict induce for the variability or rain, one can summarise this condition as basically a derivation from a rainfall reign whose effects are aver on people, animals and planate of a particular climate zone. In this area (Katcha farming community) of the study what determines the variability of rainfall is the totality of how dry or wet ht preceding year was, how late this year's rain is established. How early it ceases, who well the rain received is distributed in addition to how large the amount of rainfall is.

It is a common knowledge that availability of water has been man's major concern throughout history. Water has been man is means of survival and at times his enemy. At various places and at different times people migrated from place to place in search of water or in order to run away from drought, flood and erosion. In his effort to provide and acquire a safe and comfortable environment for sustainable development man, has since then continued to intensity research in area of drought flood mitigation, erosion control. Water resources development for irrigation, navigation, domestic and industrial water supplies.

The establishment of many meteorological stations towards the middle of the 20th century provided climatic record to more adequately describe the a real extent of rainfall distribution and variability. There fine using rainfall data from various well established stations. fisher (1975) summarised historical evidence indicating that drought and fermine conditions prevailed in different parts of present day northern Nigeria in the year 1983 - 1937, 1847, 1855, 1873, 1888 and 1889 - 1890. And Abdulmuminu (1984) has extended three more episodes, which cover large areas in sub-tropical zone in 1918, 1942 and 1973 supporting the opinion of other Authors, Abdulmuni confirmed that since 1972 only two years 1974 and 1975 yielded higher rainfall than normal in many years in Africa.

2.3 WHY VARIABILITY IN RAINFALL DISTRIBUTION.

For example, changes in global aim pressure and general circulation as stressed by (Lamb,1973) dated back from twenty to twenty years. According him, sahelian rainfall has been predicted to decline by a change in global pressure belts. The argument is based on the theory that reduced pressure gradient from the equator has resulted in the tropical maritime air mass which brings moisture to the northern part of Nigeria sweeping less for north and consequartely disposing a higher proportion of its rain near equator.

If the atmospheric circulation system changes, an area normally under ascending convictives system comes under descending stable system. It will experience reduced

rainfall no matter what the surface vegetation cover it. Although according to Abdulmumin (1984) desertification doe not under estimate the importance of large scale vegetation clearing in changing micro climate of an area.

2.4 RAINFALL VARIABILITY EFFECTS.

In this development, environmental effects compounded by certain human activities which include the global warming as a consequence of a zone depletion that results from the release of chleroflouro carbons, nitrate oxides, melthare carbon moon oxides and over green house gases, vegetation clearance etc are so serious that only with massive efforts and a return of normal rainfall will the agricultural lands and crop yields ever recover their desire level. According to Apeldorn (1978) the soil of most of the drought affected areas have becomes so hardened and eroded that young plants even if sprouted, cannot survived or facilitated the espected yields, as the lands have be come increasingly patched and subjected to erosion.

Hydologically, many steams have drastically reduced their volume rate of flow. For example Niger River was reported as being at its lowest for 30 year in 1972 (Thomas and Bonna 1973) and it lowest for sixty years in 1973 (Ald 1973).

2.5 RAINFALL AND DROUGHT.

As early as 1960, on wards, the sehele region suffered a progressive deding in rain fall which culminated between 1968 and 1973 in a drought so severe that it sterved

flocks and hards, even human, and damaged soil and natural vegetation. Though, rains returned to some areas in 1974, the 1973 drought has persisted in others and re-invaded West Africa in 1979.

However, due to relatively abundant rainfall after that drought episode, although periodic drought spells still persisted. The shale never recorded the normal rains with most places recording rain fall averaging only about 70% of the long term mean.

Meteorologists attributed rainfall deficiency as condition of absolute and partial of at east 15 consecutive days non of which is credited with 0.2mm or more of rainfall of which does not exceed 0.2mm (Mac'nitosh 1963). Thus, deficiency is said to occur when the rainfall received in a year or season is less them a specific percentage of the long term annual or seasonal average required for crop cultivation. This contribution does not allow to grow at optimum rates and occurs any time the daily supply of moisture from the soil or falling precipitation. (Rain fall) soils to meet the daily water needs or rice. A slow drying of the soil tacked place and crops fail to grow at their optimum rate, thus resulting in less then optimum crop yields (Akoh and Okenode 1995).

In another development, in adequacy of soil moisture or write below soil surface for nutrients in take by plants is not a function of rainfall, but its spread, distribution and reliability (seasonally) is a greet determination from plants production. So that, in research area Katcha (farming community) takes a look of occurrence or non assurance of the three set of parameters is decisive on possible management through

the degree of wetness and water equivalent to avert drought for best result (Jeseph 1995).

Further more, drought in Agricultural practice relates to seasonal vegetation development, a situation when the demand for water by plants is not. this may occur even when total annual rain fall amounts do not change but temporary distribution could be such that plants receive less rain at the time of maximum demand. This aspects is though to be related to significant drop in agricultural yield, which was a function of spatial and temperaral variations of precipitation pattern during the 1973 monsoon season.

In another development, drought is a function of weather producing system in west Africa. In the tropics anomalities of pattern of precipitation (annual amounts, seasonal, variable distribution in times and space etc) between 1970/1990 have aroused much interest & various studies have given the cause of such anomalies in West Africa as ranging from the failure of the Monsoon and the atmospheric synoptic scale features to the increasing albedo effects due to the surface vegetation which will result in lower thermal heating needed for convection. (Charmey et al 1977, Adefolulo 1984b).

Being a seasonal wind system, the climatological features of the monsoon suggests that there are too rainfall season, dry and wet in general. It is dry from mid October to mid April, while the wet season cons the other half of the year.

CHAPTER THREE

3.0 RERSEARCH METHIODOLOY

This research methodology for Data collection included library studies notes, field studies, and questionnaire, survey, and statistical analysis from field.

3.1 LIBRARY RESEARCH

The research work, used and consulted the existing publications, which include weather records some relevant literature on drought, desertification and precipitation effectiveness. The aim is to ensure relationship between rainfall variability and rise production. And also to highlight the influence of rainfall variability in other areas with similar problems.

3.2 METEOROLOGICAL DATA.

Data on rainfall, from 1991-2000 and 1994-2001 of Katcha in the study areas will be used. The Data are available at meteorological station Minna, and Niger State Agricultural Development Project Bida, climatic Change centre FUT Minna. The annual mean and monthly rainfall data for Katcha and its environs will be used for a period of ten years and 12 years respectively. This will be useful for computation of onset, cessation and

length of the rainy season (LRS) these three (onset, cessation dates of the rains and length of rainy season,) if base on mean monthly rainfall data, rainfall values will give the effective period which determines the rainy season for particular year. This is unlike the practice of detaining certain threshold values of mean annual rain fall. Course there may be uncertainty of the actual day/date during a particular month when the commencement of rainy season is due to commence. Togetherness or consistence monthly data years will prove the values needed to determine the differences as it spread over the exactly wet period.

As you may already aware that cessation means the effective determination data of the rainy season. This does not imply the last day of rainfall, although rainfall can no more be assured. The values estimated from monthly rainfall data when less than 600mm of rain was received, be wrong. But from the estimate of realistic onset (s) and cessation date (cd) the effective length of rainy season (LRS) may be outline as LRS-CD-ST.

This is good to note that optimum crop yield is just a function for the hydration neutral zone it is also in areas where effective proper evapotranspiration (ET) is high. So also, for drought prone semi arid zones potential evaporation increasingly exceeds precipitation and actual

evapotranspiration decreases that adequate control measures to enhence the later crop yield shall then decrease in the study environment.

Therefore, if adequate water is not been made available, plant grow shall be stunted and yield will be negligible. Hydro deficiency must be vary well checked to determine the required water demand of rice to ensure good crop yield.

3.3 STATISTICAL TECHNIQUES.

In the area of data analysis, this research work will make use of the following methods.

(a) Simple mean

(b) Percentage, ranking correlation.

The means and percentage are to explain the rice yields between deficiency years and the normal years. For example Pearson's product of movement correlation by coefficient is to give the degree of association between two set of pared variables to be used as rainfall distribution and rice yields. However this is to show either rice production or yields are very much dependent on rainfall influence.

3.4 FIELD TECHNIQUES

a) Questionnaire:

The questionnaire is one of the main instrument or material used for the collection of data for this research work. The steps for its effectiveness, include personal existence reading carried out by the writer on some related topics, inn relation to some consultations with the supervisor. And an acceptable questionnaire was later established to farmers.

In another development, as result of closed control questions, researcher hoped to assist, to a certain extent of against irrelevant answers and thus, ensure reliability in the responses collected from the work. The questionnaire was also prepared in such a way to cover aspect of farmer's planting time, harvesting time, the yield per hectare and storage facilities family size and system of farming etc. It is self administered to farmers on their farmlands and homes.

The simple random sampling will be used. Fifty farmers (ten from each five communities Katcha, Bakeko, Edatsu, Lafiagi, Badeggi, will be sample. For the purpose of two hypothesis were postulated i.e null and alternatives hypothesis. This is to demonstrate the probability that change alone might not yield the given date. The two hypothesis are formulated so that if null

hypothesis are rejected as a result of the statistical test to be applied, it will then logically alternatives. The rejection level is put at 0.05 probability 5%.

b) Field observation:

The writer of this research will personally visit farms to see for himself, in order to give a first hand information on the sizes of farm lands, that experienced low or significant yield as a result of the variability in rainfall. Some Farmers estimated the areas of their farmland in 1994,1997, 1999, and 2000. This gives way for rice yield and rainfall influence for ten years.

CHAPTER FOUR.

4.1 DATA ANALYSIS AND DISCUSSION OF RESULT.

The following data analysis is based on the information gathered actual from the questionnaires administered into five villages/randomly selected. These villages are Edotsu, Lafiagi, Badeggi and Katcha.

As such the information received from them include age variation of interviewed people, occupation religion, experience in farm work, type of crops growth most, planting season period of first rain, estimated production for the following years 1992, 1994, 1997 and 2000 at 4 years respectively and experience in flooding and drought. And causes of low yield in rice for specific period and effort of government to farmers and possible ways or solutions to control low yield of rice in relation to moisture content.

Rainfall and its distribution throughout the year is most important single characteristic of climate element determine the potential of plants unless irrigation is used.

The effect of rainfall has on crops is vary tremendously, because the length of the growing season is determined by the on set and end of the rain. There is possibility for triple or double cropping when rainfall is prevalent and when rainfall is seasonal, it permits single cropping as it is the case in this part of the country. So agriculturist and modern day farmers

and intensifying their efforts to introduce some varieties that will take only few days to mature, (precisely) forty-forty five days. However this has not been vary effective because of the unsteadiness in the onsets of the rain yearly.

It is not the total amounts that matters but its equitable distribution over the growing season. Therefore from the general clearing of the land that is done, very close to on set of the rains in this community. First rain have then marked the beginning of farming activities. For proper use of rain to rice, the rain for particular years must be well distributed with long period and must allow the soil to retain water for rice to grow to the maturity without long interruption.

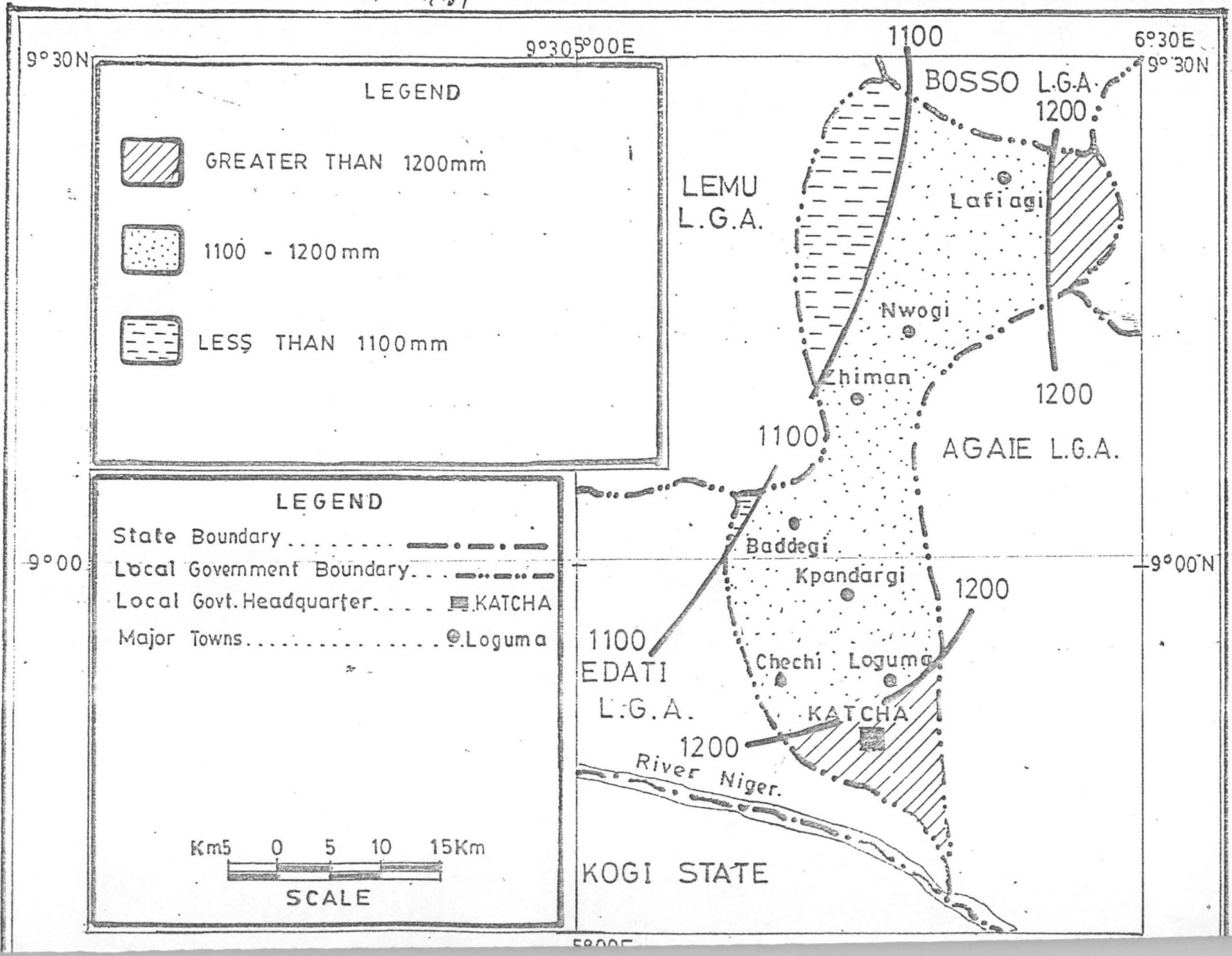
In contrast to above assertion is the delay in planting or reduction in the size of farm and increase in capital expenditure. Therefore tilling of land commences with the first rain. As such any delay of first rain therefore affects the tilling and subsequent farming activities either drought or not. The delay cause in planting is the most critical here because in an abnormal distribution affects yield and size of farm lands to be cultivated by individual farmer as it limits the length farming period during it occurrence at large.

In another development farming is the people's major economic activities and is only consolidated by rearing of livestock with petty trading in the dry season period.

The climate of the study area is a sub humid type classified as the tropical wet and dry by Koppen (1971). The two seasons are vary much dependent on two prevailing air masses over the country at different time of the year. The dry tropical continental air masses of the sahara region and humid maritime air mass originating from the Atlantic ocean. The two air masses nearly opposite in direction met at a zone of discontinuity stretching east west across West Africa known as the inter tropical discontinuity. It migrates northwards and southward following the east revelation. Its thereby reaches the south limits at latitude 5^0N in January and its northern limits in vicinity of latitude 20-24^0N in the August. The I.T.D. as explained above reaches the study area at 4^0E and 8^0E between April and may and it recedes in October.

However rainfall amount and its variations constitute the most significant set of climate variability, which directly affect the amount, reliability and timing of available water for agriculture crops in this study area. (Udo 1970) that this study area general the variation in the rain fall in

FIG I 4:1


LEGEND
GREATER THAN 1200mm
1100 - 1200mm
LESS THAN 1100mm
LEGEND
State Boundary
Local Government Boundary
Local Govt. Headquarter KATCHA
Major Towns Loguma
Km5 0 5 10 15Km
SCALE
9°30N
9°30
5°00E
6°30E
9°30N
9°00
9°00N
1100
1200
BOSSO L.G.A.
LEMU L.G.A.
Lafiagi
Nwogi
Zhiman
AGAIE L.G.A.
Baddegi
Kpandargi
Chechi
Loguma
EDATI L.G.A.
KATCHA
River Niger.
KOGI STATE

the area is the greatest climate determinate for growth and cultivation of rice.

4.2 RAINFALL VARIATIONS IN THE STUDY AREA.

For example, Jackson (1977) believes that any variations in rainfall for the about 30% is still normal for the tropical wet and dry climate, the average duration of 6 month wet month at study area that length between 5 and 7 months. Any variation in the amount and duration of rainfall according Olofin 1984 results in three rainfall regimes as follows.

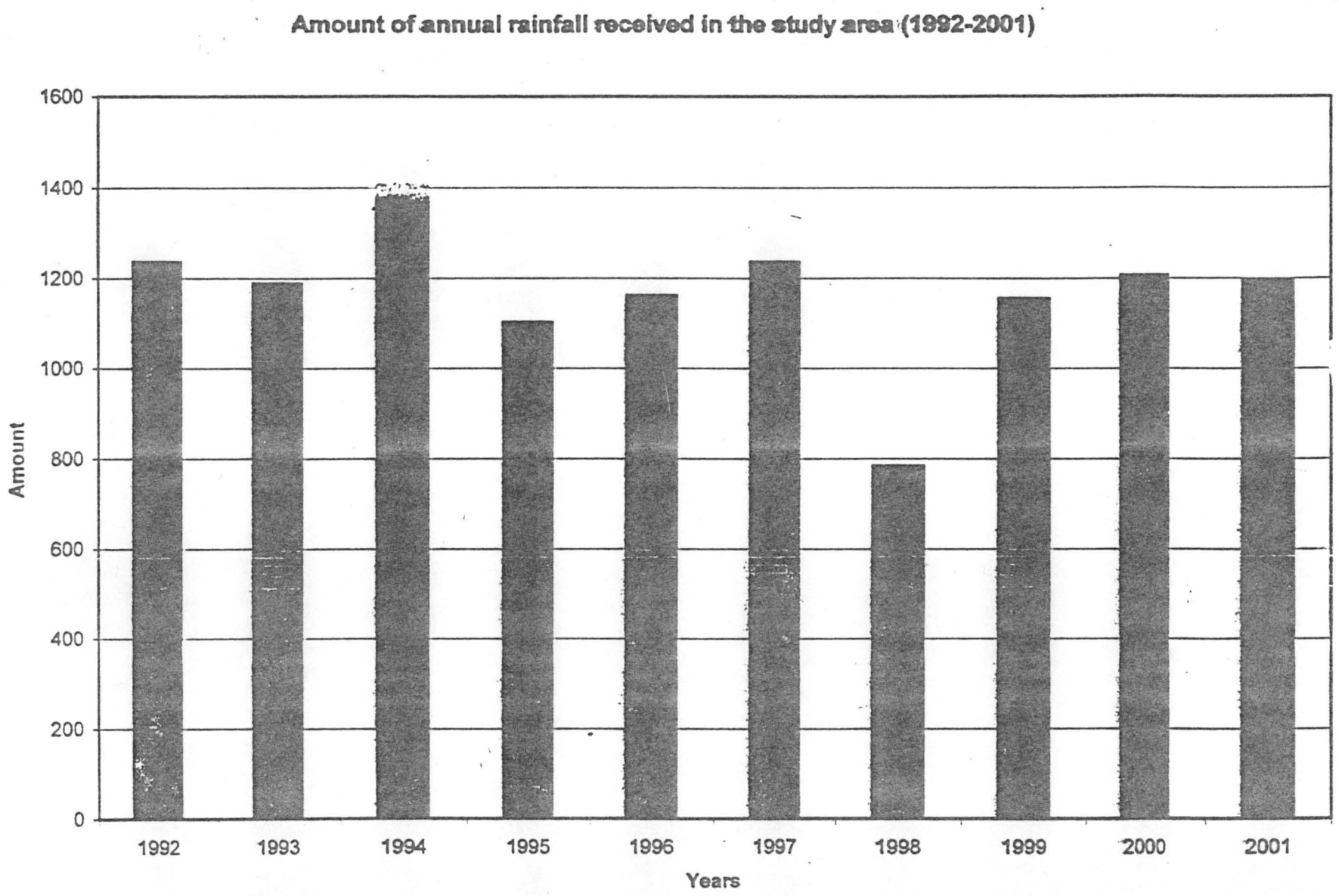
(a) The wet region, when amount of rain is longer then normal, the duration is longer and the rainfall pattern is steady.

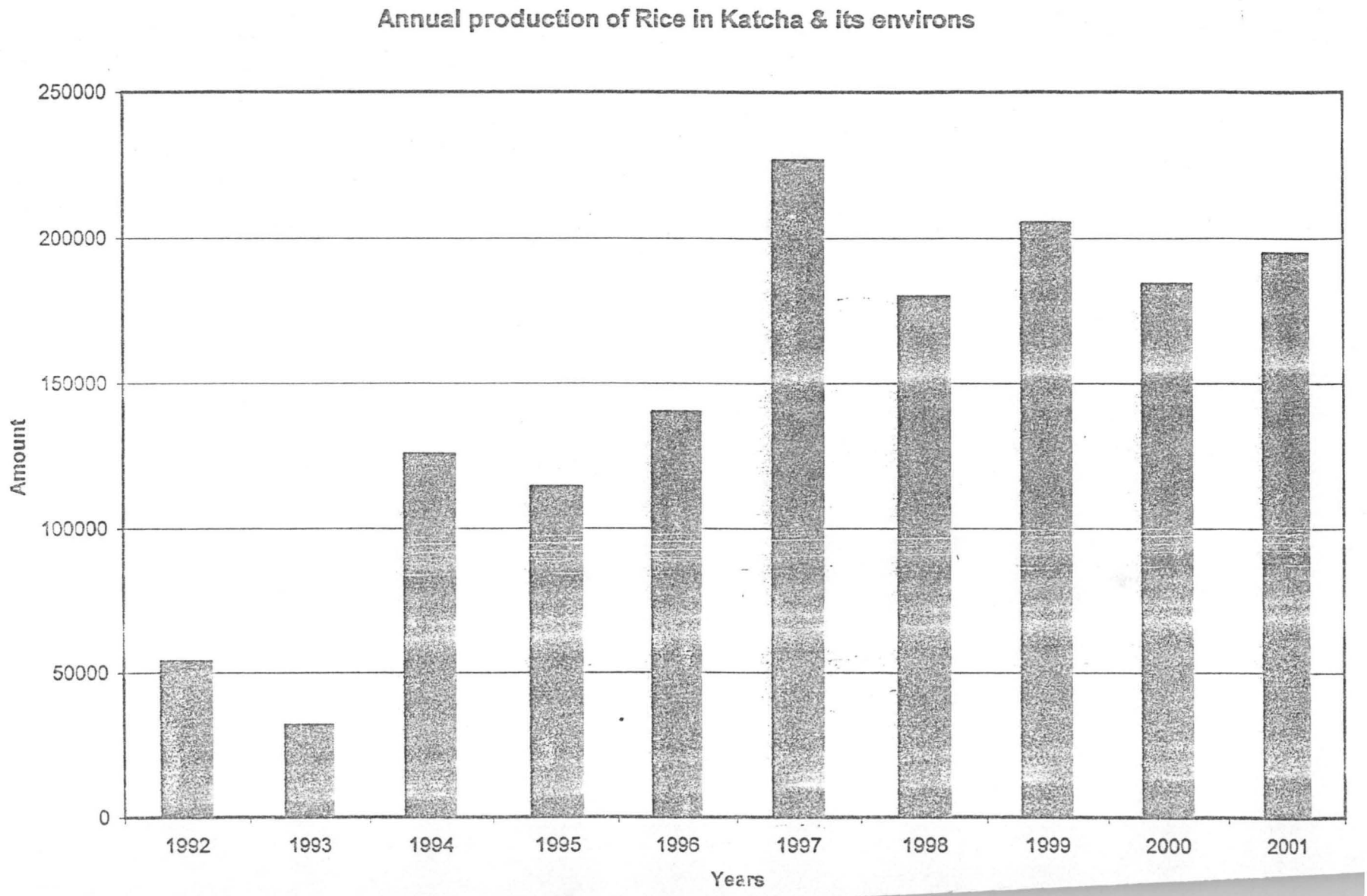
(b) There is moderate regime when amount and the duration of rainfall are approximately the same as the mean value and the rainfall pattern is fairly steady over the areas.

(c) When the dry regime accounted, is that either the amount and duration of rainfall is less them the mean value with erratic rainfall pattern or both the amount and period of rainfall are less than mean value.

This graph reveals that some years with high rainfall recorded high yield, because 1997, 1999,and 2000 seems to be years with high rainfall, and high yield of rice. But this is not much true to some extent, because 1993 and

FIG 4.1


Amount of annual rainfall received in the study area (1992-2001)
1600
1400
1200
1000
800
600
400
200
0
Amount
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Years


Annual production of Rice in Katcha & its environs
250000
200000
150000
100000
50000
0
Amount
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Years

yield of rice. But this is not much true to some extent, because 1993 and 1992 also have moderate rainfall recorded. But experienced low yield. This is a great indication, that rainfall influence production of rice, but not as much to some extent. it has relationship with production, but the correlation may very week.

What proved that relationship between rainfall and Rice production is very week, is that both table of ten years rainfall and ten years Rice production showed that production couldn't much depend on rainfall at large.

When I put ten years rainfall and ten years Rice production and computed together to get their correlation. Using pear son Ranking correlation co-efficient statistical method, and brought reliable result of 0.04242. Meaning that relationship exist but very week.

To calculate the co-efficient of rank correlation by pears of formula

$$R = 1 - \frac{6ed^2}{n(n^2-1)}$$

where D = the different between the corresponding values of the two variables.

N = the number of pairs of the observation.

R = Ranking the observable variables.

TABLE 4.1 SHOWING RAINFALL AND RICE PRODUCTION IN TONNES FOR TEN YEARS IN THE STUDY AREA.

YEARS	ANNUAL RAINFALL	RICE PRODUCTION IN TONNES
1992	1236.7	53975
1993	1142.2	31924
1994	1358.5	125680.2
1995	1102.6	114459.6
1996	1161.8	1401.38
1997	1236.5	226722
1998	784.5	179813
1999	1155.1	205482.65
2000	1206.6	184242
2001	1195.8	194862

Source (ADP Bida Zonal Report). Field work 2002.

This table 4.3 reveals that rainfall influence rice production, because most of years with high rainfall, indicated high production of rice from the table. For example, 1992 with high rainfall accounted for 53975 tones of rice. And

While in 1997 with high rainfall accounted for 222672.2 tones per year. As result, the rate of rainfall then influences the rice production to some extent. Although there are silent factors like flooding, drought that some times affect the production. But for purposed of my objective, I am strongly limited my self to influence of rainfall. If at all rainfall is what

determine rice production then 1993,1992, 1994, 1995 with moderate rainfall would have high rice production. As such the result of correlation by pear son formula that gives us 0.04242 is indicating little relationship.

It is now believed that, there is relationship between rice production and rainfall. The result from statistically analysis using spear son Ranking correlation co-efficient, with the formula, $R = \frac{1-6ED^2}{N(n^2-1)}$ resulted in

(0.04242.)

YEAR	$R.F^X$ (MM)	PRODUCTION IN TONNES	X-RANKING	Y- RANKING	X-Y=D	D^2
1992	1236.7	53975	2	9	-7	49
1993	1189.2	31924	6	10	-4	16
1994	1328.5	125680.2	1	7	-6	36
1995	1102.6	114459.6	9	8	1	1
1996	1161.8	140138	7	6	1	1
1997	1236.5	226722	3	1	2	4
1998	784.5	179813	10	5	5	25
1999	1155.1	20582.65	8	2	6	36
2000	1206.6	184242	4	4	0	0
2001	1195.8	194862	5	3	2	4
						ED=172

compute into the formula above.

i.e.

$$r = \frac{1-6\,ED^2}{n(n^2-1)}$$

therefore $r = \frac{1-6(172)}{10(10^2-1)}$

$$= 1-\frac{6(172)}{10(100-1)}$$

$$= 1-\frac{1032}{10(99)}$$

$$= \frac{1-1032}{990}$$

$$= 1-4242$$

$$= -0.04242.$$

This then shows that there is relationship exist between rainfall and rice yield but very week.

STUDY AREA

TABLE 4.2 SHOWS NO. OF DAYS RAINFALL EACH YEAR IN TEN YEARS

YEAR	DAYS
1990	87
1991	93
1992	50
1993	75
1994	80
1995	92
1996	73
1997	88
1998	85
1999	83

SOURCE NCRI BADEGGI.

Field work 2002.

In the study area, rainfall can be say to be moderate to some extent based on the location of the area. The table reveals that 1990-1999 receive fairly rainfall but characterized by fluctuation in the number of days, thus accounted for variation rainfall. This implies that rainfall is not all what influence production, if so the production in table 4.3 would have almost equal production. Therefore influence of rainfall in rice production in the study area has small correlation 0.04242.

IN THE STUDY AREA THE TABLE 4.3 SHOWING NO OF MONTHS RAINFALL IN TEN YEARS.

YEAR	MONTHS
1991	8
1992	8
1993	7
1994	8
1995	6
1996	8
1997	7
1998	6
1999	7

SOURCE – NCRI BADEGGI.

Field Work 2002.

This study area experiences 6-8 month rainfall but the problem of onset and cessation characterized the system if not moderate rainfall is observed to bring adequate production in rice farms. But this farmers according to them always wait for may and June rain before planting rice. If not in this area rain is not total absent in each of the ten years estimated above.

TABLE 4.4 DISCRIPTION OF RAINFALL IN 4 YEARS FARMERS PERSPECTIVE.

	Edotsu	Bakeko	Lafiag	Badeggi	Katcha	Total	%	Years
Less than normal	2	3	2	3	3	13	27	1992
Little than normal	4	4	4	4	4	20	43	1994
The same throughout the year	2	3	3	2	2	12	26	1997
More than normal	1	1	-	-	-	2	4	2001
Total	9	11	9	9	9	47	100	

Source – Field Work 2002

This table 4.6 reveals that about 27% said these years rain is less than normal years. While about 4% says, it is just little than normal years, of course about26% said, it was the same throughout years estimates above. While only 4% said this rain was more than normal. In this respect, farmers couldn't observe rain period well and no much attention to duration of rain. That could be why they put much emphasis on certain crops with early rain

and some time other crops could not meet their demand with rest period of the year.

TABLE 4.5 CAN RICE BE HERVESTED ALL AT THE SAME TIME? FARMERS RESPONSE

	Edotsu	Bakeko	Lafiage	Badeggi	Katcha	Total	%
Yes	3	2	4	2	1	12	20.5
No	4	5	6	5	5	25	41.5
Because of its variety	4	5	5	5	5	24	39
Total	11	12	15	12	11	61	100%

Source – field work 2002.

Table 4.7 reveals that rice could grow and matured at different time, because of verities. About 42% rejected that it depends on the variety you used in the farm. While about 39% said variety has part to play also term of planting of individual seeds. There by 12% said it generally the same in maturation stage.

Table 4.7 has revealed that rice can not matured at the sometime, because it has variety and each has period of maturation with short difference.

This could be one way that rain influence production of rice. For example those planted with early matured before that of late rain. Any shortage of rainfall can influence production, unless irrigation method is used.

TABLE 4.6 SHOWS THE RICE PRODUCTION IN TONES 1992,1994,1997,2000. FARMERS PERSPECTIVE.

	Edotsu	Bakeko	Lafiage	Badeggi	Katcha	Total	%
10-20	1	1	2	3	4	10	11
21-30	3	3	2	3	3	11	12
31-40	5	5	6	5	7	23	27
41-50	5	5	6	7	8	26	29
50	5	5	5	5	4	19	21
Total	19	19	21	23	26	89	100%

Source – Field work 2002.

Table 4.8 reveals that about 29% harvest between 41-50 tonnes within this period of high rainfall. While about 27% said, they had returned from rice farm of about 31-40 tones in these few years. So also about 21% harvested together. 50 tones and above, 11% and 12 ranges between 20-30 tones.

TABLE4.7 SHIOW LOW YIELDS THROUGH FLOODING.

	Edotsu	Bakeko	Lfiage	Badeggi	Katcha	Total	%
1992	4	2	3	2	1	12	21
1994	3	3	2	1	1	10	18
1997	5	5	5	5	5	25	45
2000	2	2	3	3	1	9	16
Total	14	12	13	9	8	56	100%

Sources – field work 2002.

Table 4.9 reveals that about the population experienced flooding into their rice farm during four 4 years mentioned above. This caused low harvest, while about 21% said that 1997 was year of low yields in his rice farm, because of flooding.

In addition to that about 18% experienced it on the year 1995 and resulted to low yield in their farm. This because no alternative ways to bring water to farm than rainfall. And about 16% revealed that flooding is actual reduced his production of rice.

5.0 SUMMARY CONCLUSION AND RECOMMENDATION

5.1 SUMMARY:-

This research work attempts to describe the correlation between rainfall and rice production in Katcha and its environs, with some suggestions for lasting solution. Although relationship very week.

The annual rainfall has been fluctuating since the drought of 1973 and 1983. Since then, decline of yields in crops as result of uncertainity on the part of the farmers as what might happened to the, if they plant earlier than normal time of planting, or delay, planting when rain might have stoped before cessation dates.

It has been found that most of the farmers responded to the drought or flood by adopting new techniques of production, including the cultivation of early maturing crops (new high breed variety), and dry season irrigation farming.

5.2 CONCLUSION

The effect of variability in rainfall in [illegible] is not as severe and serious in this area as compared with other parts of the country especially where drought were persistent, although some crops fail to mature or yield much as desired.

A drought or flood year effects farming activities in the following year, hence there was always some reluctance on the part of farmer for fear early planting and experience sudden break. How ever farmers have discover from this research that to keep fertilizer, pesticides ready in case the rainfall normalizes

They employed to increase the output through increase in the hectare of the farm land.

In general the variability of rainfall will continue to affect the region and northern part of Nigeria, unless some thing remarkable is done by the government and the people themselves to adopt and check the situation.

RECOMMENDATION.

The farmers need capital from government to enable them cope with modern techniques of farming, because, chemicals, tractors, and seeds variety with early maturation period are required. And each of them deserved money or kind. To avoid land disputes.

All middle men are to be removed between government and farmers, during annual distribution of farm imputes irrigation farming, construction of water ways to up land farms, application of fertilizer and early planting of rice with the first rain must be encouraged, to avoid rice failure when rain could not required month for rice.

BIBLIOGRAPHY

Ojo O. (1977). The climate of West Africa, Ibadan Heinemann pp 019-157

Ojo O. (1983). Recent trends in aspect of Hydrology of Humid Tropical Regions ed R. Keller, IAHS pub. No 140, pp97-104.

Thompson 1957 in water, Climate and Agriculture ed. By Jackson pp 63-65.

Obasi et (1977) fluctuation in animal value in Nigeria, the West Africa Monsoon Experiment (Wamex) proceedings of the pre-Wamex symposium and West Africa Monsoon-Express printer pub. Hagosmipe pp. 368-455.

Ayoade J.O. (1988). Introduction of climatology for the tropics. John Wiley, New York pp. 125-223.

Adefolalu D.O. (1990): Precipitation Effectiveness and Predictability for sustainable Development WMO Lecture Series in Agrometeorology.

Adefolalu D.O. (1990): Averting Drought Situation in Sahehian and sub-Sahehian Region of West Africa Approaching Nigeria.

Adefolalu D.O. (1990): Desertification Studies (with emphasis in Nigeria) in Vaughan

R.A. (Ed) Micro Wave Remote Sensing for Oceanographic and Marine Weather

Forecast Models (Proceedings of NATO Advanced Study Institute.

Abdulmumin S. (1985): Drought Causes Predictability and Solution Article in Study

New Nigeria Newspaper, February 5th 1984.

Adewale O. (1995): Environmental Monitoring of Drought and its effects on

Agricultural Products in Northern Nigeria. A Paper presented at the 3rd National Workshop on Land Administration and Development in Northern Nigeria.

Lam H. H. (1988): Weather, Climate Human Affairs, and Routeledge New York.

MORKTMORE. M>J. (1974)Famine in Hausa Land Savanna Vol.2. No. 2.

Akpo I. S. (1974): Effects of Climate veriability on Agricultural in the Kano Plains of Northern Nigeria.

Olofin E. A. (1984) Climate Constraints to Water Resources Development in the Sudan Sahahian Zone of Nigeria. Paper presented at international seminar on the quality of the Environment of Hausa Land, Sokoto.

W.M.O. (1980): The Role of Agrometeorology in Agricultural Development Project.Technical Note No. 168 (WMO No. 526).

W.M.O. (1980): Proceeding of the Technical Conference on Climatic Africa (WMO

No. 596) Pp. 438-458.

W.M.O. Technical Note No. 144 Rice and Weather.

W.M.O. (1967): West from Weather WMO No. 220 TP 177 Geneva.

APPENDIX I.

QUESTIONNAIRE.

1a. Name.....

b. Village.....

c. Age variation.....

Tick one

15 - 25 [ ] 26 - 35 [ ] 36 - 45 [ ] 46 - 50 [ ]

2. Your major occupation

a) Farming [ ] b) Bladesmith [ ] c) Civil servant [ ] d) Fishing [ ]

b) Schooling [ ]

3. Your secondary occupation

a) Tailoring [ ] b) Contraction [ ] c) Schooling [ ]

4. Your third occupation

a) Student [ ] b) Premolar [ ] c) Hatbalish [ ]

5. Your religion

a) Islam [ ] b) Christianity [ ] c) Traditionalist [ ] d) Free thicker [ ]

6. Your educational level

a) Primary school level [ ] b) Secondary school level [ ]

c) Tertiary level [ ] d) University [ ]

7. Your area of specialisation?

a) Agriculture [ ] b) Administration [ ] c) Commercial [ ] d) Medical [ ]

8. For how long have been farming?

a) Less than 10yrs [ ] b) 11- 15yrs [ ] c) More than 15yrs. [ ]

9. What type of crops do you cultivate most?

a) Rice [ ] b) G/Corn [ ] c) Yam & Legumes [ ] d) Banana [ ] e) S/cane [ ]

10. If both cereal & legumeous are cultivated, at what ratio are they cultivated.

a) 20 - 80 [ ] b) 30 - 70 [ ] c) 40 - 60 [ ] d) 50 - 60 [ ]

11. What time of the year do you usually plant your crops?

a) March [ ] b) April [ ] c) May [ ] d) June [ ]

12. What time of the year do you usually plant rice.

a) March [ ] b) April [ ] c) May [ ] d) June [ ]

13. What time of the year do you get first rain.

a) March [ ] b) April [ ] c) May [ ] d) June [ ]

14. Which month do you panted other than those selected above.

a) April [ ] b) July [ ] c) February [ ] d) January [ ]

15. Which crop or crops do you plant at this time of on-set among the following crops as appropriate?

a) Millet [ ] b) Maize [ ] c) Rice [ ] d) G/nut [ ] e) Sorghum [ ]

16. Please specify the period and month you plant your crops from the year 1991 - 2000.

YEAR	PLANTING PERIOD MONTH
1994	
1995	
1996	
1997	
1998	
1999	
2001	

17. How would you compare the rain from 1991/1996 and 1997 and 2000.

a) Same are very much less than normal [ ] b) Some little than normal [ ]

b) Some are move than normal [ ] d) Some are move than normal [ ]

18. Characteristics pattern of rainfall years above?

a) Stoped late [ ] b) Stoped early [ ] c) Started early [ ]

d) Rainfall in all years during raining season [ ]

e) There are enough rain for these crops all years [ ]

19. Can you estimate (rate of harvesting per hectare for the years (1994 - 1996) 1997 - 98. A rate of harvesting as in tick.

YEAR	LITTLE	MODERATE	VERY MUCH
1991	.....	.....	.....
1992	.....	.....	.....
1993	.....	.....	.....
1994	.....	.....	.....
1995	.....	.....	.....
1996	.....	.....	.....
1997	.....	.....	.....
1998	.....	.....	.....
1999	.....	.....	.....
2000	.....	.....	.....

20. You harvest all crops at the sometime?

a) Yes [ ] b) No [ ]

21. Reasons

a) Variety problem [ ] b) Nature of rainfall [ ] c) Depend on time of planting [ ]

22. What type of Agricultural system do you offer?

a) Mechanical system [ ] b) Traditional type [ ]

b) Both mechanical & traditional [ ] d) None of above [ ]

23. How do you improve your production capacity on crops like maize rice, sugar cane.

a) Application of fertilizer [ ] b) Insecticide/herbicide [ ]

b) Weeding only [ ] d) Local manure [ ]

24. Where/how do you get fertilizer and other chemicals

a) Through government agencies [ ] b) Through marketers [ ]

b) Private company [ ] d) Co-operative [ ]

25. In your farm land which crop/crops yield most as from 1991 - 2000.

a) sugar cane [ ] b) Leguminous [ ] c) Rice d) Beans [ ]

26. Can you give account of the years that you experienced heavy or high appreciable harvest that attribute to rainfall.

a) 1994 - 98 [ ] b) 1995 - 96 [ ] c) 1996 - 97 [ ] d) 1998 - 2000 [ ]

27. From your experience what can you accept as cause of low yield of rice and sugar cane?

a) Low rain fall [ ] b) Late onset [ ] c) Fertilizer [ ] d) flooding [ ]

e) Diseases [ ] f) Weeds.

28. Which of the period of year do experience flooding on your farm land.

a) 1991 [ ] b) 1996 [ ] c) 1997 [ ] d) 1992 [ ] e) 2000 [ ]

29. Out of the factors mentioned in No. 27 above which do you think has grates influence on Rice production?

a) A & B [ ] b) C & D [ ] c) E & A [ ] d) E [ ]

30. What is your attitude to wards farming as occupation?

a) Very encouraging [ ] b) Discouraging [ ] c) composory [ ]

31. Which of farming practices that offer you much yield among the following crops?

a) Mono cropping [ ] b) Mixed farming [ ]

c) Crop rotation [ ] d) Shifting cultivation [ ]

32. How would you assess the rate of flooding and drought among the problems?

a) The most serious problem [ ] b) One of the serious problem [ ]

b) One of slight problem [ ] c) One of the serious problem [ ]

d) Dangerous to plant/aimed

33. How do you control future flood and drought.

a) Look for another job [ ] b) Stop sell and food stuff [ ]

b) Leave that area for another area [ ]

c) Construction of drainage tree and bridges [ ]

34. What are effort of government to you in times of aid when experiencing flood and drought.

a) Always money & kinds [ ] b) Sometime [ ]

c) Never at all [ ] d) Orate instruction & promises [ ]

35. If there is any aid on what for is such aid?

a) Little food stuff. [ ] b) Fertilizer/chemical [ ]

b) Improved seeds [ ] d) Machines e.g. tractor [ ]

c) Little money and little food stuff [ ]

36. How do you encourage high production of Rice rather than rainfall.

a) Co-operative farming [ ] b) Fertilizer [ ]

c) Scientific farming & comparative [ ]

d) Seeds, chemical, machines crop rotation [ ]

e) Irrigation channels and bridge [ ]

37. Types of rice farm you posses?

a) Up land rice term [ ] b) Low land rice farm [ ]

b) Underground water rice farm [ ] c) Both A and B.

38. In which ways do you prevent low yield in your rice farm?

a) Through mechanised farming [ ]

b) Through growing both up and low rice [ ]

c) Through application fertilizer alone [ ]

d) Improve your capital [ ]

c) Get enough capital and take to mechanised farming. [ ]

39. Where you ever involve in any land dispute?

a) Yes [ ] b) No [ ]

40. If yes your source of land disputes you once were involved

a) Upland for farming [ ]

b) Marsh land for rice farm [ ]

c) Land for residence

41. Frequency of land disputes per year you were involved

a) 0 - 5 [ ] b) 6 - 10 [ ] c) 11 - 15 [ ]

42. Possible ways of growing rice very well in the study area.

a) Through scientific method [ ]

b) Avoid late rain [ ]

c) Wait for June [ ]

APPENDIX II

To calculate the co-efficient of ranking correlation by pears of formula.

$$r = \frac{1 - 6ED^2}{n(n^2 - 1)}$$

Where

D = the difference between the rank for corresponding values of the two variables.

n = the number of pears as the observations.

YEARS	ANNUAL RAINFALL	YEARS	P/RICE
1992	1236 .7	1992	53975
1993	1189.2	1993	31924
1994	1328.5	1994	125680.2
1995	1102.6	1995	114459.6
1996	1161.8	1996	140138
1997	1236.5	1997	226722
1998	784.5	1998	179813
1999	1155.1	1999	205482.65
2000	1206.6	2000	184242
2001	1195.8	2001	194862

Source: ADP Bida.

YEAR	R.F^{X}(MM)	TONES PRODUCTION	X-RAKING	Y=RAKING	X-Y=D	D^2
1992	1236.7	53975	2	9	-7	49
1993	1189.2	31924	6	10	-4	16
1994	1118.5	125680.2	1	7	-6	36
1995	1102.6	114459.6	9	8	1	1
1996	1161.8	140138	7	6	1	1
1997	1236.5	226722	3	1	2	4
1998	784.5	179813	10	5	5	25
1999	1155.1	205482.65	8	2	6	36
2000	1206.6	184242	4	4	0	0
2001	1195.8	194862	5	3	2	4

$ED^2=172$

Compute into the formula above.
i.e

$$r = 1 - \frac{6ED^2}{n(n^2-1)}$$

therefore

$$r = 1 - \frac{6(172)}{10(10^2-1)}$$

$$= 1 - \frac{6(172)}{10(100-1)}$$

$$= 1 - \frac{1032}{10(99)}$$

$$= 1 - \frac{1032}{990}$$

$$= 0.042$$

very week.

BADEGGI: 12 YEARS ANNUAL RAINFALL.

S	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
0	00	4.3	0.0	81.8	287.3	117.7	264.7	180.6	160.0	109.9	00	00	1206
1	00	0.5	68.3	50.8	205.9	331.5	237.0	244.7	249.6	75.7	00	-	1364
2	00	0.0	0.00	141.7	136.6	133.9	128.9	148.4	216.0	31.5	00	00	936.2
3	00	0.0	61.6	8.9	154.7	241.8	206.9	308.4	240.4	152.5	00	00	1375.5
4	00	0.0	0.0	38.9	171.9	154.4	75.8	425.7	194.0	102.1	00	00	1159.8
5	00	0..0	22.9	43.8	92.3	128.7	236.7	307.5	152.2	105.6	12.3	00	888.97
6	00	18.9	00	12.6	199.4	190.7	201.8	326.1	170.5	11.3	00	00	1161.8
7	00	0.0	64.9	53.9	129.3	279.2	219.0	227.2	147.5	135.4	7.2	00	1263.6
8	00	-	000	67.1	213.2	75.5	239.7	145.5	153.7	103.0	00	00	997.7
9	00	2.8	0.8	112.1	135.4	196.8	264.1	194.5	153.7	98.0	00	.0	1158.2
0	00	0.0	9.5	15.4	118.5	280.5	171.9	284.3	262.8	72.0	00	00	1154.95
1	00	0.0	00	62.4	115.9	117.8	245.9	385.5	308.6	65.2	00	00	1033.5

Source: NCRI Badeggi Field work 2002