

**DESERTIFICATION PROCESS AND
ENVIRONMENTAL MANAGEMENT CHALLENGE
IN THE SUDAN-SAHEL**

A CASE STUDY OF KATSINA STATE

BY

JIBRIL ASMAU

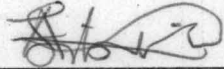
PGD/GEO/2000/2001/133

**A PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE AWARD OF POST GRADUATE
DIPLOMA IN ENVIRONMENTAL MANAGEMENT**

MARCH, 2002

DECLARATION

I declare that this work is wholly that of the author conducted under the supervision of Dr. M. T. Usman. It is not formed part of any presentation for any other qualification



JIBRIL ASMAU
STUDENT

05-04-2002


DATE

DEDICATION

This project work is dedicated to my beloved mother **HAJIA BARAKA** and my father **ALHAJI YAKUBU JIBRIL**

CERTIFICATION

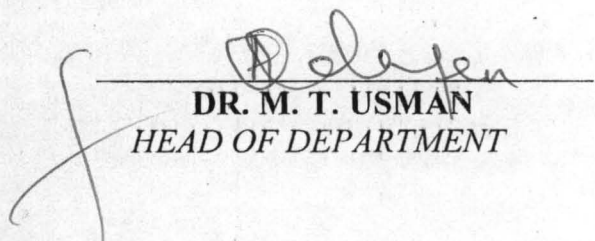
This project entitled "Desertification process and Environmental Management challenge in the Sudan-Sahel: A case study of Katsina State: by **JIBRIL ASMAU**, meets the regulations governing the award of post Graduate Diploma in Environmental Management.



DR. M.T USMAN
SUPERVISOR

20/3/02

DATE



DR. M. T. USMAN
HEAD OF DEPARTMENT

20-03-02

DATE

EXTERNAL EXAMINER

DATE

PROF. J. A. ABALAKA
DEAN POST GRADUATE SCHOOL

DATE

ACKNOWLEDGEMENT

First, I have to give all thanks and praises to God Almighty for guiding and protecting me throughout my course and my life as a whole.

My profound and utmost appreciation to my supervisor DR. M.T USMAN. I wish to express my inexhaustible gratitude for your kindness, patience, advice, criticism and observation, which laid the foundation of this work.

I want to thank all the staff (Academic and non-Academic) of the geography department for their kindness and support. May God reward you all.

This is to my Mother **HAJIYA BARAKA** for her unending love, support and encouragement. May God reward you with all the beautiful things in this world and the hereafter. Also to my dear Father, **ALHAJI YAKUBU JIBRIL** for caring and loving me right from time. May God reward you abundantly. I love you all.

To my Uncle, **ALHAJI SANI MALUMFASHI**, words cannot describe my appreciation. Thank you for everything.

To **ALHAJI U. F. AHMED** and his wife **HAJIYA YABI AHMED** who have been there for me. Words cannot describe how grateful I am but God will surely reward you. Thank you very much.

This is to my cousin **BILKISU** and her Husband **AMINU BAKO** for their love and support and to their Son **SULTAN (NIGGA T.)** keep up the big boy moves.

To **HAUWA BAKO, CHUKS, MAIGARI AND MA'ULA** thanks for hearing me out and keeping me laughing. You've all represented and you will always be in here.

This is to **HALIMA RUFAl** for always being there for me. Lets keep up the love and friendship. To all my classmates for being friendly-Thanks, I hope we meet again.

To all those who have helped me in any way, I will always appreciate it.

ABSTRACT

Desertification is one of the most serious environmental problems in Katsina State, with dire economic consequences on the entire nation. Interviews and group discussions were undertaken due to the time constraints of this research work, but adequate results were obtained. Also photographs were taken as visible proves confirming the role of desertification and also journals and research papers were consulted for justifiable results.

The causes of desertification are diverse combination of natural and anthropological processes, which were critically analysed and tackled at local and national levels in this research work.

Desertification has been with us for sometime. Regrettably, not much attention was paid to the phenomenon which has developed into an alarming scope needing concerted effort and huge investment by Government involving the masses to ensure effective control on short and long-term basis.

However, in the course of this research work, it was discovered that most of the village communities are not involved in Government Projects, hence the apparent ignorance of the consequence of their negative activities, which have serious implication on the worsening situation in land degradation in the State.

TABLE OF CONTENTS

Title Page	i
Declaration	ii
Dedication	iii
Certification	iv
Acknowledgement	v
Abstract	vii
Table of Contents	viii
CHAPTER ONE	
1.0 Introduction	1
1.1 Definition	1
1.2 Study area/location	2
1.3 Statement of the Problem	3
1.4 Justification	4
1.5 Aims and objectives	5
1.6 Scope and limitation	5
CHAPTER TWO	
Literature review	7
CHAPTER THREE	
Methodology	14
CHAPTER FOUR	
Results and discussions	17
4.1 Government efforts	17

4.2	State zonation	21
4.3	Land satellite imagery	22
4.4	Causes, consequences and control of desertification in Katsina State	26

CHAPTER FIVE

5.1	Summary	31
5.2	Conclusion	31
5.3	Recommendation	32
	References	34

CHAPTER ONE

1.0 INTRODUCTION

In recent decades there has been a growing concern over the on going desertification in northern Nigeria. Nigeria is a large country, with a substantial part of its area extending into the Sudano-Sahelian belt, which, together with the neighboring northern Guinea savanna constitutes the dry lands of the country. The severity of desertification in the dry lands of the world prompted the United Nations Organisation to adopt a convention to combat desertification (CCD) in 1994. Nigeria ratified it in 1997.

1.1 DESERTIFICATION

This is the total end result of all factors of land degradation, which is a process leading to a desert like condition with extreme water deficiency accompanied by desiccation winds due to climatic and biotic factors as a result of deforestation, over-grazing, drought and soil erosion.

It is also described as the diminution or destruction of the biological potential of the land, leading to the creation of desert-like conditions in the area outside the climatic desert.

It can also be defined as land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities.

Desertification is aggravated in the dry lands of the country by increasing human attempts to exploit the resources of the ecological zone in the face of persistent

drought. Before now, Nigeria has been tackling the problem of desertification the best way it could, but with little success. There is a general Consensus that desertification is by far the most pressing environmental problem in the dry-land parts of the country. The visible sign of this phenomenon is the gradual shift in the vegetation from grasses, bushes and in the final states, expansive areas of desert-like sand.

1.2 STUDY AREA/LOCATION

Katsina State which is geographically located between lat.11.7 and 13.2 degrees North and long.6.5 degrees and 9.2 degrees East has a total land area of 23,930sqkm and an estimated population of 4.37 million. Rainfall ranges between 400-1100mm. The geological formation of the state is of basement complex origin in the south and sedimentary formation in the north giving rise to clay, loam and sandy soil in the south and north respectively.

The agricultural production reflects the ecological zonation of the state where we have about two (2) million hectares of arable land out of which 1.6 million hectares is under cultivation. Katsina is bestowed with a large number of livestock consisting of one (1) million cattle's, 2.5million sheep/goats and 600,000 horses and donkeys, which at present are above the carrying capacity of the rangelands. The state forest estate comprising of 96 forest reserves, 244 communal forest areas and over 2000 hectares of forest plantations/shelter belts/wood

lots, cover only ten percent (2,420 km²) of the total land area of the state as against the 25% minimum requirement.

The location of Katsina State, in the arid zone, makes it vulnerable to the gradual deterioration of the environment due to persistent deforestation, over grazing, desertification and faulty farming practice. This adversely affects the socio-economic life of the inhabitants, indeed, population pressure and increased human activities coupled with non-adherence to existing legislation compounds the land degradation problem posing serious threat to human and livestock survival in Katsina State.

1.3 STATEMENT OF PROBLEM

The dry lands of Nigeria are the least developed in terms of the ability to meet basic needs. Per capita income is not only low, but the population growth rate is high, morbidity and mortality rates are high, medical services are lacking, the transportation system is chaotic and food security is not guaranteed. Therefore, over-stocking, over-grazing, over-population, cultivation of marginal land, and poaching are seen as possible responses to a harsh and inhospitable environment.

The major adverse problems of desertification phenomenon are;

- i Deflation of the resources base.
- ii Worsening (and spread) of poverty.
- iii Threat to and reduction of food security arising from crop failure, hence rising incidences of hunger and malnutrition.

- iv Threat to, and inhibition of, biological diversity of plants and animals as well as their habitat
- v Conflict between and among groups (such as pastoralist and farmers) over resources that are in short supply
- vi Long term social and economic dis-organisation on affected communities including forced migration.

The total end result of deforestation, over grazing, soil erosion, and drought leads to desertification, which has devastating effect on the survival and socio-economic aspect of Katsina State inhabitants. Unless bold corrective measures are employed, the continuous existence of Katsina State is bleak.

1.4 JUSTIFICATION

The soil in this area, though well drained, is sandy, low in soil organic matter and is characterized by low water holding capacity. The only exception to this observation is the Fadama soil that is fine textured with a higher organic matter content and relatively higher water holding capacity. Further more, this zone is the most grazed as well as where increasing desertification incidents has caused changes in plant species, such as the invasion of the Katsina area by thorn bushes native to the Sahel. It is also the zone where farmers have encroached on the grazing reserves and climatically marginal areas, leading to increased incidence of pastoralists-farmers conflict and desertification. Moreover, in terms

of human activities, the dry land areas of Nigeria have been inhabited and cultivated for centuries. It is a zone where the period of fallow has been reduced to the barest minimum in many areas, or non-existent over a radius of 30km around some urban centers thus the pressure on the land is much more than it is in some other parts of the country.

1.5 AIM AND OBJECTIVES

The aim of this work is to study desertification Process and Environmental Management Challenge in the Sudan-Sahel.

Specific Objectives

- To identify the physical factors contributing to desertification.
- To assess the extent of desertification in Katsina State.
- To recommend possible ways of checking or ameliorating the problem.

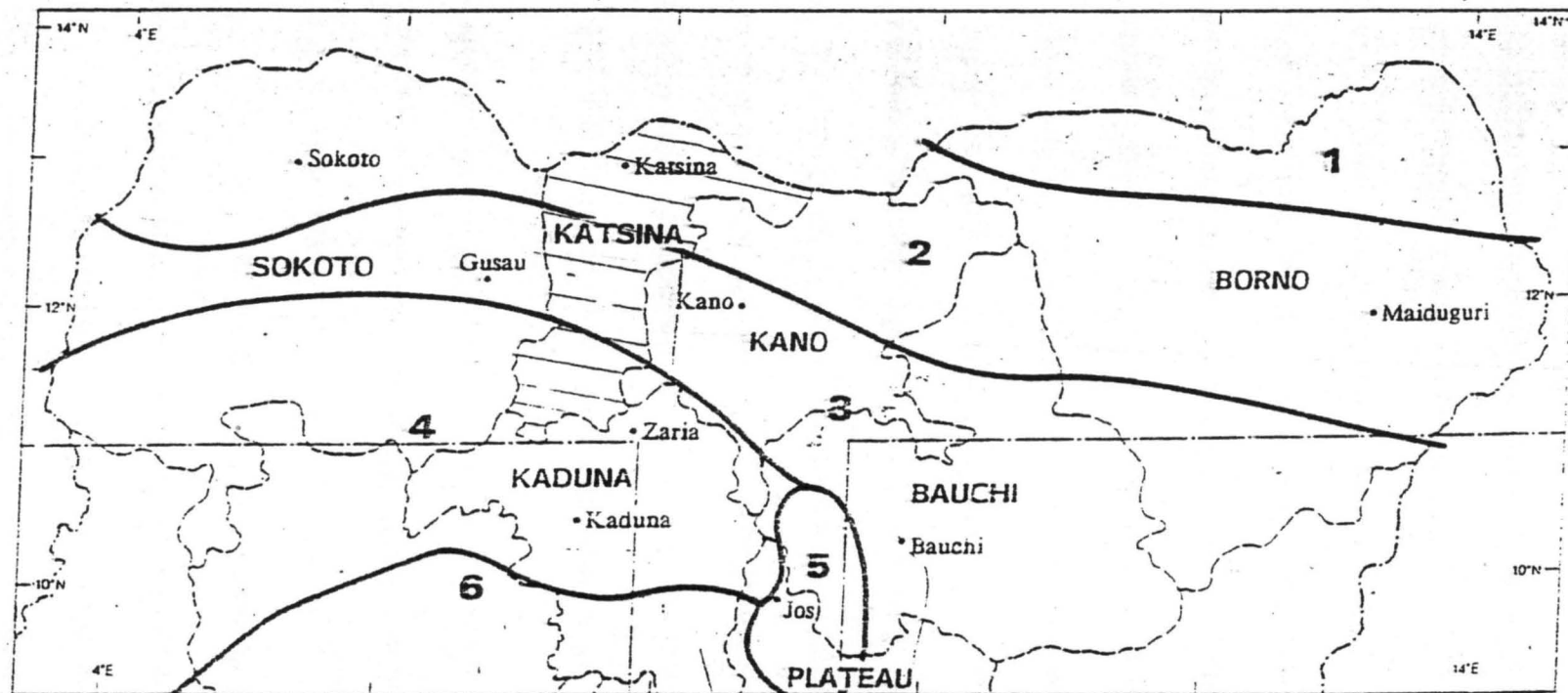
1.6 THE SCOPE AND LIMITATION


The study will cover Katsina state due to the obvious high rate of desertification observed in the area. The ways and manner of desertification will be studied and their subsequent impact on the environment. Concern will be shown on the causes and ways of checking it.

Fig. 1.1

Location of Study Area, States and Ecozones

Figure 1.1



- International boundary
- State boundary
- Ecozone boundary
- Boundary of air survey
-  Location of study area

BT HIG 28

Source : Silviconsult, 1991

F.C.T, Plateau, Taraba, Niger, Kwara and Kaduna States. These buffer states have about 10-15% of their land area threatened by desertification.

Desertification as an on going process in Northern Nigeria has been proven by field studies which began since 1978 and reported upon (Thambyahpillaly, 1982). Sand encroachment has been a continuing process both from without Nigeria's northern borders and from within. Seasonal blowing of sand encroaching upon farmlands is a common phenomenon to be observed over the entire region extending from Sokoto eastward and up to the shores of Lake Chad. A 10-year monitoring has revealed that some of the sands are derived from within Nigeria as a result of reactivation of the fossil dunes.

An investigation (Msheliza, 1986) has shown that even some tree species have become extinct. Further more, the same survey has drawn attention to the lowering of water table, which has made it necessary for wells to be periodically deepened. An approximate of 9km sand encroachment and sand-creep annually has been estimated.

According to some experts the current rate of desertification is about 3.5% and desertification is gradually advancing southward (latitude 11degrees north) at the rate of 8km per annum. During the reservation exercise of 1942-1959, the then Katsina province recorded 13% forest cover, but due to encroachment and other forest land abuses the percentage has dropped to a threatening figure of 6% (D.K.S.G, 1998).

About 680 million people live in 44 million km² of desert and semi-desert covering about 32% of worlds land area (Agarwal, 1979). The rate of desert encroachment has been put at roughly between 50,000-60,000km² per annum. There has been a

speculation that as much as lands has been lost to man's use as the total area now under cultivation (1390 million ha) (Walls, 1977). Algeria, Egypt, Libya, Morocco and Tunisia together loss a total of about 100,000ha of productive land to advancing deserts annually (Agarwal, 1979). More than half of the land surface of Kenya with an annual rainfall of less than 600mm is classified as semi-arid (Griffiths and Collins, 1983).

However, it is becoming increasingly and clear that human mismanagement and excessive exploitation of the endangered areas are the main factors responsible for the spreading degradation (Le Houeron, 1977, Ojo, 1978). The recurrent droughts of the last few decades have resulted in loss of rangeland productivity leading to widespread desertification (United Nations, 1977).

Ironically, in most lands threatened by desertification, the population doubles in 20-23 years, corresponding to an annual growth of 3.00-3.50%. The current rate of population increase in Nigeria has been put at 3.5% per annum while the state capitals are estimated to be growing at the rate of 6.0% per annum (Falodun, 1985). Furthermore, in all the regions so far studied, where both farmers and nomads live, the farming populations have always increased faster (Swift, 1977). To compound this problem of desertification, pasture in most places is not only more intensively used for herds of nomads (Mortimore, 1978) and for settlers, but still more intensively used to gain fuel, particularly by the faster increasing settled groups (Satchell, 1978; Walls, 1977; Akintola, 1978).

Clearly, man has radically altered the earth's surface with accelerated impact in recent times. There is a need to understand the natural systems and the interaction between various earth's surface processes and the impact of human activities and actions and to manage resources in sympathy with the natural environment.

Animal husbandry can also have a major impact on the landscape (Revvien, 1990). He further explained that heavy grazing of cattle leads to trampling and compaction of soil, reducing its capacity to hold water and altering its structure. Degradation has especially been regarded as ensuing from situation where herd sizes are allowed to increase in an almost uncontrolled and irresponsible manner. Rising livestock numbers in dry land grazing system have particularly been seen to lead to desertification (Umoh, 1999).

Ibrahim (1978), illustrating the processes of desertification shows that the main cause of desertification is man himself through the destruction of the natural resources. According to this work, the process of desertification is set up by the human impact, through the land use methods, which are incompatible with the physical geographical pre-conditions (irrational cultivation, excessive felling of trees, and over grazing) and which constitute a misuse of the agro-ecosystem.

A simplified formulation represent a summary definition of desertification is in the form

DROUGHT + MAN = DESERTIFICATION

By drought is meant the non-availability of adequate amount of water for man, Animals and plant (growth, development and yield or maturity) as and when needed.

Man, the other variable on the left hand side represents all activities of man that bring pressure to bear on vegetal cover (leading to decimation), land resources which result in degradation due to over-exploitation or poor management etc. These combine in a variety of ways to alter the cycle of climatic variability to the extent that some changes in total geo-environmental resources now appear irreversible.

Thus, desertification cannot (and should not) be studied from the context of just one of the variables on the left hand side of the above equation. They are inter-related by way of some important interactive processes that arise from the sub-components of each variable. These are illustrated in the organogram shown in figure 1.

With man, there are basic activities that he must continue to carry out for mere existence if nothing else. Land must be tilled for food production in terms of crops and animal protein. About 60% of the world population lives in rural areas and coincidentally (but very unfortunate) in the fringes of desert in arid environments with most of them dependent on vegetative production as their sole energy source, especially in Africa (Adefolalu, 1981). As the population of the world continues to grow with no corresponding increase in available land for development, a third major component of desertification will be land ethics. The dichotomy of urban/rural differentials is known to be the main cause of the urban 'heat island' in relation to climatic state. In addition, the use of land areas for development (communication, highway etc) is gradually reducing the rural environment to an alarming degree.

All of these are directly linked to increase albedo values either on local, regional or global scales. The consequence of increased albedo is a direct reduction in the

effective heating power of the sun, which as shown in figure 1 is the major second arm of the interactive processes in the desertification chain of actions. If any study of desertification is to have any credibility, the data input must be such that can adequately capture the role of each of the above sub-components of the two major variables of desertification: Drought and Man.

Grainger, (1990), stated that "the benefits of economic development are not shared equally among the inhabitants of a country. It is often the poorer people forced to live on the worse lands who are the most directly involved in causing desertification, the most seriously affected by it, and the least able to prevent it from happening".

While lack of rain is generally and correctly referred to as drought, under certain conditions drought effects may be due to encroaching deserts. Warren (1980) expatiated that "the problem with desert is at their edges where rain, though scanty, can sometimes support pastures, wells and here and there, some agriculture"

When such highly fragile lands are over-exploited for any or all of the above purposes, the danger of expanding desert condition is imminent and drought can only aggravate the situation but may not be its cause. It is known that the Sahara desert of Africa has taken over in marginal areas where the soil has been over worked. This problem had earlier been speculated upon (Bovill, 1921) in a study titled 'the encroachment of Sahara in the Sudan'. There are also serious debates on the green house effects of CO₂ re-distribution in the atmosphere, (USEPA, 1986). All these have been tagged 'drought-related desertification.

If the process of desertification continues with time, the threat of desert conditions spreading further into arable lands is imminent and this is already affecting the programmes of food production by African countries. As rightly put out by Ajayi (1985), farming systems in the tropics are extremely diverse and complex in an environment where highly weathered soils of tropical Africa are characterized by low nutrient and water-holding capacities-factors which limit the growth and yield of crops.

CHAPTER THREE

METHODOLOGY

Procedures

In an effort to achieve the desired objectives and due to the nature and frame work of the research work coupled with the time constraints of the study, the following methods were adopted. Personal interview was carried out as an appropriate and veritable tool for getting first hand information from farmers, individuals and other stakeholders. In addition to this, group discussions, field visits and photographs were obtained to broaden the volume of cogent information to be collected. The use of materials from relevant text books, journals and research papers stands out as an imperative tool. The above mentioned techniques or methods gave ample opportunity for adequate information.

Personal Interview

Farmers, individuals and stakeholders were personally interviewed on issues related to the research work. The Interview involves extraction of information form the various groups of people. Verbal interaction was explored and also a great deal of skill was adopted in communication. Government owned and individuals with large hectares of land were interviewed. Probing questions were asked to give more details about the theme of the research work. A lot of information was extracted for the research work using the interview method. Direct and more elaborate exploration on desertification and it's causes were obtained. Pertinent and probing questions where asked thereby revealing some basic information about the research.

Group discussions

Discussions with officials of the various agricultural development projects in Katsina State were under taken. Group discussions were held at the ministry of agriculture, Katsina State afforestation projects unit (KTAPU), Katsina State agriculture and rural development agency (KTARDA), Katsina State environmental protection agency (SEPA), where first hand information relating to desertification were gathered. Direct and more elaborate information was obtained. Also causes, impact and control measures were detected. Probing questions were discussed and hopeful solutions were arrived at.

Reconnaissance/ field visits

A reconnaissance survey was carried out in some local government areas of both the northern and southern parts of the state. The surrounding environment and seriously desertified places were visited. Sand dune areas around the border to Niger which are Jibia, Maiaduwa and Babban mutum were surveyed. Also, survey of the mid-southern and southern areas such as Kankara and Funtua respectively were under taken. The survey involves watching and evaluating the extent of desertification in these areas.

Use of hand camera

In the cause of the field trip, photographs were taken of some sites to further amplify the magnitude of desertification in Katsina State. Photographs were taken to show various government, NGO'S and individual efforts in controlling desertification. Pictures were taken to serve as signs and proves confirming the role of desertification

Other sources

Materials and data of relevant empirical works from books, journals and research papers were consulted in order to have justifiable results. Desertification is a global issue therefore a lot of research work have been documented on it. Research reports and journals that dwell extensively on desertification were used.

mostly in the Northern part of the State in its determination to reverse the negative trend prevailing in the arid zone. Similarly, industrial plantation projects were undertaken at the southern parts such as Malumfashi, Funtua, Faskari, which also covered 1080 hectares to increase forest cover and revenue base of the State. These are shown in Plate 4.1a and 4.1b Plate.

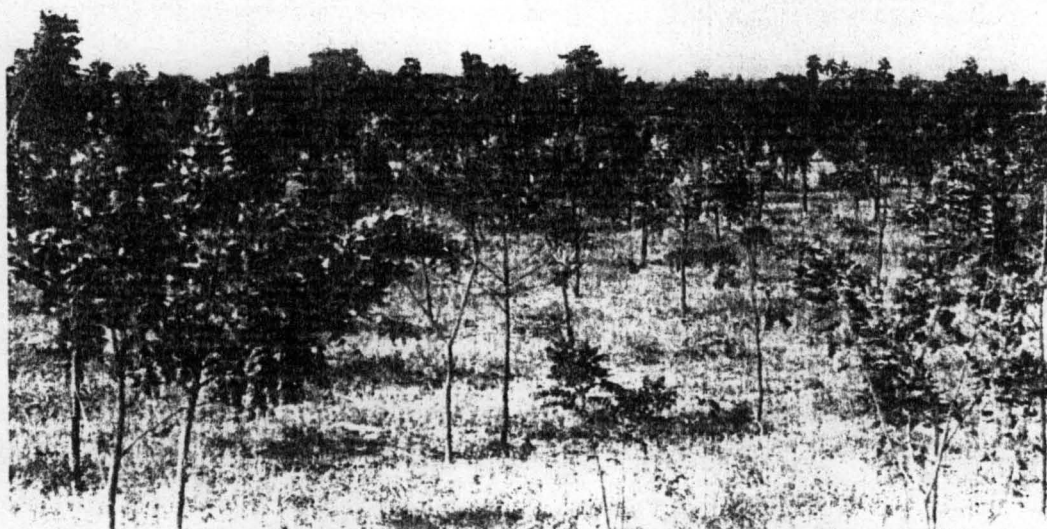


Plate 4.1a Shelterbelt Plantation for Control of Desertification



Plate 4.1b Windbreak Plantation for Desertification Control
SOURCE: Field Survey

- In an effort to encourage people's participation in tree planting activities various administration have been conducting annual tree planting campaigns in order to indicate the need for collective contribution in fighting desertification. See plate 4.2a. Also there has been manpower development where enlighten through education and training were conducted all in the hope of combating desertification processes. This is shown in plate 4.2b.



Plate 4.2a Community Participation in Tree Seedling Production & Planting

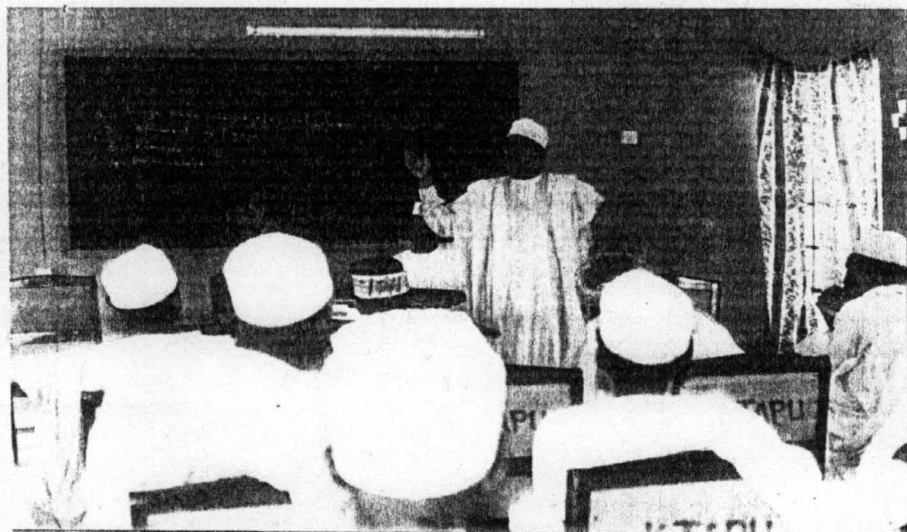


Plate 4.2b Manpower Development (Training Session)
SOURCE: Field Survey

- Women participation is also very important because of their high population rate in the State. Planting trees in and around their homes and the use of coal and kerosene stoves has reduced deforestation greatly. Also schoolgirls have been participating in forestry and conservation clubs. See plate 4.3a and 4.3b



Plate 4.3a **Women Participation in Tree Planting and Maintenance (Home Gardening)**



Plate 4.3b **School Girls Participation in Forestry and Conservation Clubs**
SOURCE: Field Survey

4.2 STATE ZONATION

Lat 12°N of the State fall within the arid zone and has an annual precipitation total of 200-400 mm it has a sparse and scanty vegetation of perennials and annuals. This is the zone of pastoral nomadism and irrigated farming. Its aridity index range from 0.03 to 0.50. The zone falls within the desertified area of the state. See plate 4.2a. The southern part of the state (sub-humid) has a yearly precipitation of about 400-800mm and encompasses better vegetation than the Northern parts. The aridity index is about 0.50-0.75. See plate 4.2b



Plate 4.4a **Desertified and Degraded Farmlands in Northern Part of the State**

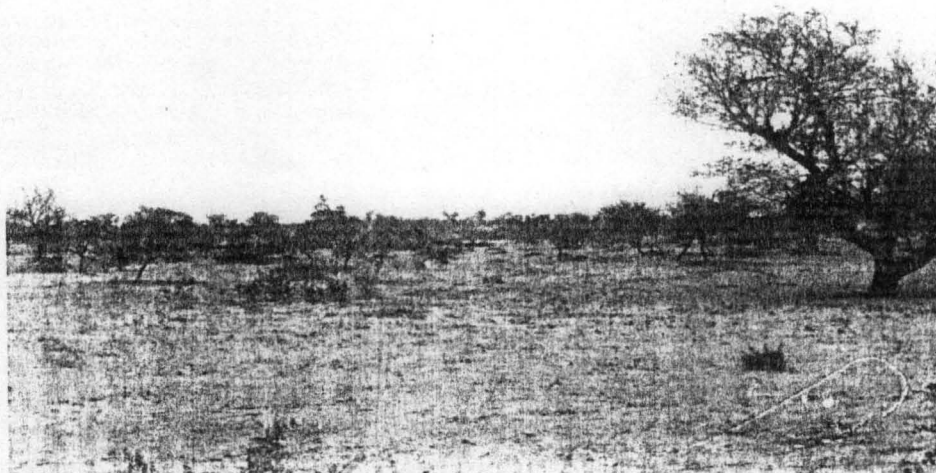


Plate 4.4b **Desertified and Degraded lands in the Southern Part of the State**
SOURCE: Field Survey

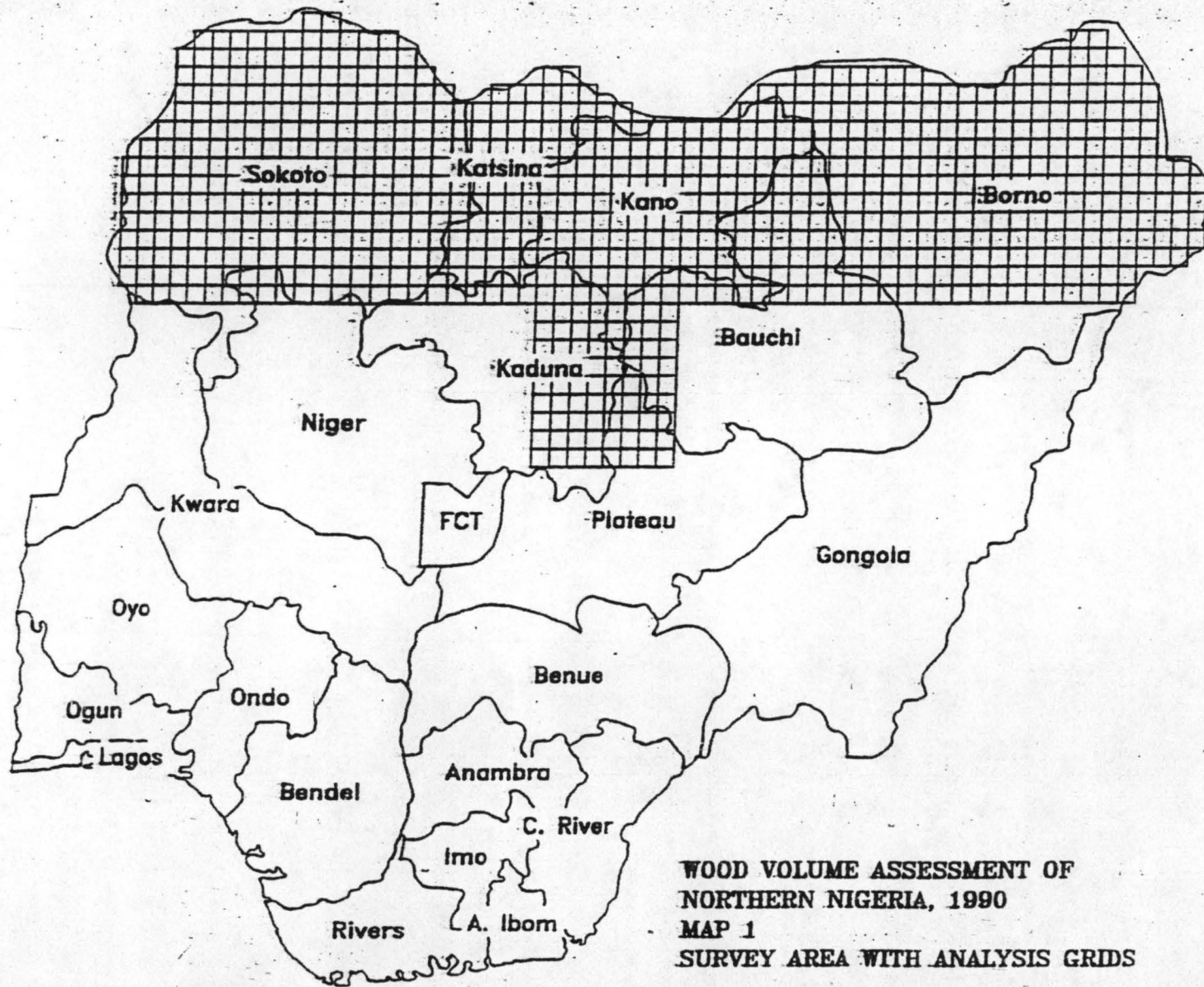
4.3 LAND SATELLITE IMAGERY

The measured area of land use stratum-cultivation, shrubs/grass, tree canopy for Katsina State can be seen from land sat imagery maps (1-3). The stratum includes that of the neighboring States for comparison and note the extent of land degradation and desertification.

This figure 4.1 is showing the part of the country and the names of the States covered in the survey where Katsina State is amongst.

In figure 4.2, over-cultivation, which is one of the main causes of desertification is shown clearly. Over 90% of the total land cover of Katsina State is being cultivated. The two most important driving forces in the State are limited agricultural land and high population, which is increasing rapidly. This results into large family with a small farm, low production per person and increasing landlessness. A consequence of large farm shortage is rural poverty. Land farm and poverty taken together lead to non-sustainable land management practices, the direct cause of degradation. Small-Scale farmers are led to clear (forest) vegetation on shallow soils, cultivate steep slopes without proper soil management procedures which leads to a very low percentage of shrub/grassland in Figure 4.3 increasing population also leads to more animals rearing which eventually causes over-grazing, due to small grazing land, but large number of animals.

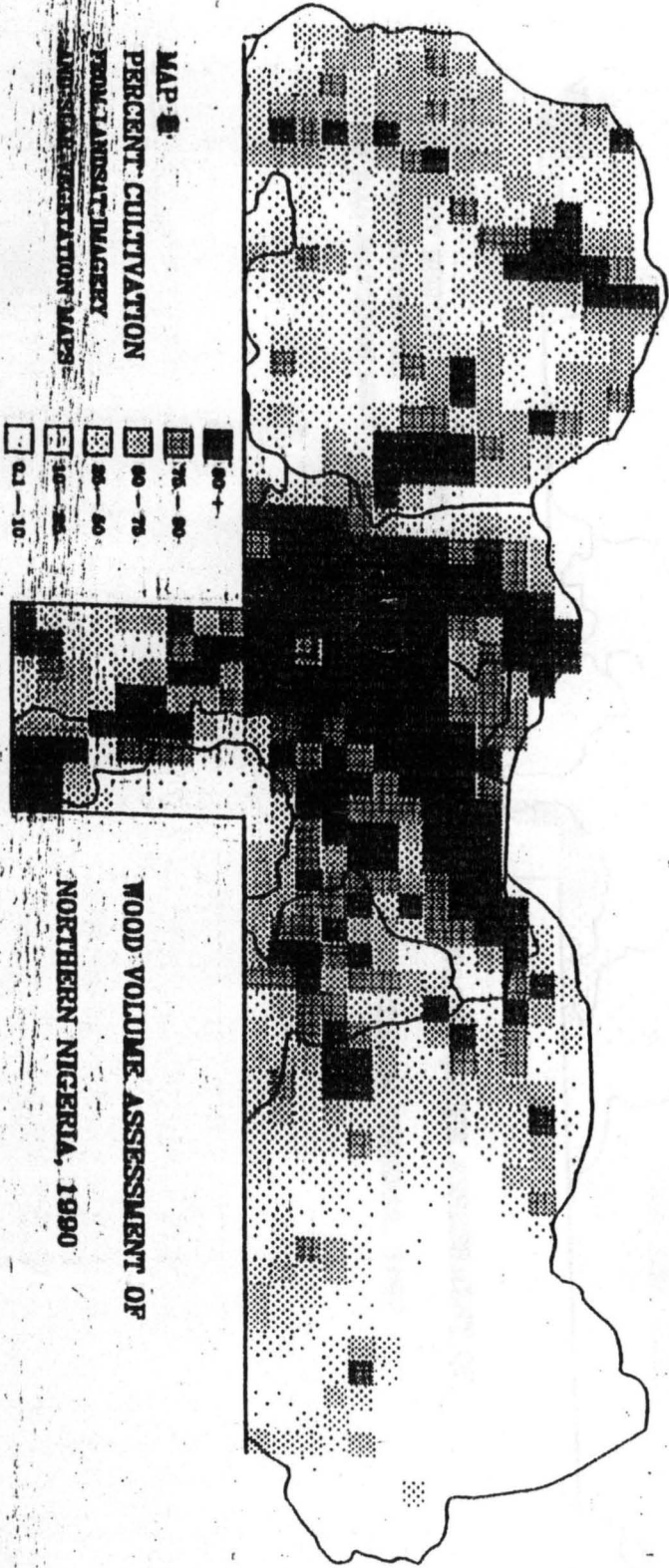
Fig 4.1



**WOOD VOLUME ASSESSMENT OF
NORTHERN NIGERIA, 1990
MAP 1
SURVEY AREA WITH ANALYSIS GRIDS**

Source: Silviconsult, 1991

Fig. 4.2



4.4 CAUSES, CONSEQUENCES AND CONTROL OF DESERTIFICATION IN KATSINA STATE

CAUSES OF DESERTIFICATION

There is by now universal acceptance of the factors identified as principal causes of desertification in Nigeria particularly in Northern States where Katsina State is located. These include natural causes and human activities.

Natural Causes

The natural causes of desertification include the poor physical conditions of soils, vegetation, topography as well as the inherent extreme climatic variability, as evidence in periodic droughts. Climate variation is perhaps the most important natural cause of desertification. Drought and rainfall are regarded as, probably, the most significant climatic factors in desertification

Human Activities

The effect of human activities in bringing about degradation of the environment is also well recognized. Man's influence on natural vegetation is probably the most important element in the degradation processes. The anthropogenic factor is mainly the disruption of the ecological system, caused by poor land use and ever increasing pressure put upon the available resources by the expanding population. More specifically, there are five primary causes in Katsina State, notable wood extraction, bush-burning, over-grazing, deforestation, over-exploitation and poor irrigation processes. Other factors that accelerate desertification process are over-cultivation, poverty, etc.

Wood extraction for fuel and construction

Without alternative sources of energy in Katsina State, the demand for fuel wood has been on steady increase by the increasing population and rapid urbanization. As the demand for wood for construction, fuel and other uses, the removal of trees, shrubs, herbaceous plants and grass cover from the fragile land of Katsina State will continue to accelerate the degradation of the soil to desert-like conditions.

Bush-burning

Bush-burning is an agent in the process of deforestation. Owing to the low relative humidity coupled with very dry harmattan wind, there is always a high incidence of bush fires every dry season. The occurrence of fire within the zone can be attributed to bush burning by villagers during land clearing for agriculture, hunters who in search of game, set fire onto the vegetation and cattle herdsman who set fire to dry grass to stimulate growth of dominant grass buds.

Over-grazing

Katsina is bestowed with a large number of livestock consisting of 1 million cattle, 2.5 million sheep/goats and 600,000 horses and donkeys which at present are above the carrying capacity of the range lands. Nomadic herdsman graze their livestock throughout the area and are constantly in search of suitable pastures. Additional pressure is also put on pasture resources by livestock from neighbouring countries, notably Niger. Over-grazing is one type of land degradation arising from the inability of the land to sustain a number of animal per given area.

consequence of desertification-induced migration is separation of families as men usually abandon the women and children to seek for employment in the urban centres.

Land and Water Resources

In addition to the socio-economic impact, desertification has a serious consequence on available water resources. Long-term drought could adversely affect the level of upper ground water and stream flows, as well as the underground water.

Resource Use Conflicts

Desertification encourages economic and social strife. This is often accentuated by lack of proper natural resource planning and management as well as rapid population increase in Katsina State, and the diminishing environmental resources base.

Destruction of Habitat and Loss of Biodiversity

The flora and fauna of Katsina State have been badly depleted as a result of climatic variation and human mismanagement and or over-exploitation of the environment. Most of the indigenous plant species that were identified in the 1960's are now hard to come by, especially those with medicinal value and edible qualities such as *Khaya senegalensis* and *Mitrogina spp*. Also a drastic reduction in livestock population.

Long-term social and economic disorganization on affected communities including forced migration.

DESERTIFICATION CONTROL MEASURES

- State policy
- Institutional and legislative frame work

- Management of water resources
- Land-use policy
- Alternative source of energy.
- Prevention of bush burning and indiscriminate felling of trees.
- Silvo-pastoral system.
- Sand dunes fixation.
- Training and man power development.
- Public awareness.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

Desertification, which is one of the major problems of land degradation in Katsina State is aggravated by increasing human attempts to exploit the resources of the ecological zone in the face of persistent drought. The frequency of drought at regular intervals in the sub-region and the man-made activities wholly contributed to the desertification effects in Katsina State. However, some observable indication of desertification observable indication of desertification features are disappearance of natural vegetation, desiccation of the soil profile, dune formation/reactivation, lowering of ground water table, prevalence of harmattan winds, extreme weather condition, total disappearance of wild fauna, diminishing biological productivity, gradual decline of farm crops yield an so much more.

In the course of this research work, the following findings were made.

- There is a general depletion of vegetation cover, which has a devastating effect.
- It was also found that the State resource base has been seriously reduced as a result of encroachment in forest estates and grazing lands.
- There is a general laxity towards forest and grazing laws by members of the public.

5.2 CONCLUSION

It is highly imperative and pertinent to note that after thorough examination of the causes and consequences of desertification in the State it is established beyond reasonable doubt that a wide range of factors such as increase in human population, deforestation, overgrazing, soil erosion, drought and socio-economic activities

1. A general up ward review and enforcement of forest and grazing laws is necessary
2. All pastures/grazing reserves should be rehabilitated to reach the required carrying capacity.
3. Implementation of proper water management plan
4. Use of alternative energy sources such as solar energy, wind energy, coal, kerosene, natural gas and electricity.
5. The need for intensive adult literacy campaign
6. Support and continuity of the afforestation project, which should include in their mandate raising and distribution of endangered indigenous tree species and sand dune fixation.
7. Conservation, protection and regeneration of vegetation.
8. Employment of additional staff to cater for protection of forest/grazing reserves and soil conservation activities.

REFERENCES

- Agarwal, A. (1979):** Why the World's Deserts are still Spreading. Nature 277
pp 167-177.
- Ajayi, O. (1985):** Improving Farming Systems in Africa. Daily Times of Nigeria
August, 30 1985 pp.5
- Akintola, F. (1978):** Mineral and Energy Resources in A Geography of
Nigerian Development. Pp 57-70
- Bovill, E. W. (1921):** The Encroachment of the Sahara on the Sudan. J. Roy African
Soc., 20, 259-69
- Document of Katsina State Government (1998):**
Report of Investigation Committee on Land Degradation with particular
reference to Desertification in Katsina State February, 1998
- Falodun, F. J. (1985):** Address by the President of Population Association
of Nigeria to the Annual Conference of the Association holding at the
University of Nigeria, Nsukka, 27-30 Nov, 1985
- Grainger, A. (1990):** The Threatening Desert Controlling Desertification, IDED,
London.
- Griffiths, G. H. and Collins, W. G. (1983):** Mapping the greenness of semi arid
range land vegetation in Northern Kenya from land set digital data 21-23 Sept
1983
- Ibrahim, F. (1978):** Desertification in Der Sahel Zone Der Republik Sudan Africa
spectrum, 2.

- Le Houerou, H. N. (1979):** The nature and causes of desertification. Desertification, Environment degradation in around arid Lands, pp 17-38
- Mortimore, M. (1978):** Livestock Production in Geography of Nigeria Development. pp 240-260.
- Mortimore, M. J. (1989):** Adapting to Drought Famines, Farmers and Desertification in West African. Cambridge University Press
- Msheliza, D. S. (1986):** Desertification in Borno State. MSc Dissertation (University of Maiduguri, Nigeria 1986) unpublished.
- N. A. P. (2000):** National Action Programme to Combat Desertification and Mitigate the Effects of Drought, December, 2000.
- Ojo, O. (1978):** Climate Variations and Desertification in West Africa University of Ibadan.
- Revvien, E.F (1990):** Desertification and it's Implication. In journal of Issues in a Development Heinemann. Pp. 156-174
- Satchell, J.E (1978):** Ecology and Environment in the United Arab Emirate. Journals of Amis Environments vol. 1 (36).pp 201-206
- Silviconsult, (1991):** Federal Forestry Management Evaluation and Coordinating Unit. August 1991
- Stebbing, E. P. (1935):** The Encroaching Sahara: the Threat to West African Colonies. The Geographical Journal
- Swift, J. (1977):** Sahelian Pastoralists: Underdevelopment, Desertification and Famine. Annual Review of Anthropology: 6pp 457- 478

- Thambyahpillay, G.G. R. (1982):** Desertification in Northern Nigeria. Proc. Assoc. Geoscientists int. Dere: Kaduna, Nigerian 6-19 1982.
- Umoh, U. T. (1999):** Handout on Environmental Problems, Effects and Control
- USEP, A. (1986):** Greenhouse Effect, Sea Level Rise and Salinity in the Delaware Estuary. USEPA Pub. No. 230, 05-96-010 pp 88
- Walls, J. (1986):** Man's Desert. The Mis-managed Earth: Mazinzira 2 pp 16-25
- Warren, (1980):** Doubtful Dogma about the Deserts. London times. June, 5 1980.pp 25.