DESERT ENCROACHMENT AND SETTLEMENT FORM IN BORNO STATE

M.Sc(U.R.P.) Thesis
by
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Being a thesis submitted to the postgraduate School, Ahmadu Bello University, Zaria, Nigeria, in partial fulfilment of the Requirement of the degree of Master of Science, Urban and Regional Planning.

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D E C L A R A T I O N

I hereby declare that this thesis has been composed by myself and that it is the outcome of my research work. It has not been accepted in any previous application for a higher degree. All sources of information are specifically acknowledged by means of reference.

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.....
Date

C E R T I F I C A T I O N

This thesis entitled "DESERT ENCROACHMENT AND SETTLEMENT FORM IN BORNO STATE by YANKURAMA, BATA meets the regulations governing the award of the degree of Master of Science of Ahmadu Bello University and is approved for its contribution to knowledge and literary presentation.

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Chairman, Supervisory Committee Date: 28th May 1989

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Dean, Postgraduate School Date: 26-9-89

D E D I C A T I O N

Hassana, Wife

Fati, Daughter

who missed my love and care

during this course of study.

--- Yankurama, B.

A C K N O W L E D G E M E N T

Work of this nature has to receive the moral and financial support of many whose names cannot all be mentioned here.

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To All I Say GOD BLESS YOU!!!

—— Yankurama, Bata

A B S T R A C T

IMPACT OF DESERT-ENCROACHMENT ON SETTLEMENT FORM IN BORNO STATE

The alarm now being raised by governments and peopie will with regards to the threat of drought, dessication and desert-encroachment on the settlement form in Nigeria and especially Borno State is undoubtedly genuine. Desert-encroachment results largely from climatological, ecological and anthropogenic vagaries. This study look at the impact of desert-encroachment on the settlement form in Borno State with particular reference to a delineated area. The physical and socio-economic characteristics of the inhabitants are also studies.

It was discovered that the structure of the buildings and the general form of the settlements shows some adaptation to desert conditions. The study also discovered functional relationship exists between the settlements of various hierarchies. The impact of the desert encroachment is noticeable on the physical environment and the socio-economic activities of

the inhabitants in the delineated area. Such is manifested in the migratory movement of the people and livestock to areas that are yet under this environment vagaries; i.e., Southern part of Borno State.

Principles for planning settlements in areas faced with the threat of encroachment of the desert that boarder on the siting and design of settlements to adapt to conditions while ensuring that the functional base of settlements is maintained are developed. Also strategies and policies for containment and planning of settlement are drawn up. These policy proposals are broad based. Conceptual planning models for the planning of settlements in the area under the threat of desert-encroachment are proposed.

— Yankurama, B.

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CHAPTER - ONE

1.00 INTRODUCTION

1.10 STATEMENT OF RESEARCH PROBLEM

The Northern part of Borno State forms the boarder line between the ancient Sahara Desert and this part of the country, Nigeria. This transitional zone between the Sahara Desert and the Sudan Savannah is referred to as the 'Sahel' Zone.

Scholars and Scientists are increasingly linking drought with deser-encroachment. It is believed further that poor cultivation practices, deforestation, overgrazing, bush burning and over use of marginal lands 'Sahel' are major contributors to the phenomena of desertification. After the 1968 - 1973 drought which struck the Sahel zone, the problem of desertification became more endemic. This is a process which reduces the lands productive capacity and leads ultimately to the creation of desert-like condition.

The growing awareness of the problem of desertification led to the covening of the 1977 U.N. Conference on Desertification (UNCOD) which formulated a World Plan of Action. Its goal was to halt

desertification by the year 2000. The United Nations Environmental Programmes (UNED) has just completed a two year assessment of the status and trends of desertification which shows that the global threat posed by desertification to 100 U.N. member states, far from diminishing has actually increased in severity. As a result the goal set by UNCOD is no longer considered feasible.

According to the UNRO-NEWS (1984, P. 16) currently about 35 Per cent of the world's land surface is at risk and the livelihood of 850 million people who inhabit these areas are directly threatened. Nearly three quarter of the 45 million square kilometres that make up the worlds dry lands and sub-humid tropics is already affected between half and a quarter severely so. UNEP's assessment reveals that land reduced to zero or negative net productivity is showing on an increase at 21 million hectares annually. Projections to the year 2000 include that a loss on this scale will continue if nations fail to set up remedial action. Surely on 'haemorrhage' of productive land at such a rate must lead to cataclysm - one that is already occuring in the poorer developing nations and another that will inevitably spread to the industrialised

nations, some of which - notably Australia, U.S.A. and U.S.S.R. - are experiencing severe desertification problem of their own. If these nations with all their vast resources and know-how are in difficulties, how much greater are those of their under-priviledged naighbours like Nigeria.

The UNED estimated an investment of $4.5 billion needed for each of the next 20 years to halt the advancement of the deserts of the world. However, since the past six years only N26.0 million, about 25 Per cent has been collected. The main constraint appears to be the low priority given by both recipient and donor countries to anti-desertification in the overall process of development.

The UNED then recommend an alternative plan of action expecting each affected member Nation to fight desert-encroachment on her own. In December, 1977, Nigeria established a Committee on Arid Zone Afforestation comprising of (Forestors, Economists, Agriculturalists and Administrators) at the Federal level with sub-Committees in the then Seven Northern States which are prone to desert-encroachment. These States were Bauchi, Borno, Kaduna, Kano, Gongola, Plateau and Sokoto States.

This thesis therefore, attempts to examine the phenomena of desert-encroachment in Borno State emphasising on its impact on the human settlement form. It also critically identifies and studies the resulting organisational structure, adaptability and changes within the settlement form in this environment.

1.20 JUSTIFICATION FOR RESEARCH

The threatened encroachment of the Sahara desert in the _____ region in Northern Borno is evident. Rainfall and temperature over the years compounded by frequent drought mirrors the phenomena of desert-encroachment. Vegetation is becoming more peremial. Erg and Sand dunes are becoming more rampant in the Northern part of the State especially within the transitional zone demarcated as the Sahel Zone. Migratory movements of people and livestock towards the Southern part of the State where pasture and farming opportunities abound is on the increase.

This study therefore, will help to augment the existing knowledge about the phenomena especially as it affects human settlements and activities. It will serve as a formative pivot in planning these

settlements by exposing the underlying casual forces for their development, their organisational and structural characteristics.

1.30 AIM AND OBJECTIVES OF RESEARCH

The aim of this research is therefore, to study the impact of desert-encroachment on the settlement form in Borno State with a view to making effective physical planning proposals.

The following objectives are set out to achieve this aim;

i. To examine the phenomena and process of desert-encroachment.

ii. To study the nature and process of desert-encroachment in Borno State.

iii. To identify and delineate areas affected by desert-encroachment in Borno State.

iv. To examine the physical characteristics of some settlements in the delineated area and the socio-economic characteristics of inhabitants of such areas.

v. To assess the impact of desert-encroachment on some selected settlements in the delineated area and identify associated problems of desert-encroachment.

vi. To review and evaluate the strategies to contain desert-encroachment.

vii. To make proposals for settlement planning and suggest implementation policies.

1.40 SCOPE AND LIMITATION

The scope of this thesis covers the process and causes of desert-encroachment. It limits itself to examining the impact of desert-encroachment on the settlement form in Northern Borno State. To establish what is and when encroachment sets in and proceeds to affect the physical and socio-economic viability of the inhabitants of the settlements. Attempt is also made to evaluate the strategies to contain desert-encroachment. The study provides some physical planning proposals for containing and planning settlements form in these affected areas.

1.50 RESEARCH METHODOLODY

Data for the study was collected through the following methods:

(a) Field Survey

Trips were taken to the study area where observations were made pertaining to the physical character of areas, extent of encroachment and socio-economic conditions within affected areas.

During the process of field survey, interviews were conducted both of a formal and informal nature. Formal interview was conducted randomly for the purpose of ascertaining the impact of the encroachment on the physical and socio-economic activities of the people. Informal discussions were held with community leaders and village heads in some villages chosen randomly for the purpose of getting more informations about the desert-encroachment and the changing settlement form in some few years back compared to the present form.

(b) Secondary Source

Government documents, published and unpublished materials were intensively used. These provide

useful information on the rainfall and temperature trends over the last 30 years at an interval of 10 years. Soil conditions and arability of the land were also got from the official source. Other secondary sources like journals, books enthressed the conceptual understanding of the subject.

(c) Data Analysis

Data for this study was mannually analysised and presented in the form of tables and diagrams. There was also the extensive use of maps.

1.60 CONCEPTUAL FRAMEWORK

Figure 1.1 shows the conceptual framework of the thesis from problem identification stage, to analysis and proposals.

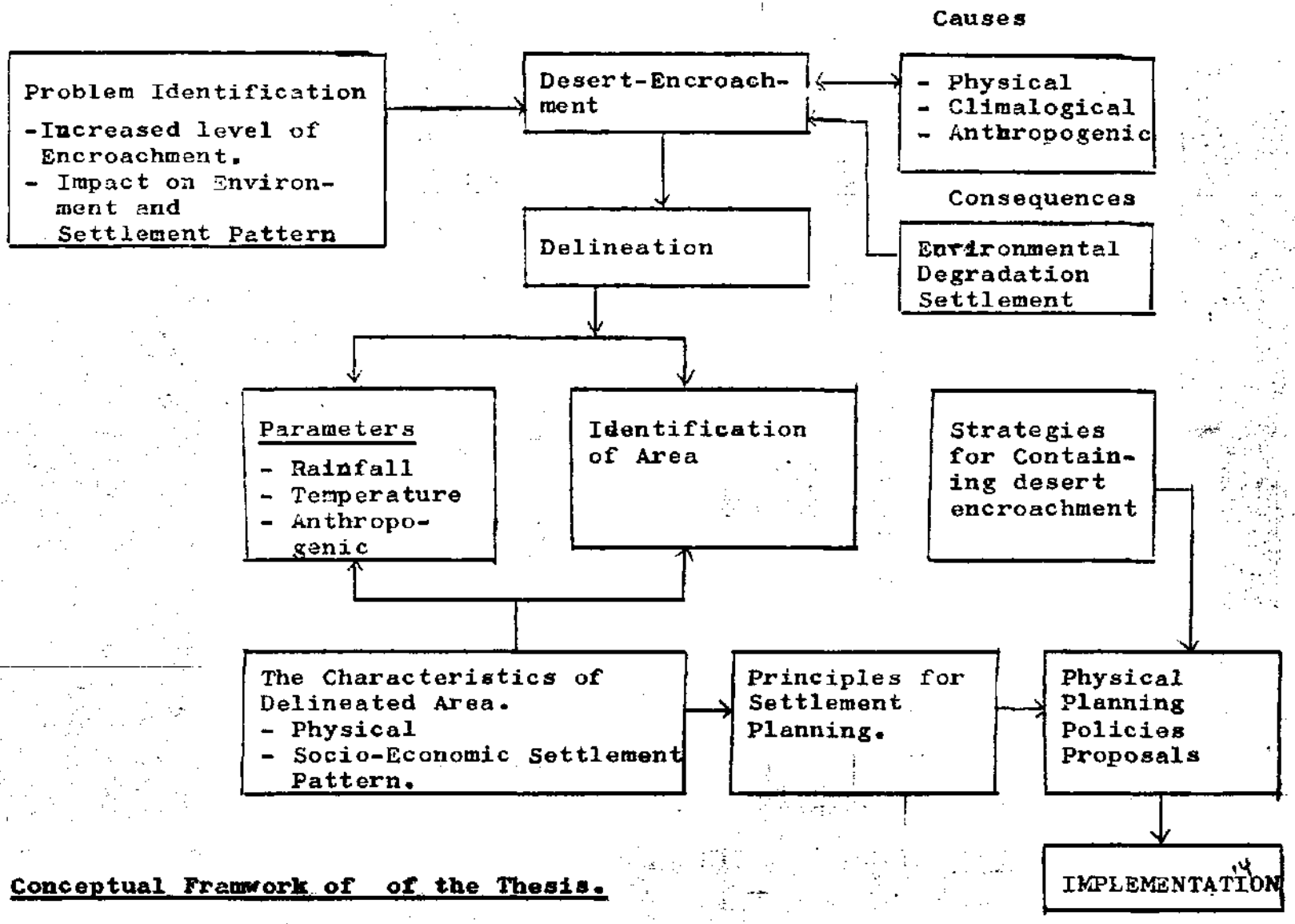


Fig. 1.1 **Conceptual Framwork of of the Thesis.**

CHAPTER - TWO

2.00 DESERT ENCROACHMENT: A LITERATURE REVIEW

2.10 CONCEPT OF DESERT AND DESERT ENCROACHMENT

Deserts seem to be an 'elusive' phenomenon associated with varying view points.

The Geologists see deserts as being both geophysical and edaphic in character. The climatologists understand a place to be desert in relation to synoptic weather patterns of wind, preciptation and temperature. The Ecologists might see the desert environment in terms of biotic communities and the intricate system that function to keep the delicate infrastructure of nature in balance, Miller,(1978).

The difficult task of understanding the concept of desert is further complicated by the fact that there are several kinds of deserts. Deserts are seen in a wide range of latitudes from the earth polar regions to the tropics. They consist a remarkable variety of land-forms, soil types, plants and animal life. For this study, it is the hot Sahara desert situated North of Borno State that is in context.

The issue however, is that what is the common denominator for all these kinds of desert regions of the world? Simply lack of 'MOISTURE'. There could be too little moisture subjected by evaporation due to extremely high temperature or locked up in ice by extreme cold. Thus, descriptively desert could be hot, cold, windy or dry.

The operational defination of desert for this purpose of the study is an area with scanty rainfall below 250 millimetres with accompanying high temperature ranges above 35^{o}C that cannot support the natural growth of plants and human settlement.

The concept of desert-encroachment is a new phenomena, implying the extension of desert like conditions beyond its original limits into its marginal lands. In West Africa and indeed Borno State, this marginal land is largely represented by the 'SAHEL'. The causes of desert-encroachment on the marginal land can be either due to climatic or anthropogenic consequences. When there is anthropogenic causes the process is called DESERTIFICATION. This terminology of Desertification means; the bring about desert condition in an area that was not earlier a desert environment, Thambyaphillay,(1982) P.13.

2.11 DESERTIZATION

This is the evolution of desertic environment by natural process notably climatically induced.

However, the Food and Agricultural Organisation and the United Nations Environmental Development (FAO/UNED) see desertization as a process involving all forms of degradation (natural or man-induced process disturbing the equilibrium of soil, vegetation, air and water) of land vulnerable to severe edaphic or climatic aridity leading to the reduction of or destruction of biological potentials of the land, deterioration of the living standard are intensification of 'desert' like conditions. The climatic aridity here refers to a situation of drought. The phenomena of drought on the other hand signals a period in which moisture availability falls below the current requirement of some or all the living communities in an area and below their ability to sustain the deficit without damage, disruption or excessive costs, Apeldroom (1981) P.9.

2.20 LOCATION OF DESERTS DISTRIBUTION IN THE WORLD

According to the UNED,(1977) there are five main desert belts on the earth which are expanding into their marginal lands. These deserts include:

(a) A vast belt of deserts running from the Atlantic Ocean to China and including the Sahara, the Arabian desert, the deserts of Iran and the USSR, the Rajasthan desert of Pakistan and India, and the Takla-makan and Gobi deserts in China and Mongolia.

(b) The Kalahari desert and its surrounding arid lands in Southern arid lands in Southern Africa.

(c) The Atacama desert, a thin Coastal desert strip running West of the Andes from the Southern Ecuador to Central Chile, where dry climates extend East-wards.

(d) Sonoran desert of the North Western Mexicco and its continuation into the desert basin of the Southern Western United States.

(e) Most of the continent of Australia is desert, (Figure 2.10).

The phenomena of desert-encroachment or desertification occurs in areas with subsiding air masses, causing high pressure areas. This accounts for a prevalence of dry climates between latitudes 15 and 30 degrees North and South of the Equator. However, the

DESERT OF THE WORLD

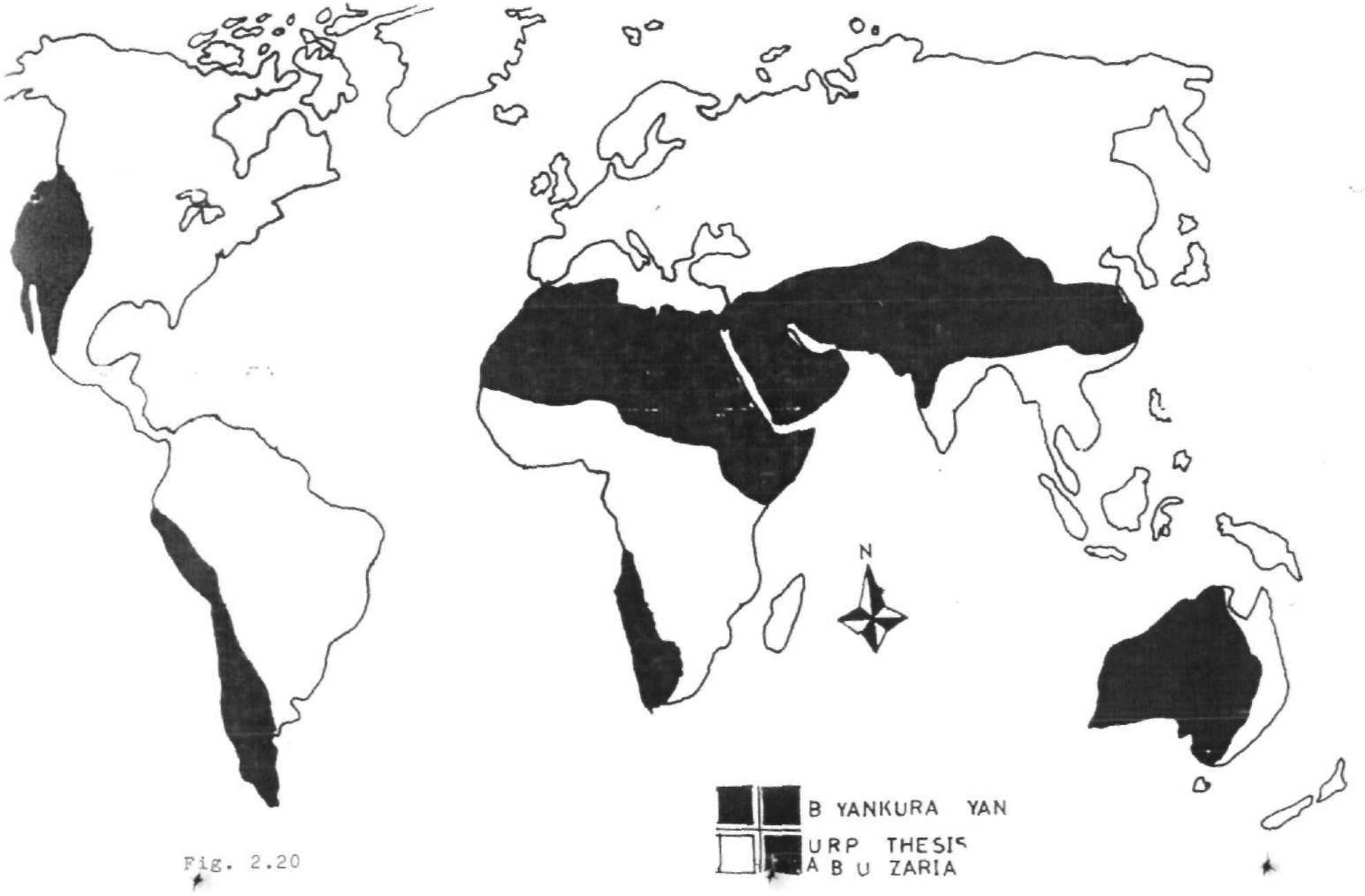


Fig. 2.20

dry climates are extended into other latitudes and their pattern further complicated by additional factors such as distance from the rain-supplying oceans, the seasonal high pressure zones of large continental areas linked with monsoonal systems. The other factor could be due to the presence of mountain barriers down which area spills on their lee sides creating rain shadows.

In Nigeria and indeed Borno State, it is in this part of the country where global patterns of atmospheric circulation that dictate when and where rain will be due to the great sub-tropical regions of descending air masses.

The locational characteristic of the Sahara desert explains in part the movement and carrying capacity of the distance of the monsoonal wind which is the rain bearing wind can reach a particular distance. The distribution of rainfall in Nigeria therefore, follows this pattern of monsoonal winds which varies in extent and intensity. Thus, in Borno State the 'SAHEL' area is defined by a monsoonal rainfall regimes. It is an area with a short rainy season lasting from June to October with rainfall ranging from 200 - 250 millimetres and a long dry season from October to May. Temperature is generally high ranging from 35 C - 40 C annually.

The vegetative cover consists of mainly of annual plants with short height and of sparse density.

The desert proper on the other receives less than 200 millimetre rainfall a year supplied by the rare and unpredictable rainstorms which occur with a frequency of less than once a year and may strike any part of the entire deserts area. The landscape are generally devoid of life.

Since the Sahara desert forms the boarder line of the Sahel, desert-encroachment is therefore, possible but its occurance must be regarded as a step by step process, Petrov,(1976) P.63. According to Ikime,(1984) P.12 "this Sahel region of Borno State in the past years, has undergone many climatic changes which are reflected in the history of Lake Chad and its environs. The present Lake Chad only represents the diminished minute remains of a former lake of great extent and depth which scholars formerly described as a mega lake" Ikeme (1984) P.13; emphasised that it was the increasing dessication of the Sahara desert after 800 BC that eventually led to the contraction of the mega chad and Bornu empire to their present position and size.

During the earlier period (seven centuries) when the empire of Borno was just beginning, the shores of the then great Lake provided easily gathered food supplies for stone age man while the banks of the rivers that flowed into it - particularly those in what is now desert supported a considerable population and communication in all direction was easy. Dessication and the spread of desert subsequently restricted such communications.

The resultant effect of this environmental problem was the development of the erg and sand dunes. Indeed the dry bed of the Lake Chad must have provided ample food supplies for hunters and gatherers, while the many water courses and wet season pools were frequented by possessors of a cultural and traditional occupation between the mesolithic and neo-lithic era. It should be admitted therefore, that the likely and potential desertification areas in Nigeria is the Sahelian region situated in Northern part of Borno State.

2.30 CAUSES AND PROCESS OF DESERT ENCROACHMENT

Inspite of the age long problem of desert encroachment, there is still some controversy and disagreement as to what constitute the underlying

causes of desertification. That man is one of the agents of desertification cannot be over emphasised, but that short term changes in the general circulation of the atmosphere that produce prolonged drought periods which are always catalysts for accelerated desertification is also beyond dispute, Aladipo (1985) P. 17.

Whenever, severe drought occurs, there is the suggestion that the deserts could be expanding into their marginal lands. The recent Sahelian drought of 1968 - 1973, reawakened the serious concern that the Sahara desert is encroaching in land mass of Borno State. This implies therein the physical scenario of an advancing Sahara desert South-wards into the marginal territory designated the Sahel. Indeed this transitional zone between the humid and desert areas has been the locus of man's greatest gamble with nature.

If desert-encroachment is caused by droughts, the question that remains unanswered is whether droughts feed on subsequent droughts by setting up positive feed-back loops? And are such feed-back loops accelerated by man so that man-made desertification affects the climate itself by limiting rainfall?

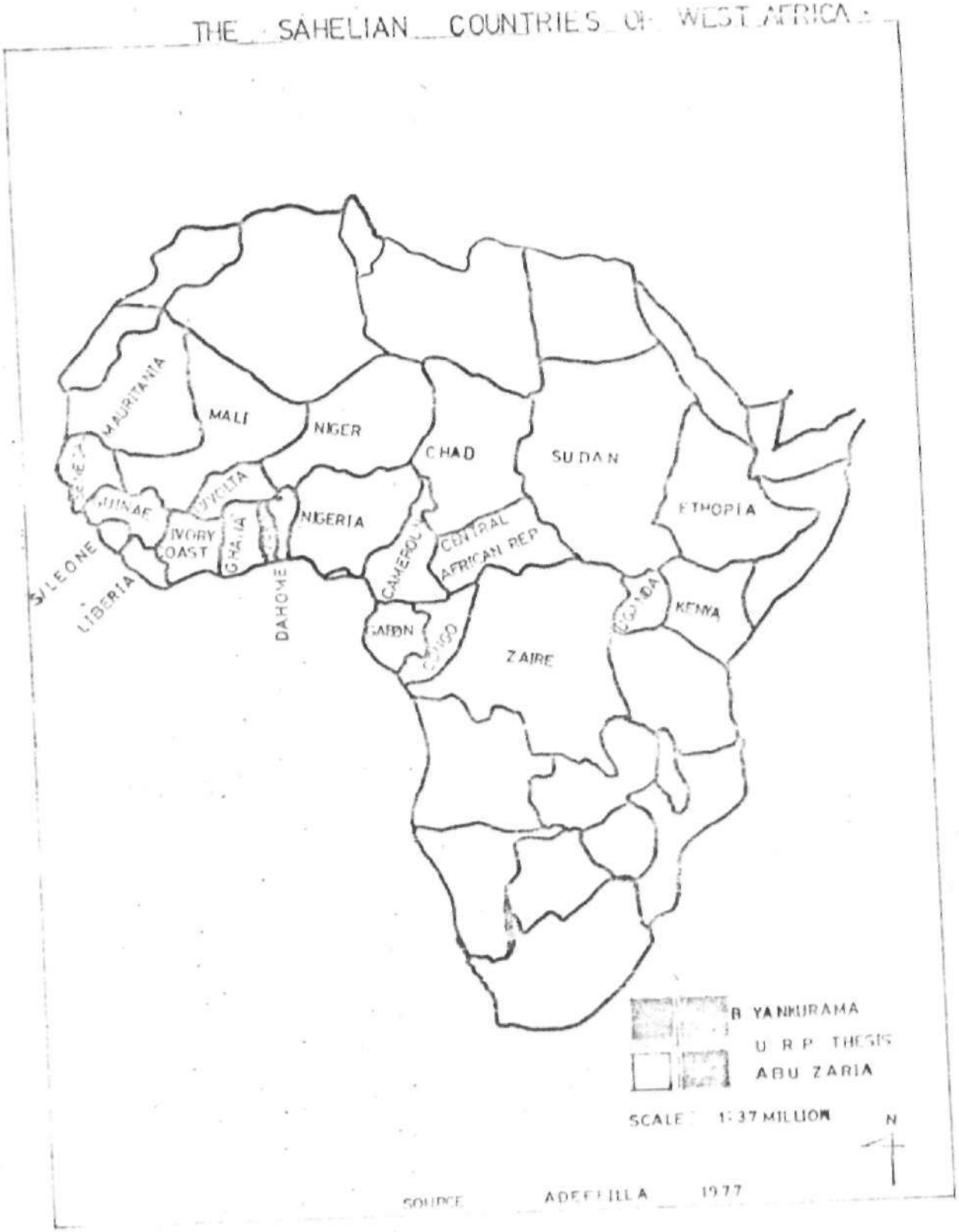

THE SAHELIAN COUNTRIES OF WEST AFRICA
MAURITANIA
MALI
NIGER
CHAD
SUDAN
ETHIOPIA
NIGERIA
IVORY COAST
LIBERIA
DAHOMEY
CAMEROON
CENTRAL AFRICAN REP
GABON
ZAIRE
KENYA
B YANKURAMA
U R P THESIS
ABU ZARIA
SCALE 1:37 MILLION
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SOURCE ADEFILLA 1977

Fig. 2.20

It is then argued that desert-encroachment or desertification is a complex environmental problem whose causes and process of formation may not follow a particular sequence. Thus, desert-encroachment should be likened to the growth of a living thing. The growth being so slow to be dictated in a day, week or month but rather over years in its physical development. Thus, different mechanisms may nonetheless end at similar convergence, the result of which the formation of desert-encroachment. In the semi arid and arid zone (Sahel) of Borno State, desertification is primarily evidenced by a partial or total loss of vegetative cover. In this place climatic extremes and high land pressures have reduced the growth of vegetation to a level of which significant regeneration is impossible. Thus, in short the desert-encroachment phenomena is caused by both climatic inducement and anthropogenic consequence (see figure 2.30).

Perhaps, never before, as in the present half century, have we of this generation, been afforded a more opportune time and adequate facilities to monitor the natural environment and understand more fully the true nature of the atmosphere and its manifold ramifications. The provision of sophisticated

PROCESS AND CAUSES OF DESERTENCROACHMENT

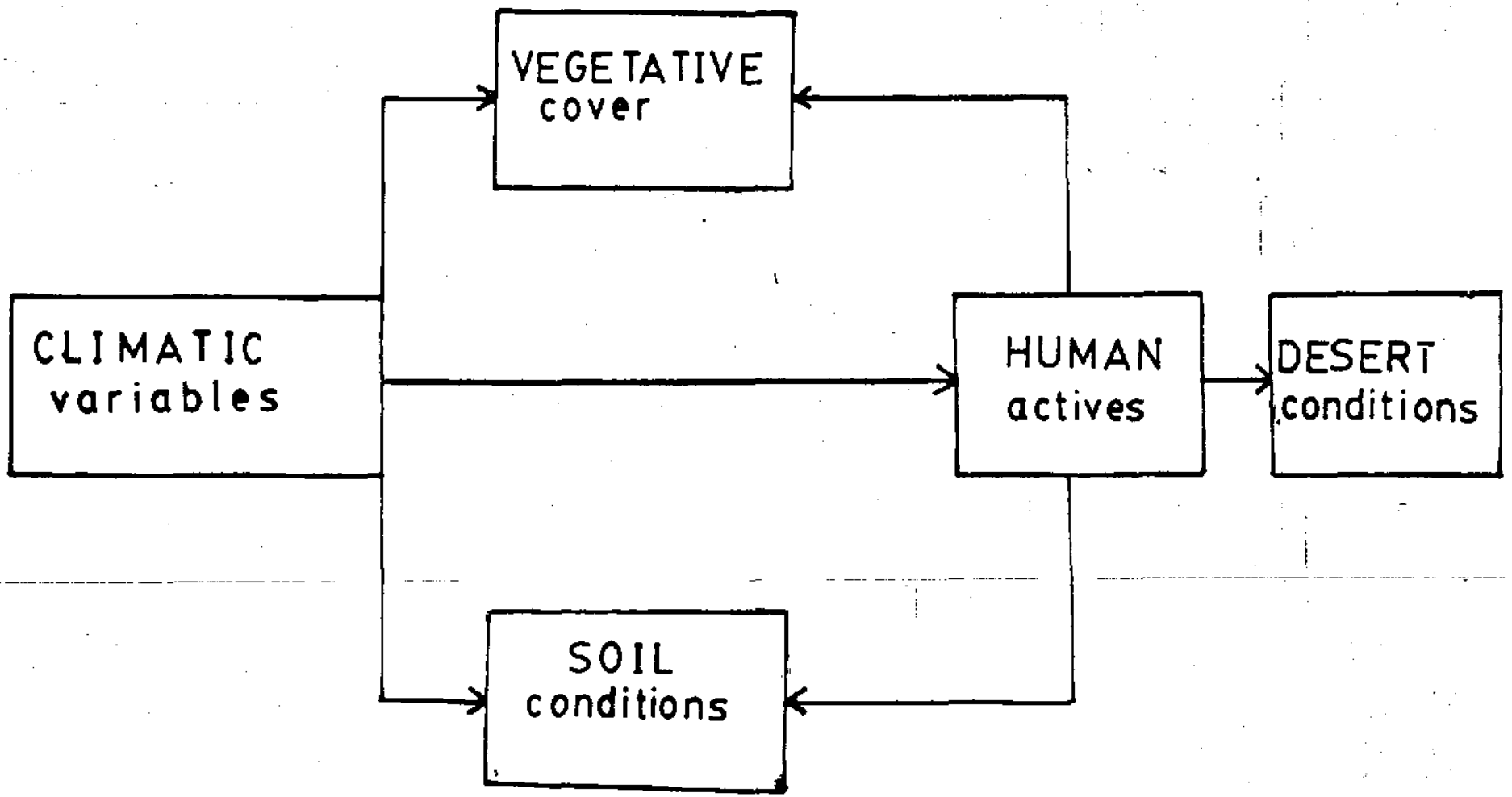


Fig. 2.30

instrumentation, the facilities afforded via the computers and the continuous and simultaneous collection and transmission of data to ground-based monitoring stations by weather Satellites, have now made it possible for the Meteorologist to better decipher global weather patterns. The information so obtained, in collation with evidence from documents, diaries, administrative folios, and climatic indicators' such as tree rings, lanstrine layers, river regines and lake levels have proved of immense value in understanding even the present day climatic trends and desertification process.

1. Climatic Inducement

Climatologists and Meterologist have shown that detailed multi-disciplinary investigation of the long sedimentary sequences in Africa and the adjacent oceans have demonstrated a higher degree of climatic variability over the Sahara at all scale of time, with market changes in hydrological conditions apparently at scales ranging from decades to centuries and to millennia. It is doubtless that comparable climatic vagaries have also been experienced in other desert regions of the world.

Based on an analysis of precipitation data from 419 African stations in the area 10 S to 37 N have revealed a number of features pertinent to the establishment of the desert climate in the Sahel zones. Thambyaphillay (1982) P.18, recognising four precipitation zones (the Saharo-Sahelian, Sahelian, Sudano and Guinea Sudano) Thambyaphillay (1982) P.21, concluded that all the four latitudinally distinct zones exhibit a marked and steady rainfall decline since the 1950s and as at about 1960 a relatively dry episode. It is affirmed that while rainfall increased in 1974 and 1975, nevertheless, the regional mean continued to be abnormal and the gross parallel behaviour of all the four adjacent zones suggested coherent climatic variation throughout the entire region (figure 2.10).

Earlier, the world witnessed here in West Africa, the Sahel Drought that prevailed for five years, from 1968 to 1973. This was the worst drought in sixty years. The animal and human population of this five million square kilometres (5×10^6 km^2) extending from Coastal Mauritania, through Senegal, Gambia, Mali, Upper Volta, Nigeria, Niger and Chad, suffered untold hardship. The precipitation

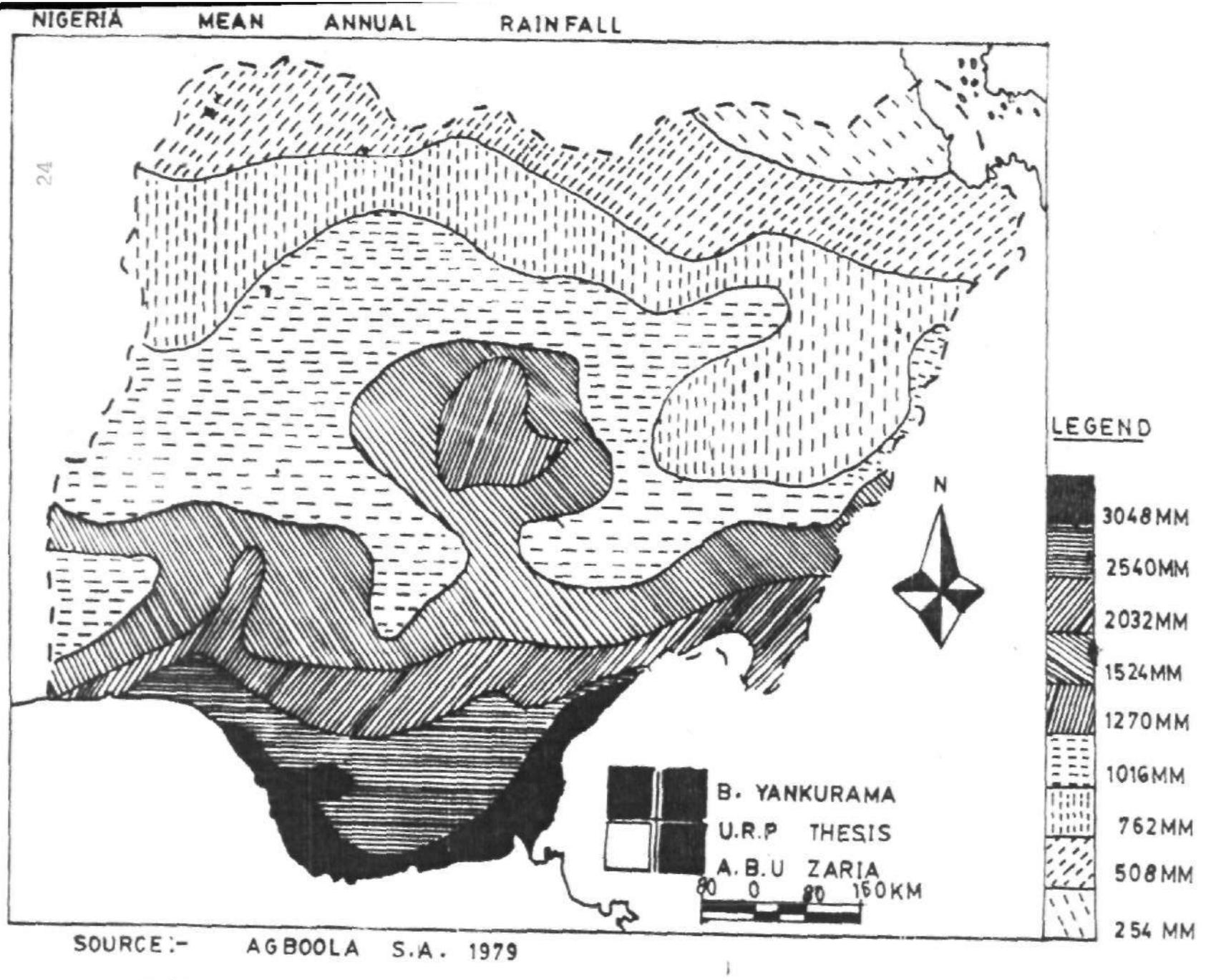

NIGERIA MEAN ANNUAL RAINFALL
LEGEND
3048MM
2540MM
2032MM
1524MM
1270MM
1016MM
762MM
508MM
254 MM
N
B. YANKURAMA
U.R.P THESIS
A.B.U ZARIA
80 0 80 160KM
SOURCE:- AGBOOLA S.A. 1979

Fig. 2.40

shortfall in the Sudan/Sahel zone was approximately 250 millimetre (10 inches) below the mean, in an area of generally deficient rainfall. The crop shortfall over the entire region was between 50 and 90 per cent. In Nigeria, the millet crop was estimated to have been less than 25 Per cent of normal production. The rains did come to the Sahel both in 1974 and 1975 but the drought climate persisted.

Again it was observed that when equator-to-pole and surface-to-upper air temperature difference are greater, desert marking climates should be further south than normal, hence also corresponding displacement of the monsoonal rains. In addition one degree latitudinal shift of the inter-tropical divergence (ITD) can be responsible for the Sahelian drought which leads to the phenomena of desert-encroachment. (see Figure 2.50).

(b) Anthropogenic Consequences

Man is increasingly changing his environment and this leads in many ways to unwanted effects. Polution of air, water and soil is a problem in many countries, but this does mostly, have

MOVEMENT OF INTER TROPICAL DIVERGENCE IN AFRICA

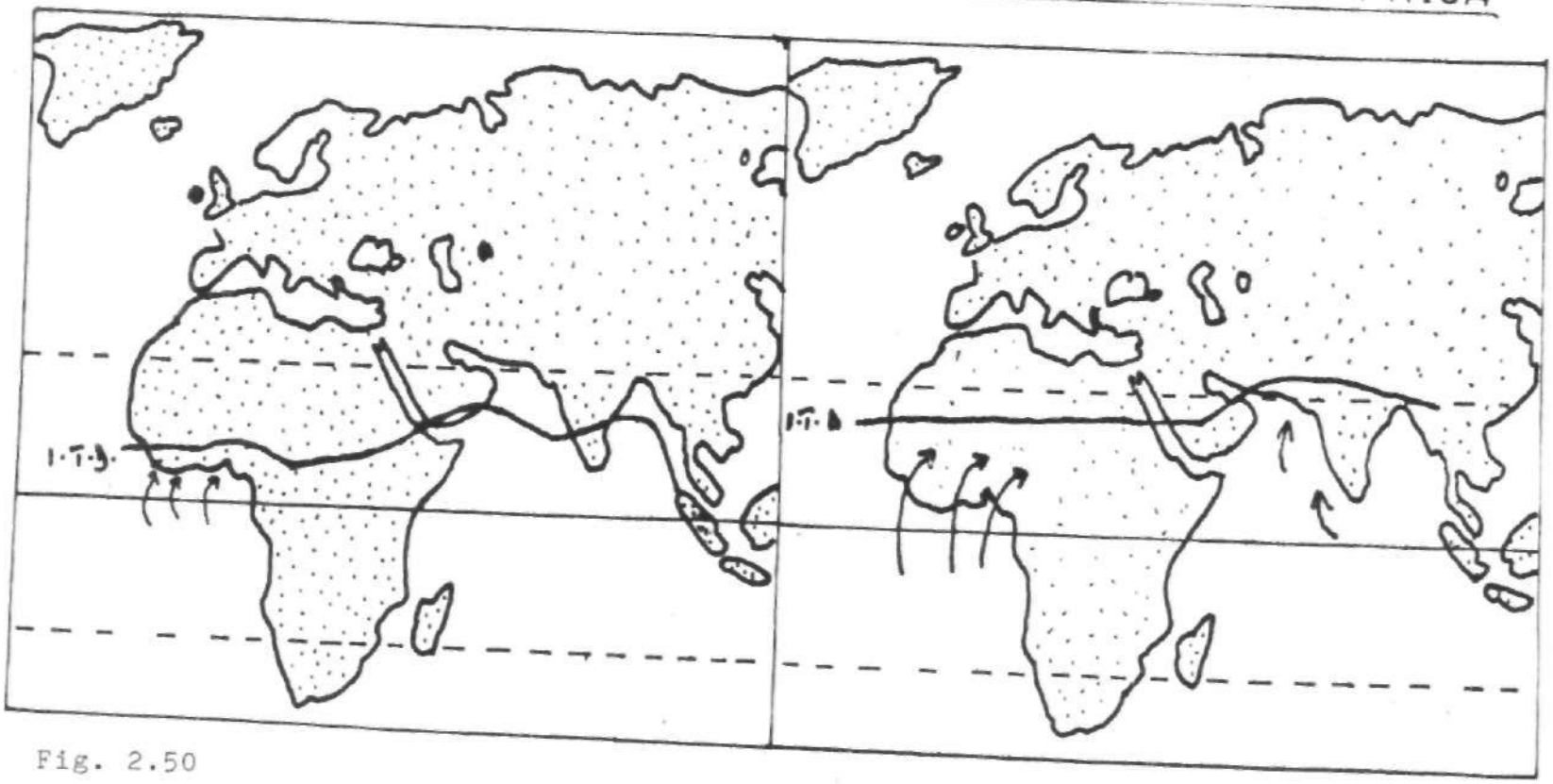


Fig. 2.50

irreversible effects and measures can usually be taken to counteract these, even if such are not always economically feasible. But human population explosion together with land pressure will not be easily counteracted.

Desert-encroachment or desertization therefore, does represent the disastious degree of environmental degradation usually a gradual and insidious process, accelerated during times of protracted drought - the cause has been the pressure man and his animals have placed on the land, Mortimore (1973) P.24.

This means that a common mechanism of desert encroachment comprises the following, Petrov (1976) P.65.

i. Expansion and intensification of land-uses in marginal dry lands during wet seasons. This action includes increased grazing, ploughing and cultivation of new land using sophisticated technology and wood collection around new camps or settlement.

ii. Wind erosion - Deflation areas of total or partial loss of productivity via removal of

top soil, nutrients and humus; in combination with dessication caused by increased run off from a crusted ground surface.

iii. Damage is also caused by deposition of dunes or slope wash sediment but these depositional features are probably small in area and often less sterile than the deflation scars increased salinity or alkalinity are other causes of local desertification in Borno State.

Thus, in short, the increased high demographic pressure of which result into over-grazing, clearing of natural pastures and over cultivation of sandy soils destruction of woody species for fuel, extension of mechanised ploughing in the Sahelian region of Borno State have the total results which leads to the new desert-landscape, Golany (1978) P.8.

2.40 IMPACT OF DESERT ENCROACHMENT ON SETTLEMENT AND ENVIRONMENT

Over the past half century, the Sahara desert has engulf some 650,000 square kilometres of arable land, Golany (1976) P.6. Vast areas of Indian land have been

over-run by the 'Thar' desert and the Atacama has swallowed thousands of square kilometres in the Northern Chile and Peru. Similar disasters have befalled large areas of the United States, Mexicco, Middle East, Venezuela, Argentina, Southern Africa, Sibnia, China and New Zealand according to Lundholm and Arapp (1976) P.231 - 236.

Unfortunately, scholars and professionals have failed to learn or remember the lessons silently taught us by both the vast and impressive historical experience of the numerous early civilizations that existed and thrived in these semi-arid and arid zones of the Middle East, Africa, Iran, Afghanistan, Pakistan and Central Asia, Golany (1978) P.7. For instance the area referred to as Rejputana or Thar desert has been observed to be expanding into the marginal land for 50 years. This desert even 30 years ago was expanding at the alarming rate of 0.8 kilometres per year. Thus, from 1951 - 1961 grazing land declined from 13 million hectares of 11 million hectares. It is noteworthy that nearly 4,500 years ago (2500 BC) there was in this same region a most sophisticated civilization called the Indus ("Mohenjadaro Harrappah"), urban based civilization, encompassing an area extent twice that

of the Mesopotania and Egyptian civilizations combined. Today, this same region presents. The picture of a parched and scorched piece of land.

Khartoum, the capital of Sudan, Africa's largest country, strategically located where the white Nile meets the Blue Nile is an intermediate position, in a country of arid but edible pasture where the herding of livestock has been practised for as long as man can remember. In recent years Khartoum has watched the implacable advancement of the Sahara desert, moving down from the North at an in exorable rate of 5 to 7 kilometres per annum far beyond Atbara to the very out skirts of the capital itself and its population left at the mercy of UNDR (United Nations Disaster Relief) as noted by Bitan (1973) P.124.

Down here in Nigeria, the first capital of the Kanem-Bornu empire which was situated at Njimi, a town whose location is North-East of the present Lake Chad. Ogini (1981) P.26. "This is to say that it was situated outside the boundary of today's Republic of Nigeria. In the fourteen century the

2.50 THE HISTORY OF DROUGHT AND DESERT ENCROACHMENT THE GLOBAL PERSPECTIVE FROM EARLY EMPIRES

Historians, have unfortunately tended to ignore the climatic environment and thus, have been poorer for their inadequate interpretation of the historical process of collapse of early civilisations and empires. It would seem pertinent at this juncture to bring into focus evidence of climatic change which brought a contributing factor in the collapse of some early empires and civilisations.

2.60 THE COLLAPSE OF THE MYCENEAN CIVILISATION OF GREECE

The City of Mycenae located on a plain some 100 kilometres South-West of Athens in Greece was the centre of a civilisation around the period before 1300 B.C. Even the two connected centres of Pylos and Tiryus in Southerly locations in the Peloponnesus Peninsula collapsed according to historians by the invasion theory.

However, it was not until Heinrich Schlienmann began excavation in 1870s that the history of these cities came to light. In 1968 Rhys Carpenter where the invasion theory was discontinuited. It was thus, asserted that Mycenea were never invaded but it was

Mycenean themselves who evacuated from their city. Carpenter drew parallel from these large scale migrations of starving people throughout Aegean region and concluded that it was drought then that led to the collapse of the Myceneau civilisation.

2.70 THE COLLAPSE OF MOHENJADARO-HARAPPA CIVILISATION OF INDIA

History may likewise be re-written with respect to the Indus-civilisation in the Indian sub-continent. The ruins of the two cities Herappa and Mohenjadaro were set in the Indus valley and were part of once flourishing civilisation sometime around 2500 B.C. This Indus civilisation encompassed an area twice that of the Mesopotanian and Egyptian civilisations combined. The two cities occupied flood plains and are noteworthy for their large granaries and brick fortresses. The inhabitants grew wheat, barely, melons and were perhaps the first to cultivate cotton.

Today, this region of the Indus basin exhibits an almost entirely irrigation based Agrarian culture. This was an area of the same region 4500 years ago was rain based. Evidence of a decline of this civilisation was seen in 1700 BC. Like the case of Mycenean

civilisation where invasion theory was applied, so here too historians had attributed the decline and sudden collapse of the Indus civilisation. However, recent studies using carbon dating techniques, have indicated that the time lapse between the material culture of the Harappans and Aryans was of the order of at least six centuries. Gurdip Singh in 1971 studied the salt lakes of Rajaputana as they exist today. He has demonstrated from pollen grain analysis that the salty characteristics of the present day lakes go back to only about 2000 B.C. G. Singh pointed out that, the lakes would have been of fresh water prior to this period as revealed by the moisture loving plant fossils.

Thus, at the height of the Harappan civilisation, water was plentiful which demonstrate a humid period of ample precipitation. It was then that drought set in and like the earlier mycenaen civilisation, the Indus civilisation faced famine and began to decline. By the Seven Century frequent dust storms seem to have assailed this region - a period of desertification. By 1000 A.D. the present Rajasthan desert came to be established and perhaps had never diminished in extent but progressively encroached more and more upon the marginal and arable lands. It is indeed remarkable that 4000 years ago,

this was a centre of a most highly sophisticated civilisation based on rain-fed agriculture. Today it stands out as a bleak and unwelcome land parched and thirsty.

2.80 THE COLLAPSE OF THE MALI EMPIRE IN WEST AFRICA

It would indeed be rewarding to investigate into the possible role that the climatic parametre of drought, might have played with respect to the collapse of that area Mali Empire during the Fifteen and Sixteen Centuries here in West Africa. According to Thambyahpillay (1979), the period commencing around the 1540s has come to be recognized as the 'Little Ice Age'. It was also in 1570 that Emperor Akbar commenced building his capital city of Fatelipur Sirki. However, hardly had fifteen years passed, when Sirki had to be abandoned simply because of a totally inadequate water supply. By 1585, Sirki was given up due to this climatic calamity. A correlative scenario of climatic histories point to drought in the broad monsoonal zone, including the area of the Mali Empire.

2.90 DECLINE OF KANEM-BORNU EMPIRE

Down here in Nigeria, the first capital of the Kanem-Bornu Empire which was situated at Njimi, a town

whose location is North-East of the present Lake Chad has undergone the desertification problem. Ogini (1981) P.28. "This is to say that it was (Njimi) situated outside the boundary of todays Republic of Nigeria. It was during the fourteen centuries that the inhabitants moved West of the Lake Chad which explains in parts the degrading environment of the settled community at that time. In 1477 the establishment of Birni Ngazargamu by the Kanuris was another sign of the threatening desertification.

2.100 MEGACHAD (Lake Chad)

The shoreline of the then water body name Megachad (today Lake Chad) is seen to begin from the foot hills of the Tibesti Mountains, some 700 Kilometres to the North. It may be traced to about Bangor in the South (Chad Republic) and thence to the Northern end of the Mandara Mountains here in Nigeria. At its maximum, Megachad was estimated to have been at least 150,000 kilometre square which was ten times its present extent and thus, equivalent to the area extent of the Caspain Sea, the largest natural lake in the world. Thus, the local climatic scenario in the Chad Basin must likewise have been wetter. This evidence of the contemporary phenomena of the receding shoreline of the ancient

Megachad and the shifting settlement (Capitals) of the Born o Empire has once again re-awakened the alarming prospects of desert-encroachment, Thambyapillay (1979) P. 12.

2.110 THE IMPACT OF DESERT-ENCROACHMENT AND DROUGHT IN SOME AFRICAN COUNTRIES AT PRESENT

(a) Mauritania

Tens of thousands of livestock breeders have been left destituted when their herds died from lack of feed following widespread drought in Brakna Trarza, Tagant and Adran regions. Trypanosomiasis and rinderpest are rampant. There is also severe malnutrition, particularly among children as has been reported by UNDRO News (1983).

(b) Swaziland

Prolonged drought and desertification has been cited as the cause of the death of 500 children from a protein deficiency desease called Kwashiorkor, UNDROWS News (1983).

(c) Chad

At least 2,000 death and mass migration have been recorded since last August due to acute malnutrition

and about 150,000 displaced persons need urgent relief assistance. UNDROW News (1984).

(d) Ethiopia

The country has been suffering from prolonged drought and the government authorities report over seven million persons affected are living helplessly, UNDRO News (1984).

(e) Mozambique

Drought conditions are continuing and over one million persons are still affected by drought in the Northern province. UNDRO News (1984).

(f) Rwanda

About 420,000 persons, 40 Per cent of them children are reported to be in need of emergency food aid. The food deficit of the country is estimated at 60 Per cent. 27 of the 48 communities of the country are affected.

(g) Tanzania

About 1.9 million persons reported by UNDRO News need urgent relief in the normally grain surplus Northern Regions of the country.

CHAPTER - THREE

3.00 IDENTIFICATION AND DELINEATION OF AREAS AFFECTED BY DESERT ENCROACHMENT IN BORNO STATE

3.10 LOCATIONAL AND GEOPOLITICAL CHARACTERISTICS OF BORNO STATE

Borno State lies in the extreme North-Eastern part of the Federal Republic of Nigeria (see Figure 3.10). It is located between latitudes 10.0^{o}N and 13.04^{o}N and longitude of 9.08^{o}E and 14.04^{o}E. It is bounded by the Republic of Niger in the North. To the North-East and East by the Republics of Chad and Cameroon respectively. It also shares a common boundary with Gongola State to the South, Bauchi in the South-West and Kano State in the West.

Borno State was created in 1976 deriving its name from the famous Bornu Empire which has a dynasty that has ruled for about a Century. It consists of Eighteen Local Governments with Maiduguri as the State Capital (see Figure 3.20).

3.11 Climate

The geographical location of Borno State has placed it at a disadvantage climaticwise. Borno

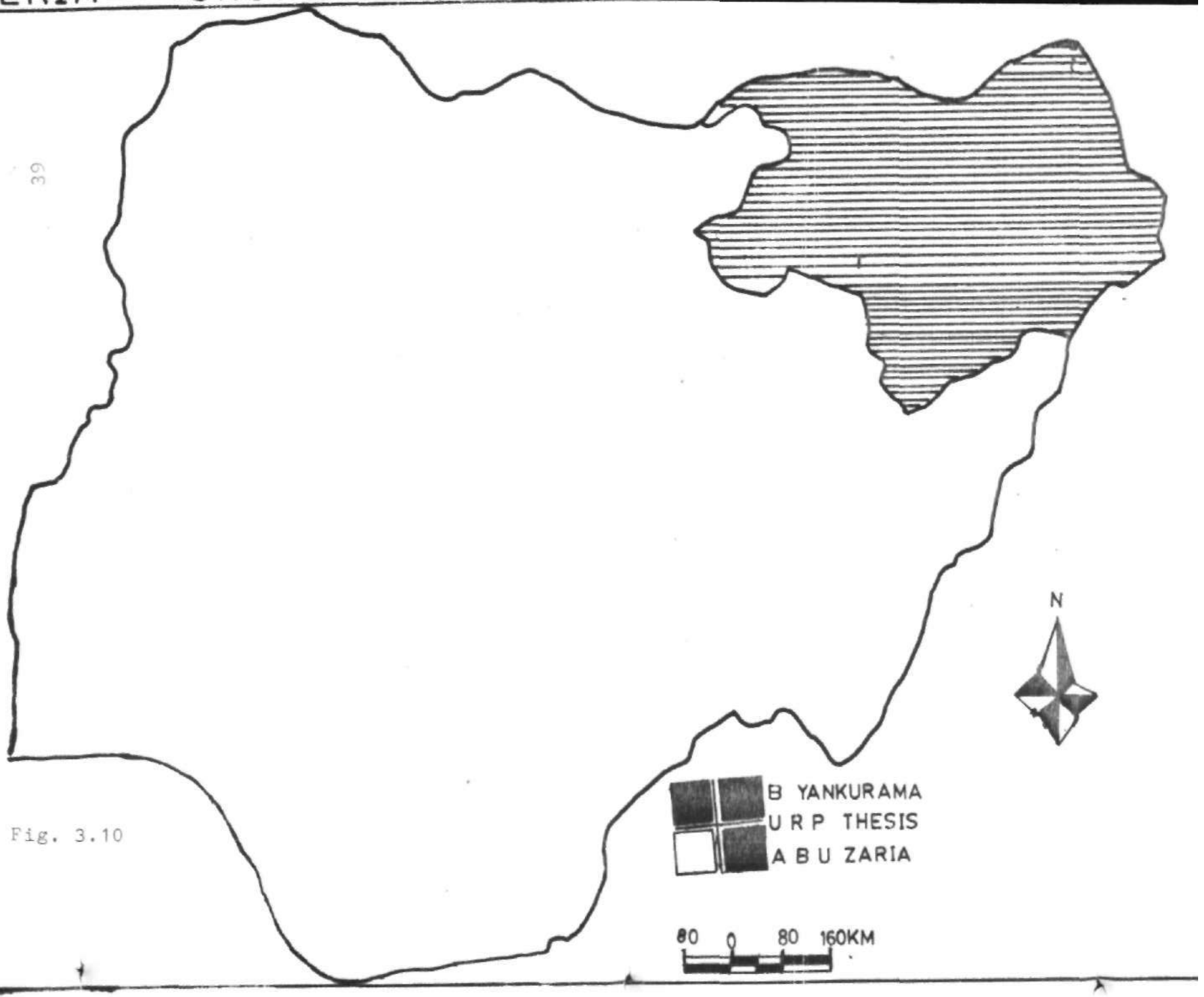


Fig. 3.10

BORNO STATE SHOWING L.G.A.S

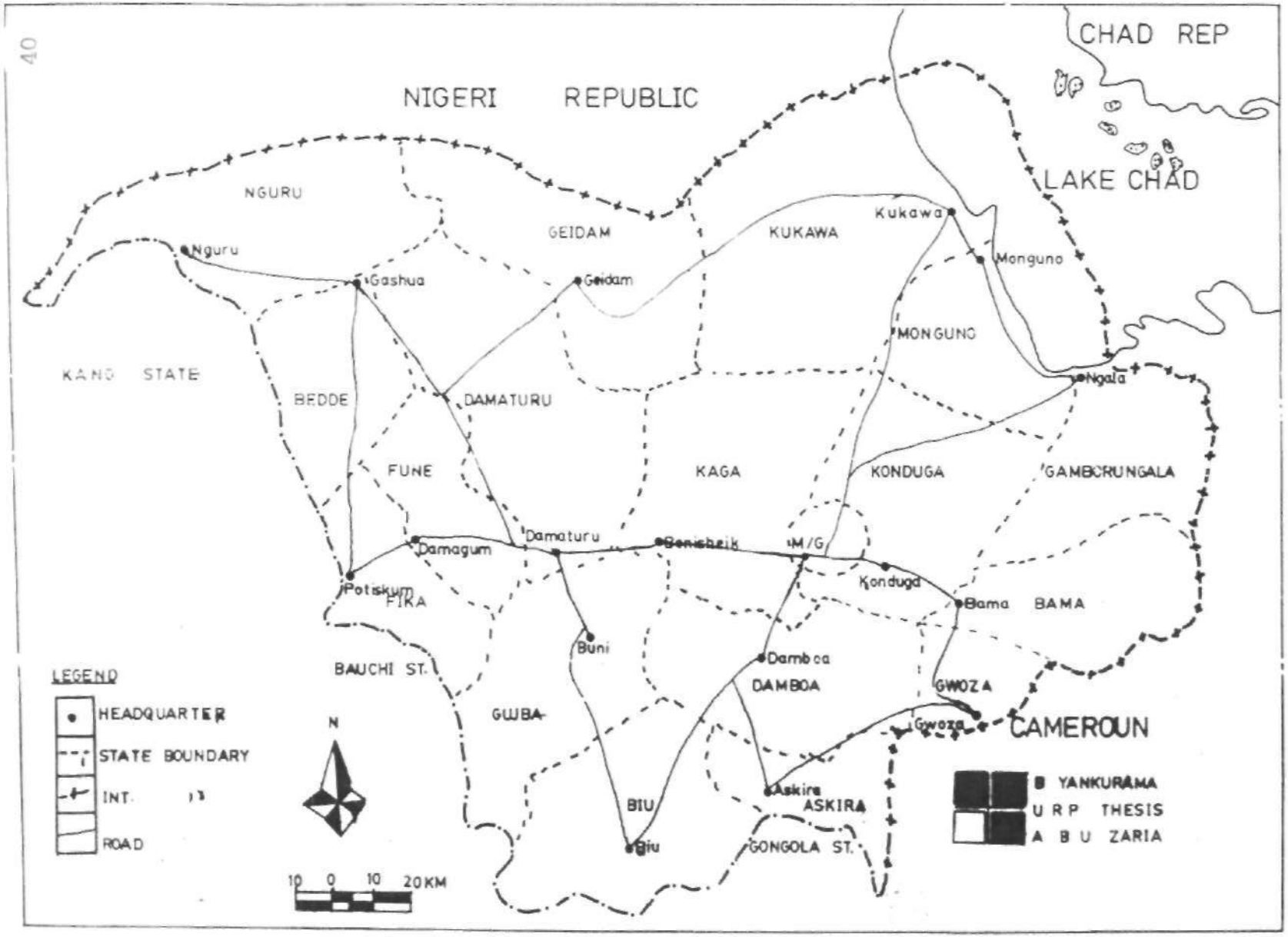


Fig. 3.20

State is the only State of the Federation that has the transitional zone between the Sahara desert and the Sudan Savannah referred to as the 'SAHEL'. Generally, in the greater part of the year, the weather is hot and dry with short spell of rainfall from June to September. The period of wet season varies within the State. Areas like Geidam, Ngunu and Gubio and other Northern parts of the State, rainy season last for only three months during normal years. The mean annual rainfall is less than 250mm. In the Southern part rainfall regimes last from April to October with mean annual rainfall ranging from 800 - 1000mm. The example of places having this amount of rainfall are Biu, Gwoza and Askira Uba.

3.12 Relief and Drainage

In the Southern part of the State is the Biu Plateau stretching through Asira-Uba to Gwoza hills and Mandara Mountains. These land-forms are volcanic in origin and geologically is a basement complex which is probably of pre-cambrian formed over 600 million years ago.

In the North are the undulating regions of flat plains which spread from the Lake Chad Basin as far as to Nguru covering Kukawa, Ngala, Dikwa, Bama, Geidam, Damaturu and parts of Fika Local Government Areas.

The major drainage is the Lake Chad with its present area extent of 15,000 square kilometres, Thambyaphillay (1982). The rivers that drain in the Lake Chad are the river Yobe and Yedzeram.

3.13 Population and Ethnic Base

Borno State is one of the least populated states of the Federation. In 1963 the total population was put at 5.5 million people. In 1983 however, the estimated population was put at 6.1 million people with an average density of 52.4 persons per square kilometre. The pre-dominant tribes are the Kanuris, Bura-babur, Shuwa-Arab, Karai-karai, Bolewa and Margi. There are others like the Fulanis, Jarawa, Terra and Pidlimdi tribe. (Table 3.10) shows the population extimate of Borno State by Local Governments.

Table - 3.10: Population Estimate of Borno State 1983

	Local Government Area	1983	Area in Square Kilometres	Population Density
1.	Askira Uba	179,709	2,464	73
2.	Bade	212,068	5,004	42
3.	Bama	250,261	6,176	41
4.	Biu	469,272	8,641	54
5.	Damaturu	359,290	10,696	34
6.	Mamboa	219,012	8,500	26
7.	Fika	426,159	3,946	108
8.	Fune	224,018	5,270	43
9.	Geidam	492,907	8,692	57
10.	Gujba	183,062	6,187	30
11.	Gwoza	151,902	2,687	56
12.	Kaga	295,746	8,890	33
13.	Konduga	328,626	8,104	41
14.	Kukawa	544,624	14,110	39
15.	Maiduguri Metro	700,000	543	1,289
16.	Monguno	319,459	3,926	81
17.	Ngala	298,732	5,392	55
18.	Ngum	450,515	7,354	66
	T o t a l	6,105,362	116,589	Average 52.4

SOURCE: Borno State Statistical Year Book, 1983.

3.20 PARAMETRES FOR DELINEATION OF AREA UNDER DESERT ENCROACHMENT IN BORNO STATE

In order to establish and delineate the area under the threat of desert encroachment, there are some important indices or parametres that are used conventionally. They are rainfall, temperature and soil conditions as natural factors. There are also man made factors like over-cultivation, over-grazing, deforestation and bush burning.

3.21 Rainfall

This is done by measuring empirically the degree of moisture deficiency. Here it implies the use of isohyets (lines of equal rainfall distribution). Any isohyets less than 250 millimetres is considered to be exhibiting desert like condition in terms of rainfall.

3.22 Temperature

When temperature ranges between 35°C and above, the area is seen to indicate desertified environments. Indeed the emphasis here is that there is a minimum degree of temperature under which plants could survive, such as between 25°C - 29°C. It reaches critical levels when this is exceeded.

3.23 Over-cultivation and Over-grazing

The emphasis here is that when there is over-cultivation in these marginal lands desertification can easily be initiated. However, the problem here is determining when an areas becomes over-cultivated bearing in mind the present technology, where fertilizers and hybrid crops are emphasised. Over-cultivation is a situation where a particular piece of land under use cannot produce as much yields as it used to despite the application of machines, fertilizers and other in-puts. This parameter is a strong element to consider when delineating an area under the threat of desert encroachment.

Related to over-cultivation is the factor of over-grazing by animals. The big issue here is to know the measured area of land for grazing, the number of animals, the type of the vegetation to graze on and the time period of grazing before one can safely apply it as a factor for the delineation of the area under the threat of desert-encroachment.

3.24 Deforestation and Bush Burning

These two parameters are also misleading. In the case of deforestation, one has to establish the degree of forest destruction and the time period it will take to regenerate, otherwise deforestation cannot stand on its own as a parameter. The issue of bush burning also creates another great doubt. Although we are aware that bush burning could cause delay for plant regeneration but how to establish this as a factor of desert-encroachment knowing fully that the Sahelian region of the state under consideration has a dry season. One will expect that during the dry season, seasonal plants will definitely go dry and die. How could their burning cause desertification?

Thus, opinions have varied considerably over what parameters should be included or excluded as well as the emphasis to be placed on each. There are a lot of arguements that even the degree of moisture content as a parameter has proved over an simplification for a rather dynamic condition because rainfall alone is an insufficient criteria by which we can measure aridity

accurately and hence desert encroachment. This is because, the effectiveness of precipitation depends on seasonal occurence, duration, intensity, rate of evaporation and nature of the soil, all of which may vary considerably from one arid region to another, Miller (1978) P.12.

However, in 1918, Dr. W. Koppen linked precipitation (rainfall) together with temperature to define the boundaries of the desert of the world and semi-arid areas. Thus, using climatic parameters have provided more reliable and scientifically empirical than other elements or parameters. Indeed vegetation and soil moisture and functions of temperature and rainfall. Thus, for this study, temperature and rainfall are considered as the critical parameters for determining desertification. The issue of vegetation and things like soil condition and man-made factors will be considered here as the resultant effect of deficiency of rainfall and the intensity of temperature.

3.30 DELINEATION OF THE AREA UNDER DESERT ENCROACHMENT IN BORNO STATE

Since the parameters for delineating areas under desert encroachment are so complex, Albert Einstein observed that;

> When the number of factors coming into play in a phenomenological complex is too large the desert-encroachment phenomena, scientific method in most cases fails... we need to only think of wether (temperature and rainfall) occurance in this domain because they are beyond the reach of exact prediction, due to a variety of factors in operation not because of any lack of order in nature.

The above quotation explains the difficulties involved in delineating an area of desert encroachment. However, since the common denominator for all regions is simply moisture deficiency resulting from lack of enough precipitation and excessive evaporation, the behaviour of rainfall and temperature patterns from 1963 to 1983 at a ten year interval in Borno State will be examined.

3.31 Rainfall and Temperature of 1963

Based on the mean annual rainfall of 1963, rainfall recorded as much as 900 millimetres in the Southern part of the State (e.g., Biu as a station) and its amplitude decreased as one moves

MEAN ANNUAL RAINFALL (1963 - 83)

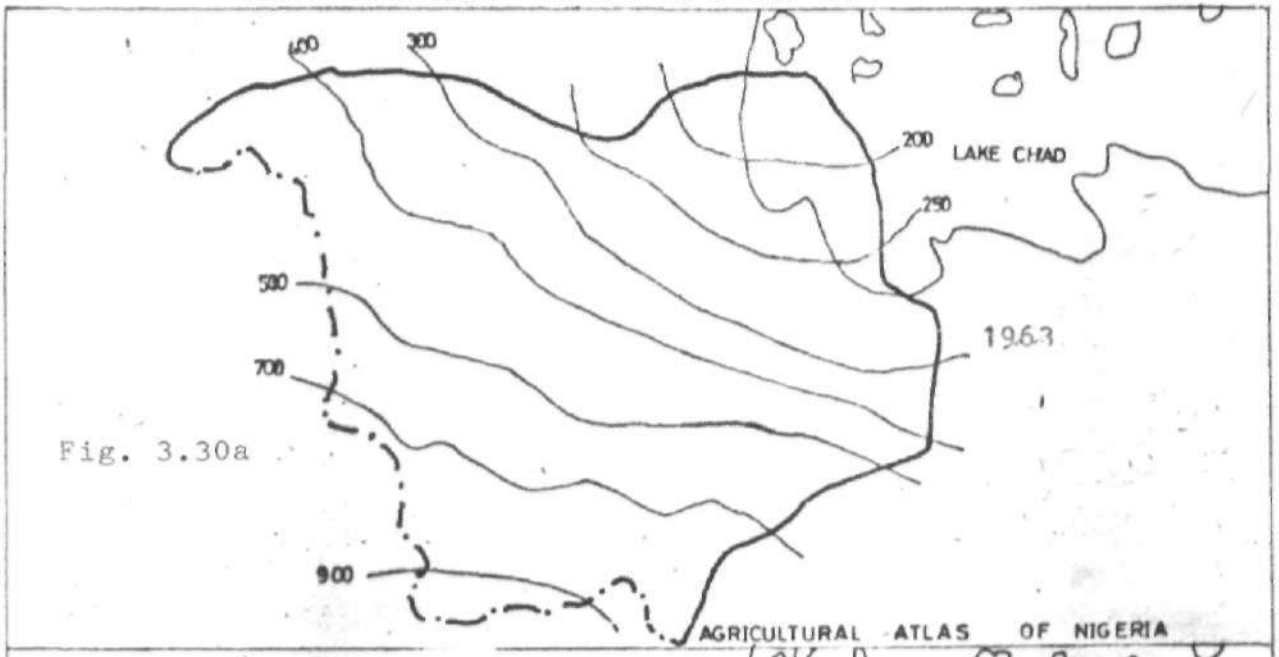


Fig. 3.30a

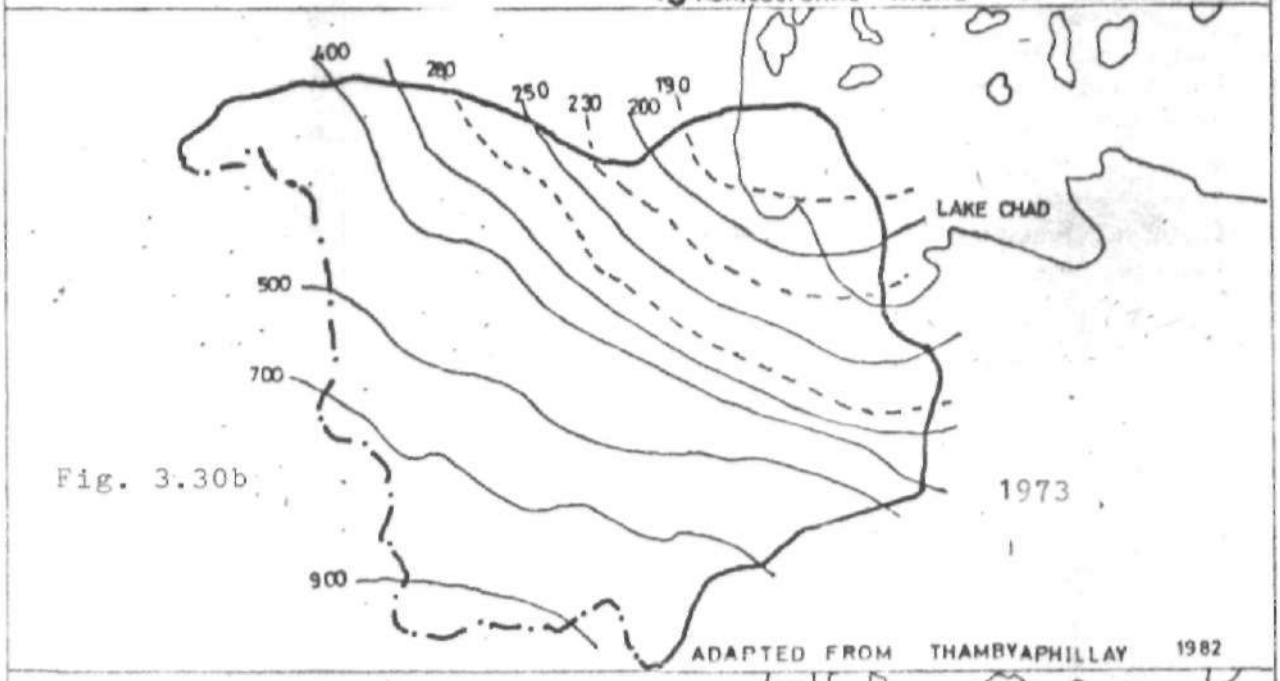


Fig. 3.30b

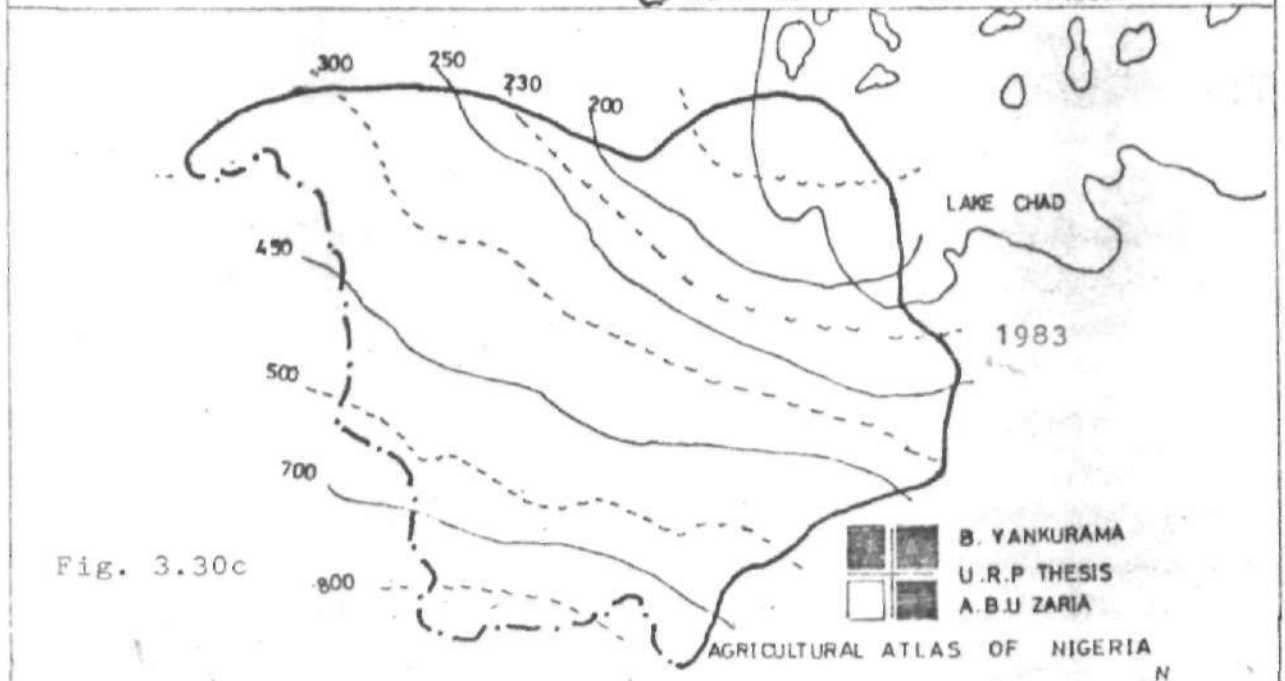


Fig. 3.30c

MEAN ANNUAL TEMPERATURE (1963 - 83)

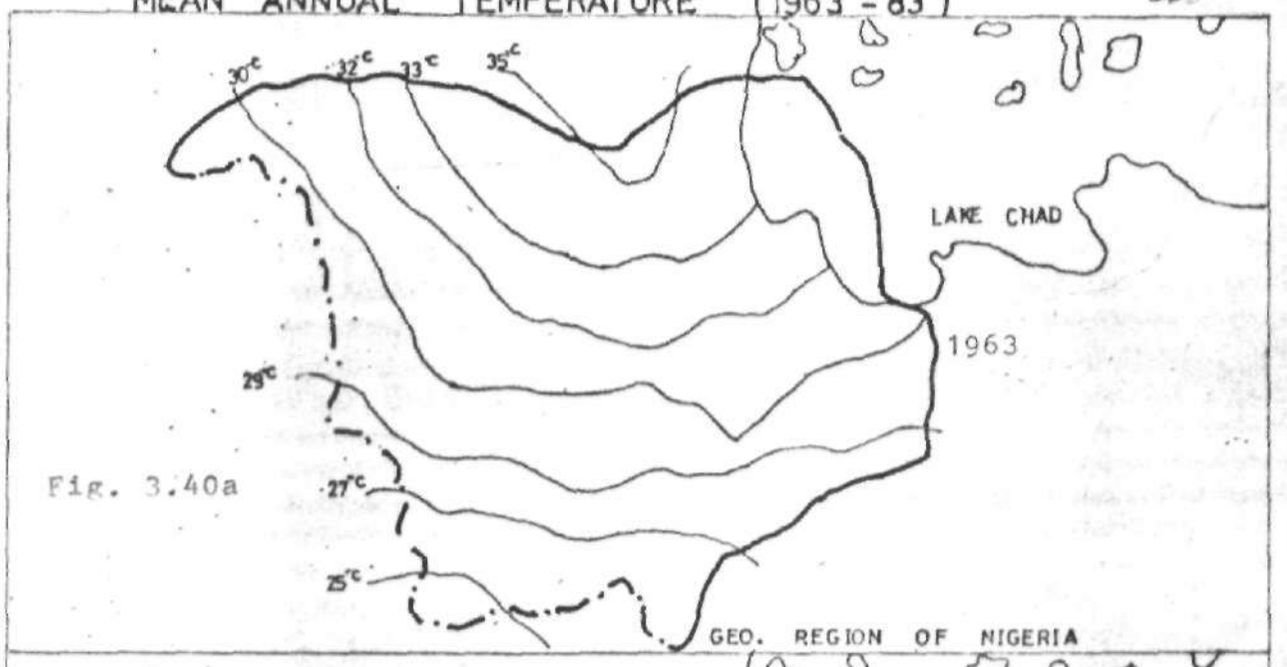


Fig. 3.40a

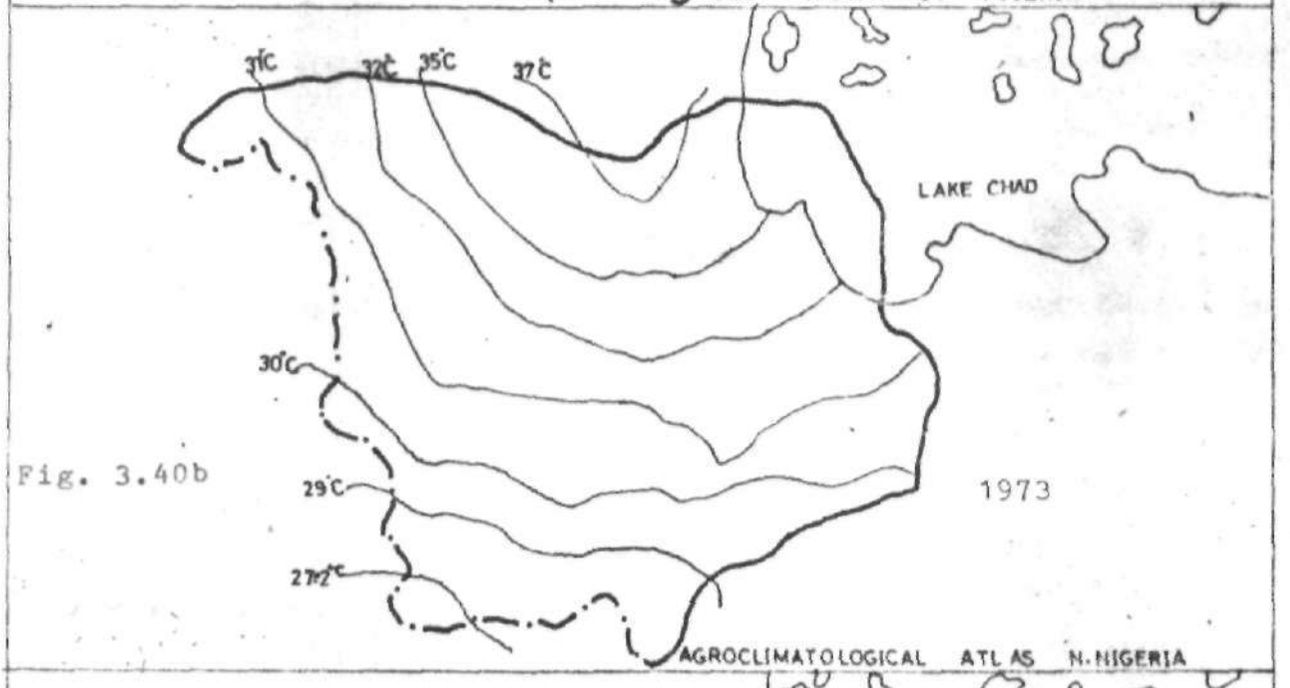


Fig. 3.40b

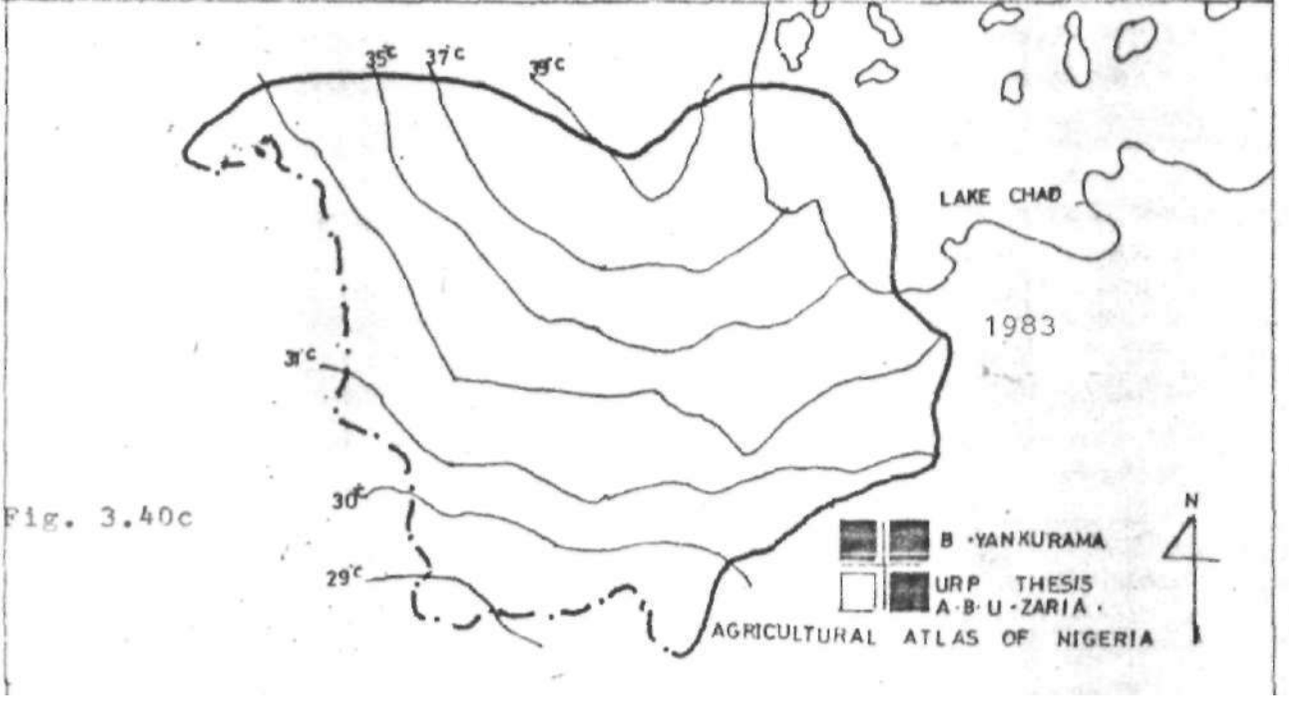


Fig. 3.40c

North-ward to an area where it recorded less than 250 millimetres in areas like Geidam and Gubio. (see Figure 3.30a).

The temperature on the other hand showed a reversed pattern. The temperature in the Southern part of the State recording about 25 C increased steadily thoroughout the State to the Sahel Region where it recorded as much as 35 C. (see Figure 3.40a).

3.32 Rainfall and Temperature of 1973

In 1973, (Figure 3.50b) rainfall variations from 1963 to 1973 with an annual variation or reduction and fluctuation of 20 millimetres in rainfall especially in the extreme Northern part of the State with no significant changes in the Southern part of the State when one looks at the stations of Geidam and Biu respectively. This explains the influence of the monsoonal wind (rain bearing wind) and the movement of the inter-tropical divergence zone (I.T.D.) in the distribution and intensity of rainfall in the tropics.

The other explanation for the variation in the North and less variation in the South stations could be due to the absence of cloud cover in the North and the nature of the soil (Alluvial).

Figure 3.40b shows the mean annual temperature variations from the Southern to the Northern part of the State as compared to the 1963 annual temperature. This explains the climatic and weather anomalies signaling the desert encroachment in Borno State.

3.33 Rainfall and Temperature of 1983

The rainfall and temperature of 1983 compared to that of 1963 and 1973 has shows a decrease of a mean annual rainfall and an increase of mean annual temperature (Figures 3,30c and 3.40c. These decreases and increases in rainfall and temperature could be explained by the acenario of drought years.

3.40 DELINEATED AREA

Ten square kilometre grids is superimposed on the State to obtain the average mean temperature and rainfall of 1963, 1973 and 1983 on a composite map (see Appendices A, B and C).

Weight exponential method was used to establish aridity. This is by applying a given value of temperature and rainfall for the ten-year periods and their value added and interpolated (see Appendices D, E and F).

TABLE - 3.20: The Weight Exponential Values for Rainfall and Temperature (1963-1983)

Rainfall (mm)	Value	Temperature (^{o}C)	Value	Total Value (TR)
Less 250	4	Over 35	1	5
251-351	8	33 - 35	2	10
352-452	12	30 - 32	3	15
Over 452	16	Less 29	4	20

mm = Millimetres

0^{o} = Degree Centigrate

TR = Temperature and Rainfall

Thus, it is then interpreted as from:

0 - 5 is VERY ARID

6 - 10 ARID

11 - 19 is MODERATE

20 above is NOT ARID

A single weight exponential index map for 1963, 1973 and 1983, that represents the pattern of changes from 1963 - 1983 is shown in Figures 3.90d, 3.90e and 3.90f respectively.

INCREASING ARIDITY IN BORNO STATE .



Fig. 3.50a

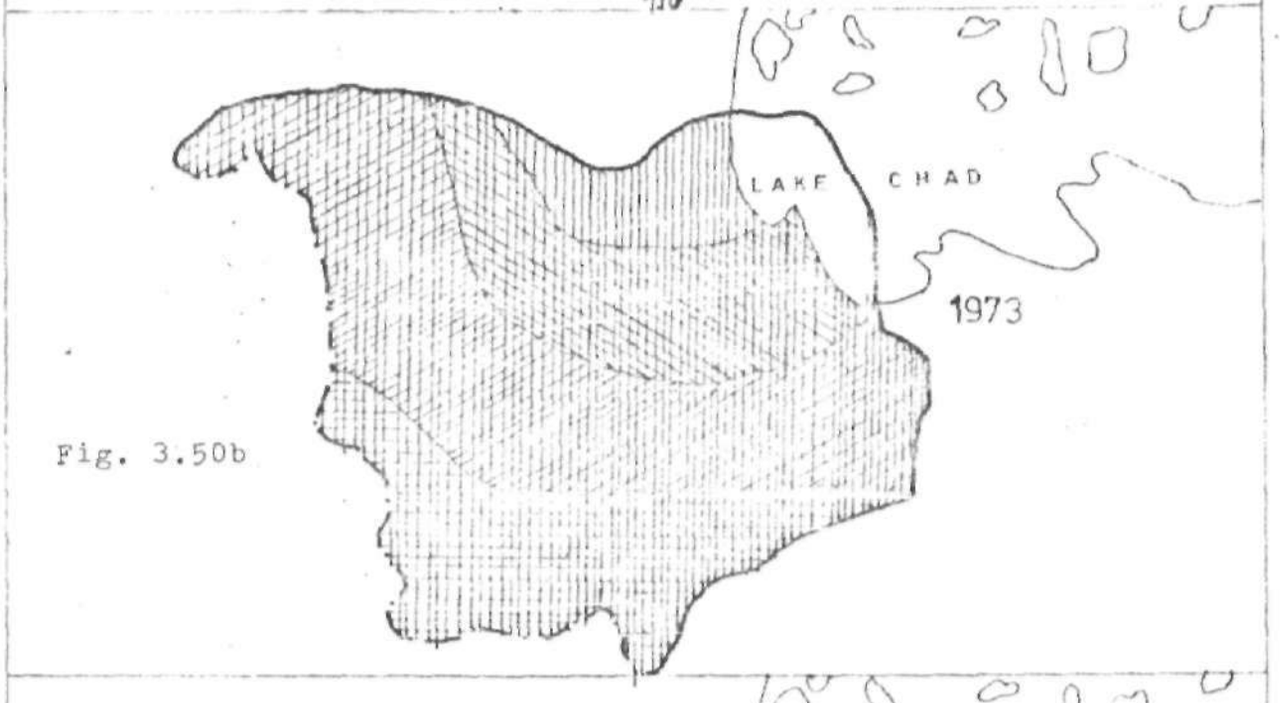


Fig. 3.50b

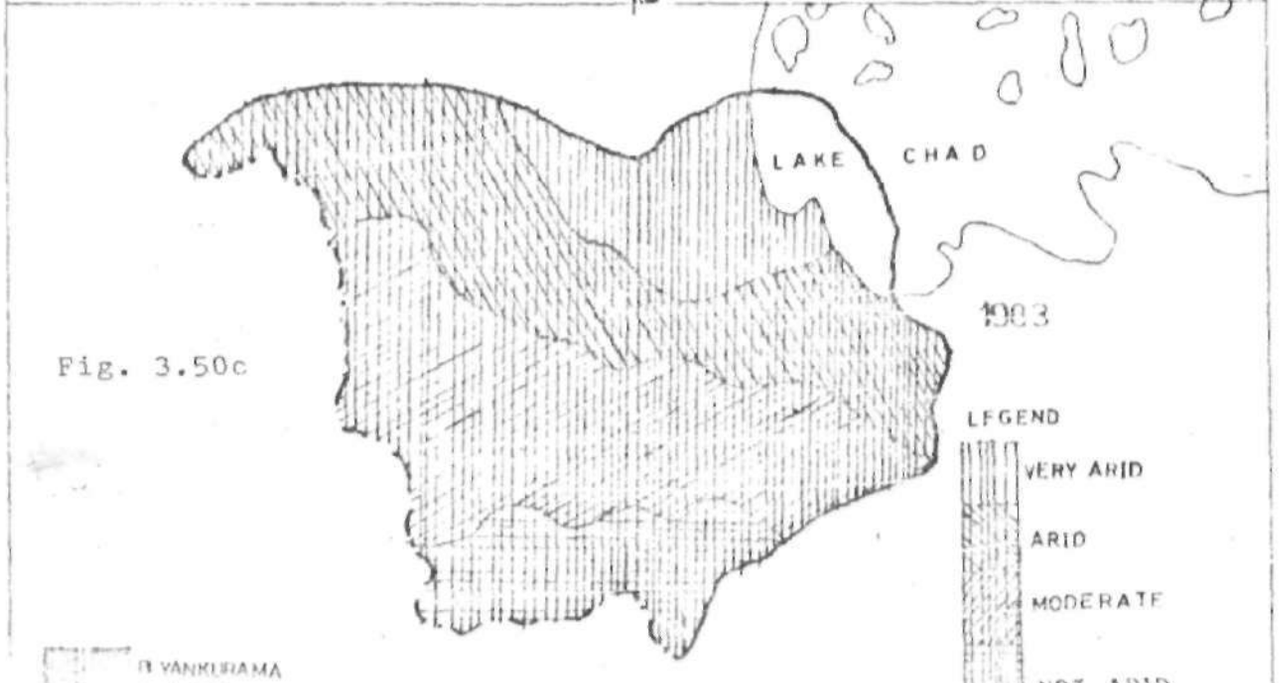


Fig. 3.50c

B.YANKURAMA
U.P.P.THESIS
ABU ZARIA

SOURCE: UNDP/FAO REWS FIELD SURVEY SCALE 1:500,000

3.41 Very Arid Environment

The common features here is the excessive heat and low moisture co-efficients for human habitation. In this environment annual mean temperature is above 35 C and mean annual rainfall is less than 250 millimetres.

Vegetation and biotic communities are very sparse and exist only when there is down pour of rainfall but they could dry away when there is prolonged drought. This environment could resemble that of the Sahara desert.

3.42 The Arid Environment

This environment represent the Sahel environment where the annual rainfall is generally ranging between 251-351 millimetres. Temperature on the other hand is annually ranging from $33^{o}C$ - $35^{o}C$. Vegetation here is sparse associated with drought but less than that of the VERY ARID environment. Recovery of any destroyed ecosystem may take a long time to regenerate. Geidam and Gubio stations are good example.

3.43 Moderate Environment

The common features here resemble that of the Sudan Savannah where rainfall is much higher ranging from mean of 352 - 452. These are as could also have temperature ranging from 30 C to 32 C. The vegetation here is a mixture of trees and shrubs. Growth is seasonable being more remarkable during the wet season. During the dry season some grasses die and decidious trees shed their leaves. Damboa, Gujiba and Bama stations could be sited as examples of settlements falling within this belt.

3.44 Not Arid Environment

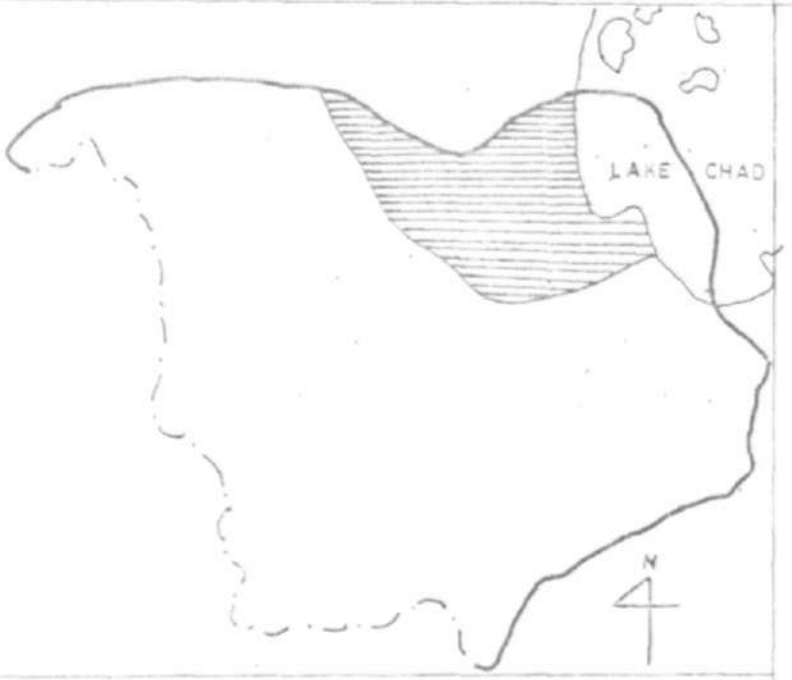
This is a place where rainfall is much. But during drought years it could be 451 millimetres or more. Here plant growth is high. Trees could measure as tall as 35 - 40 metres.

Examples of these settlements are Biu, Asikira-Uba, Gwoza and Shani.

Based on the above analysis therefore, the area delineated as area under the threat of desert

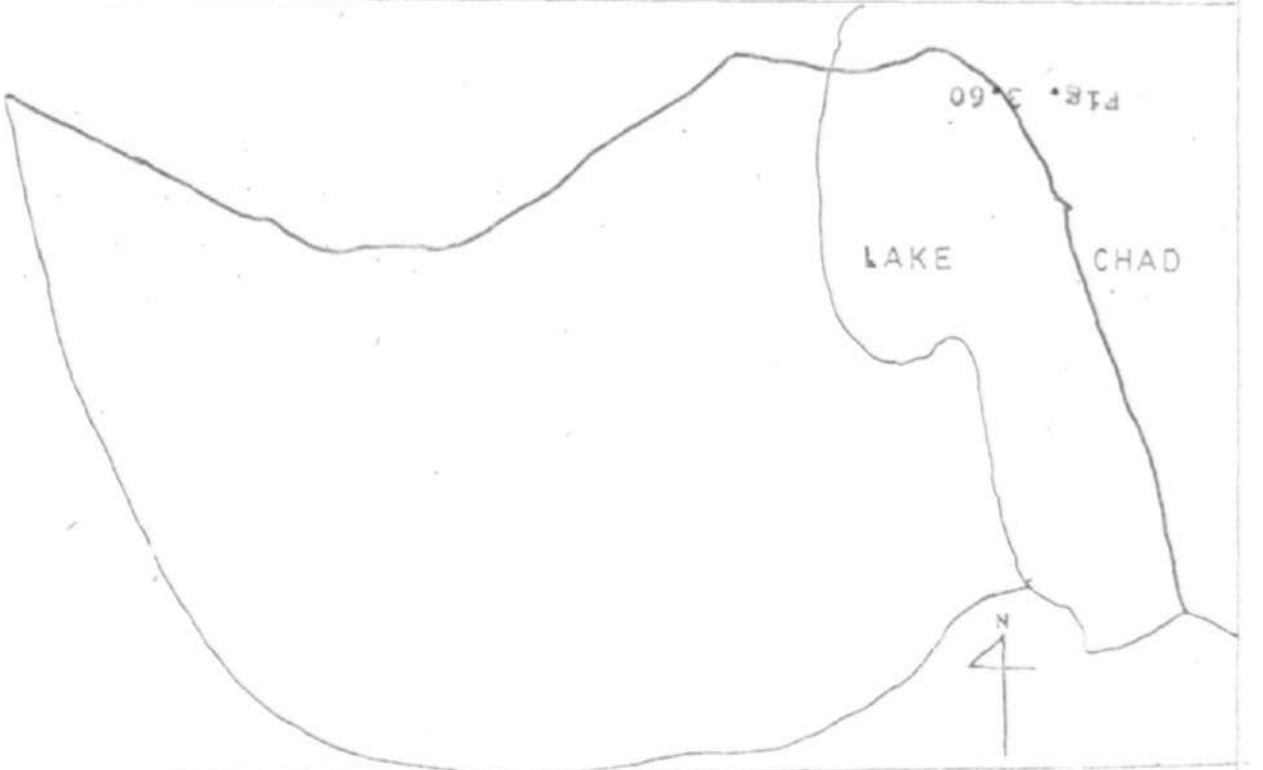
encroachment is seen in Northern part of Borno State (see Figure 3.60). The encroachment is expected to cover the whole State by the year 2163 (see Figure 3.70). Presently the area that is partially or completely under the threat of desert-encroachment include part of Damaturu, the whole of Geidan Dukawa and part of Monguno Local Government Areas (see Figure 3.80).

BORNO SHOWING THE DELINEATED AREA



SOURCE FIELD SURVEY SCALE 1:500,000

DELINEATED AREA OF DESERT-ENCROACHMENT



SOURCE FIELD SURVEY SCALE 1:350,000

BIYANKURAMA
U.R.P. THESIS
ABU ZARIA

Fig 3.60

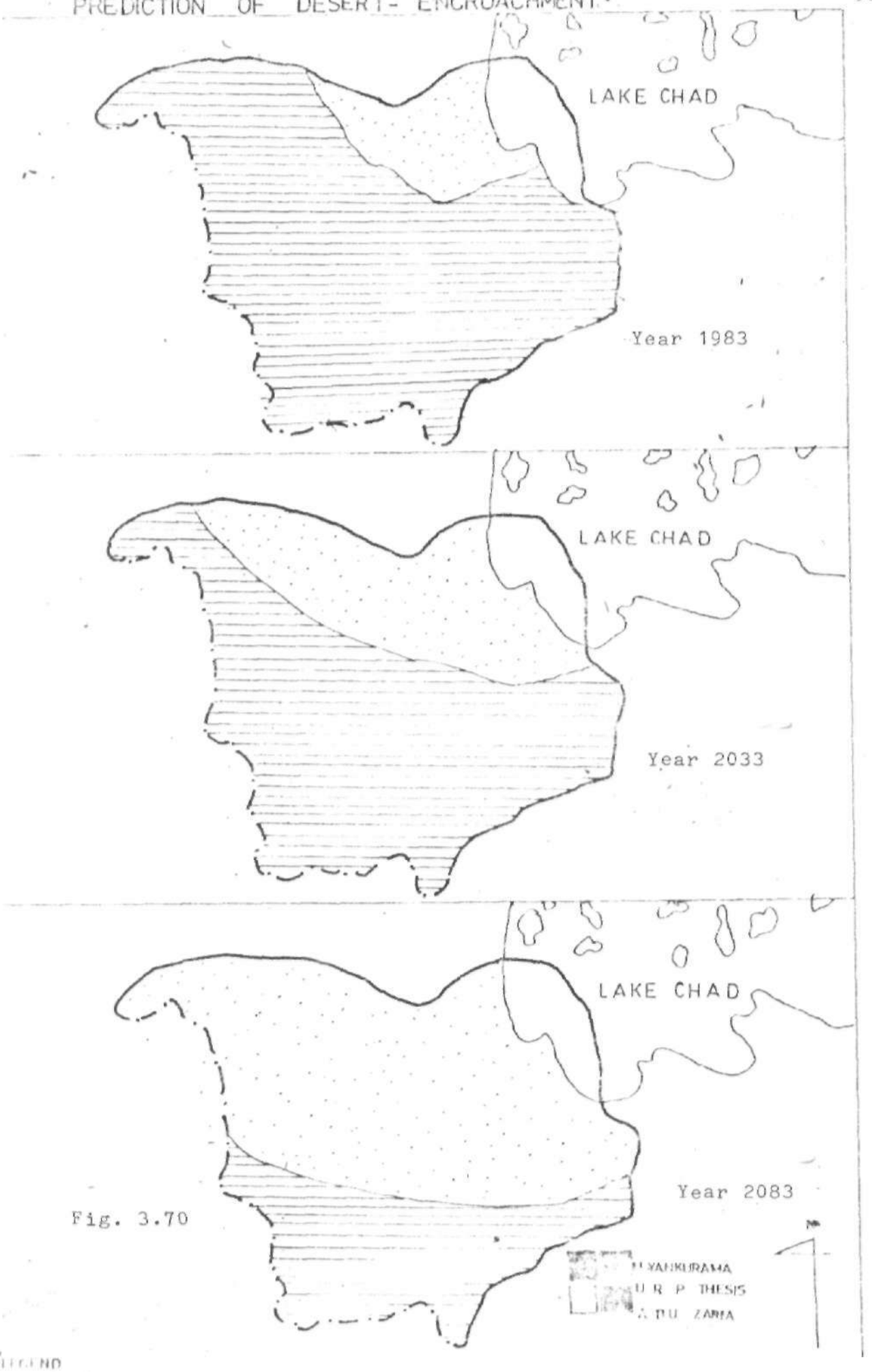

LAKE CHAD
Year 1983
LAKE CHAD
Year 2033
LAKE CHAD
Year 2083
LEGEND

Fig. 3.70

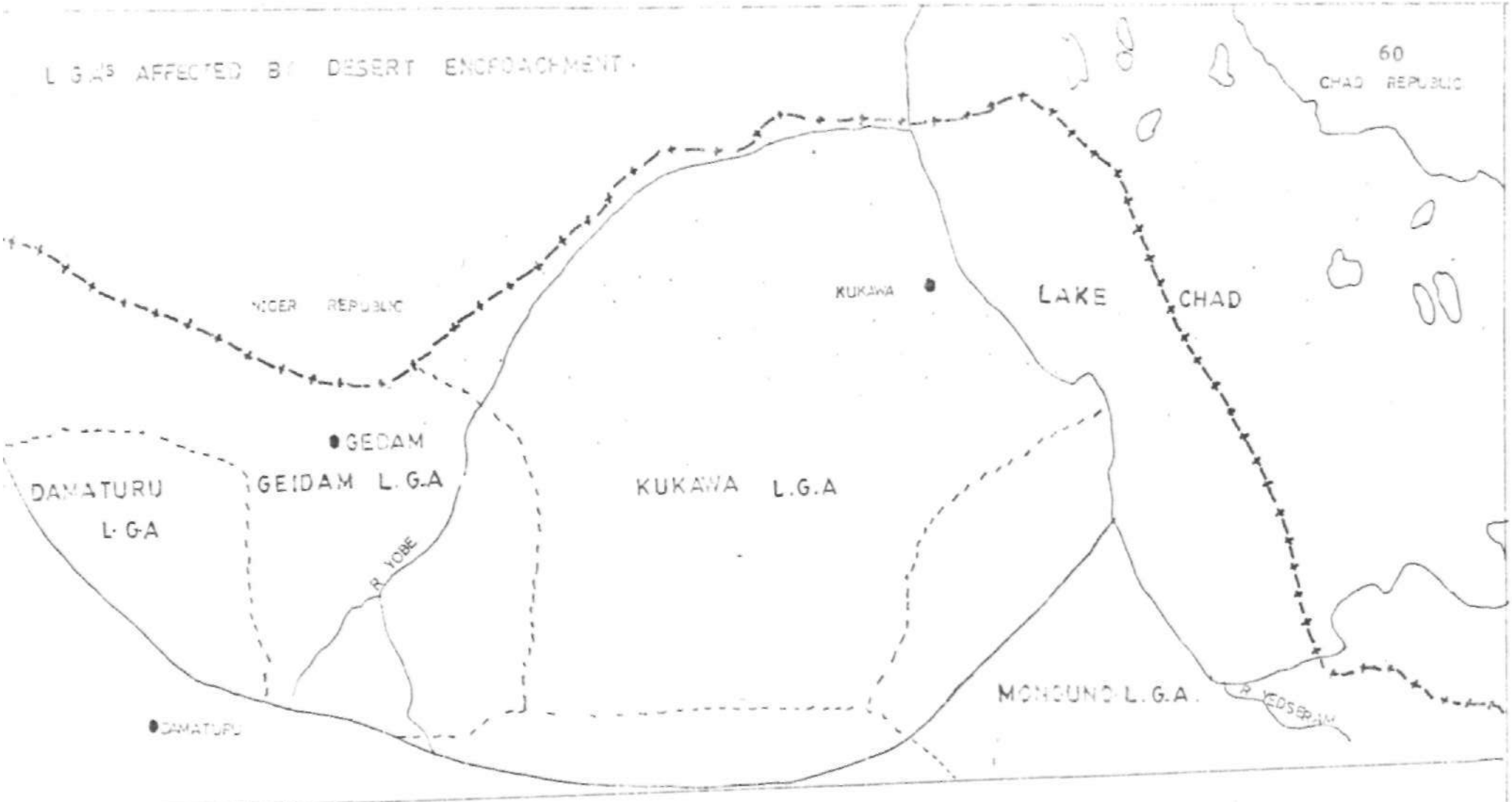


Fig. 3.80

SOURCE FIELD SURVEY

CHAPTER - FOUR

4.00 THE PHYSICAL AND SOCIO-ECONOMIC CHARACTERISTICS OF SETTLEMENT IN THE DELINEATED AREA

4.10 IDENTIFIED SETTLEMENT PATTERNS

There are three types of settlement pattern identified in the delineated area of desert encroachment. They are as follows;

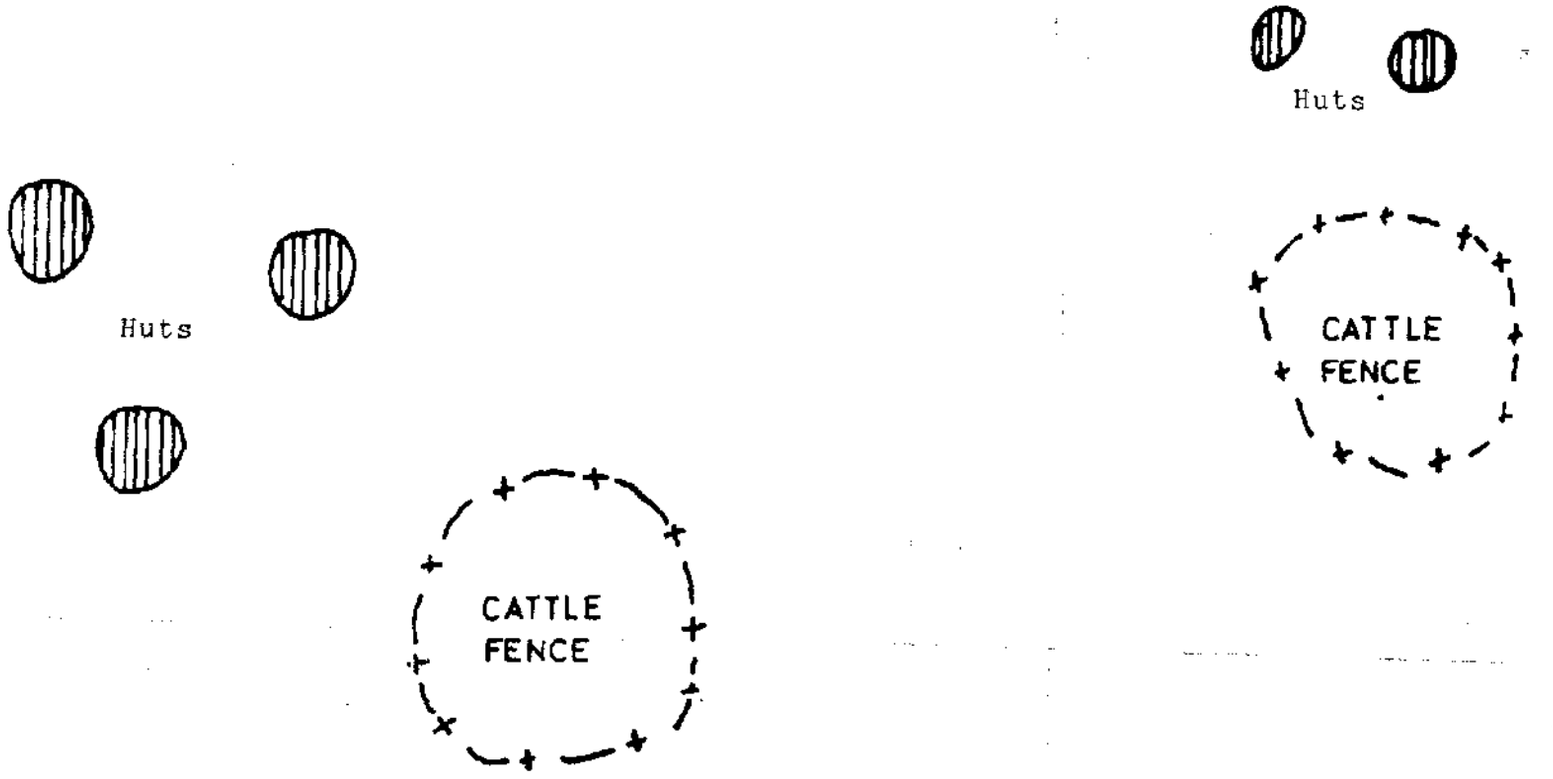
(a) Temperary Nomadic Settlement Pattern

This type of settlement consists of less than five household heads in a particular area. The location of these type of settlement is along water course. For instance along River Yobe, Yedzeram and Lake Chad. These settlements are temporary depending on the availability of pasture and drinking water. However, some settle on the harvested farm land especially in areas around Gubio and Gusari.

The structure of the settlement, (see Figure 4.10) consist of single thatched grass built by the children and their mothers for their own usages. Nigeria, the settlement of about 40 to 50 metres is a temporary and easy to make fence where the animals are kept.

NOMADIC FULAN SETTLEMENT

NOMADIC FULANI SETTLEMENT FORM



B YANKURAMA
URP THESIS 1987
A. B.U ZARIA

Fig. 4.10

As the settlement is so isolated from other settlements and as temporary as possible one would not expect a full functional relationship between the inhabitants and other people in a different settlement for some of their basic needs like money, food and where they could sell their dairy products. The other issue of the isolation is that the animals could cause distruction to farm lands. Table 4.1 shows the distance of Nomadic settlement to other settlement.

TABLE - 4.10 The Distance of Nomadic Settlement to Other Settlement

Name of Settlement	Distance in Kilometre
Bukari	2 Kilometres
Kasacia	1½ "
Cillima	1½ "
Damasak	2 "
Kariwa	1½ "

SOURCE: Field Survey, 1987.

(b) Isolated Village Settlement Form

This is a permanent settlement where the main occupation of the inhabitants are either farming

or herdsmen. (see Figure 4.20) shows the settlement form of Kariwa and Cillima. The number of compounds range from 20 - 30 as with Kalawa, Baimari and Babangida in Geidam Local Government Area. The Table 4.2 shows the number of compounds in each village.

TABLE -4.20: Number of Compounds in Some Selected Villages

Name of Village	Number of Compounds
Kalawa	20
Baimari	35
Babangida	15

SOURCE: Field Survey, 1987.

The internal structure of the compound gives the idea about the harsh weather conditions. All the houses are built with thick mud walls to help reduce the intensity of heat during the dry time. The roofs are also made of mud. There are instances where one sees thatched hut which serve as reception area (Zaure) located at the entrance of the gate leading to the compound (see Figure 4.30).

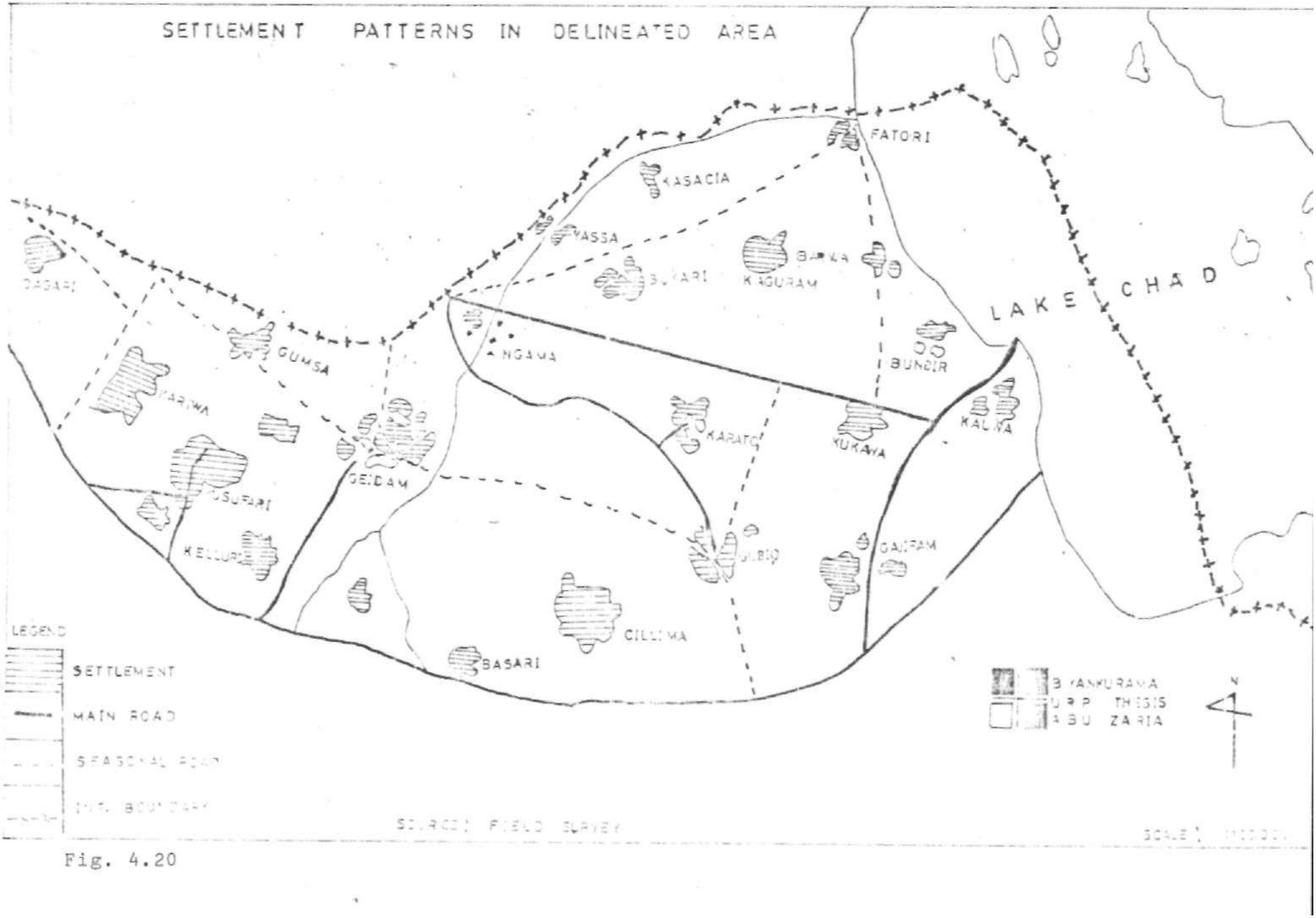

SETTLEMENT PATTERNS IN DELINEATED AREA
FATORI
KASACIA
YASSA
BUKARI
BARKA KAGURAM
DAGARI
GUMSA
ANGAMA
BUNDIR
LAKE CHAD
KARIWA
KARATO
YUKAWA
KALWA
GELDAM
KUSUFARI
KELLURI
GULBIO
GAUFAM
CILLIMA
BASARI
LEGEND
SETTLEMENT
MAIN ROAD
SEASONAL ROAD
INTL. BOUNDARY
BARKURAMA
UPP THISIS
ABU ZARIA
N
SOURCE: FIELD SURVEY
SCALE:

Fig. 4.20

TYPICAL HOUSE WITH TRADITIONAL COURTYARD

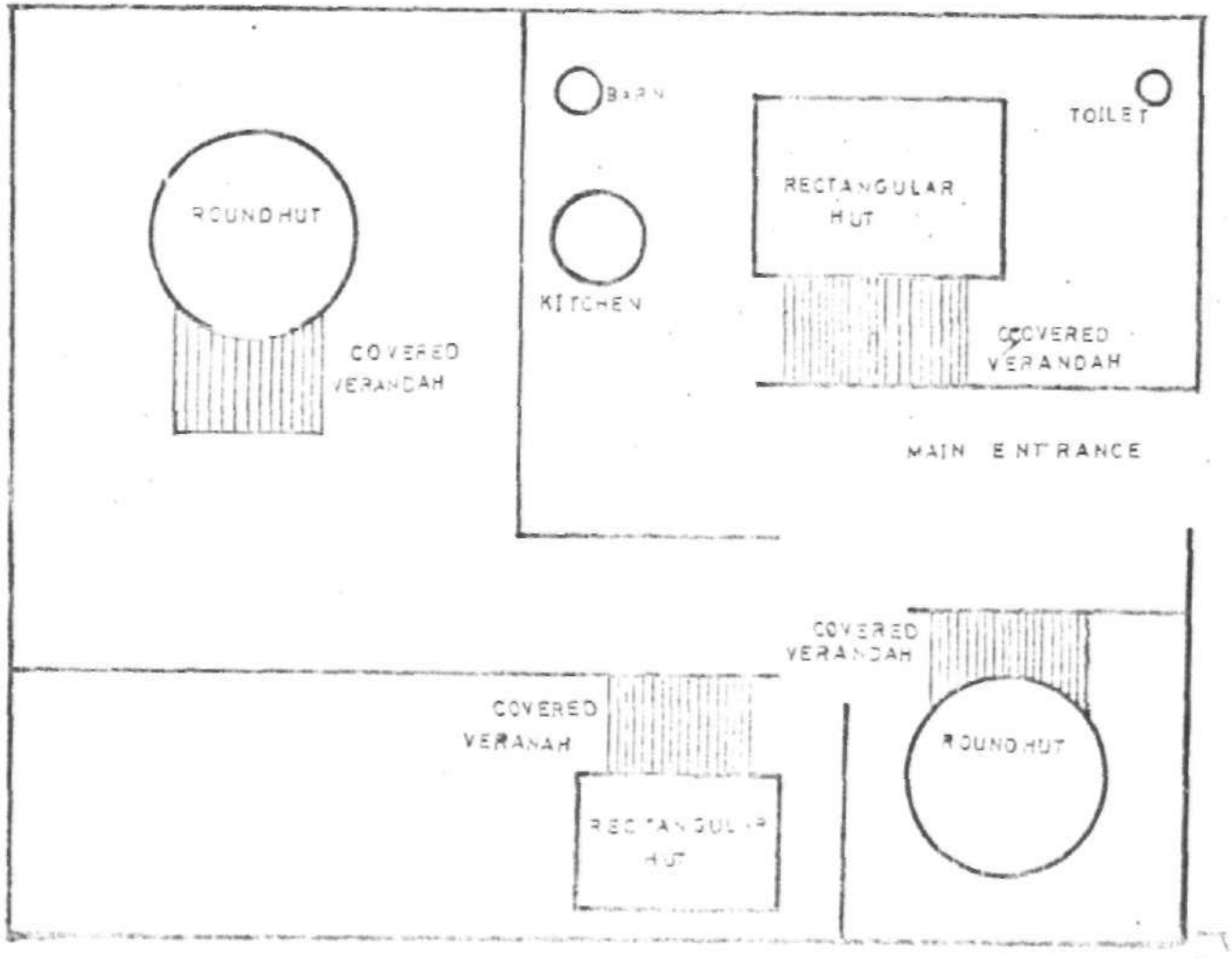


Fig. 4.30

(c) Clustered Permanent Settlement Form

Here the emphasis on modern technology like building materials (zinc and block), transportation facilities and involving in tertially activities have given rise to relatively large clustered metropolis that serve as important growth centres to the surrounding villages. These settlements function as the Local Government Secretariat and administrative Headquarters of the Local Government Area. Example are Geidam, Kukawa and Monguno

The internal structure of these settlements exhibit a unique characteristic. About 60 Per cent of buildings are block zinc, 25 Per cent are mud-zinc, while 15 Per cent are mud-mud. (see Table 4.3).

TABLE -4.30: Building Condition of Kukawa

Building Materials	Percentage
Mud-mud	15
Mud-zinc	25
Block-zinc	60

SOURCE: Field Survey, 1987.

4.20 THE IMPACT OF DESERT ENCROACHMENT ON THE SETTLEMENT FORM

About 324,482 families are now being threatened by desert encroachment. The people in this figure include Kanuris, Kwayams, Shuwa-Arab and the Fulanis. The increasing aridity manifested by the absence of enough rainfall for cultivation and decreasing pasture landslands for animal grazing explains in part some of the reasons for the changing settlement form (see Figures 4.40, 4.50 and 4.60).

In the field survey of five village settlements in the delineated area of study about 31.82 per cent have abandoned their houses and migrated to other areas (see Table 4.40).

TABLE - 4.40: Five Villates Affected by Desert Encroachment

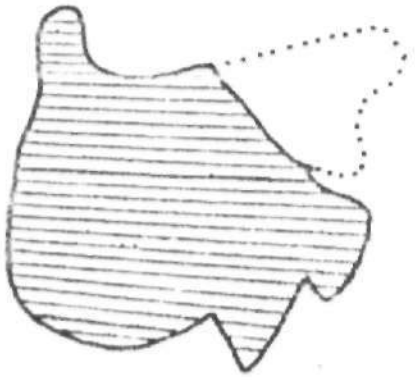
Name of Settlement	Number of Compound	Number of Compound Affected	Percentage
Bukari	85	13	12.35
Kasacia	47	5	2.35
Cillima	53	12	6.36
Damasak	101	20	2.20
Kariwa	40	8	3.20
	226	66	31.82

SOURCE: Field Survey, 1987.

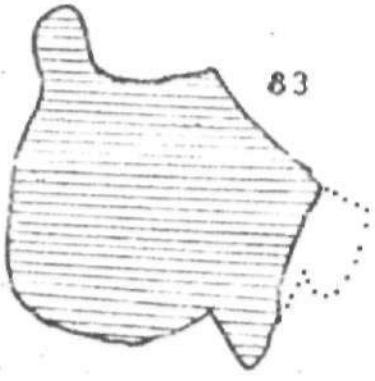
VILLAGE KARIWA



KARIWA VILLAGE



KARIWA VILLAGE



Legend

BUILT UP AREA

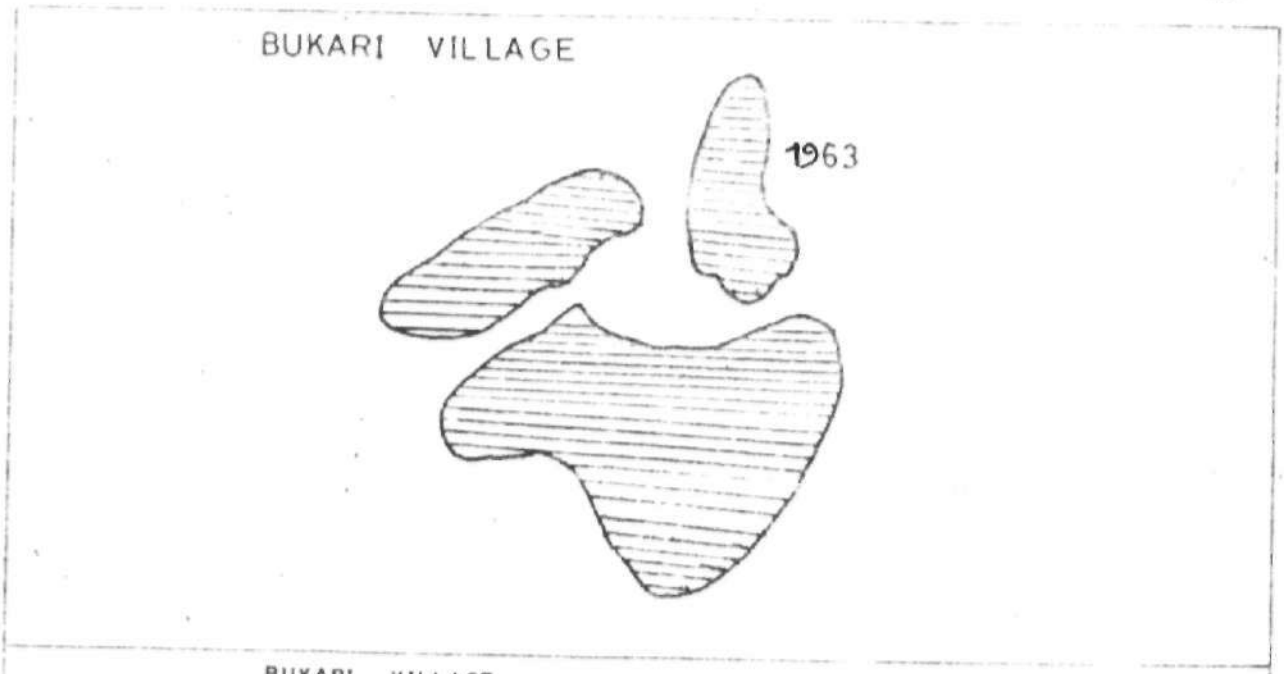
Evacuated

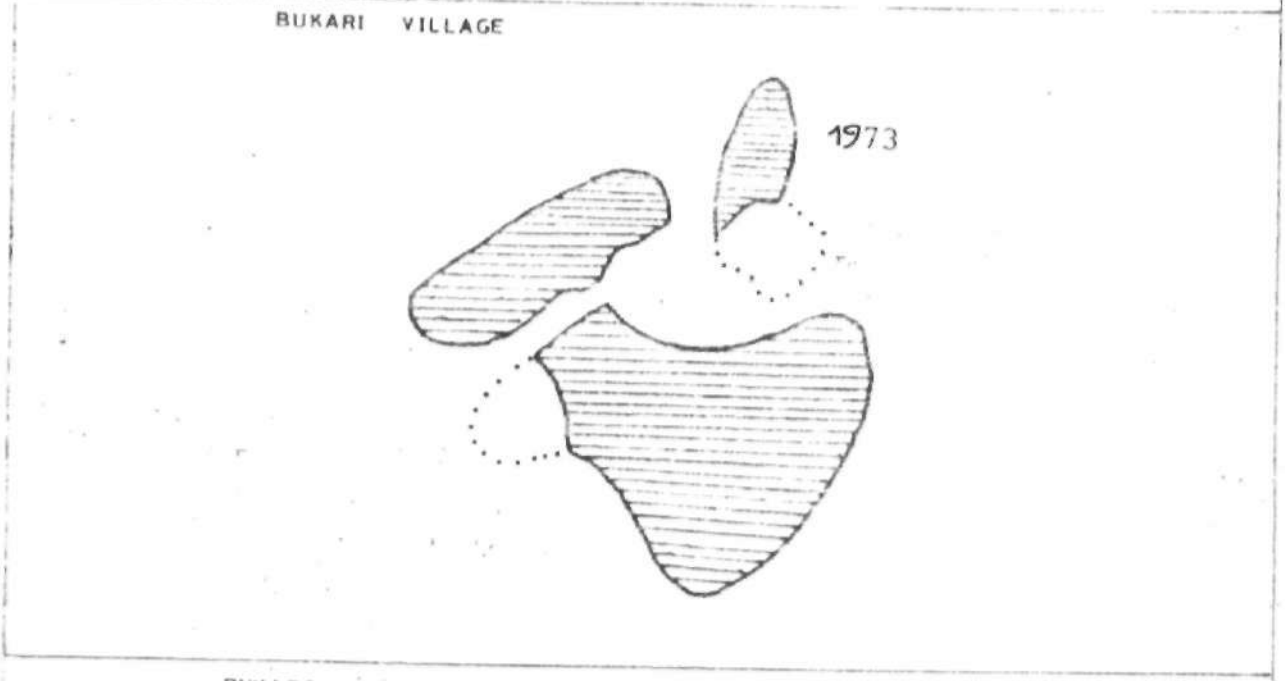
B YANKURAMA
U R P THESIS
A B U ZARIA

Fig. 4.40

SOURCE: FIELD SURVEY

SCALE 1500


BUKARI VILLAGE
1963


BUKARI VILLAGE
1973

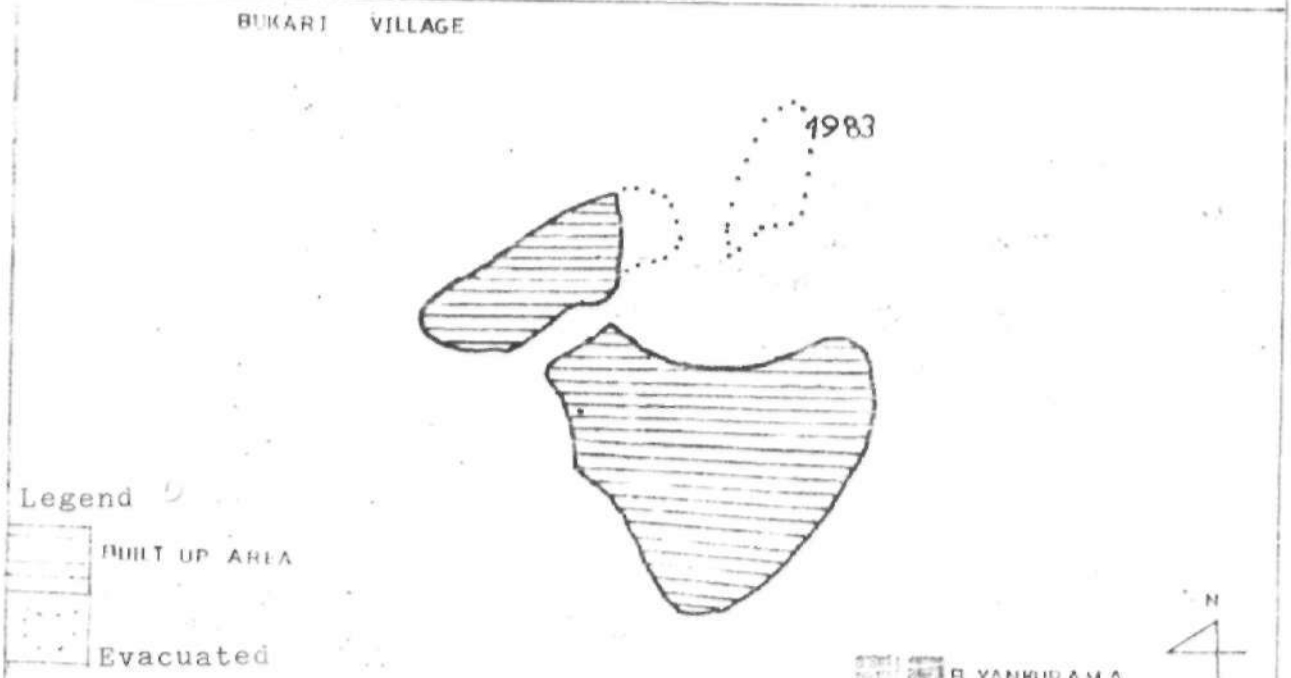

BUKARI VILLAGE
1983
Legend
BUILT UP AREA
Evacuated
N
B YANKURAMA
U R P THESIS
A B U ZARIA
SOURCE FIELD SURVEY
SCALE 1:500

Fig. 4.50

CILLIMA VILLAGE



1963

CILLIMA VILLAGE



1973

CILLIMA VILLAGE



1983

Legend

BUILT UP AREA

EXCAVATED



Fig. 4.60

SOURCE FIELD SURVEY

SCALE 1:500

In an investigation carried out in Biu, Gujba and Damboa Local Government Areas which constitute the receiving area. The following villages showed some Kanuri and Fulani migrants as seen in Table 4.50

TABLE -4.50: New Settlement Formation in Some Local Government Areas

Local Government Area	Name of Settlement	Number of Old Compounds	Number of New Compounds
Biu	Bumsa	52	10
Gujba	Balarafa	85	12
Damboa	Wawa	38	6

SOURCE: Field Survey, 1987.

4.30 THE IMPACT ON THE PHYSICAL ENVIRONMENT OF THE DELINEATED AREA

Over 64,120 square kilometres or 55 Per cent of the State total surface area is now classified as arid or semi-arid. In areas like Bedde, Geidam, Kukawa, Monguno, Ngala and Ngunu Local Government Areas the landscape offers a most bewildering scenery, reminiscent of threatened desert.

The fossil sand dunes between Maiduguri and Aregege Northern area of the State could easily be cited as possible source of dust origin from the Sahara especially where these fixed dunes had become deprived of vegetation due to anthropogenic consequences. During the drought disaster of 1968 to 1973, some parts of these sand dunes became mobile. This general reaction of the sand dunes which are covered with grasses and Acaisias would in effect mean a South-ward encroachment of the Sahara into the ecologically fragile Sahel zone desertification can take place even locally over a short period of time, if man's profound impact on the fragile ecosystem coincided with a period of prolonged drought - a scenerio witnessed in relation to the Sahel drought of 1970 - 1973, Thambyaphillay (1982) P.8.

4.31 Soils

The mobile sand dunes appear to be of acolian origin which deposits and drifts. There are three main soil types in this delineated area of desert-encroachment which are sensitive to desertification. These are as follows: (see Figure 4.70 and 4.80).

BORNO STATE SOIL CLASSIFICATIONS

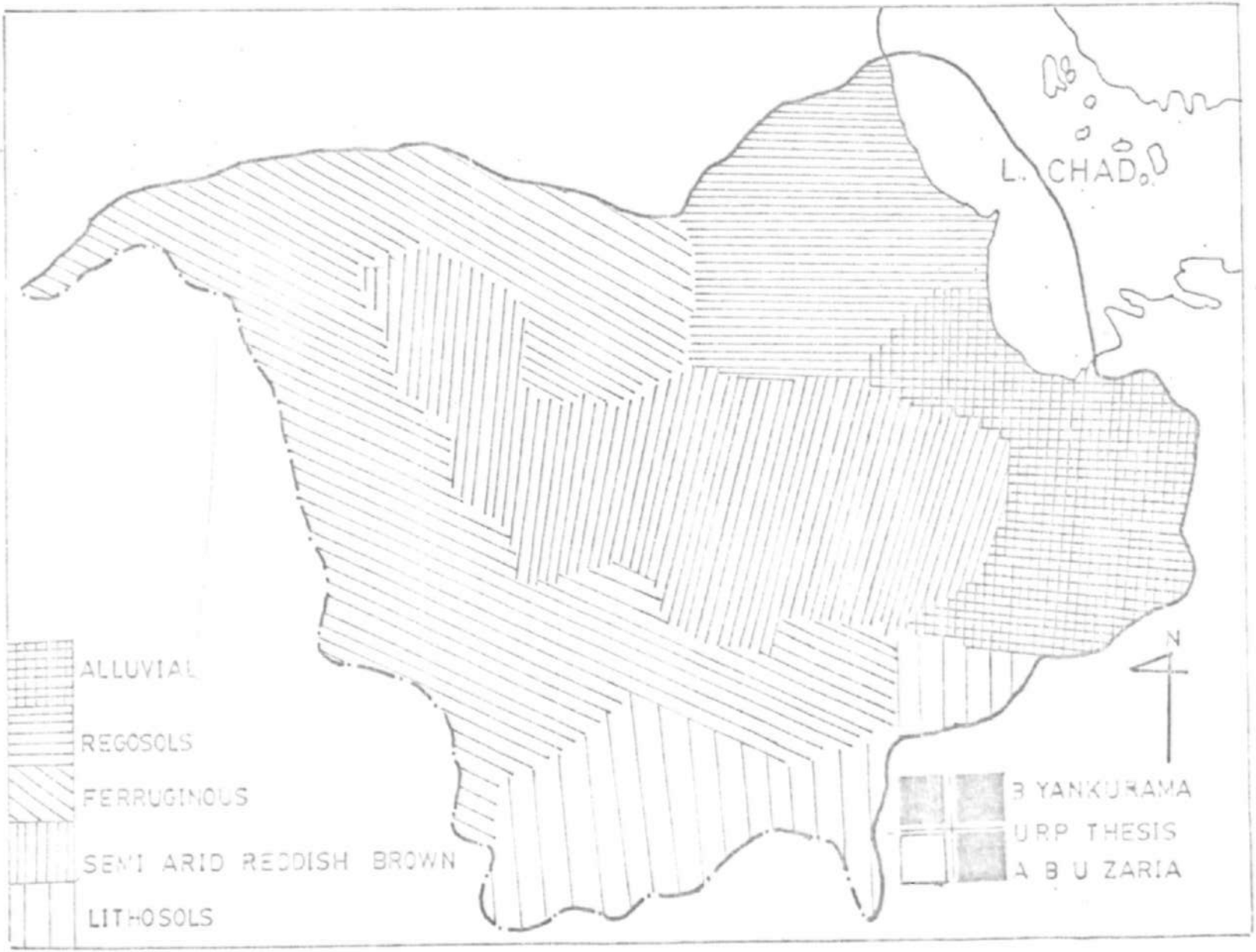


Fig. 4.70

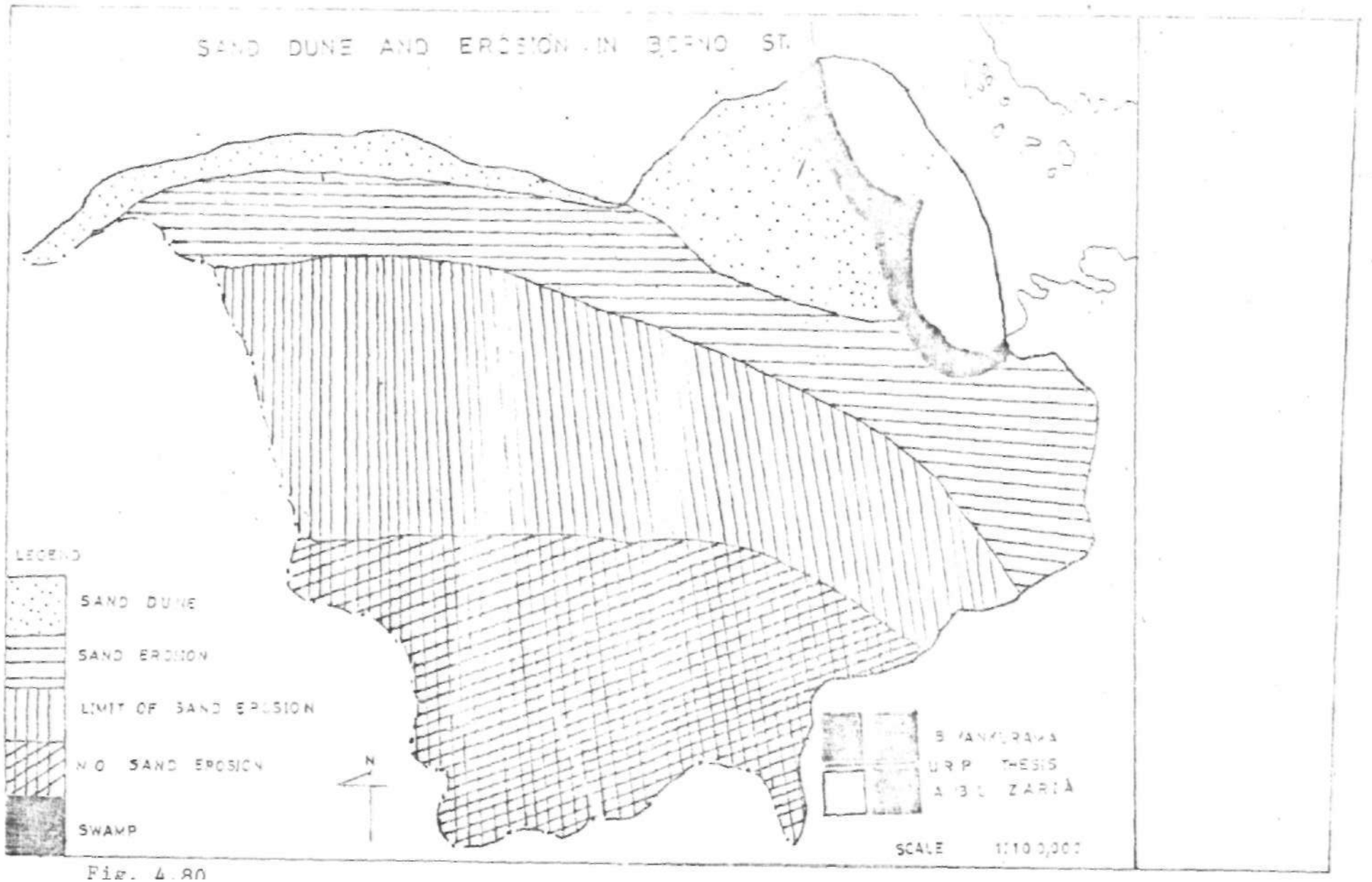

SAND DUNE AND EROSION IN BORNO ST.
LEGEND
SAND DUNE
SAND EROSION
LIMIT OF SAND EROSION
NO SAND EROSION
SWAMP
N
B. YANKURAMA
URP THESIS
A.B.U. ZARIA
SCALE 1:10 0,000

Fig. 4.80

(a) Alluvial Soils

This is very sensitive to drought and consists of salinity and alkalinity.

(b) Ferruginous Soils

Very sensitive to drought, poor water holding and wind erosion.

(c) Redish and Brownish Soils

These types have very low and inadequate moisture contains. They consist of low organic matter and have poor drainage which will not permit or encourage plant growth.

The past and present trend of the area extent of what was regarded as the mega chad partly explains the phenomena of desert encroachment.

The alarming contemporary spectacle of the Lake Chard's receding shoreline and its area dimensions have appeared to be of real concern. Indeed, when viewed in the context of the recent Sahel Drought (1968 - 1973) as related to fundamental changes in global atmospheric circulation pattern then the circumstance of a continuing desiccation is evident.

The chronological fluctuation of the Lake Chad could be seen below:

(a) 19th Century

i. 1800 - 1840s

High Lake levels were noted by the British explorer Denham (1826) for the years: 1823 to 1825 and with low corresponding low levels of the Lake in 1828 - 1839.

ii. 1850 - 1890s

Observations by Barth (1857) refer to high Lake levels during 1853 - 1855 causing undations of the shore region extending West-wards to be beyond Ngorno. Later observations have shown high level (1879 to 1889). The levels were above mean level of 282 metres.

(b) 20th Century

i. 1900 - 1940s

The turn of the century was marked by dramatic falls in Lake levels, viz; 1895 to 1910, probaly in 1908, when a dry Lake was reduced to a single Baga pool. The low levels may also be note in 1916 - 1918 and 1942 - 1944.

ii. 1950 - 1980s

Though during the 1950s, Lake levels rose with increased precipitation in the Sahel zone, the high water mark was reached during the short 1961 - 1964 spell, the highest Lake level for the century having been recorded in 1962 as 5.0 metres above the mean level of 282 metres. The notorious Sahel Drought (1968 - 1973) set in effect the dramatic falls in Lake levels, continuing in the 1980s. However, high levels were restored during the period 1974 to 1976 when rains returned temporarily to the Sahel.

These scenarios of the 19th and 20th centuries sh should allay the fears of a 'shrinking lake', in view of the evidence of lake level fluctuation sequences. This lake level have continued to 'fall' now for the past 14 years since 1969. This phenomena of shrinking lake is another available evidence that the Sahel drought was associated with fundamental changes in the circulation patterns in the entire belt of the low latitude. The further cause for alarm which has continued to assail the minds of people in the context of the fluctuation has that the period during low level

has never been compensated or return back to its position, Thambyaphillay (1979). For example, despite the remarkable increase in the 1950s and reached its highest in 1962 with and area extent of 30,000 square kilometres the Lake to this day has not recorded more than 13,000 kilometres. Indeed in 1980s (1986) the area extent of the Lake Chad is only but 10,000 kilometres. In 1987, the Lake's area extent has decreased by 70 kilometres. The common causative factor of fluctuation of the Lake Chad was cited as due to the Monsoonal Mechanism, which is correlated with the upper Westerlies and the sub-tropical anticyclonic migrations. It is envisaged that the levels of Lake Chad, situated as it is within the monsoonal anticyclonic interface zone should also reflect the demonstrated secular sequence.

The other factor is that a new concern has intruded itself upon the prospect of a shrinking Lake Chad. The abstraction of immense amounts of water from the Lake, following upon its utilization for irrigating the vast area of land under two projects, the South Chad Irrigation Project (SCIP) and the Baga Polder Project (BPP) is being visualised in the context of an already depleted Lake. The water used for these projects would inevitably result in serious short-falls

of Lake levels and consequent diminition of its surface. The alarm is then greater when viewed against a lowering and levels since the 1960s.

However, in 1979, was a commissioned an ambitious project to provide irrigation water for 67,000 Hactare (170,000 acc.) designated the South Chad irrigation project (SCIP). Up-to-date it is the first stage that is presently in operation. This involves the abstraction of Lake water by means of a 38.3 kilometres long in-take channel, which commencing from the Baga Pool. The Baga Polder Project (BPP), the second largest schemes to use water directly from Lake Chad, was inaugurated in 1982. Water for irrigation of the project is drawn from the Lake by a 13.5 kilometre long in-take channel, commences from within a deep part of the Baga Pool. It is to irrigate 20,000 Hactare (50,000 ac.).

Naturally, fears were expressed that the abstraction of immense amounts of water from the Lake to provide for irrigating the combined area of 87,000 Hactare (218,000 ac.) under the two projects would result into disastrous effects up the Lakes level and its area extent. This was especially so in view of the shallowness of this water body - a mean depth of 3.0 metres.

Also it is estimated that evaporation from the Lake approximately balances the in-flow from river discharge and precipitation. This is estimated to be about 80 Per cent.

4.32 Rainfall

The rainfall trend also explain in part, some of the reasons for desertification in this area delineated. Thus, a decreasing availability of water, increased sand dunes deposition and a progressive degradation of the vegetation which are observable today all are indicating the general increase of aridity. The increasing aridity could be best traced to the number of years where the whole Sahelian region of Western Africa was caught up in the disaster of drought (see Table 4.[illegible]).

During the drought years, cloud of sand-storms (usually mistaken for clouds of rain) constantly hovers in the sky having got dark and thick enough as to make visibility almost impossible. Even when the rains come, it comes late and sporadically. This late arrival has further hastened the threat of emminent hunger and starvation. Even when the rain comes as early

TABLE -4.60: Years of Sahelian Drought

From	To
1888	1889
1891	1892
1900	1903
1911	1912
1918	1919
1929	1931
1937	1940
1943	1944
1948	1950
1954	1955
1957	1958
1960	1961
1968	1973

SOURCE: Adapted After Thambyaphillay, 1982, P.18.

as April as it did in 1976, it could not make up the short full of the 1968 - 1973 drought years (see Table 4.70).

From 1979 to 1983, rainfall trends critically showed the threshold far below the 250 millimetres when one looks at the mean annual

TABLE - 4.70: Monthly Rainfall of 1976 of Some Selected Stations

Station	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Malamfatori	00	00	00	1.4	6.5	20.4	73.1	74.8	51.2	1.3	00	00	228.7
Yau	00	00	00	6.0	5.1	44.1	53.1	163.2	227.1	00	00	00	498.6
Damasak	00	00	00	5.5	12.2	12.2	117.7	215.8	34.6	4.0	00	00	391.8
Geidam	00	00	00	1.1	10.7	44.7	119.7	185.0	60.8	4.3	00	00	426.3
Nguru	00	00	00	8.6	39.4	33.1	197.7	164.5	61.7	3.6	00	00	508.9
Mongunu	00	00	00	14.8	35.8	35.8	145.3	158.2	73.6	10.0	00	00	428.6

SOURCE: Thambyaphillay (1979, P.5.

variations. The total mean is obviously above 250 millimetres for five years put together. (see Table 4.801).

4.33 Temperature

In terms of temperature, there has not been enough record. However, the little available shows that temperature in the delineated area under desert encroachment like the Geidam and Kukawa stations, temperature ranges from 35°C to 40°C. It should be noted that the harmattan winds being the dust and the sand dunes.

Thus, in a summary, although data on rainfall and temperature are deficient as their records have not been kept systematically for long time to explain the inavailability of water in this delineated area. The changing levels of river beds like the Yobe and Yedzerma and the fluctuation and formation of the present Lake Chad levels shows all the natural consequence of an encroaching Sahara into the marginal land designated the Sahel.

Indeed there is an ample evidence that pre-historic man hunted and lived here where it would have been impossible for him to do so today.

TABLE - 4.80: Mean Annual Rainfal of 1979 - 1983

Station	Year 1979	Year 1980	Year 1981	Year 1982	Year 1983	Years 1979-83
Sahel Zone						
Yau	615.7cm	190.3cm	163.2cm	149.2cm	118.9cm	279.6cm
Kukawa	398.6cm	288.1cm	223.1cm	169.1cm	224.9cm	269.8cm
Sudan Zone						
Gashua	464.8cm	481.1cm	408.9cm	438.4cm	200.0cm	447.1cm
Monguno	526.4cm	299.6cm	302.8cm	194.4cm	93.7cm	330.8cm
Southern Guinea						
Biu	885.6cm	974.8cm	858.3cm	741.9cm	594.9cm	865.1cm
Gwoza	675.0cm	645.6cm	100.3cm	866.8cm	604.5cm	797.7cm

SOURCE: Thambyaphillay, (1984) p.13.

His occupation in the past can be associated with periods of humidity which were known to have occured during the Quatnary period but can now be dismissed as having little bearing upon the present settlements as dictated by the present climatic phase.

4.40 SOCIO-ECONOMIC CHARACTERISTICS OF INHABITANTS OF THE DELINEATED AREA

The Sahel region of Nigeria found in the North Eastern corner of Borno State, the area now under the threat of desert-encroachment is the largest producer of livestock in the country. It supports 3.5 million herds of cattle, 2.0 million sheep and 1.7 million goats (Vangaurd, December, 1987). However, in recent times, 25 to 30 Per cent are lost due to drought and the decreasing pasture conditions.

In 1968 and 1972 to 1975, the total mortality of animals has increased. (see Table 4.90)

In terms of agricultural production, about 428,439 tonnes of assorted grains which represent 32.5 Per cent were lost to drought and desertification in 1987 (Guardian, December, 1987). About 319,263 tonnes (24 Per cent) is destroyed by the desert Grasshoppers, Locusts and Quelea birds. These loses

BORNO STATE LIVESTOCKS DISTRIBUTIONS

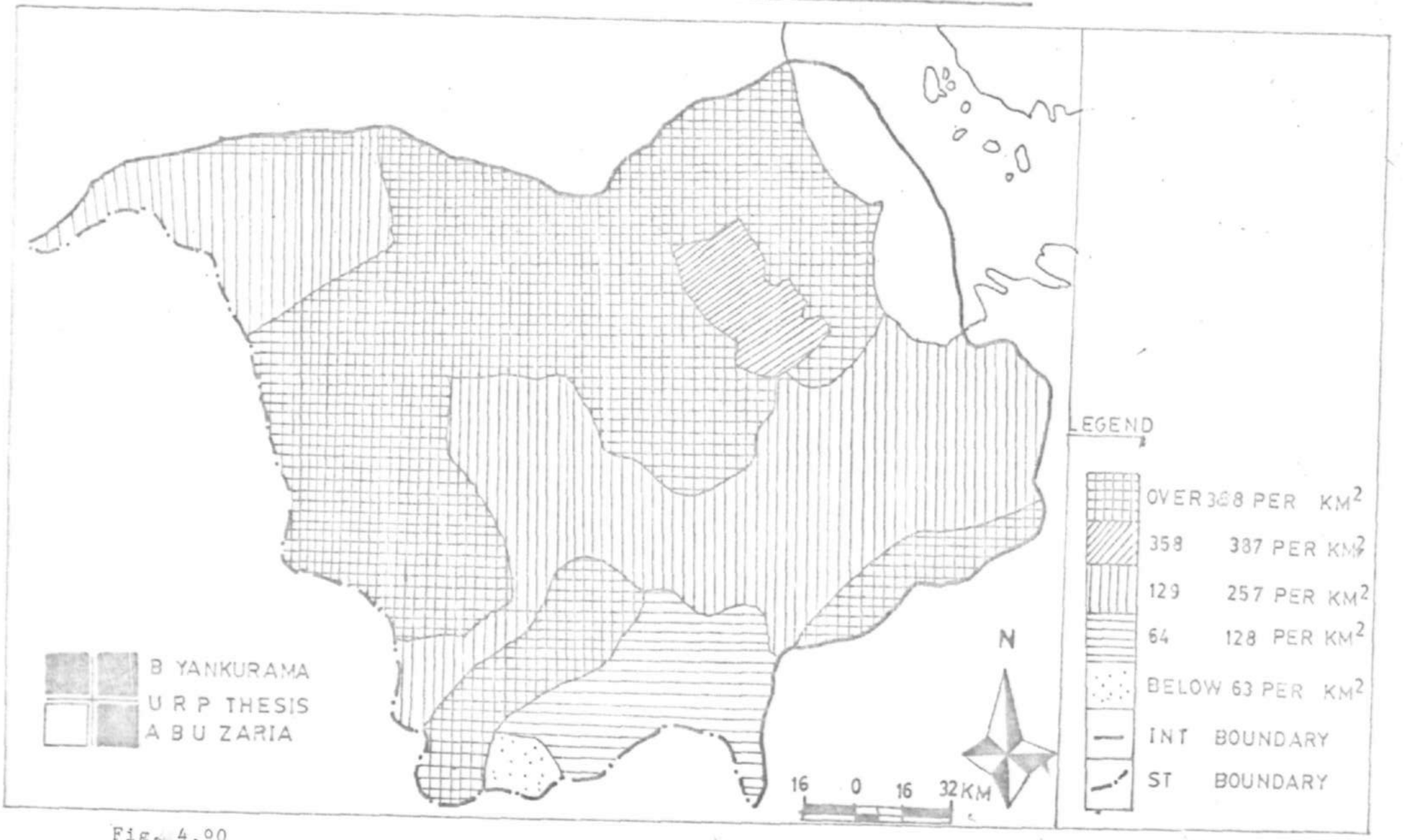


Fig. 4.90

TABLE - 4.90: Loss and Gains of Animal in 1968 and 1972 - 1975

Category of Animals	Year 1968	Year 1972 - 1975	Loss or Gain	Loss or Gain
Cattle	50,648	26,733	-23,915	-47.2
Sheep	16,659	12,895	-3,764	-22.5
Goats	63,236	50,615	-12,621	-20.0
Horses	6,066	2,517	-3,549	-58.5
Monkey	4,390	2,987	-1,403	-31.9
Camels	4,227	4,472	+444	+10.5

SOURCE: Apeldroom, (1978), P.26.

of grains is not new because in 1980 this disasterous problem had once again affected Borno State Sahelian Region. (See Table 4.109)

It can therefore, be seen that the destruction of crops, the high mortality rate among animals and the environmental degradation in this fragile land delineated under desert-encroachment cannot be over emphasized. Thus, a quick and timely remedy is required to check the phenomena of desert encroachment otherwise the situation should be better imagined than seen.

TABLE - 4.100: Food Surplus and Deficit of 1980

Category of Crops	Supply in '000 Tonnes	Food Surplus or Deficit '000
Millet	1,953	-1,051
Guinea Corn	2,774	-11,913
Beans	801	+60
Maize	1,065	-300
Yams	6,808	+383
Cassava	9,744	-4,261
Cocoa-yams	1,039	-1,717

SOURCE: Apeldroom (1978), P.27.

CHAPTER - FIVE

5.00 PHYSICAL PLANNING PROPOSALS AND IMPLEMENTATION OF STRATEGIES

5.10 REVIEW OF STRATEGIES TO CONTAIN DESERT ENCROACHMENT

The main obstacle to the development of arid zones and areas threathened by desert-encroachment has been the lack of proper strategies or the lack of human and material resources needed in the implementation of such. Furthermore, government policies and strategies towards the problem of desert-encroachment is recent dating back to 1977. By 1977 effort towards combating desert encroachment was made in the following areas;

(a) A Committee on Arid Zone Afforestation was formed by the Federal Military Government. The Committee by had representation of professionals in fields like forestry, agriculture, economics and administration. They were to review further some of the serious thoughts being given to the phenomena of desert-encroachment in some parts of the Northern States of Nigeria. These States were namely; Bauchi, Borno, Kaduna, Kano, Plateau and Sokoto. The overall objectives were to arrest and

eventually reverse the environmental degradation caused by the encroachment of the Sahara desert.

The Committee was also charged with the responsibility of evolving a concept and philosophy which would emphasise the need for total mobilisation and utilization of national resources in the context of self-reliance. They were to evolve a strategy and action programme in order to tackle the problem of desert encroachment. The Committee was to formulate, oversee and co-ordinate the execution of a programme for the afforestation of the arid zones of the region and develope on the policy with time if necessary for the improvement of the programme. It is also charged with the responsibility of educating the people in the affected states on the need to get themselves involved in the execution of the programme.

Funds were received through the Federal Department of Forestry and direct allocations were made to the affected States not in the form of grants but rather payments were made for services rendered on the projects.

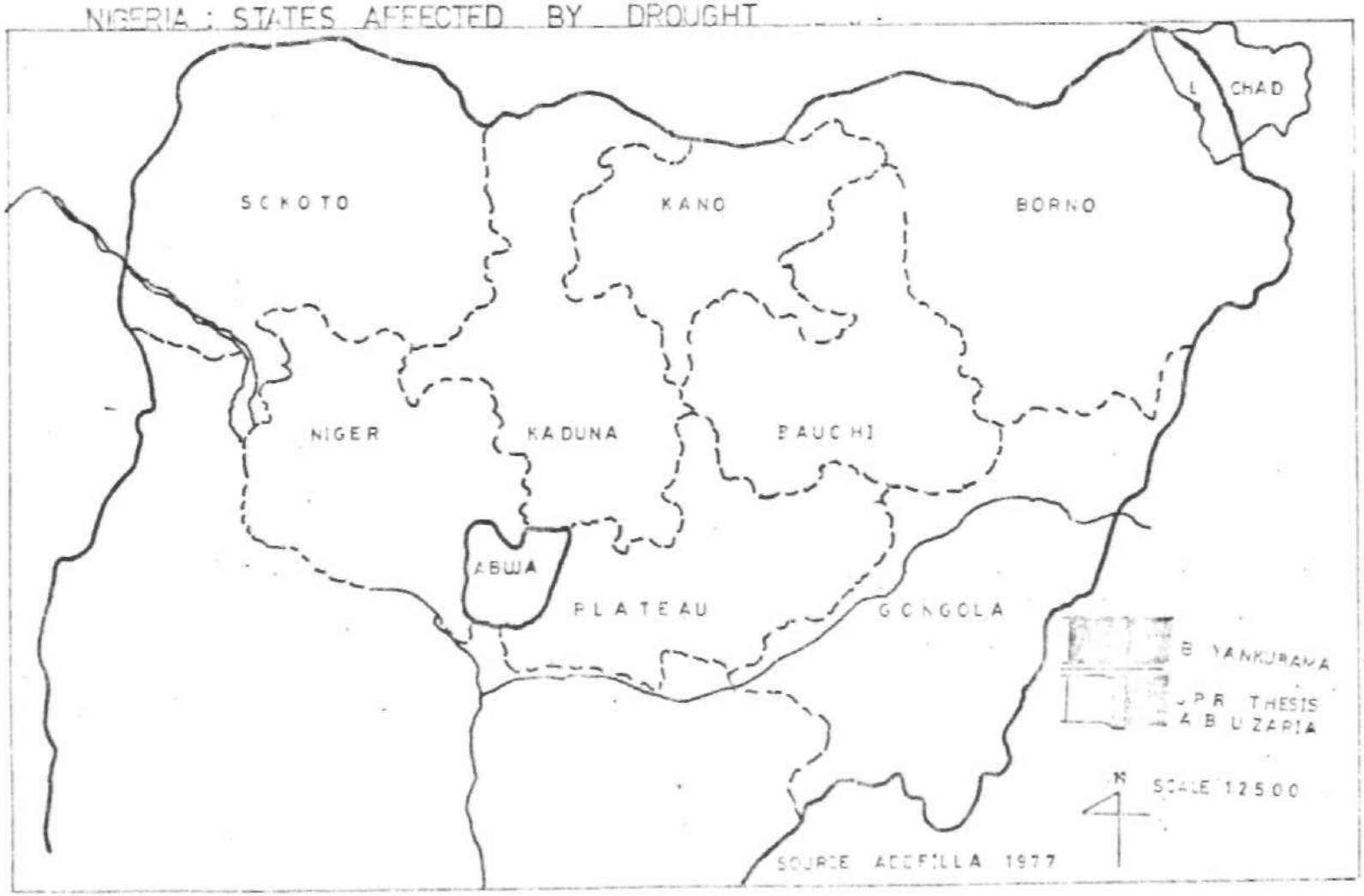

NIGERIA : STATES AFFECTED BY DROUGHT
L. CHAD
SOKOTO
KANO
BORNO
NIGER
KADUNA
BAUCHI
ABUJA
PLATEAU
GONGOLA
B. YANKURAMA
UPR THESIS
ABUZARIA
N
SCALE 1:2500
SOURCE ADEFILLA 1977

Fig. 5.10

In Borno State, forestry nurseries were established at strategic locations. Each nursery was fenced and supplied with one complete set of irrigation equipment as well as vehicles to facilitate the evacuation of seedlings during the planting season. Each nursery was targeted to raise 250,000 seedlings. While these targets were achieved in most the nurseries, there are some that could not meet up due to various constraints, the major one being inadequacy of water supply.

The distribution of the nurseries and the number of seedlings raised in each nusery is seen in Table 5.1 below.

(b) Establishing of Shelter Belts

In 1976, the Ministry for Agriculture and Natural Resources in Borno State pursued a new management approach to forestry development. The ministry has boasted of seedlings production from 500,000 to a record of 1,000,000 per annum, National Concord (15th March, 1988).

In the same vein 70 kilometres of shelter belts have been established in seven locations in the State with a borehole. There is also the

Table - 5.1: Nurseries Location and Seedling in Some Local Government Areas

Local Government Area	Location	Number of Seedling Raised
Kukawa	Kukawa	92,500
Kukawa	Malamfateri	146,000
Monguno	Monguno	185,000
Dikwa	Ngala	106,000
Kaga	Benisheik	118,000
Nguru	Nguru	280,000
Nguru	Kaska	51,000
Geidam	Bukarti	80,000
Geidam	Yunusari	60,000
Damaturu	Damaturu	218,000
Damaturu	Bulatura	74,000
Total	11	1,410,500

SOURCE: National Committee on Arid Zone. Afforestation, Annual Report, 1979 - 1980.

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establishment of 104 village woodlots out of 545 village units proposed in the State. Elsewhere communities and post-primary institutions have been assisted by the State Government in setting up block plantations - a forest resource centre has been established to research on the best tree species for future planting.

In 1987, two edicts were enacted by the State Government banning bush-burning and indiscriminate distruction of trees. To achieve these two edicts, the State Government has procured and is to distribute cookers and stoves on a hire purchase basis to the people of the State. When this is achieved, the State Government will enact a new edict to curtail the use of firewood by institutions, hotels, bakeries and restaurants. They are to switch to other energy sources-fuel namely, gas and kerosine.

(c) Improvement and Acquisation of Varieties of Seeds that are Drought Resistant and Early Maturing

This is distributed to local farmers. To facilitate this, a very close relationship has been established between the Ministry of Agriculture in the State and Research Institutes -

Agricultural Extension Research Liason Services (A.E.R.L.S.) in Zaria, the Lakechad Research Institute in Maiduguri and other national seed services.

In this line two autonomous Boards have been created to embark on large-scale seed multiplication projects for the benefit of local farmers. These are Borno Accerelated Development Agricultural Projects (BOADAP) and South Borno Agricultural Development Project (SBADAP).

(d) Provision of Hay and Fodder for Livestock

A total of 30,000 bales of hay and fodder were sold to livestock owners at subsidized rate annually during drought and dry season periods. In 1986, a survey was conducted on all grazing reserves within the State in order to physically ascertain the facilities available and those that require servicing. Of the 68 reserves identified, about half have been gazzetted for future development. To further lessen the problem of the nomads and herdmen, some of the bore-holes and ponds that would guarrantee enhanced water supply to livestock in the arid areas are now being reactivated.

(e) Master Plan for Irrigation

In recognising the importance of water, a master plan has been drawn up on irrigation development. The master plan has three main components:

i. Short Term Component

This is to rehabilitate all existing irrigation schemes in the State particularly those in the desert threatened area and setting up new ones at a cost of about five million naira (₦5,000,000·00).

ii. Medium Term Component

This is devoted to 13 minor irrigation schemes through consultancy services (e.g., with Ahmadu Bello University, Zaria).

iii. Long Term Component

This is where huge irrigation areas are to be developed, sequel to the completion of the three proposed water transfer projects - from River Haul to River Yedzeram, from River Dindima to River Jama'are to River Yobe and from River Congo in Zarire Republic to Lake Chad.

All these are to complement the programme of the Lake Chad Development Authority. The last component which cut across other countries and States cannot be achieved without their co-operation.

To finance all these projects, there is now in place a sum of ₦200,000,000·00 (two hundred million naira) loan from the European Economic Committee (EEC) assisted programme aimed at alleviating drought and desertification the State.

5.20 PROBLEMS FACING THE IMPLEMENTATION OF STRATEGIES

The Federal and the State governments who drew up the policies and strategies succeeded in the provision of relief materials rather than implement the proposed strategies. The ritual tree launching campaigns every year at the cosy comfort of Abuja and State Capitals have been more of media reports than actual things being done. Indeed this mock syndrome were not launched in areas actually affected by the desert encroachment. Even when that of 1986 launched in Gubio where a total of ₦14.5 million was "dished" out from the ecological problems fund, little was achieved practically.

5.30 TYPE OF STRATEGY FROM OTHER COUNTRIES OUTSIDE NIGERIA

5.31 SUDAN

In the Southern Sudan there is what is called the NUER strategy. Here villages are spilt out into small units or camps, particularly for grazing consisting of people from two to three house-holds.

5.32 KENYA

A typical settlement consisting of four to seven house-holds situated close to water hole is planned in the North Western part of the mountain Kenya. In order to optimise land-use and safety, each family divides up its herds into two parts. The best grazing grounds near the settlement are used by the subsistence herd, which provides the house-hold with milk. Animals not immediately needed for milk go to the dry herd, which graze further away as to avoid over-grazing in the vicinity of the settlement for 2 to 3 weeks. This strategy is called SAMBURU strategy.

5.33 ISRAEL EXPERIENCE

One of the most thorough and wide ranging projects in the field of Regional Climatic Planning has been carried out in the Jordan Valley for the past ten years

in Israel. Here three stages of planning were applied. That is planning with climatological information and construction begins with the regional stage through the stage of settlement location and right down on to the functional planning and even the detailed laying out of neighbourhoods and the houses within them.

At the regional stage, more than fifteen climatological stations were set up in each one of which observations were made for a period of four years. There are specific climatic parameters required for the Developmental Phases. See Fig. 5.20 . Based on this then the second and third stages are planned and executed.

Israel use a heat stress formula to design and built Jerusalem. Here settlement were built in dense clusters in order that walking distance in the burning sun and summer heat were reduced to a minimum. Likewise in order to offer maximum shade for pedestrians, narrow streets were constructed some of which were covered over-head and some of which earn their shade from the walls of the houses on either side of the passage ways. The walls are very thick, about two metres at times which retarded the transfer of heat inwards and ensure

PLANNING ACCORDING TO CLIMATIC CONDITIONS

ISRAEL

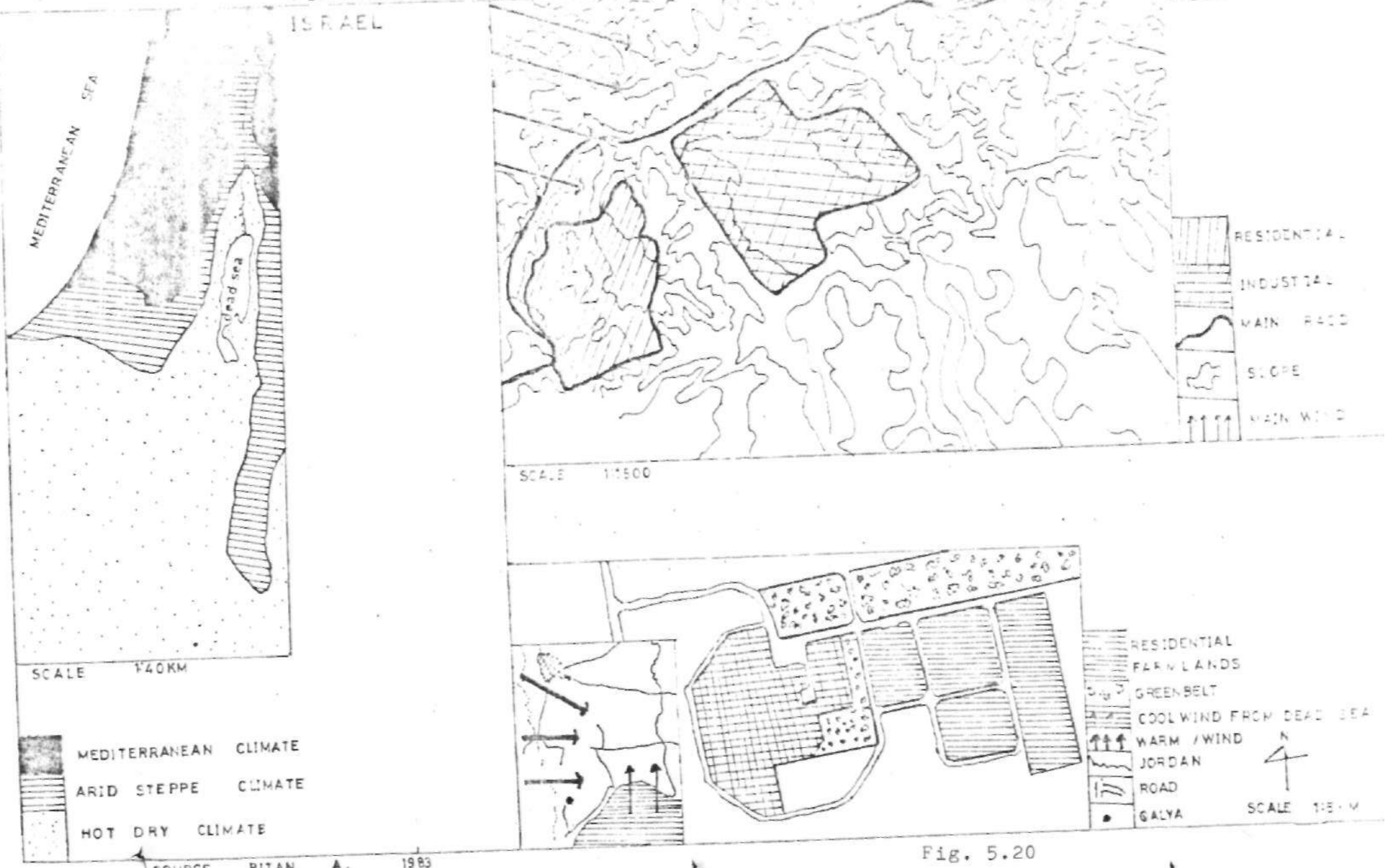


Fig. 5.20

a cool interior during the day light houses. In addition a formidable proportion of the houses were built around an interior court-yard, a part of which was always shady. There is a distinction between offices and public buildings, between structures in which there is a activity throughout the day and those in which people pass time primarily at night.

5.40 PRINCIPLES FOR PLANNING OF SETTLEMENTS IN DESERT ENCROACHED AREAS

Study of the limitations and potentialities of arid zones would lead one quickly to the conclusion that a sophisticated planning process and an innovative and unique solution to the problem of desert encroachment is required. The planning process should be a multi-faceted one. Unlike the traditional approach of migrating and sending in relief materials to the disaster affected areas of desert-encroachment, the new planning process should be comprehensive. Golany,(1978) rightly said "our study, planning and implementation processes should include the social, economic, physical and administrative principles of planning". Thus, a physical planner should take into consideration other related professionals in drawing out a workable policies, strategies and implementation.

In areas already threatened by desert-encroachment like the delineated area of study in Borno State, physical planning principles should include the following:

(a) Location of settlement in relation to the prevailing winds.

(b) Distance between settlements should be minimal to reduce heat and distances to be covered.

(c) Layout and construction of houses to include traditional court-yards.

(d) Settlement to be situated and sited near an existing water source or where the exploitation of such will be enhance.

(e) In addition to adapting dense clustered pattern of settlement, roads and other circulation patterns should be relative narrow and if possible shaded by trees if not covered.

(f) House construction to be done with thick mud walls to reduce heat transfer.

(g) Settlements to enable functional specialization to take care of various activities (farming, animal rearing, etc.).

Below are selected climatic parameter to consider in planning the arid settlement:

Wind	-	Regional Development
Temperature	-	Site Selection
Heat Stress Pattern	-	Site Planning
Heating Degree in Day	-	Building Design
Time/Duration of Heat	-	Building Detailing
Rainfall Pattern	-	Energy and Water
Dust and Air Pollution	-	Landscaping

5.50 PROPOSALS TO CONTAIN DESERT ENCROACHMENT

In order to contain desert-encroachment there should be a strong policy orientation.

(a) Monitoring and Mapping of Desert Boundaries

Since desert boundaries are areas of gradual transitional zones and their shifts thus, difficult to map, monitoring can only be done along well defined boundary and ground of the Sahara desert with reference to plots of thoroughly documented vegetation and land forms. Such should transect combined ground checking, aerial photos and remote sensing to be established at selected site of the desert-boundaries.

Since the activity of the town and the village is different, the land-use zonation should also be different.

(a) Town Level

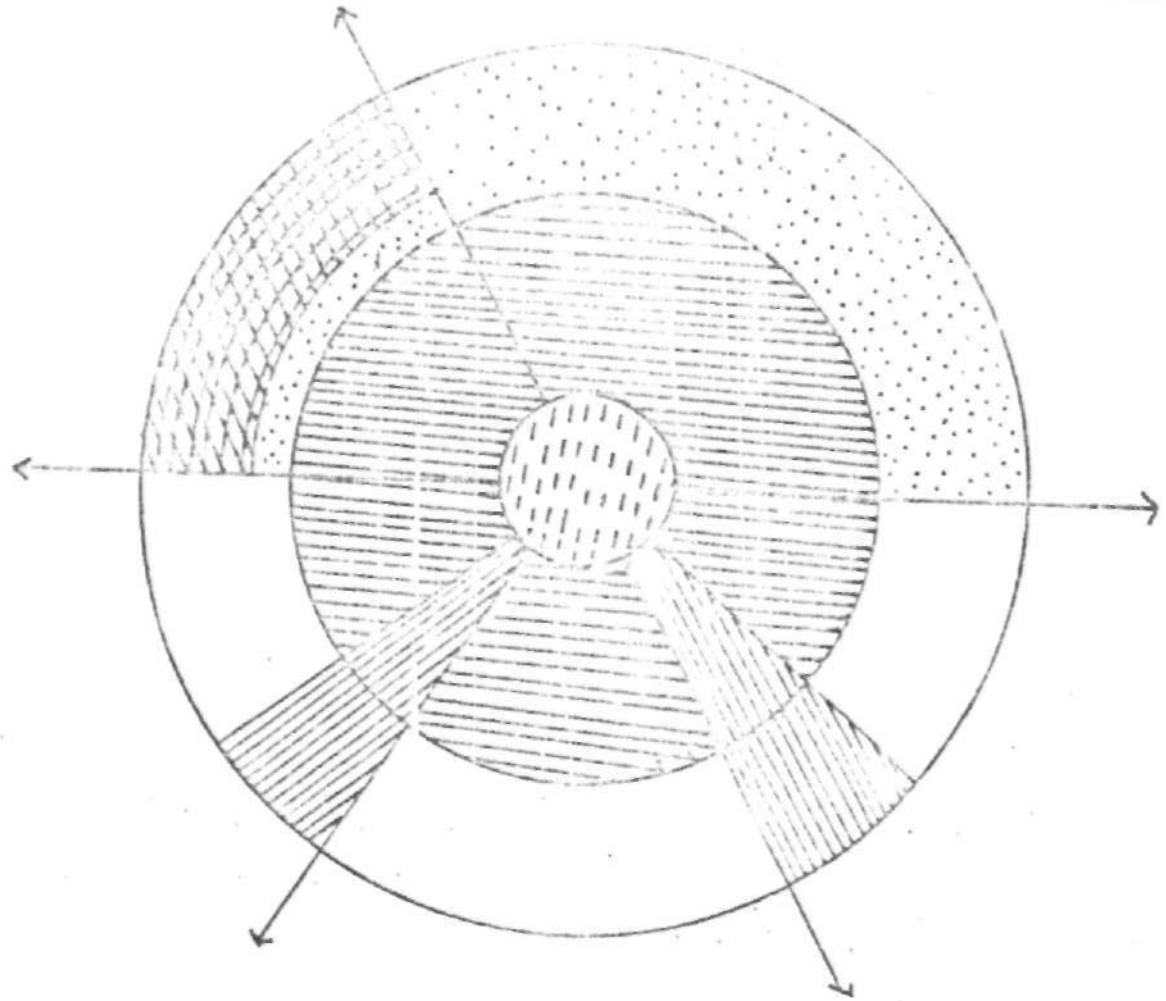
Any town in this arid zone could be well planned, if its site selection are properly organised. Thus, the Central Business District (Commercial should be at the centre). The residential should enclose the commercial area (Central Business District). The North-eastern part of the settlement should be sheltered with green belt.

Where there is need to establish an industry or industries, it or they should be located at the North-western part of the town with a strip of green belt to avoid pollution and noise. Public or semi-public land-uses could be South-west or South-east along the major roads for aesthetic and accessibility (see figure 5.30).

(b) Village Level

Most of the people living here are either farmers or animal rearers. There land-uses should therefore, vary from that of the town. Thus, at the centre, is the residential area. There should be an open space for future development encircling the settlement.

A CONCEPTUAL TOWN FOR ARID ZONE





B YANKURAMA
U R P THESIS
A B U ZARIA



COMMERIAL
RESIDENTIAL
GREENBELT
INDUSTIAL
PUBLIC & SEMI PUBLIC
FUTURE DEV.
ROADS

Fig. 5.30

From the North-west through the North to the North-east could be shelter belt to reduce the impact of the North-east winds on the settlement. Since the South-west winds are moisture winds the farm lands could be located on the South-western part of the village while that of the range land for livestock should be on the South-west. The roads should be made so that it will not affect the ecological set-up (see Figure 5.40).

5.60 APPLICATION OF THIS MODEL FOR THE PHYSICAL PLANNING OF TWO SETTLEMENTS IN THE STUDY AREA

(a) Kukawa Town

This town is located on the shore line of the former Mega Chad. It is on low sandy plain, there are sand dunes and erg. The vegetation is perenial. The total area is about 5 square kilometres. It is inhabited by three thousand Shuwa and Kanuri people About ¾ of the land-use is residential and the remaining ¼ is for petty trading (see Figure 5.50). It is the Local Government Headquarter of Kukawa Local Government Area.

When the conceptual model is applied to this town, the land-use zonations and pattern of the settlement will depict the picture as seen in Figure 5.60.

Dagari Village

This is located also on the low sandy plain of the former Mega Chad. The sand dunes are much here compared to that of Kukawa.

There are about 200 people of Shuwa and Kanuri's who are engaged in farming and animal rearing. It is situated South of the road that leads to Macina in Nguru Local Government (see Figure 5.70). In applying the concept of the model village, physical planning of this arid place will have picture look like Figure 5.80.

5.70 PROPOSALS TO CONTAIN DESERT ENCROACHMENT

In order to contain desert-encroachment there should be a strong policy orientation.

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CONCEPTUAL MODEL OF A VILLAGE

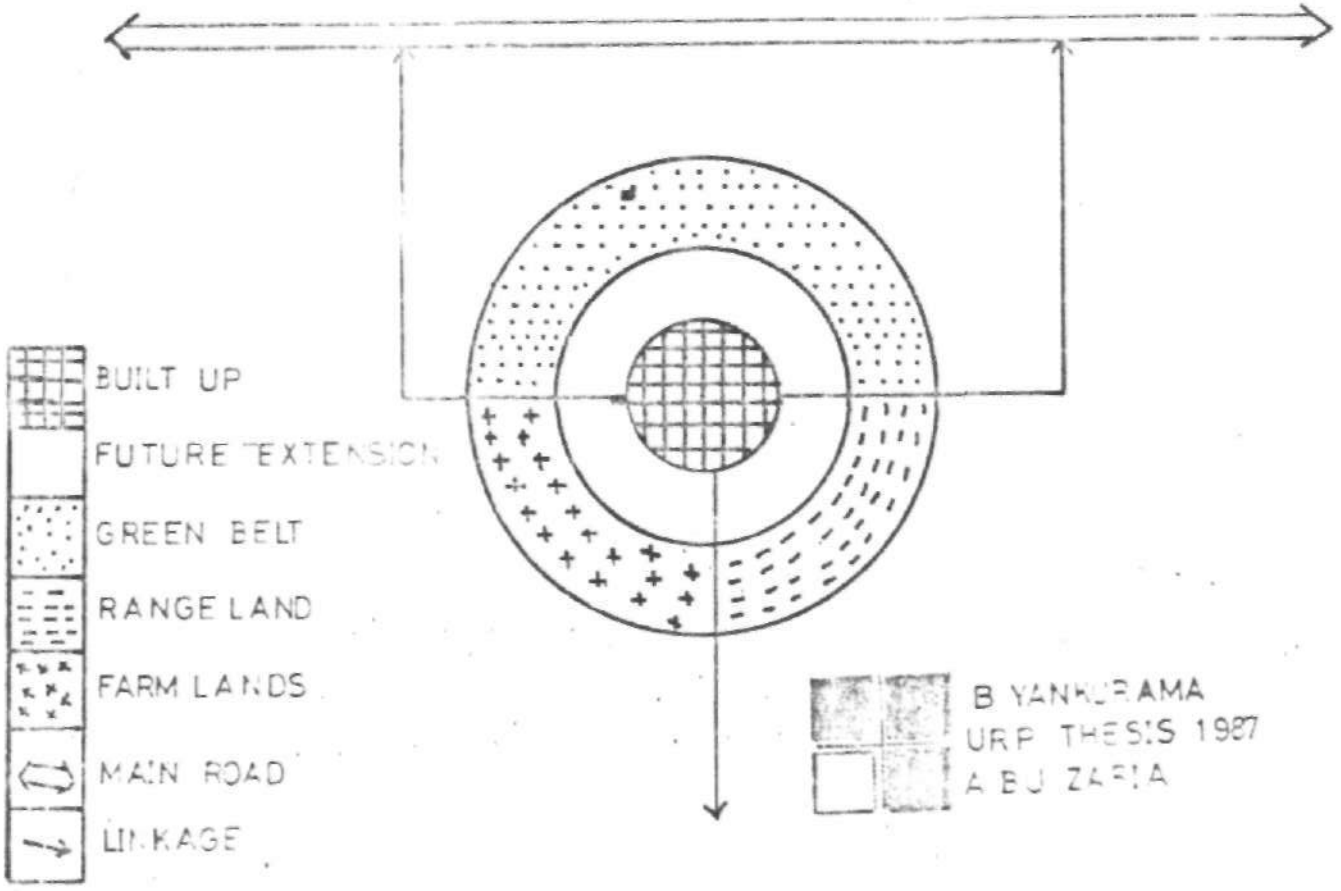
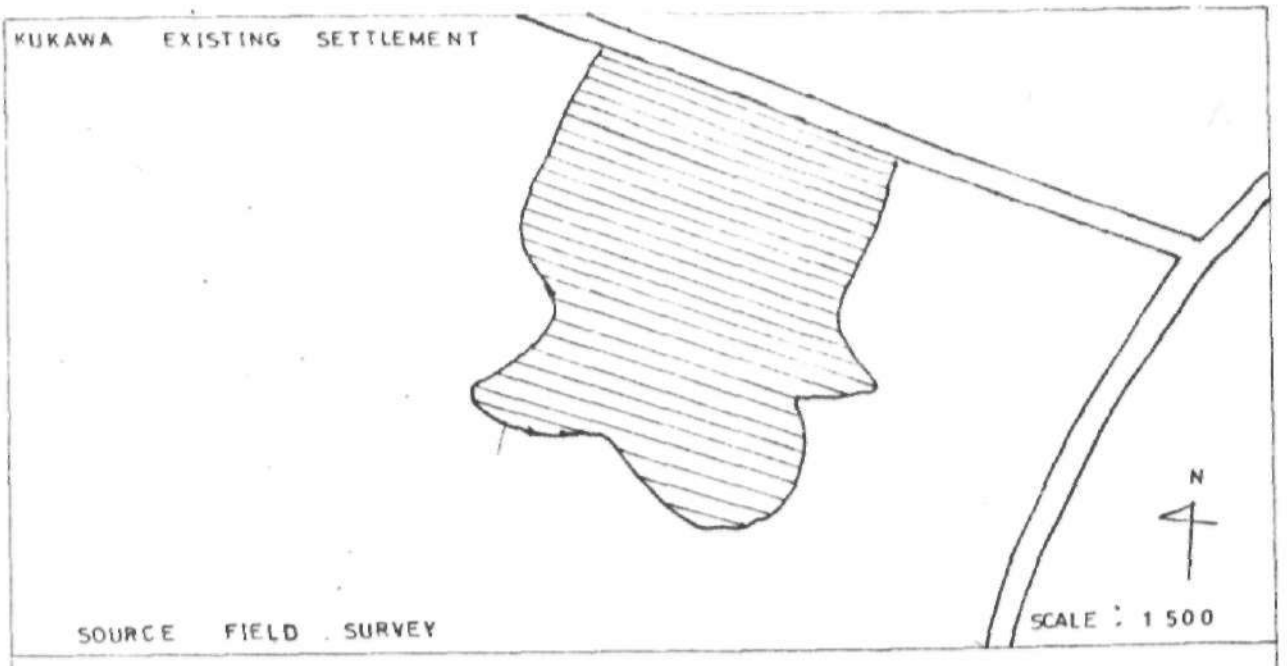


Fig. 5.40


KUKAWA EXISTING SETTLEMENT
N
SOURCE FIELD SURVEY
SCALE : 1 500

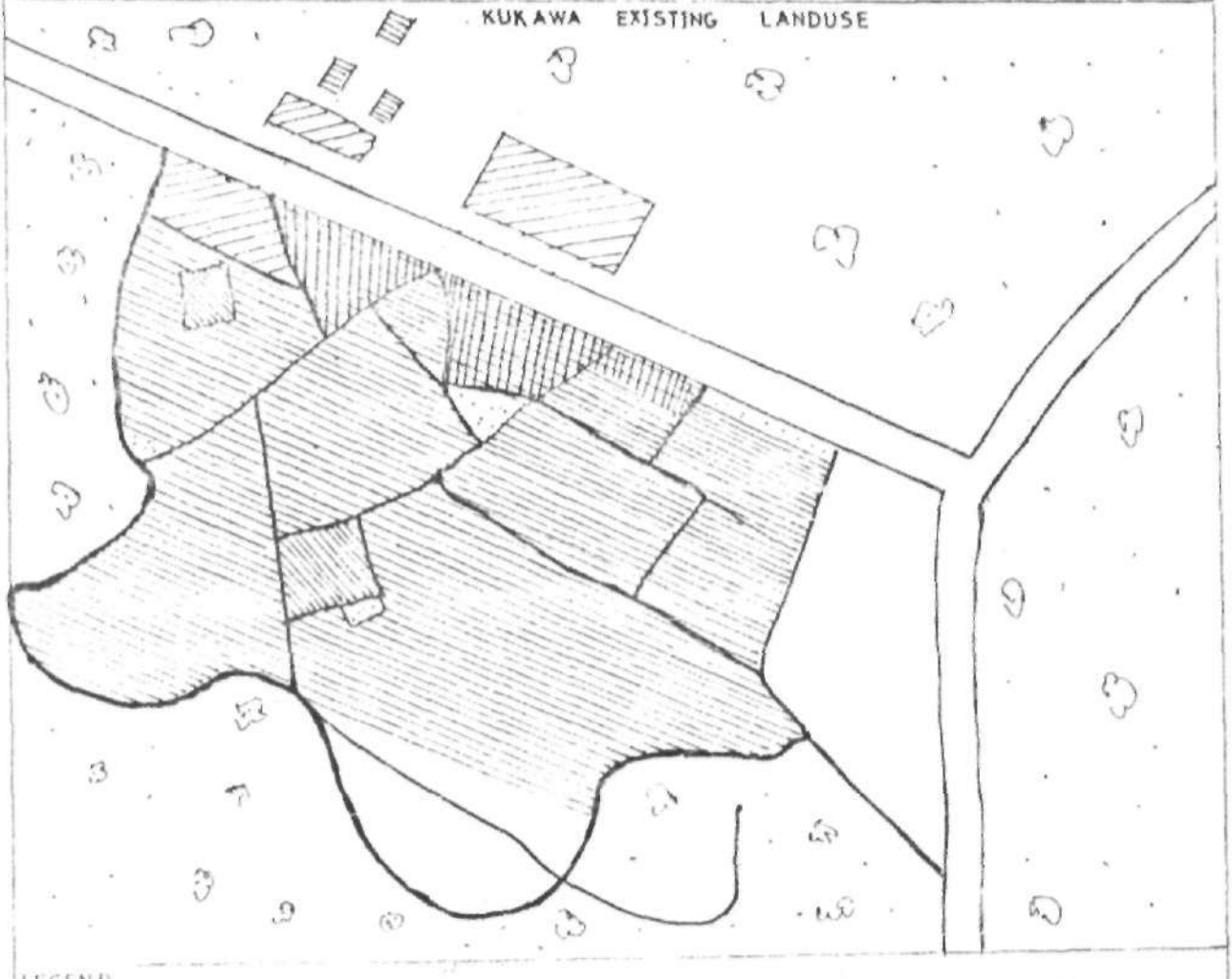

KUKAWA EXISTING LANDUSE
LEGEND
RESIDENTIAL
COMMERCIAL
INSTITUTIONAL
BUSH/FARMLAND
N
B YANKURAMA
URP THESIS

Fig. 5.50

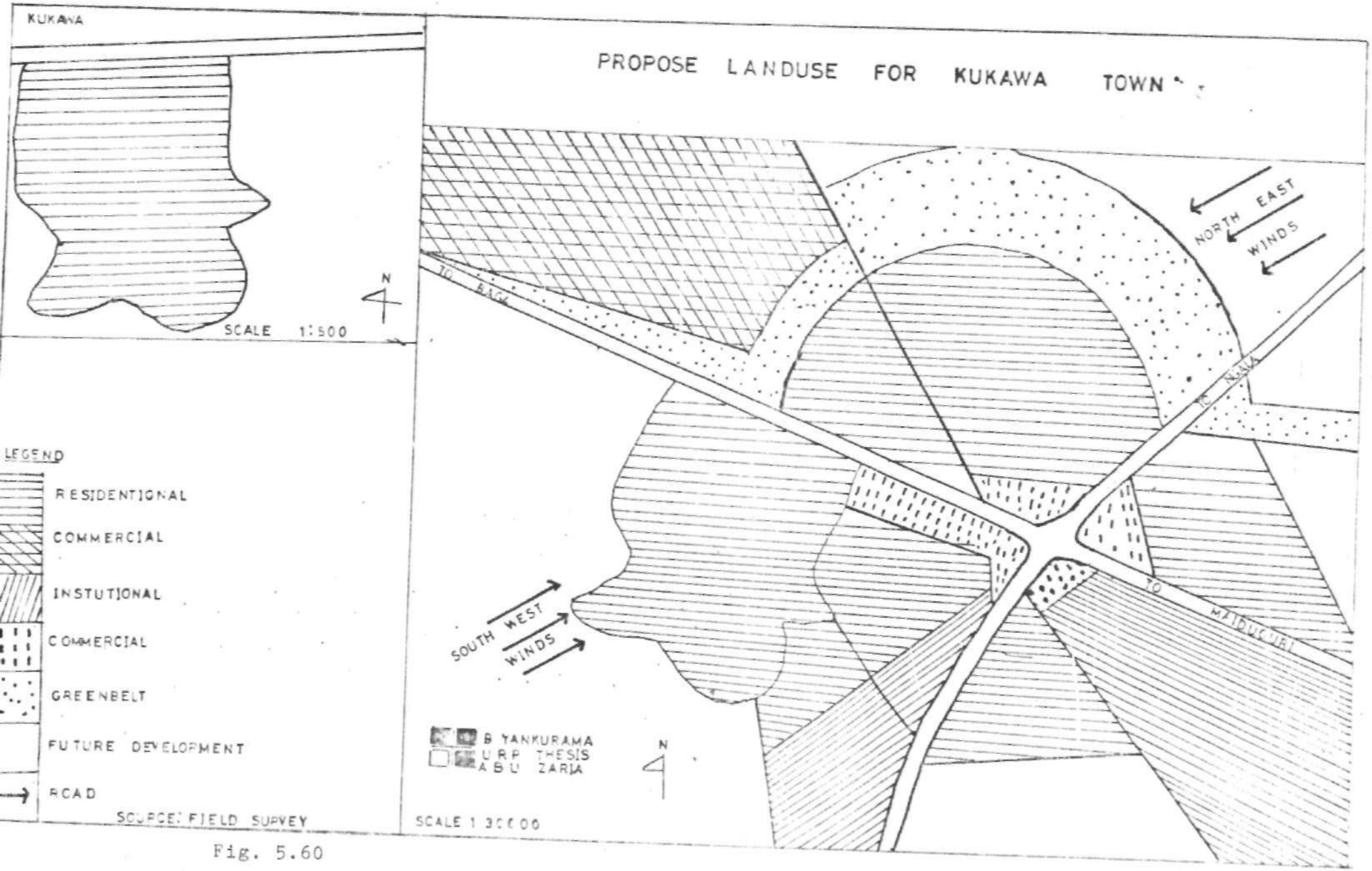
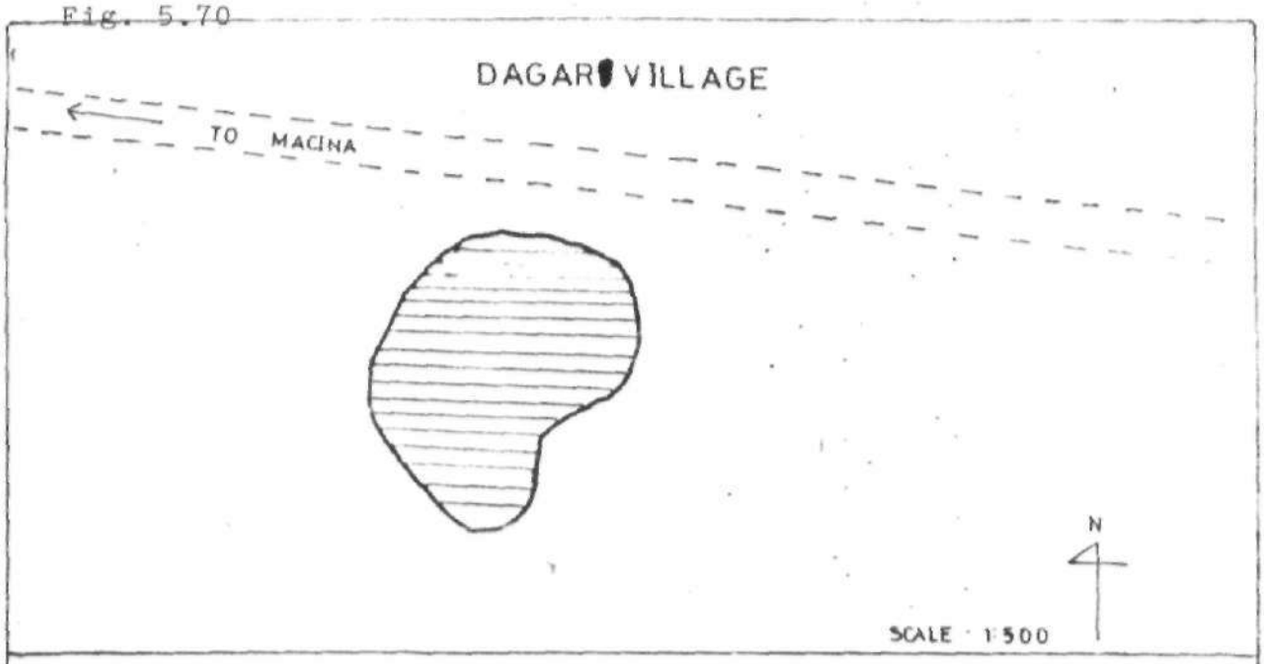

KUKAWA
SCALE 1:500
N
PROPOSE LANDUSE FOR KUKAWA TOWN
NORTH EAST WINDS
SOUTH WEST WINDS
TO BAGA
TO NGALA
TO MAIDUGURI
LEGEND
RESIDENTIONAL
COMMERCIAL
INSTUTIONAL
COMMERCIAL
GREENBELT
FUTURE DEVELOPMENT
ROAD
SOURCE: FIELD SURVEY
B YANKURAMA
URP THESIS
ABU ZARIA
SCALE 1 30000

Fig. 5.60

Fig. 5.70



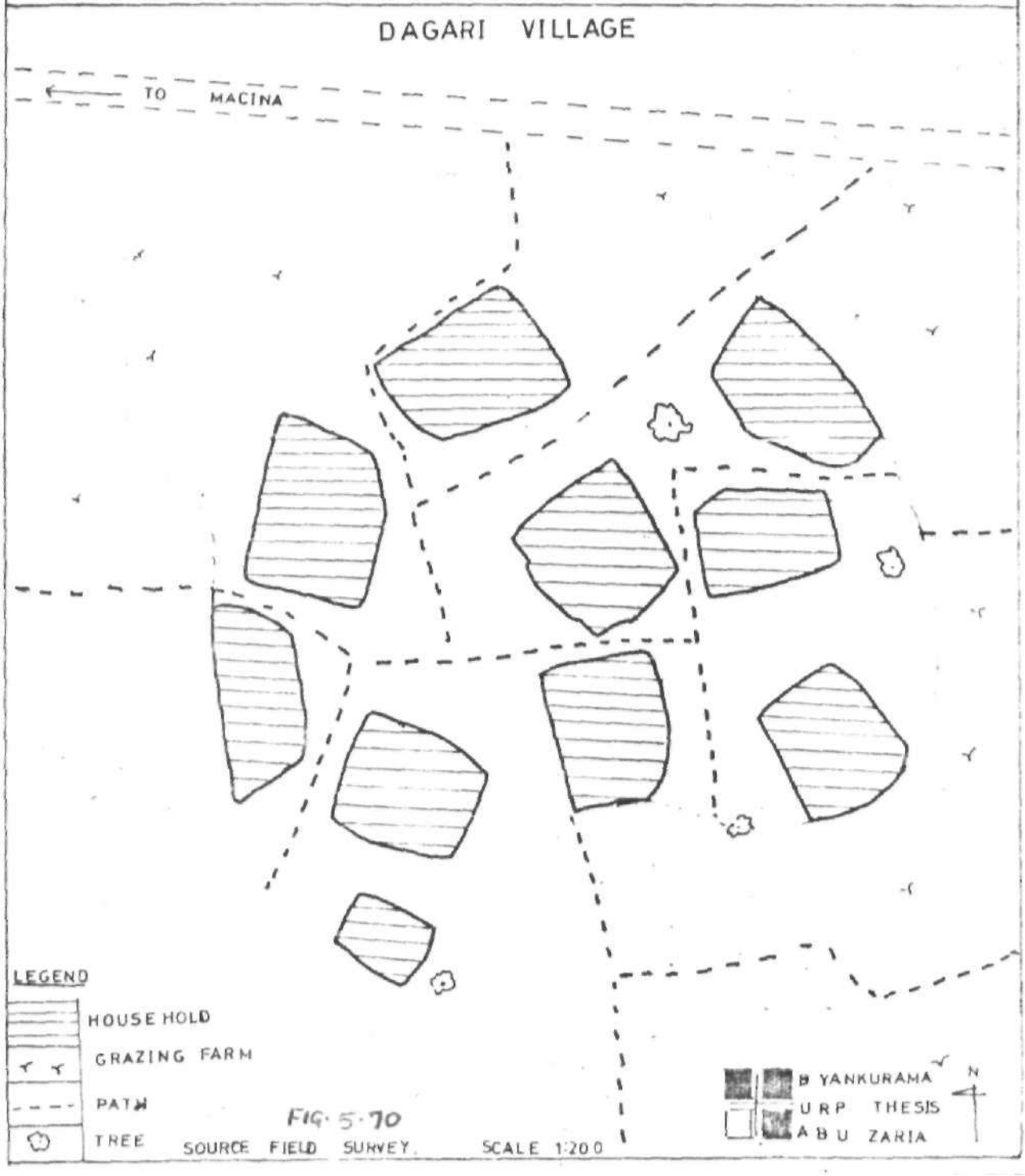


FIG. 5.70

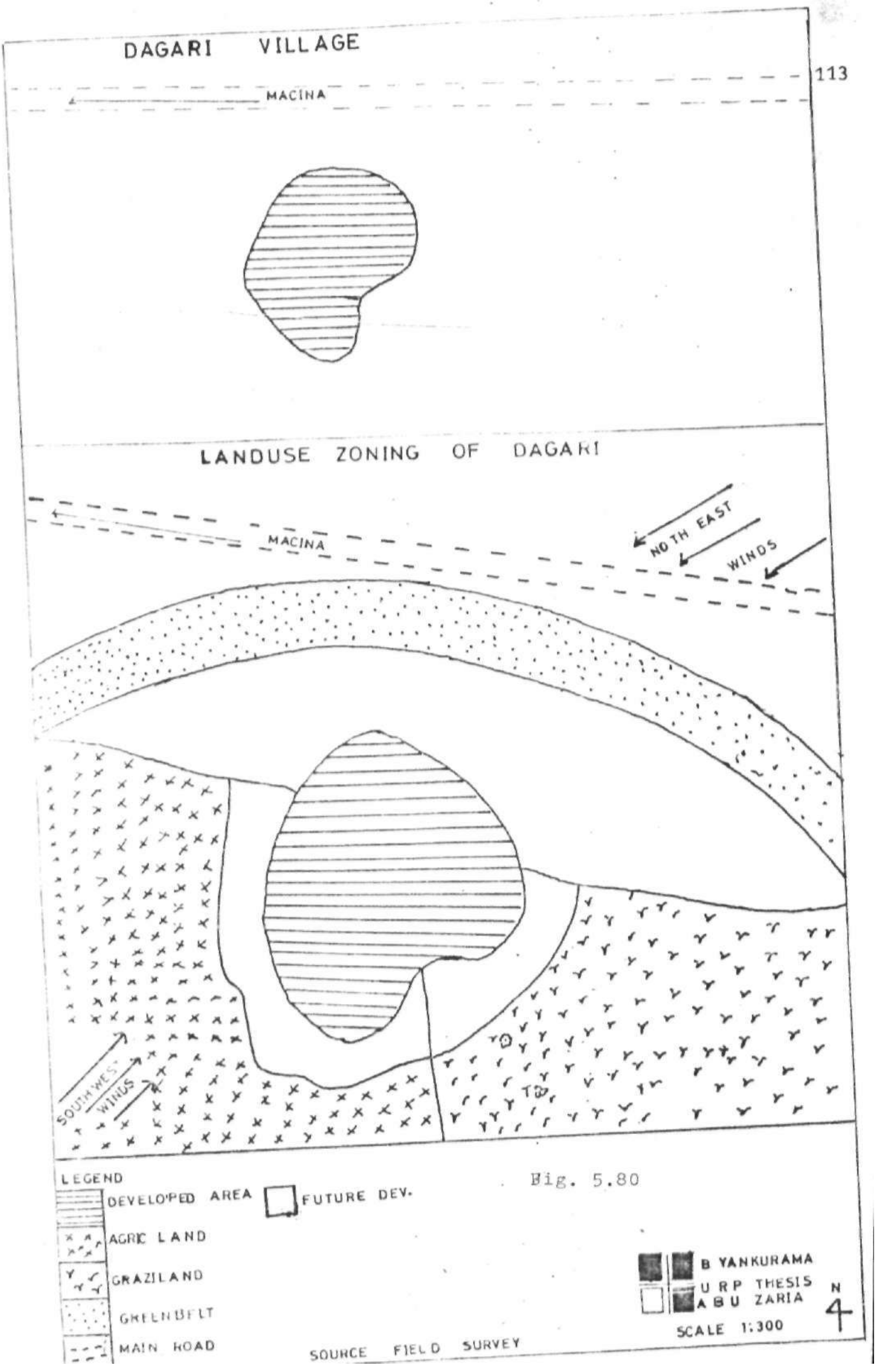

DAGARI VILLAGE
MACINA
LANDUSE ZONING OF DAGARI
MACINA
NOTH EAST
WINDS
SOUTHWEST
WINDS
LEGEND
DEVELOPED AREA
FUTURE DEV.
AGRIC LAND
GRAZILAND
GREENBELT
MAIN ROAD
SOURCE FIELD SURVEY
B YANKURAMA
URP THESIS
ABU ZARIA
SCALE 1:300
N

Fig. 5.80

(b) Formulation of Intergrated Types of Land-Use Utilisation

This can be done through land zonations to suit the evolved patterns of the settlement and the socio-economic aspect of the inhabitants. This means that putting into consideration areas under different kinds of crops, cycles of cultivation, inindividual size of the family holds and natural resource control measures to be protected and adapted. To avoid over-grazing, cattle migration circuits could be only used alone with established water places where vetinerary care stations could be built as near bore-holes or surface-water.

(c) Establishment of Shelter Belts around Settlements

This is a wind barrier of trees and shrubs deliberately created for the purpose protecting settlement and farm lands from the adverse environment in the delineated area. There are three issues about gree belt phenomena to be emphasised here (Figure 5.40, Figure 5.50 and Figure 5.60).

i. Height

Preference should be given to species which will attain the maximum height possible on

the site in the shortest time possible to serve as wind barrier.

ii. Biological Stability

The species should have the longest possible adaptive and drought resistant potential for the site. That is the species should be long lived and capable of providing effective protection for not less than 50 years with minimal maintenance.

iii. Foliage Characteristics

The species should have crown density and cross-sectional shapes as well as penetrability determine protective capacity of a shelter belt. It should consist of medium to large size crowns, high leaf density and be ever green where possible.

On the Appendix 1 are listed names of species in their botanical names and they have proved successful in arid and semi arid zones as the case of Borno State.

5.60 IMPLEMENTATION OF THE PLANNING PROPOSALS

Indeed most government policies and strategies owefully failed due to lack of proper attention given

during implementation stages. In most cases the failure come from the bodies charged with responsibility of implementation and at times the financial constraints. To plan for this area delineated under desert encroachment in Borno State and achieve the successful implementation desired there should be:

(a) A Strong Organisational Body

This body could be the Federal, State and Local Governments that will handle the monitoring and mapping of the transitional zone demarcated as desert environment. This bodies should provide the finances and train the professionals to check desert encroachment. The specification is that the Federal Government should be the policy formulation body. The State Government should be responsible for the identification and delineation of the desert encroached area. The other aspect should be that the State Government, should co-ordinate the various professional bodies like the Ministry of Land and Survey, Ministry of Agriculture and Forestry Resources, Water Board and Rural Electrification Board.

The Ministry of Land and Survey is responsible for drawing and designing the Master or the

Developmental Plan. It is responsible for the surveying preparation of lay-out. The Ministry of Works and Housing design their house types, roads and drainage. The Forestry and Agricultural Ministry will carry out the establishment of green shelter belt either for an existing settlement or new one. These Ministries will work hand in hand with BOADAP and SBADAP.

On the other hand the Veterinary Division in collaboration with Water Board be responsible for the establishment of bore-holes and the Veterinary care centres. The Rural Electrification Board then takes up the Electrification of the settlement.

The Local Government on their part undertake the mobilisation of the inhabitants through television films and radio propaganda. The individual should be given free and adequate nursery trees to plant along their houses.

(b) Financial Sources

This is the most difficult task especially when both the Federal and State Government are economic recession. However, the way to get the finance are as follows:

i. Appeal Funds

This is fast becoming a house-hold name in Nigeria. In most cases, although the exact required amount is not gained some reasonable could be gathered from philantrophic organisations and individuals.

ii. Fines

When a law is enacted banning bush burning, and unwanton destruction of trees, then any individual or group who could not comply will be fined and such fines taken to the purse of the body responsible for the combatment of desert-encroachment in the State.

iii. Taxation

The affected people could pay a token fee to supplement government efforts.

iv. Loans

This has its associated problems especially when it is tied down to profit oriented loans. However, the loans have been the major source of financing large projects. The (I.M.F.) - International Monetary Fund, the (E.E.C.) European Economic Countries and the World

Bank have for long been the major finance house for lending and borrowing.

v. Management and Supervision

The best institution is the (D.F.R.R.I.) Directorate for Food, Rural Roads and Infrastructure, be responsible the completion of the required projects through their direct labour policies.

5.70 CONCLUSION

There is no miracle remedy to the desert encroachment on the settlement in Borno State, but a set of inter-depended means of actions will prove positive. Technically desertification can be halted and the encroached areas can be redeemed. When adequate planning encompassing professionals of the environmental science desciple, adequate finance and management is brought to bear desert encroachment can be contained.

The example of Iran where about 10 million hectares of protected arid range land are steadily improving for wild life or sheep-raising and where three million hectares of sand dunes have been stablised and are progressively being brought to production - shows

clearly that desertification can definitely be halted if the decision-makers jointly with those having political and economical power really so wish.

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A P P E N D I X

Recommended Plants

Serial Number	Type of Plant	Height (feet)	R e m a r k s
1.	Zauschneria Californica	10-12	Tolerant to heat and drought.
2.	Yucca Whipplei	3-4	Highest grow in March/June.
3.	Yucca Gloriosa xylosma	6-10	Need less water hedge like. Tolerate.
4.	Congestum	8-20	Wind, heat, drought and acceptal to all.
5.	Verbena Peruviana	2-3	Soil condition. Fast growing plant tolerates drought.
6.	Vauquelinia California	--	Large shrub and form hedges drought tolerant.
7.	Vallesia	--	Flower and leaves through out the year.
8.	Teucrium Fmtican	--	Less water, tolerates heat and sun shine.
9.	Teucrim chamaedrys	--	Tolerates sun, heat and poor soils.
10.	Tecomaria Capensis	10-12	Loves heat and drought.

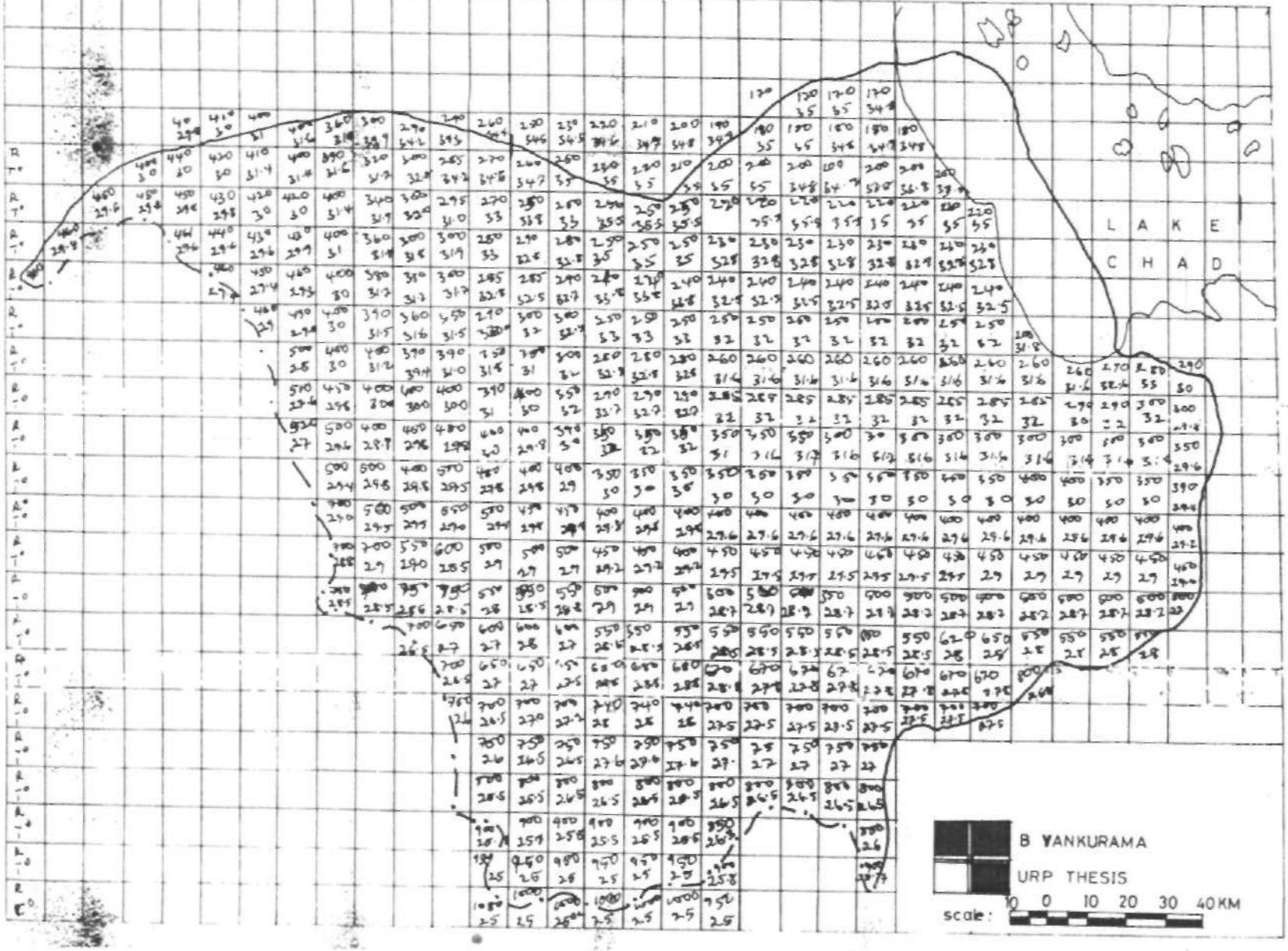
A P P E N D I C E S

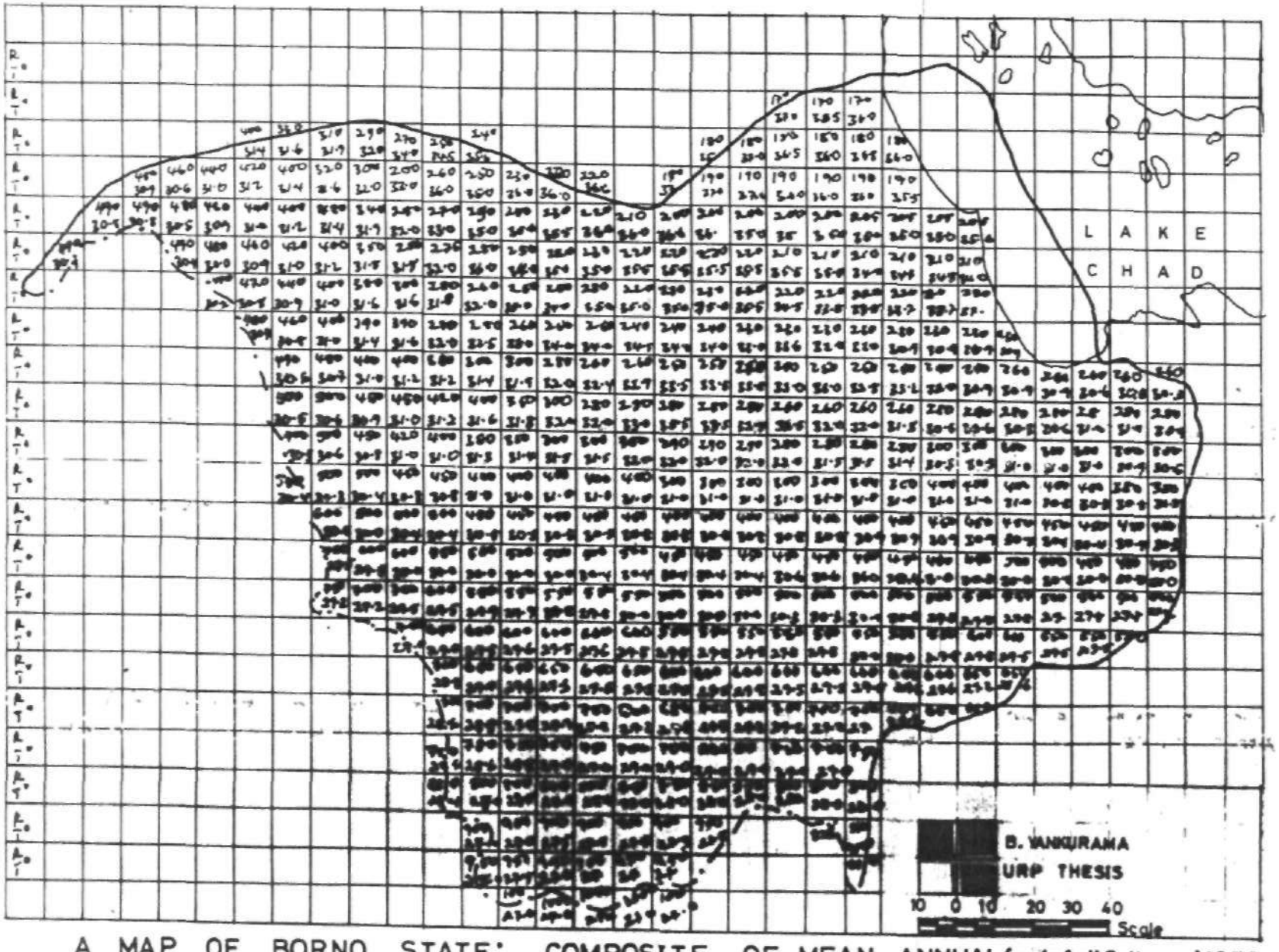
Recommended Plants

Serial Number	Type of Plant	Height (feet)	R e m a r k s
1.	Zauschneria Californica	10-12	Tolerant to heat and drought.
2.	Yucca Whipplei	3-4	Highest grow in March/June.
3.	Yucca Gloriosa xylosma	6-10	Need less water hedge like. Tolerate.
4.	Congestum	8-20	Wind, heat, drought and acceptal to all.
5.	Verbena Peruviana	2-3	Soil condition. Fast growing plant tolerates drought.
6.	Vauquelinia California	--	Large shrub and form hedges drought tolerant.
7.	Vallesia	--	Flower and leaves through out the year.
8.	Teucrium Fmtican	--	Less water, tolerates heat and sun shine.
9.	Teucrim chamaedrys	--	Tolerates sun, heat and poor soils.
10.	Tecomaria Capensis	10-12	Loves heat and drought.

Serial Number	Type of Plant	Height (feet)	R e m a r k s
11.	Tamarix Africana	10-20	Accept Salinity.
12.	Sphaeralea ambigua	3-4	Accept dry and sandy soils.
13.	Simmondsia chinensis	4-8	Very drought resistant.
14.	Pyracantha Guayacan	4-6	Less water requirement.
15.	Pennisetum setaceum	--	Need less water and drought resistant.
16.	Passiflora foetida	Climb-ing vine	Drought resistant.
17.	Dimorphotheca Emticosa	1 feet spread	Drought resistant.
18.	Nerium Oleander	10-12	Flourish from May/October.

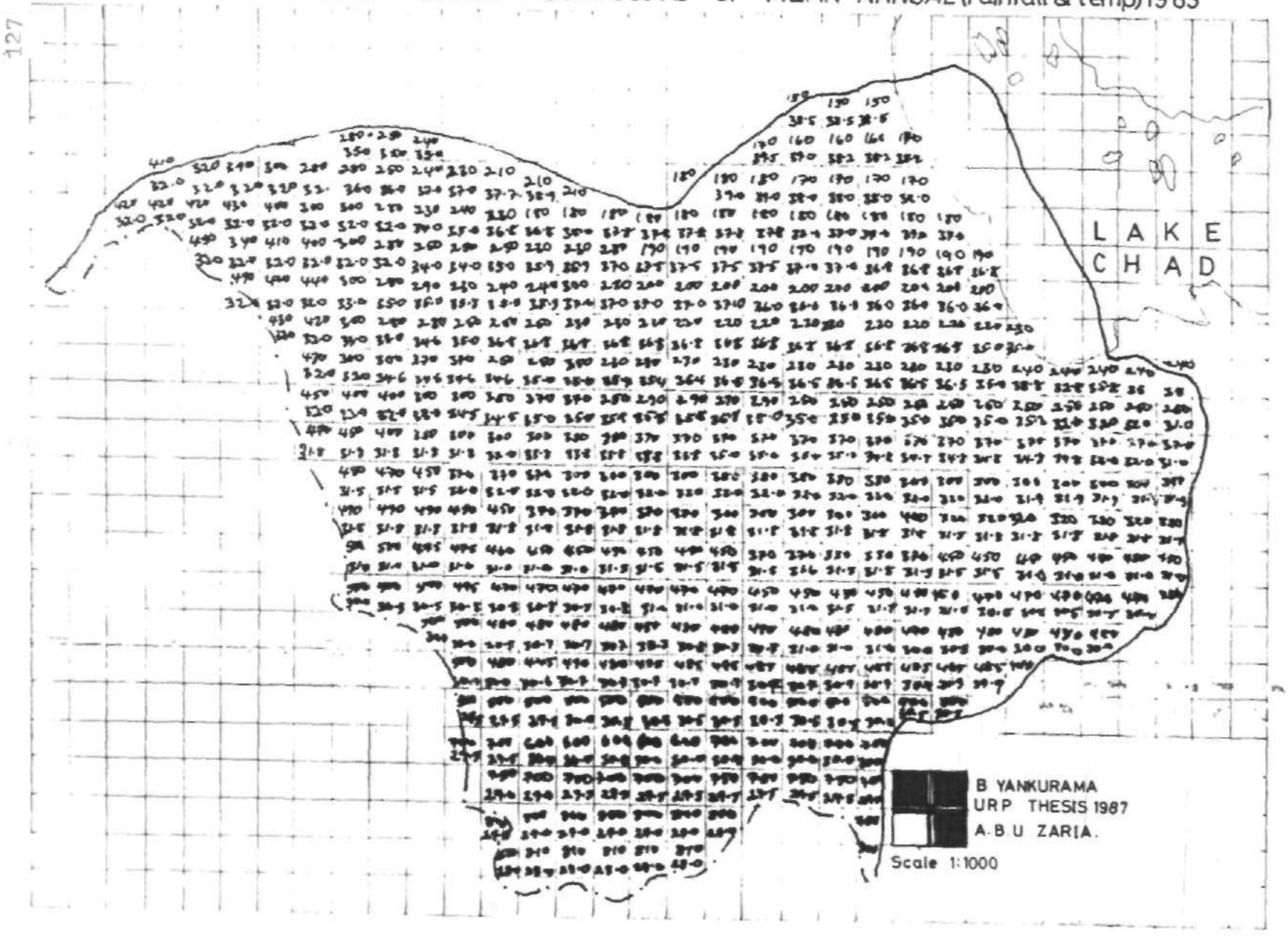
A MAP BORNO STATE: COMPOSITE OF MEAN ANNUAL(rainfall & temp)1963



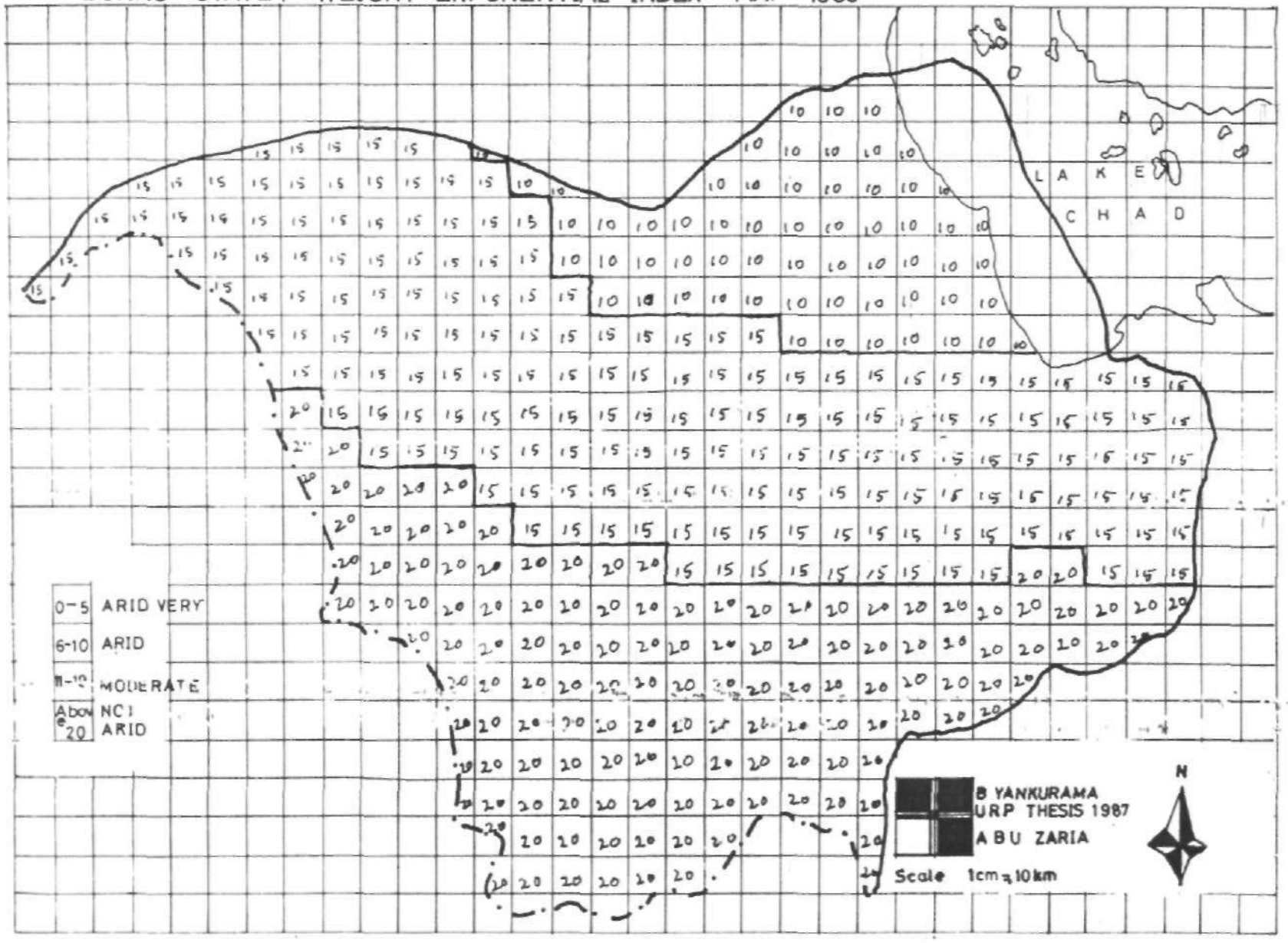


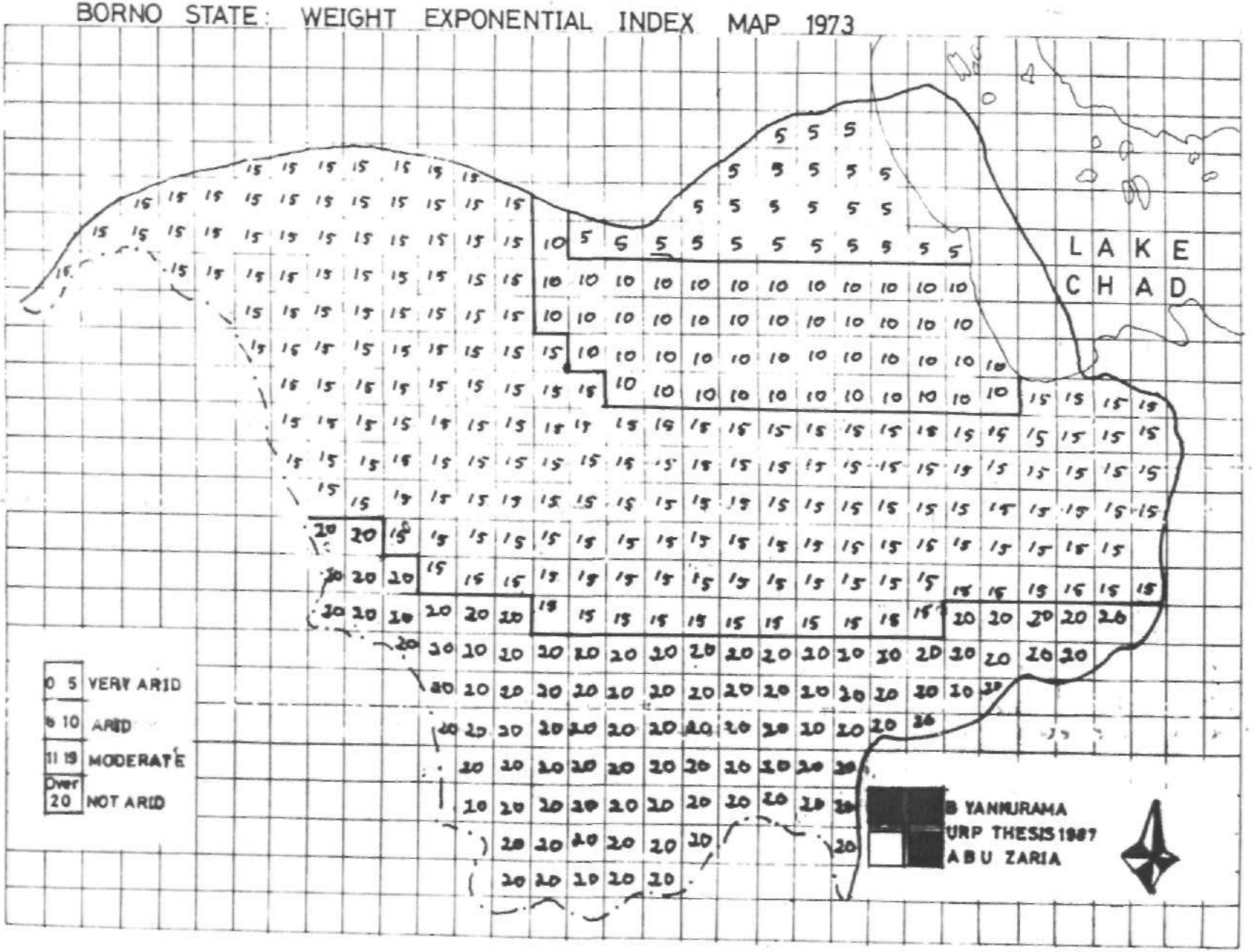
A MAP OF BORNO STATE: COMPOSITE OF MEAN ANNUAL(rainfall & temp)1973

A MAP OF BORNO STATE COMPOSITE OF MEAN ANNUAL (rainfall & temp) 1983

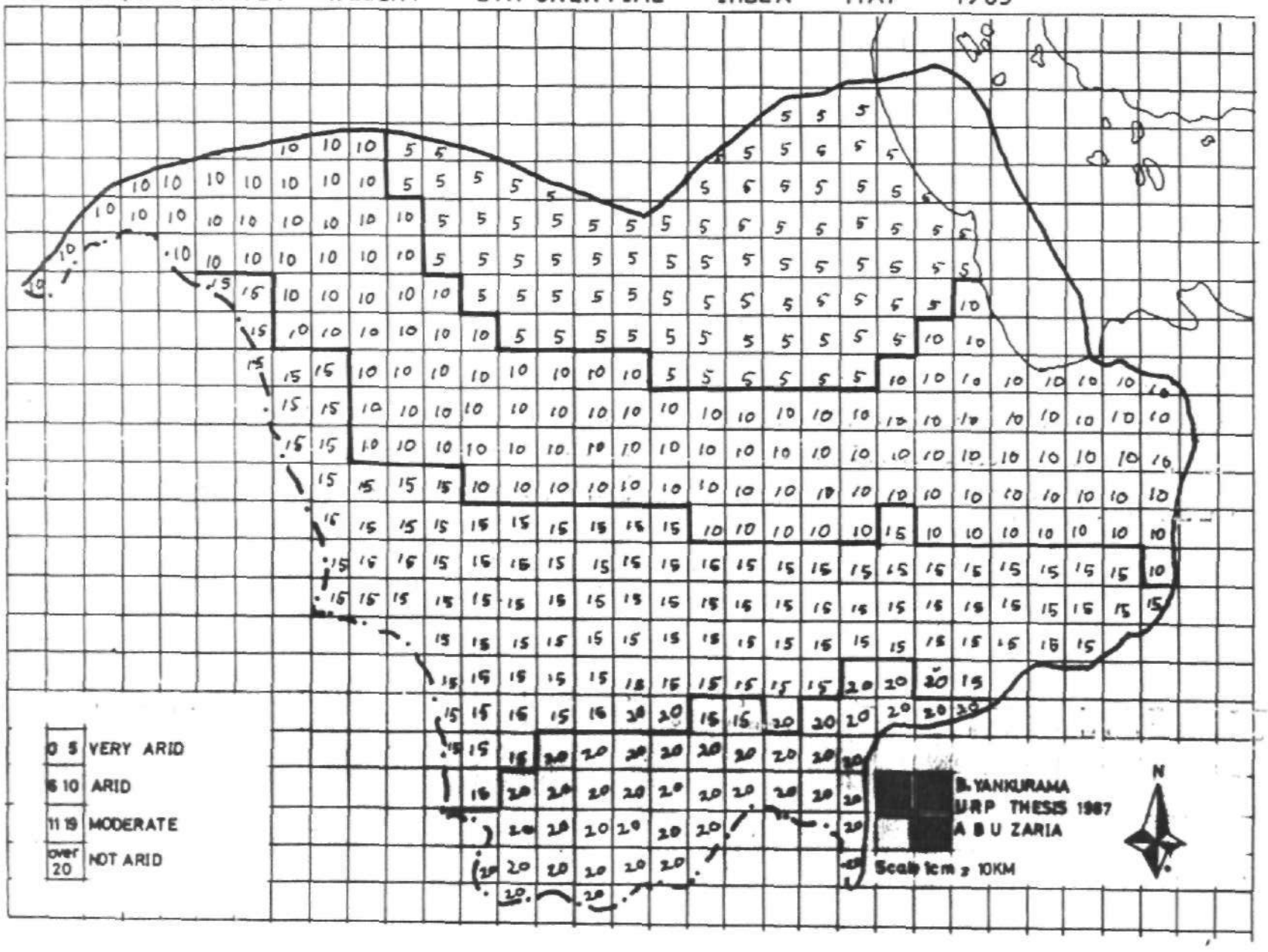


BORNO STATE: WEIGHT EXPONENTIAL INDEX MAP 1963

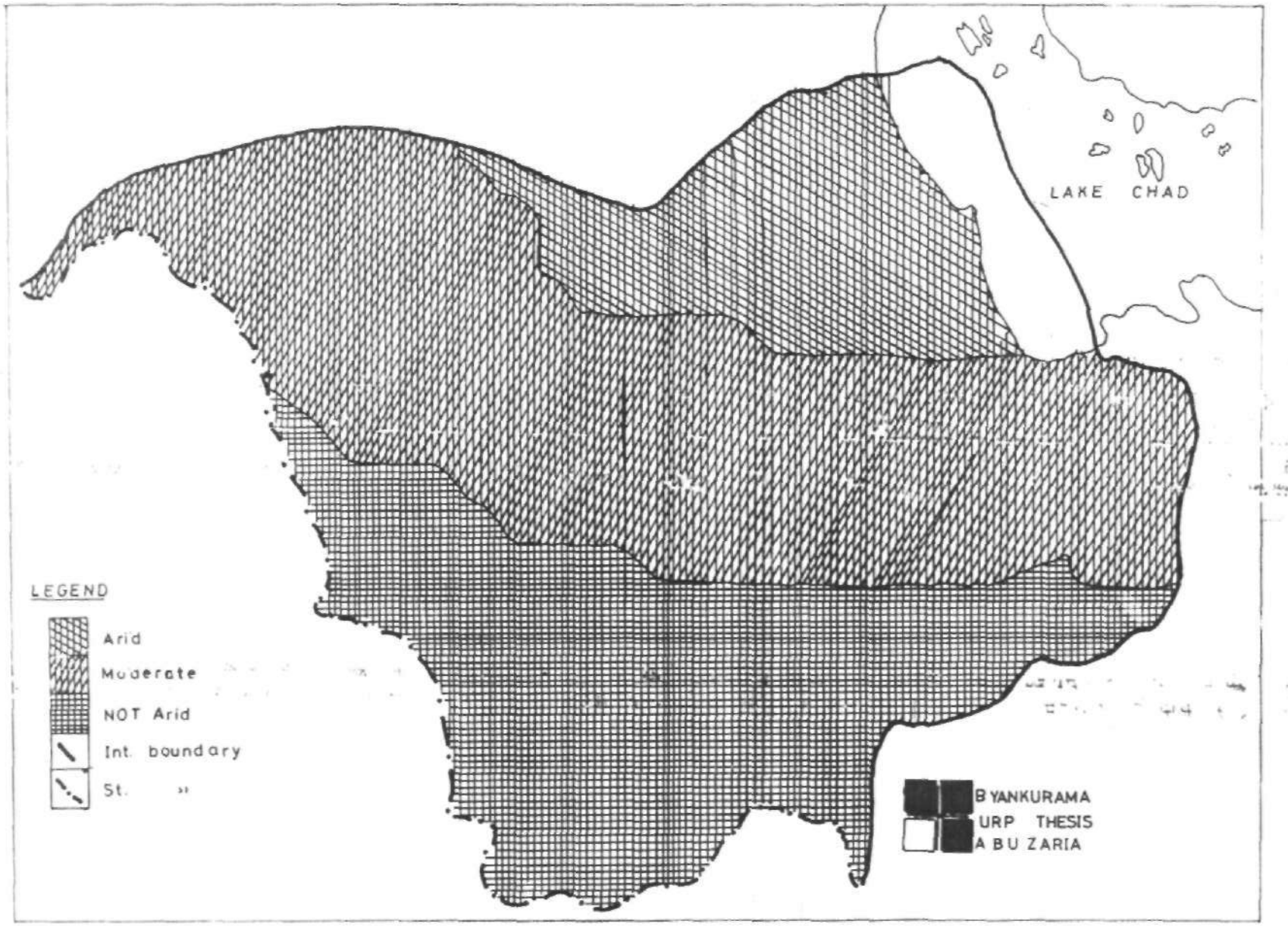



BORNO STATE: WEIGHT EXPONENTIAL INDEX MAP 1973
LAKE CHAD
0 5 VERY ARID
6 10 ARID
11 19 MODERATE
Over 20 NOT ARID
B YANMURAMA
URP THESIS 1987
ABU ZARIA

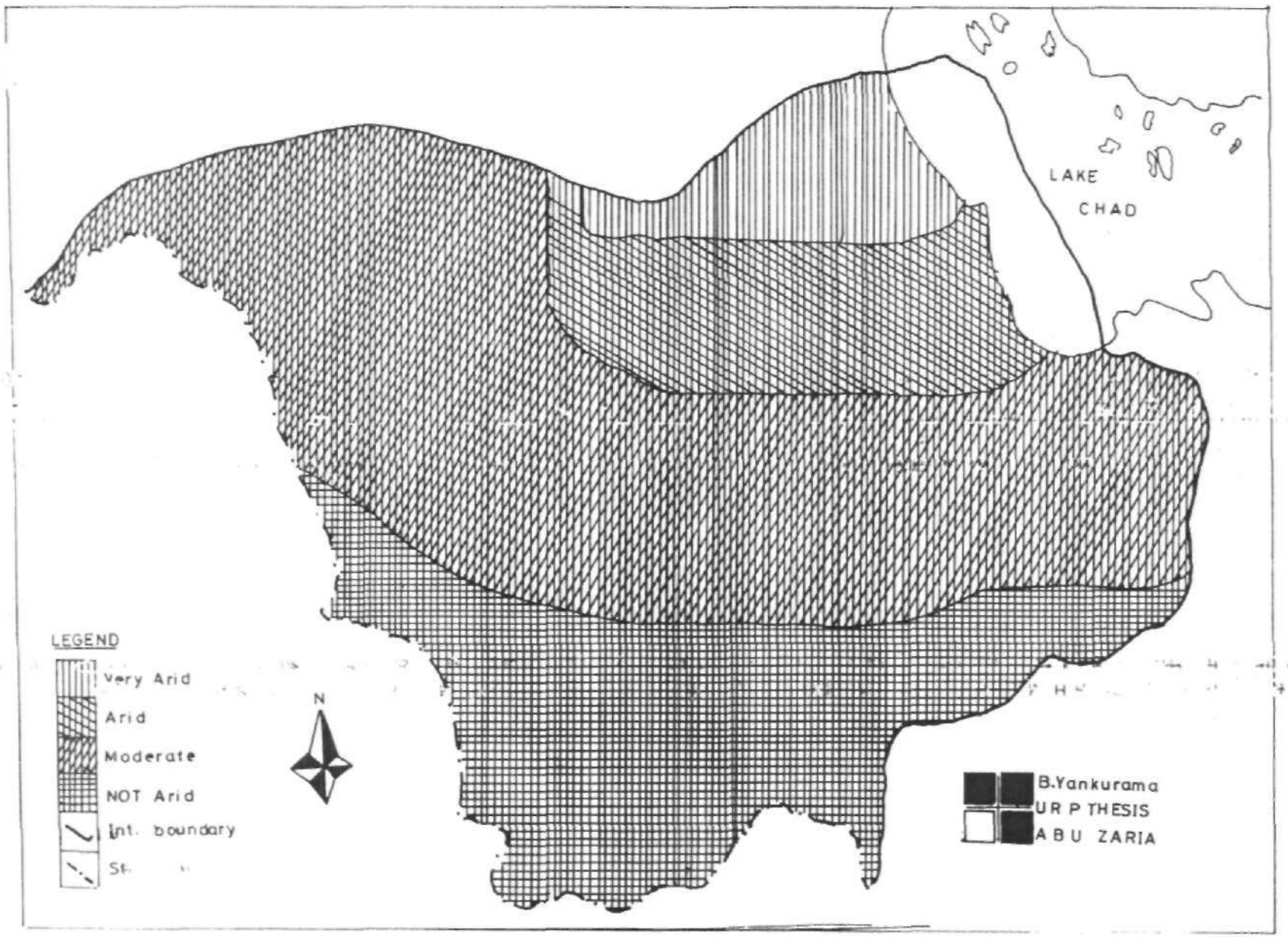
BORNO STATE: WEIGHT EXPONENTIAL INDEX MAP 1983



BORNO STATE: ARIDITY 1963



BORNO STATE: INCREASING ARIDITY 1973



BORNO STATE: INCREASING ARIDITY 1983

