ASSESSMENT OF VEGETAL COVER OVER NIGER STATE AND ITS IMPLICATIONS

BY

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CERTIFICATION

This is to certify that this project work being submitted by Hauwa Abdullahi (PGD/GEO/98/99/025) is my original work and has not been submitted before by anybody for any purpose and meets the requirement governing the award of PGD in Environmental Management. Department of geography Federal University of Technology Minna - Niger State.

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DEDICATION

This work is dedicated to you.

ACKNOWLEDGEMENT

Alhamdullilah for everything.

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This is also extended to all staff of the department and colleagues too numerous to mention for their contribution, support and understanding.

Finally, I acknowledge and salute the endurance of my family. I am most grateful.

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ABSTRACT

The increasing population in Nigeria and the various individual and governmental development processes accompanying it, are having serious environmental impacts on the natural eco-system. These impacts of negative tendencies which are either knowingly or unknowingly persistent portends severe problems to the general well-being of the middle belt zone which is now new found home for many displaced people from locations further north.

This study therefore aims at examining how much vegetation density the State can boast of, and the extent of human activities particularly agriculture-related on the available plant cover and the effect of the identified level of interference.

Raw data used were sourced from previous field surveys conducted by the Geography department, derived data were computed and analysed as well as visits and observations carried out.

Findings of the analysed work include identification of serious vegetation depletion at some locations already grappling with the consequences. Others are stable but stand the risk of being threatened.

Solutions and strategies towards mitigating the identified problems are proffered accordingly.

CHAPTER ONE

1.1 STUDY AREA BACKGROUD

Niger State lies in the middle belt of Nigeria. It is situated between longitude 4° and 8°E and latitude 8° and 12° N and covers an area of about 64,480 sqkm with an estimated population of about 3Million. It is bounded to the Northwest by Benin Republic and Kebbi State, Northeast by part of Zamfara, Kaduna and Federal Capital Territory Abuja, on the Southwest by Kwara State and Southeastwardly by Kogi State and has a total of 25 Local Government Areas.

The State experiences distinct dry and wet seasons, the wet season reducing in length and amount of rainfall from the South towards the North. The mean annual rainfall varies from 1,100mm in the North to more than 1,600mm in the East and the length of the rainy season varies from 150 to 210 days North to South (NALDA, 1993).

Its vegetation is mainly the Guinea Savanna. It has a vast abundance of land and rich savanna region with substantial tree forest, shrub and grassland as well that make up an "average 60% of vegetal cover two decades back" (Usman, et. al, 1997).

About 65% of the inhabitants are farmers whose livelihood depends entirely on the productivity of their soil. However, degradation experienced here involves the loss of soil fertility such that some communities are compelled to migrate in search of more fertile land. This problem of internal migration is further compounded by the invasion of the study area by cattlemen from the northern

part of the country who consider the region as one with an abundance of land for their cattle. Not just nomads are moving in, but also those in search of fuel wood for sale and other uses.

This is posing a serious threat to the vegetation cover of Niger State bearing in mind the fast rate at which desert is encroaching. In addition, unsustainable agricultural practices, nomadism and indiscriminate felling of wood has led to the serious problem of desertification in some states of the Federation warranting State Governments to employ "curative" methods of annual tree planting campaigns, which are not commensurate with the damage done on a daily basis. How many of the trees even survive to grow as no care is given afterwards. Thus, the state is now left with only an average of 30% forest/woodland cover (as at 2 years ago) as against the 60% average woodland/forest cover some 20yrs back and less will be left a few more years to come. Subsequently, none at all may be left unless serious measures are employed to check the encroachment. New settlements are equally springing up in the state along the roads to some remote areas where vegetation surrounding is quite undisturbed. These areas with new communities are beginning to manifest their presence by encroaching on natural vegetation.

The proximity of the nation's new Federal Capital Abuja to Niger State is like a curse too as against the blessing acclaimed in the regard of admitting more settlers. It is a known fact that accommodation is the greatest problem in Abuja not merely securing a job. Therefore, civil servants and other non–governmental organisations find it easier and cheaper to re-settle their families in parts of Niger

State from where they can be shuttling to work daily or weekly. This is so with civil servants also transferred from Lagos who are yet to be secured accommodation by their employers. This is putting increased stress on the state, as all other problems associated with migration/settlement are already showing their faces.

1.2 PROBLEM STATEMENT/JUSTIFICATION

The now growing problem of harsh weather conditions and the continuous awareness arising from the attendant negative consequences is a cause for great concern.

Land as a resource and the plants therein have more recently, as long before, been a cause for which many are dying in the struggle to own or gain access to. This is because a lot is contained ranging from the ordinary land to be used for habitation, to mineral resources embedded underneath, and resources on the surface such as animals and plants. Man's exploitative tendencies have led to the mass reduction of such resources in his place of abode, to his need for migration towards a greener pasture for himself and his animals. We have heard of desert encroachment at very fast rate, of people forced to move south wards to where the vegetation is still better compared to the far north, such massive shifts of population and the associated human activities on the environment which include some forms of agricultural policies that encourage immediate conversion of land to agricultural use; is posing serious threat to the Savannah woodland vegetation within which the study area is situated.

Is Niger State also threatened? By what degree, if yes? What are the factors that come to play in the threat? And what is to be done in the light of the foreseen problem?

1.3 SCOPE AND LIMITATION

This study is within the confines of Niger State, and it is restricted to one hundred and eleven (111) locations fairly distributed across. The use of these 111 locations is not biased by simply being selected but it is on the basis of their easy accessibility by being connected to motorable roads. It most however be noted that some stations are not motorable hence the need to reach them through water transport means. Much as one could try to be very accurate, we cannot rule out the possibility of some unnoticed errors and other unforeseen events or circumstances that could have made these data perfectly in place. Factors such as hunger, fatigue, state of mind, time and weather conditions could have slightly affected the quality of this work. The 4-month closure of the university to academic work as a result of students uprising has in one way or the other also effected the enthusiasm of work. This is further compounded by yet another face-off exhibited by the Academic Staff Union of Universities (ASUU) nationwide barely two-weeks to re-opening from the 4 months stalemate. This made it further stressful particularly for those of us having to shuttle between the University and states of origin.

1.4 AIMS AND OBJECTIVE

The aim of the study is to assess the nature of vegetation pattern and its distribution across the state.

The objectives towards achieving these are to:-

1. Determine the level of plant cover across the state
2. Assess the possible extent of human interference activities in the spread of vegetation
3. Evaluate the areas that the best environment stability.
4. Proffer possible intervention measures at further depletion of the natural vegetation.

CHAPTER TWO

2.0 LITERATURE REVIEW

The pattern of plant cover and the animal life of any area principally depend on the soil water availability, which then depend on the amount of rainfall that falls and its distribution. The pattern is however modified by activities of cultivators, grazers, woodcutters and blacksmiths. Rainfall varies from place to place, season to season and accordingly so do plant and animal systems. The focus here being the plant system or vegetation. Vegetation simply put is plant collectively or plant life as described by the Oxford University press dictionary.

Plants hardly grow in isolation. More often they are found in some extent of spatial association with other plants either of the same species or of different species. This collective growth of plants materials which covers most of the Earth's surface is referred to as vegetation. The basic unit of vegetation is the plant individual and the nature of the vegetation at any given site is both defined and characterised by the component individuals,

Vegetation is normally composed of individuals belonging to many different species of plant which may also be regarded as an interacting system of population of species." The corporate growth of plant materials – which mantle most of the earth's surface" as description by David A Moore is however obviously distinct from flora. The clear distinction between vegetation and flora, is that flora of an area comprises the species of plants that are found growing there. The vegetation however, also includes the quantitative contribution of the species

to the total plant cover, the spatial organisation and arrangements into plant communities.

2.1 CLASSIFICATION OF VEGETATION

There is a whole range of features by which vegetation can be classified as a basis for description, viz: Physiognomy, structure, dominant species and floristic composition. This can also include the criteria based on habitats and presumed climaxes.

While physiognomy refers to a concept, which has frequently been confused with that of structure, this term is applied to the general appearance of vegetation and, as such, it incorporates a number of different concepts relating to structure. For example, such broad classes as forest, grassland and savanna are essentially physiognomic terms which refers to the general appearance given to the vegetation by the dominant species rather than taxonomic terms, and which do not take account of floristic composition.

In this concept, an element of vertical structure description of the living plant material in space is given as the term forest immediately produces an impression of a vegetation type dominated by trees which therefore possesses a particular layering of biomass above the ground into a characteristic and rather complex system. The term grassland on the other hand suggests a similar layering system in the vegetation type. Desert implies open, sparse vegetation cover.

Another main approach to vegetation description is the floristic composition pattern also known as the phytosociology approach. This simply

refers to the study of plants as gregarious organisms – the sociological interactions between plants of both the same and different species and the way in which they grow together to form plant communities.

This aspect (phytosociology) has an enormous scope ranging from primary description of stands in terms of structure, physiognomy and floristic composition to the detection of which species are recurrently found growing together and the detailed determination of the factors that are instrumental in causing this. Such sociological studies can include not just a consideration of response of the individual specie to the environment and the social interaction between them eg competition, dependence but also a whole range of change in species' performance with seasonal change, population, age structure, mortality etc.

Phytosociology is however used quite often in a narrower sense to refer to the floristic description of vegetation, their classification, naming and distribution. This is useful in documenting the vegetation of various parts of the world and used as well in the production of vegetation maps for areas concerned. Such works also aid in the provision of descriptive frameworks into more detailed studies on particular plant communities to be identified.

Plant materials that comprises vegetation may also be derived from any of the major taxonomic group – angiosperm, gymnosperm, ferns, mosses, and liverworts. The different species contributing to the vegetation cover have a characteristic size and shape and this structure of vegetation is another basis upon which vegetation can be classified, though this may be a rather variable

property, however it is possible to classify into broad morphological or growth form categories, when as is usual, plants of different growth forms grow together, they generate structure within the vegetation. Hence, vegetation structure is defined "as the spatial organization of the component plant material, and it encompasses the abundance of the individuals, their distribution and pattern (horizontal structure) and their vertical organization into layers or strata (vertical structure)" (Moore, 1982).

In some instances, vegetation is described by just the most dominant species that are present there. By whatever approach vegetation is described, the physical factors that govern their existence can not be over – emphasized.

Variations in climate across the earth surface is a major evident factor on the distribution pattern of plants which is largely due to the different penetrating effect of sunlight energy.

The maintenance of all living organisms also requires continuous biochemical reaction within their bodies. This is enhanced at a moderate temperature of between 0°c to 32°c. The temperature exceeding 40°c to 50°c are destructive to biological systems, and problems equally arise for plant as their water and dilute salt solutions within the plant tissue may freeze and cellular structure particularly membrane systems become distorted, when temperatures are extremely low below 0°c.

An equally salient factor in the life of plant is light. It is essential that plants and photosynthetic bacteria use light energy directly from the sun to obtain and

store chemical energy for themselves and as well as other non – photosynthetic organisms such as animals, fungi etc.

Life for any living organism is also impossible without water. This is because life itself began in water and has evolved in such ways that is has remained completely dependent upon it. All living tissues may account for over 90% the tissue weight in water, and plants generally are no exception.

In climates where rainfall is adequate, the vegetation in that environment stand out distinct from areas with less rainfall. This also explains why vegetation in the desert is non–existent or very sparse, as the soil is poor in nutrients. A lot of factors determine the vegetation type of any given locality or region.

Exposure here is very salient. A place is called exposed when one or more prevailing aspects of the climate are accentuated. When a place is exposed, the most important components of climate to the plant being temperature and moisture are affected. The effort of exposure to high wind speed maybe seen in trees on slopes where shoots on the exposed sides of the plant grow poorly than those on the leeward side, hence the trees grow away from the wind. Overexposure is therefore damaging to plant structure that is why sheltered plants are more stable.

2.2 TYPES OF VEGETATION

As aforementioned, a whole range of features has been used to describe vegetation, it is usually most effectively classified on a regional or world basis. And the world vegetation is most readily described in terms of physiognomic classes differing in the overall appearance of the plant cover – simply as forest

and non – forest types, but broadly speaking, there are five main physiognomic types, forest, shrub, grassland, desert and tundra (Ibid)

2.2.1 FOREST

"Structurally, the most complex types of vegetation are forest" (Ibid). Forests are plant communities, which have a closed, canopy of trees, beneath which maybe other smaller trees, shrubs and a ground layer of herbs. It is said to make up about 40% of the world's land surface and occurring in a variety of climatic zones.

One major forest type is the rainfall forest which occupy millions of hectares of land in the wettest climates of rainfall between 4000mm (160in) of rain per year. This is a complex type with rich species communities and best conditions for plant life with no dry or cold season to interrupt growth. The trees here are as tall as 30 – 45m, others even up to 60m beneath which grows a dense profusion of smaller trees. The tallest trees usually stand out isolated with a continuous canopy.

The undergrowth plants consist mostly of small trees, hardly with shrubs and herbs. Different tree species reach different heights at maturity and make up different layers of the canopy, with certain families composing the upper layer and others making the lower layer. The tallest trees usually have broad umbrella – like crowns with numerous small, dense sub–crowns. The smaller trees commonly have conical crowns. Buttresses may reach up to 10m or more, up to the trunk. The bark is very diverse varying from black through to orange white, and on stems larger than 0.3m, it is commonly scaly. Leaves are prolonged with

"drip lip", compound and pinnate leaves are also present. Climber types of plants and epiphytes are common in a great diversity of forms and species. Some of the species that start life as epiphytes ultimately engulf and kill the host tree.

As the rainfall drops to 2000mm and a clear dry season becomes increasingly prominent, tropical rainforests change to various kinds of seasonal forest. Taller trees become deciduous, shedding their leaves. This is the dry tropical forest type. This is a much simpler forest structure with fewer woody species. Where dry season is close to five months, as in the so called "monsoon forest" only a few major plant species stand out distinct. Lower annual rainfall of about 500mm and a dry season extending to about 7months, the tree cover becomes more open as the forests are gradually replaced by woodlands, shrubs or grassland, hence the savanna forest characterised by deep rooting and the flattened crowns of numerous trees and shrubs, which are dominant and having small leaves, except where thorny. The flora here is rich with many fire–resistant herbs, and grasses in the dryer and more open types. Such open forests support a rich fauna especially big game.

In some other parts of the world, a move from the tropics to the higher latitude is accompanied by a cool winter, which results in distinctive forest types. The **warm temperate forest** where rainfall is plentiful (1500 – 3000mm) and well distributed throughout the year, the forests here are rich in tree species especially broad evergreens. Some conifers are often present, epiphytes and climbers are also prominent. Plank buttresses are absent, some of the trees are

deciduous, leaf size decrease by altitude. Plants reproduce abundantly on ground and tree trunks.

2.2.2 SHRUB

This is a major vegetation type dominated by shrubs – woody plants of more than one stem. Many parts of the world support such vegetation as a result of man's modification of forest. Restricted shrubby vegetation is often found where conditions become unsuitable for tree–growth. They occur on the dry side of forest or bound grasslands where desert conditions are approached.

The largest expanse of semi – desert shrubs occur in a belt along the South side of the Sahara and other North African deserts through the Arabian Peninsula, and unto western Asia, from Mauritania (west) to the Thai Region on the borders of Indo–Pakistan (east).

Rainfall is low, down to 120mm in some places but tend to be somehow seasonal with average temperatures high. Shrubs are either thorny or succulent and can be as high as 2m with thorny herbs at ground level. Rainfall generally does not exceed 200mm.

The dominant plants are broad leafed sclerophyllus shrubs and small trees, but a special feature of this vegetation type is the importance of annual plants which may account for up to half the total species, they are specially favoured by mild, moist winters and summer drought.

2.2.3 GRASSLAND

Grassland is a vegetation type that the predominant species are perennial grasses with characteristic long, narrow, parallel veined leaves and fibrous root system composed of mainly adventitious roots. The vegetative feature gives rise to two main growth form i.e. tufted or tussock and prostate or creeping types depending upon the pattern of development. Both growth forms produce a mat of roots and shoots known as turf or sward, which is resistant to a variety of human controlled influences from grazing and burning to recreation. Numerous perennial herbs also grow along. Woody shrubs are sparse or absent. The herbs commonly have limited flowering periods and throughout the season of growth and reproduction, confer a characteristic aspect of colour upon the background green of the grassland, yellow being the predominant colour and a feature thought to be an adaptation to enhance pollination for many insects.

Grasslands are found in all continents of the earth between latitudes 60°N and 50°S and used primarily for grazing. The wet and dry tropical zone savanna grassland covering large areas of Africa has a winter dry season followed by rainy season and a minimum mean temperature of 18°C in the coldest months, the range of precipitation varying between 200 and 1000mm. Three broad categories that can be recognized are savanna woodland, savanna parkland and savanna grassland which represent a gradual transition from closed woodland with a canopy cover greater than 50% to an open grassland where trees and shrub cover is less than 20%. These major types of grassland can be found in

the true savannas of the West Indies and Guinea, and Sudan vegetation zones of West Africa, and the range lands of Central and East Africa.

Savanna occur on the flat plains and plateaus and due to the marked seasonal pattern of rainfall, there are pronounced differences in the seasonal appearance of the savannas, marked clearly by yellowish coloration from green at the end of the rainy season.

2.2.4 DESERT

Very low precipitation of less than 125mm because of very cold or very dry warm air moving over an area, so that plant cover is discontinuous and often virtually absent is used to describe desert conditions, other times described as "where nothing grows". These areas are characterised by low rainfall and unpredictability in it's amount, duration and annual distribution and extremes of temperature. This is a serious negative vegetation type.

About 20% of the world's land is made up of desert (Leong, 1971), however only a small fraction of these are "true desert". On careful study of the world map, can be realised that almost all the deserts are confined within 15° – 30° parallels of latitude north and south of the equator. They also lie in the trade wind belt on the western parts of the continents where trade winds are off–shore and supply cold currents that produce a desiccating effect so that moisture is not easily condensed into precipitation.

Leong classified deserts into five viz.; rocky desert consisting mainly of stretches of bare rocks swept clear of sand and dust by wind with the exposed rock part smoothed and polished. Stony desert composed of extensive sheets of

pebbles and gravels, which the winds are unable to blow off. The desert type is more easily accessible than sandy desert, which typifies the popular idea of desert scenery. Here wind deposits vast stretches of undulating sand dunes in the heart of the desert.

A fourth type of desert recognised is badlands – typifying an area where it is badly eroded by occasional violent rainstorms into gullies. Bunnett also identified these four classes of desert types. There is however a fifth type by Leong known as the mountain desert. These are found on highlands such as plateaus and mountain ranges.

2.2.5 TUNDRA

This is an area of no growth, tree – less or barren land. Dominated by low shrubs and herbaceous perennials with mosses and lichens, it is found in the Polar Regions and characterised by long cold winters and short summers with a chance of frost at any time. The mean air temperature of the warmest month usually falls between 0 – 10°c and annual precipitation is less than 200mm of rain.

Another form of vegetation type is the Mountain Vegetation. This is evident as one progresses from the foot of a high mountain to its peak, as influenced by temperature since air temperature decreases with increase in altitude at the rate of 0.5^0c per 100m. Wind speed and exposure to wind also increases with higher altitude and these are affected by slope and temperature. Precipitation however differs here.

These aforementioned classes of vegetation are described by Moore as zonal vegetation in view of the fact that they are major types that can be found in all continents of the world unlike uncommon ones that are not known quite well, and very sparse in their location, but more importantly because they occur in the world's principal climatic zones.

Other vegetation types that are not necessarily linked with the climate of a region occur because of favourable microclimatic conditions, hence the name "azonal vegetation" (Moore, 1982). The most important factors responsible for these azonal vegetation are soil fertility and exposure.

i. Hearth

This is a plant formation in which trees and tall shrubs are sparse or lacking and the dominant life–form is that of dwarf shrub mostly evergreen with small leaves and forming a canopy at a height not exceeding 1m above the ground. Other dwarf shrubs, herbs and mosses may form subordinate strata underneath.

ii. Wetlands

In conditions where water table is near the soil surface in most part of the year, the resultant waterlogging produce plant communities collectively referred to as wetlands. Wetlands where peat is prominent and the water is nutrient rich gives the vegetation type known as bog whereas where peat is low and water is hence nutrient poor, a fen develops.

Bog plants most often called bog mosses have perforated cells both on the surface of their stems and leaves which permit them to grow very rapidly,

they grow submerged in water and can survive alternate periods of dryness and wetness.

iii. Marsh

This refers to an area of soil and vegetation in which the water table is close to the soil surface creating waterlogged condition for at least part of the year.

In another edition, Moore also identified another class of vegetation called Coastal vegetation. This type occurs at points where the continents give way to the world's oceans. Plants here experience conditions of nearly constant salinity. Within the tropics, halophytic vegetation such as tree–dominated mangrove swamps are found as well as herb dominated salt marsh. While mangrove swamps are found on coasts of a geographical belt surrounding the equator and develop on sheltered muddy shores of deltas and estuaries exposed to the tides, they vary in width and accommodate evergreen species with thick leaves often associated with plants of saline soils. The vegetation is entirely woody varying from low shrub to rainforest height, contain few species, most of which have seeds, which begin to seed before fruits are shed, and have various types of aerial roots.

Apart from the diverse general classification of vegetation, locally, in Nigeria particularly the vegetation is different. The type here can be grouped into three (3) major classes namely forest, savanna and montane vegetation (Iloeje, 1980). The first two are further regrouped depending on the characteristics and location.

Tropical savanna vegetation is described as a combination of woodland and grassland. A savanna vegetation maybe woodland consisting mainly of trees and shrubs, woodland savanna made up of a ground layer of herbaceous plants especially grass and a layer of trees whose crown form a closed canopy, tree savanna – similar to woodland only that the trees are scattered and form no closed canopy. There is also the shrub savanna composed mainly of grass and woody shrubs growing more or less at the same height, and grass savanna consisting a uniform layer of grass with little or no woody plants at all. Adeola, et. al., (1992) identified four savanna ecological belt vegetations in Nigeria in

Sahel - a shrubland with vegetation made up largely of scattered shrubs with little or no grass at all and often associated with semi–arid regions. This is found in the extreme northeastern part of Nigeria.

Sudan - This is grassland with a continuous cover of grasses interspersed with trees and shrubs. This stretch across most part of the Northern region from the Northwest parts of Sokoto, Zamfara, Kebbi, Katsina, Kano, Bauchi, Gombe up the North East i.e. Borno State.

Guinea – The guinea is mainly woodland i.e. trees and shrubs with little or no grass. This is referred to geopolitically as the middle– belt of Nigeria and run through the whole of Niger State to Kaduna, Plateau, FCT, Kogi, part of Kwara, Benue, Nassarawa, Adamawa, part of Taraba and Yobe States.

Forest Savanna- This belt is a combination of woodland and forest vegetation. It is located at the Southern part of Nigeria stretching across parts of Kwara and Kogi down to Enugu States in the East. The structure of vegetation is encountered as one departs from forested regions moving inland. This belt, Iloeje, (1980) identified as "high forest".

The second major class of vegetation in Nigeria is the forest.

The forest of giant woods and just a small proportion of woody shrubs and herbaceous plants. This forest is also referred to as the fresh water swamp forest (Ibid, 1980) and found covering all the States of Western Nigeria and most of the Eastern States and those called the mid – central States.

The coastal forest and mangrove (Adeola, et. al., 1992) can easily be found in States situated along the coastal areas of Nigeria.

The third major class of vegetation existing in Nigeria is the montane type. This vegetation type is found on mountainous areas where altitude is high and warm moist condition, which favour tree growth. This is a mossy forest with heavy rain on tropical mountains and has a dense canopy of small trees with thick crowns of tiny leaves. Trees abound with thick epiphytes including mosses and other flowering plants. Much of the precipitation is derived by the fog condensing on the vegetation. This belt is located only in the mountainous parts of Plateau and Adamawa States.

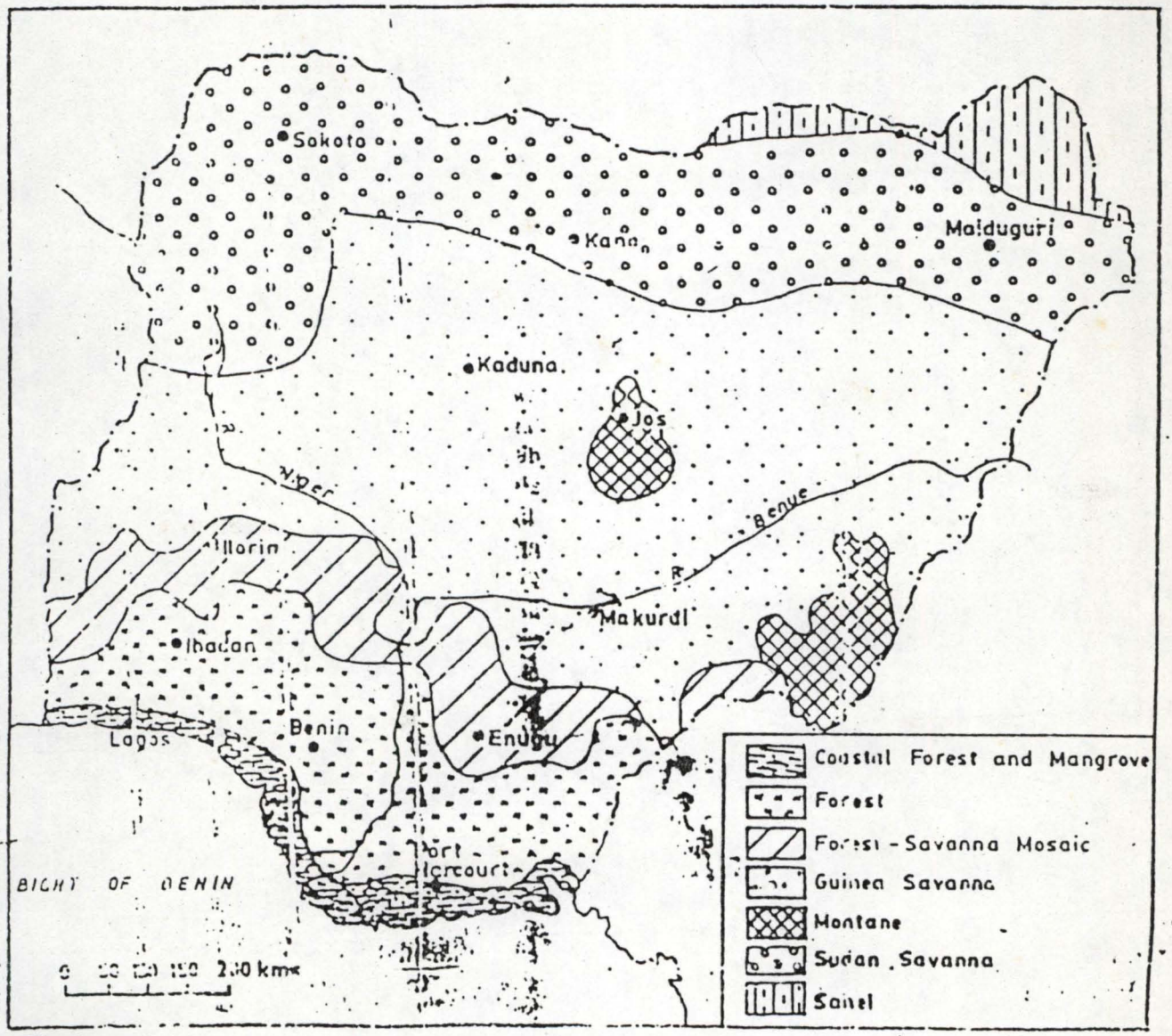


FIGURE 2·1

Vegetation Belts of Nigeria

Source: Certificate and Advanced Geography.

2.3 ECOSYSTEM BALANCE

Ensuring a stable vegetal cover is very important in maintaining ecosystem balance as the whole complex of living and non–living components in any area which interact with each other and through which energy and nutrients flow is what ecosystem entails.

In an ecosystem, four levels are involved namely primary producers in the form of green plants, primary consumers, chiefly herbivorous, secondary consumers in the class of carnivores and the decomposers that include soil bacteria, scavengers etc.

The first class of producers manufacture their own food from dissolved minerals released in weathered rocks, water energy from solar radiation and carbon dioxide by the process of photosynthesis. The energy here is further transferred to the first level consumer by their feeding upon them. Part of the nutrient is taken up by other plants, and subsequently by the second level consumer. Upon their demise, the second level consumers are broken down by bacteria contained in soil and other scavengers as decomposers further nourishing the environment upon which plants grow again along with organic matter from litter fall. Energy is lost from the ecosystem by way of evaporation, runoff, percolation and leaching.

The different levels involved in energy flow in an ecosystem are interdependent on each other that any interference, can disorganise the entire natural processes, and hence have severe general effect on the whole

environment whether on short or long term. It is a rather complex system as C. J. Barrow stated in his book (Developing the environment p.26).

The slightest interference on the ecosystem will trigger a chain of reaction to maintain equilibrium resulting in:

i. Modification of the micro–climate becoming more arid due to over–exposure to insulation

ii. Animal population may change in size and composition

iii. Soil is more exposed to intense heat which dries it up and destroys humus content, coupled with strong wind and heavy rainfall resulting in increased erosion

iv. Runoff increases and less infiltration into soil

v. Sediments washed from land is carried into rivers silting them up and lowering water quality

vi. Evapotranspiration is heavily reduced, hence reducing the rate of water vapour carried from the earth's surface into the atmosphere.

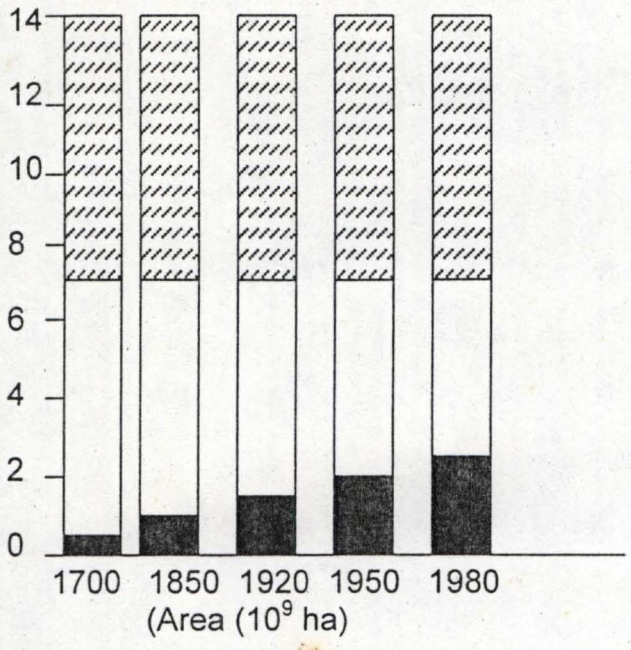
2.4 LAND USE/SETTLEMENT AND AGRICULTURE

Land as a resource is very vital in many ways either in its value and role for land speculation as a means towards boosting affluence, in livelihood, in cultivation or pasturalism/nomadism. A larger percentage of rural dwellers in developing countries have increased their need to acquire more of it due to the rise in population, migration and urbanisation. This renewed need to make land available is to serve as cropland, house the teaming populace, serve as pasture

and other numerous uses to which land is put. There is further pressure on land since more people are moving into cities, and the urban percentage of total population has risen by 50% from 1975–1990 in African nation's and has increased by an average of 5% annually in the last 30 years (World Resources 1990–1991 p.267). City populations rise resulting from rural – urban drift because of land resources deterioration and natural growth of urban population has led to increased search for better livelihood in food, shelters, safe water supply etc. Further pressure on already strained resource base, speaking about land and forest especially.

In the light of this pattern of land use, as a result of settlement, land need to be cleared for more development, in building houses, roads, and for cultivation as well. Not only are people compelled by their socio-economic background to do all sorts of thing to make ends meet which include destroying vegetation, they are ignorant of the consequences surrounding the tempering of the huge resource base believed to belong to no one in particular. Woods are fell for fueling, to serve in construction works, forests are set to fire to get at game beside for the purpose of quick re-growth in providing pasture and most of all to cultivate crops. Agriculture is one single factor that can grossly be incriminated in landuse. The expansion of cropland has largely been at the expense of forested land. According to one estimate, global vegetation cover has decreased by some 0.9×10^9 hectares since pre–agricultural times (Meyer and Turner, 1992). In contrast to that, grassland and pasture areas have virtually remained constant since 1700 as in figure 2.2.

Figure 2.2



Long term changes in global land use, 1700 – 1980

Source: UNEP – ENVIRONMENTAL/DATA REPORT 1993 – 1994

Settlements are fastly springing up in Niger States because of the following reasons:

i. Land abundance and fertility

ii. It is seen as a very peaceful state where all co – exist happily

iii. Parts of it serve as satellite towns

iv. It is centrally located to all States of the Federation

v. It has rich mineral deposits currently being explored

vi. It has a moderate climatic condition

vii. It has holiday resorts by virtue of river flowing through its land having once served as capital of the northern region.

Conflicts have often resulted because of the varying interest to which land use is put as a result of settlement springing up chiefly between nomads and pasturalist. Because we have to co–exist harmoniously, "pasturalism and normadism is reconcilable" (Baba, 1999).

2.5 ROLE OF VEGETATION

Plants of any kind wherever are very important to the soil. Primarily is the protection it renders to the surface soil. Even though the soil serve as support upon which plants stand, so does the plant hold soils in place through the network of roots intertwined, protecting it from exposure. Their roles complement each other and when tampered with, the uppermost part of the earth known as the soil is exposed and hence washed way. Thus, when topsoil is washed off, the ground upon which plants are supported is lost, and vegetation becomes non-existent. More than 10% depletion of crown cover of trees is regarded as deforestation by FAO's definition. That can be minimised when man's multifarious activities are checked in plant destruction. Deforestation, which is a consequence of vegetation clearance, lets rainwater run-off the surface causing floods and draughts downstream. Damages caused by these consequences extends well beyond the forest itself, valuable soil eroded causing siltation to build up in rivers and streams. An estimated 579 million hectares of terrain suffers from soil degradation caused by deforestation (Brown, et. al., 1998).

Vegetation cover is an essential factor in soil breakdown of organic matter into nutrient necessary to the growth of green plants by enhancing rapid decomposition, and easy percolation of precipitation, and gradual flow of surface water into streams, springs and acquires. That steady percolation aids in rapid degradation of organic matter to serve as nutrient to living plants growth.

Globally, forests play a vital role in climate regulation by storing carbon. Forest contains between 475 billion and 825 billion tons of carbon (Deutscher, 1990). Tropical deforestation therefore releases 1.5 billion tons of carbon to the atmosphere each year, about 19% of total carbon emissions worldwide (Bundestag, 1990) which could greatly alter the atmospheric concentration of carbon, hence the increasing problem of global warming that is now being experienced year in, year out.

So many non–timber forest products as essential commodities are found in plant. More than half of prescriptions worldwide contain active ingredients originating from wild species especially of plants in the tropics, and over 75% of people living in developing countries rely on traditional medicines for their Primary Health Care needs. Of these, 80% use plant extracts (Farnsworth, 1988). This is continuously lost as a result of interference in vegetation through different ways. At the rate of deforestation, a very large percent of animal and plant species are lost everyday, and by the year 2015, it is estimated that some "6 – 14% of all species are expected to be extinct" (Whitmore and Sayer, 1992). It is already evident as our traditional medicine men often complain of their inability to find particular plant or animal species that are used in the treatment of

some ailments. To find, distant walks far into the deep natural forests have to be made. This means opening up virgin forests again which also serve as habitat to majority of faunal species depending on the vegetation type. But in vegetations that have been previously interfered with, referred to as "converted area" by FAO, the normal species of these areas no longer flourish well, other times they are not found at all.

Regionally or globally as the case maybe, vegetation also influence the rainfall pattern that is experienced over a given area and time. Considering the hydrological cycle, water is lost to the atmosphere from plants through the process called Evapotranspiration. The amount of water vapour reaching the atmosphere would be reduced, limiting the rate of precipitation for a given area; with less rainfall, vegetation will not thrive well and a vicious cycle exists.

Oxygen happens to be a very important element in the atmosphere which animals use in respiration, taking it in while plants give off. This is interchanged with carbon dioxide by both users. What happens in the total absence of plants as regards air (O_2) exchange is better imagined than experienced. A balance is however maintained when both exist in abundance.

Finally, significant plant availability wherever helps in controlling the severity of wind pressure. Plant cover is able to check damages that could result from frequency and severity of stormy winds, hence need the for shelter belts.

The importance of this is emphasised in the Federal Government of Nigeria's recent pronouncement of planning to create a large shelter belt across Northern Nigeria which is to run from the Eastern to the Western part of States

particularly already highly deforested and facing the problem of desertification. This may also be the reason behind the annual tree planting campaign by all States especially of the Northern part since in the early 1980s.

Lastly, but certainly not the least, vegetation is for aesthetic value. If for no other reason as the ignorant person is concerned, the appreciation of the beauty of any given area by way of the plants in place is indicative of the good of vegetation. The cool freshness one feels approaching a green area is important. That could probably explain why individuals are seen with pots of flower to keep in their homes, even inside bedrooms. Others even make flower beds in the smallest portions that can sustain plant growth in the house. This appreciation of plant beauty is why some organisations are involved in conservation of forests.

2.6 MAN'S INFLUENCE ON VEGETAL COVER

In as much as waste is bound to generate where people live, same goes to interference in the vegetation of any place by people around. This is in providing for the sustenance of all and sundry in cultivating the required and necessary food item, and others for his overall wellbeing. In his bid to provide for his upkeep, he certainly has to clear vegetation for cropland. A piece of land tilled for so long such that it becomes degraded and no longer fertile for increased productivity would be abandoned for a new one, especially where in abundance.

A new dimension to the issue of cropland is the renewed interest in large scale farming by the affluent and retired government civil servants who need to prepare something to fall back to afterwards. Vast expanse of lands/forests are

opened up and with time, degradation sets in, leading to further abandonment of such lands for more productive ones - a vicious cycle.

Other tempting work of man on vegetation includes the need to provide pasture for his animals. Severely grazed vegetation is equally left for greener ones.

The issue of poverty is contributory in that the rural dwellers who are poverty stricken would continue to cut down trees for their own energy supply as well as to make money by selling to other fuel wood seekers. In highly forested areas, forests are opened up for commercial logging, well aided by the government and knowing the implications. Norman Myers in an article titled Guest Essay, p. 390 said "these forest new comers are responsible for well over half of all tropical forest destruction. Driven by rapidly growing population and poverty, their numbers and impact are rising rapidly. The process usually begins by a road cut open by logging companies. Once the roads are made accessible, unsustainable forms of small-scale farming begins, homes are built, cattle ranching commences as well, aided by government on lands that have been wasted".

It is very much in vogue especially amongst the affluent to compete over how much hectares of land one has as farmlands or plots as landed assets considering its values particularly in potentially reserved areas.

Also, in a particular section of the State, the most valuable gift item a bride receives from her friend is firewood – the quality of each is determined by how esteemed she is before them.

2.6.1 POSSIBLE PROBLEMS FROM VEGETATION CLEARANCE

The fact remains clear that vegetation once cleared ultimately means the ecosystem has been disrupted, some life farms are denied of their dependants. This is so because the environment is very complex such that the immediate damage done is not noticed until it has reached an irreversible dimension upon which, there is total lost of biodiversity. Plants and animals are continually threatened by extinction as a result of human encroachment on their habitat. It is estimated that one quarter of the world's 30 million species of plants and animals maybe lost by the year 2020. Faunas have lost their habitat and the floras are affected because both complement each other.

The problems in Nigeria are so numerous and include those "of drying rivers and streams in the North as a result of excessive vegetal cover removal and bad land management practices" (Usman, et..al., 1997).

Exposure of soil through vegetation clearance and burning enhances quick deforestation; earth temperature can be risen such that shift in temperature and subsequent rainfall pattern will seriously disrupt ecosystems, agriculture and food production as a whole.

Evaporation loses are bound to occur in view of the great role played by plants in the water cycle.

Wind flow over land is going to be more rough and severe because of lack of shelter that vegetation normally gives. Vegetation loss from severe trampling by beasts and even humans over a long time may degrade the soil thereby resulting in onset of erosion. Steady soil damage may occur along with landslips.

When vegetation is cleared especially by burning, lot of nutrients are lost in form of smoke and ash that is washed away after heavy rainfall, soil microbes are lost and soil organic matter destroyed coupled with chemical changes in the soil surface layers.

2.7 VEGETAL COVER ASSESSMENT

Cover is a reference to the proportion of ground that is covered by the aerial parts of the plant material growing upon it. When these aerial parts are in lateral contact and form a continuous cover, the vegetation is said to be closed. If on the other hand, the vegetation cover has gaps, which could be colonized by other individuals, it is said to be open; and if the amount of space is much greater than that occupied by plants, the term sparse is used.

The amount of vegetation cover by an individual species maybe estimated in several ways. The simplest being the use of crude subjective estimates derived from a visual impression of its aerial extent as against remote sensing techniques. One of the best known is the eleven-point scale introduced by K. Domin. It is easily applied, with a high degree of consistency in estimating plant cover over extensive areas of vegetation survey. This scale is also called cover – abundance because it not only estimates cover, but also abundance (i.e. number of individual species).

Another scale is the one by Braun Blanquet, though a six–point scale, also permit a rapid estimation of cover. An equally accurate method for cover estimation is by the use of the point quadrants where a number of long pins suspended in the frame are lowered into the vegetation and the species 'hit' by

each pin are recorded. The cover is given by the number of hits for each specie expressed as a percentage of the number of pins lowered.

Other most recent means by which vegetation cover can be determined is through Remote Sensing by use of satellite images and aerial photographs. This is essential though in providing a general view of the image of a region's vegetation but it is certainly not accurate in giving the best of results because only highly forested areas can be determined hence it excludes other vegetation types. This means, it is also not able to highlight the floristic diversity of vegetation types, implying that the different types of vegetation types in a given climate zone could be missed.

CHAPTER THREE

3.0 METHODOLOGY

The raw data for the 111 sampled locations in the State was adopted from the Geography Department of FUT, Minna. This is attached in the appendix on Table 3.1. Visits for observations were also conducted to some of the locations.

For each of the 111 locations, 4 land-cover columns (i.e. tree forest, shrub, grass and bare ground) and 1 landuse column (i.e. farmland) are indicated.

They are classed in this order :-

i. Tree forest;

ii. Shrub;

iii. Grass;

iv. Farmland;

v. Bareground

Each class carrying the percentage value of the cover.

3.1 DATA DESCRIPTION

The method adopted was a simple means of studying vegetation cover. It is about the most accurate of all manual study types especially for vegetation of this region in view of the fact that it allows an individual a good and distinct view of the different land cover classes as well as land use types. This part of the world being the kind with vegetation that allows settlement nearby unlike in the highly forested areas where only a few can co-habit; or where climatic conditions are extremely harsh as to allow for a large majority settlement.

To do this, 2 methods were involved:

3.1.1 FIELD DATA

Field data refers to the raw data derived from the field of study. The location could very large or small.

a. SMALL AREA SURVEY.

In studying a small sized area type, the individual or surveyor stands at the middle of the spot under study having taken note of his direction. He now takes from his point of stand a distant view of the area from four different directions i.e. North East, South East, South West and North West. For each direction, he notes the percentage cover for each of land cover and use for the given location.

b. LARGE AREA SURVEY

For accuracy, fairly large areas are divided into 4 sectors, namely A,B,C & D. For each of the four sectors, a survey of the different classes is taken and noted. The percentage cover of each class of landcover/use are then put together, and the mean arrived at. This will give the exact value of the location however large. This is simplified using this formula below.

$$\text{Area} = \text{value of} \quad \frac{A_{1,2,3,4,5} + B_{1,2,3,4,5} + C_{1,2,3,4,5} + D_{1,2,3,4,5}}{4}$$

Simply put

$$\%\text{ of } \frac{A_1 + B_1 + C_1 + D_1}{4} \text{ to give value for column 1 (treeforest)}$$

$$\%\text{ of } \frac{A_2 + B_2 + C_2 + D_2}{4} \text{ to give value for column 2 (shrub)}$$

% of $\frac{A_3 + B_3 + C_3 + D_3}{4}$ to give value for column 3 (grass)

% of $\frac{A_4 + B_4 + C_4 + D_4}{4}$ to give value for column 4 (farmland)

% of $\frac{A_5 + B_5 + C_5 + D_5}{4}$ to give value for column 5 (bareground)

This way the data for large spots are computed. In either of these 2 methods, the field data were arrived at depending on the magnitude of the area under study.

3.1.2 DERIVED DATA

This is an index used which enables us determine the areas or location with high vegetal cover and those with sparse vegetation.

To do this, reference is made to our table of field or raw data. The values of columns 1 & 2 are added, 3 & 5 also added, the value of column 4 remaining same. 1 & 2 showing areas with vegetation, 3 & 5 with less vegetation and 4 as used for farmlands to get the derived data employing simple arithmetic computations.

The values of each column in Table 3.1 as computed from the raw data is as follows:-

A = 1+2

B = 3+5

C = 4

D = A/B

$E_1 = A\text{-}B$

$E_2 = E_1 - \bar{E}_1$ (Statewide mean)

$F_1 = E - C$

$F_2 = F_1 - \bar{F}_1$ (statewide mean)

A. Indicate the density of vegetation cover by being made up of tree and shrub plants along with other lower plants, grasses inclusive.

B. Shows the sparsity of vegetation due to mere grass and bare ground with no vegetation of any significance.

C. Is constant with its value as a landuse category

D. Values was done by dividing A by B to determine the moderate spread of vegetation?

E_1 Here, the index of vegetation cover is determined by subtracting the value of sparsely vegetated parts from that of highly vegetated part, in this case, A – B. Where the values are high, it is a pointer to very high concentration of vegetation, and significant stability. However, where the values are in deficit or on the negative side, there is cause for concern indicative of very low cover or none at all. For example, if we have vegetal cover index i.e. value of E as 50%, we have a position index or stable vegetal cover hence not much cause for alarm, but where the index is say 10% or less than even 1%, then there is a big problem which may as well be affected by Human Intervention Index (HII) hence negative index.

This is the vegetal cover index determinate.

E_2 This shows the deviation from the mean spread of vegetation across the state.

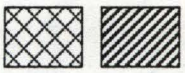
F_1 This is the class that shows the level of human interference, arrived at by subtracting farmlands from E which is the vegetal cover index of tree, shrub minus grass and bareground. Excluding the natural vegetation spread, and the only landuse, the cumulative effect of what is left is a pointer to interference. This is the called the Human Intervention Index. It is so called because it indicates the level of human influence on the natural stability of vegetation. The index maybe a negative or positive one.

F_2 This is indicative of the deviation from the mean of the degree of activities by man.

3.2 METHOD OF ANALYSIS

In analyzing the data, the indices arrived at were categorized into 5 different classes.

- Maximum class 1 for values of 60 and above;
- maximum class 2 for values of $\geq$ 40 to < 60 ;
- medium class 3 for values of <40 to – 40;
- minimum class 4 for values of <-40 to – 60 and
- minimum class 5 for values of -60 and less.

These classes are represented using these schemes of shades   for class 1,2,3,4, & 5 respectively.

These are finally plotted on the map of Niger State to show spatial and dense vegetation patterns as would be seen in the next chapter using value intervals of 20

CHAPTER FOUR

4.0 ANALYSIS

The following sections outline the details of vegetal cover and human intervention patterns in Niger State, as contained in Figure 4.1. The implications of the spatial patterns are discussed.

4.1.1 VEGETAL COVER INDEX (VCI) CLASSIFICATION OF NIGER STATE

Vegetal cover patterns can be found in three district classes. Figure 4.2 shows pockets of locations with very high density of vegetation scattered across the state. These areas are located around Kudu, Kpaki in Mokwa Local Government in Agaie Local Governments as well as surroundings of Gawu, all in the south-east of the State. Other scenes include Asha near Shiroro and Udara stretching to Mai-barimi in Kontagora locality. In these areas, vegetation is dense and not seen to be under any threat of wanton destruction.

Class 2 scenes are found enclosing class 1 locations particularly in the southern stretch of the State. They include Takuma and Labozhi. Parts of Gbako, Bida, Agaie, Lapai, as well as Gawu and its fringes. This is also found around Agwara and Lumma, Baare, New Bussa in the North west, as well as Dukku and Danrangi near Rijau in the extreme north. Shadadi along with surrounding areas of Kontagora also fall within this class (together with Yakila near Zungeru and Maikujeri close to Kagara) except for naturally occurring factors, vegetal cover in these places are stable.

The remaining parts of the State spanning through the central part of the State falls under class 3, a class of medium vegetation cover. This vast expanse

is probably due to vegetation belt of the guinea savanna, under which the State falls. It therefore can boast of relative significant spread more so as there are no scenes under classes 4 and 5 that have much lesser vegetal cover.

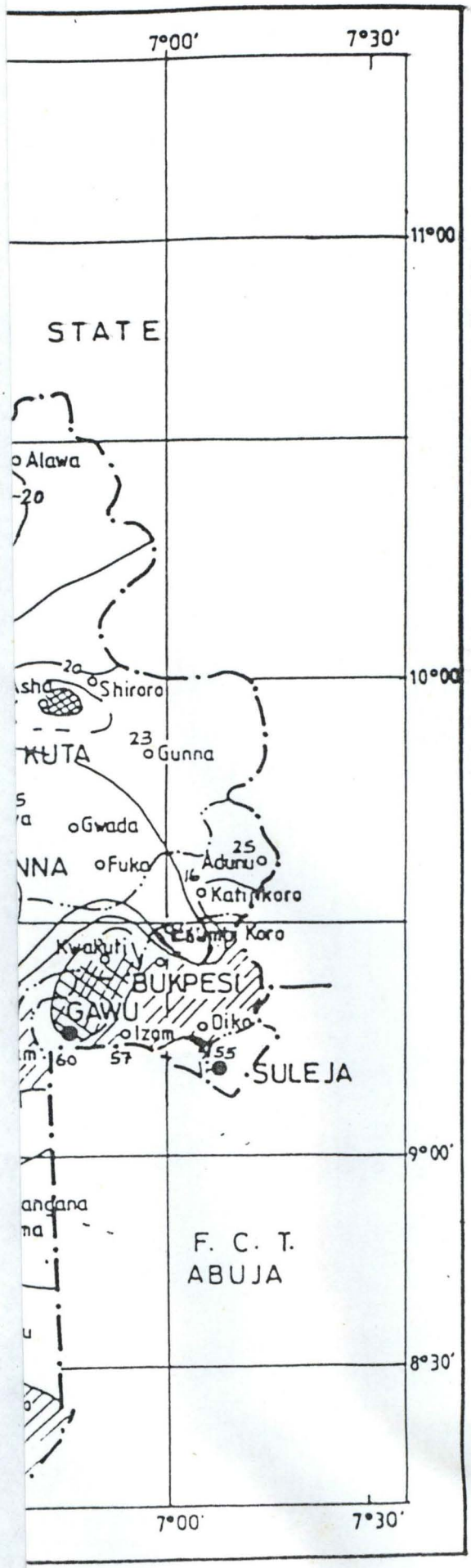
The need to ascertain the relative spatial significance of the patterns, made it necessary to examine the deviation from mean statewide index as discussed below.

4.1.2 DEVIATIONS FROM MEAN STATEWIDE INDEX

In relation to the statewide patterns of vegetal cover index classification, this figure i.e. 4.3 shows the contrast to that depicted in figure 4.2. There is no area with a first class vegetation index, better still are the locations of Batako, Labozhi in Gbako & Enagi Local Government Areas respectively south of the State as well as in Kaiama, Borgu Local government to the southwest and lastly at Udara in the northern part. These all have high vegetal cover index implying that they all have relatively stable ecosystems that need to be preserved. Besides these, few places, about 60% of the State have average natural vegetation spread meaning it is not in danger unless some factors come in to play.

Another class of vegetation spread can be found covering most parts of Kagara, Pandogari and Kusherki through a wide spread area spanning from Nasko to Kontagora, Kulbinbobi southwards towards Mashegu. Here, vegetation in sparse. The implications here is that coupled with negative human factors as the case maybe, serious land degradation may set in and desert encroachment can be fastly enhanced. This also is a pointer to the fact that sedentary farming communities would be compelled into moving in search of greener fields.

COVER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In Beji, a class 5 picture is presented. A class 5 picture can be distinctively pointed out around Beji up to Maikunkele in Bosso Local Government Area as a worst location in relation to the entire statewide picture. Sparcity here means near zero degree of even farming activities, since the fertility of the land must have been lost long ago due to serious deforestation resulting from logging activities, as such surrounding vicinity of the class 3 vegetation index stand the risk of being invaded by people.

4.2 HUMAN INTERVENTION INDEX (HII)

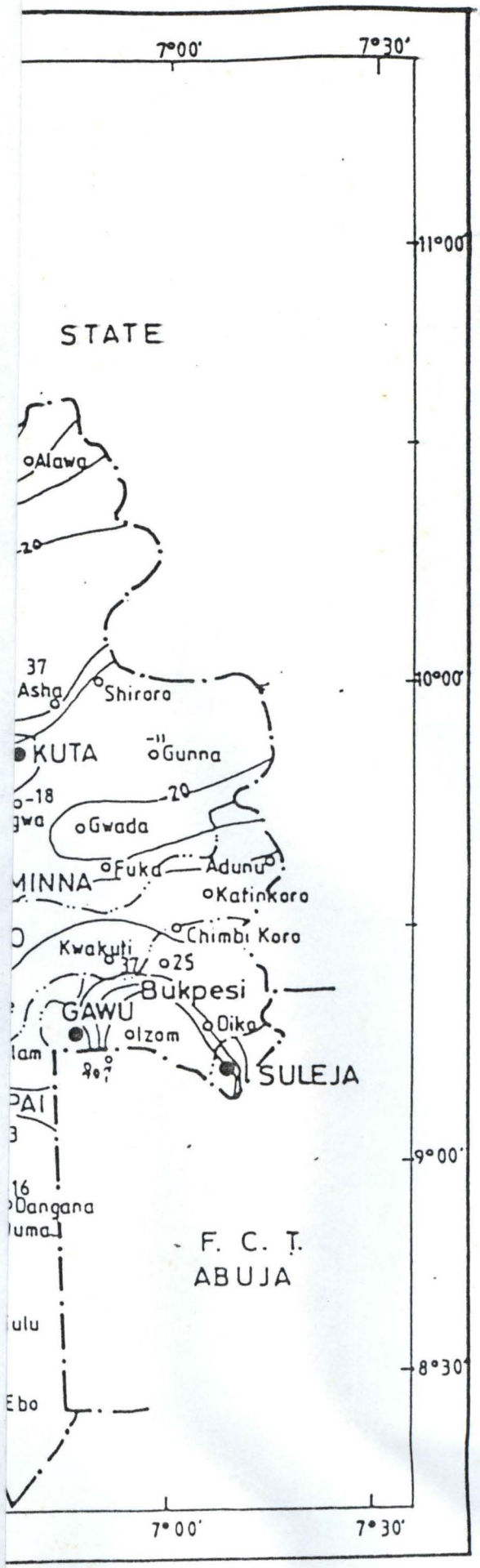
This focuses on the degree of agricultural related human activities.

4.2.1 STATEWIDE PATTERNS

Figure 4.4 presents the spatial patterns in the rate of agricultural human intervention on the environment. Analyzed using the scheme of classification discussed in chapter 3, the State under study has 3 clear classes. Class 1 which shows the most severe cases of agricultural related deforestation occurring in only three pockets in the south and north between Kudu and Mokwa (in Mokwa Local Government Area) and Batako (in Gbako Local Government Area) and between Kontagora and Mai Barimi (in Kontagora Local Government Area) respectively. In these areas, vegetal cover was and is being remove gradually to give way for farmlands which are subsequently abandoned after a few seasons. This implies that the stability of the environment is gradually being threatened.

This same figure shows a chain of class 2 scenes found in an axis running northeast to southwest through the northwestern parts of the State from Rijau through Agwara to Borgu Local Government Area. This class is also found in an

COVER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F. C. T.
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expansive stretch to the southeast through Bida, Lavun, Agaie, Lapai and Gurara Local Government Area as well as Kusherki on the Northern border with Kaduna State in class 1. In these areas, agricultural practices are not as serious as in class I but the extent to which the environment is tampered with through deforestation are as serious as in class 1, the only difference being that areas under this class 2 are naturally under very thick vegetation, but I the long run, the intervention maybe as drastic as in class 1

The remaining parts of the State falls under class 3 spanning through the central parts of the far extreme east and west as well as the extreme north. Here it cannot be clearly determined as to what extent agricultural activities have affected the environment because from the look, there are no vegetal cover left to clear it can be expected therefore that hence there are no more fertile lands to cut open, there would be gradual exodus of farming communities into classes 1 & 2 areas and an eventual invasion of relatively stable areas. Here also, the mean statewide index examination was necessitated for the importance of determining the relative spatial difference.

4.2.2 DEVIATIONS FROM MEAN STATEWIDE INDEX

Figure 4.5 show a map depicting spatial variations in the human intervention index across the State the contrast are immediately obvious between this figure and figure 4.4. Here, the statewide picture are in 5 classes; class 1 is found in the areas of Batako in Gbako Local Government Area appearing as the location with the most serious level of human intervention of agriculture related type, meaning

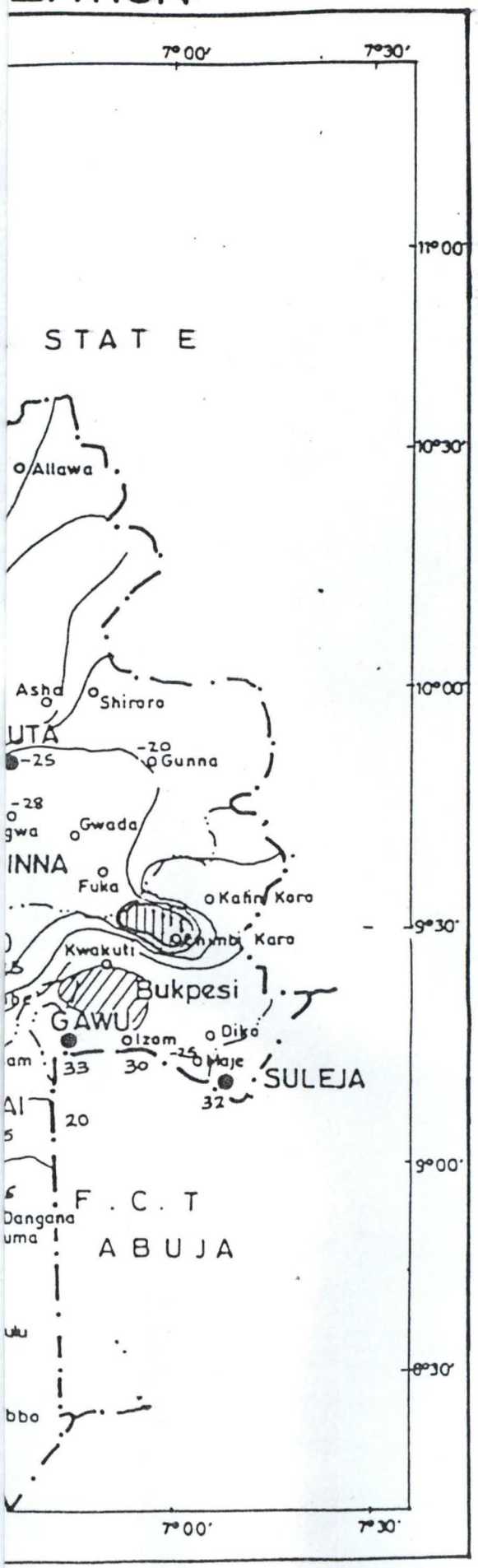
if measures are not taken soon, it would become badly deforested in the long run looking at it with respect to other parts of the state.

Kudu and Kpaki southwest of the State, Udara to the North near Kontagora and surroundings of Gawu to the southeast in addition to the fringes of Kaiama are also experiencing varying degrees of human activities depicted in class 2. This could be attributed to the high reserve of vegetation in the area and more communities are likely to migrate towards these places such that sooner than expected, large new settlements would emerge whose pre-occupation would be to further destabilize again.

A class 3 pattern is what is seen across most parts of the State, as average degree of agricultural activities all through. The expansive stretch depicts the situation of the state as one, which is consistently dependent on the yield of the soil, the fertility of which could be reduced drastically.

However, the mid central part of the State mainly of Kagara to Kulbin bobi in Nasko Local Government Area, Bangi, Kotonkoro and Pandogari in the extreme North, less human intervention from agricultural land clearing maybe taking place, but most heavy deforestation is due to the search for fuel wood. More serious cases are to be found around Mashegu in the central part of the State, Makunkele to the mid-east and Kusherki on the northern border to Kaduna State. At these few pockets, relative to the statewide picture, no agriculture takes place, if any, only little that can hardly be sustained. The human intervention that takes place is most likely to do with mass logging the extent of which cannot allow for sustainable agriculture.

ENTION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4.3 DISCUSSION

The two indices (VCI and HII) afford us the opportunity to appreciate the situation of the environment as it affects the State. The VCI allows the determination of the total vegetal cover for given spots having excluded the plantless areas. The spatial patterns present in three varying classes of vegetal cover are a plus for the State as no serious cases of naturally unvegetated grounds exist. This should foster stability for the respective localities in ensuring ecological balance.

While V.C.I. attempted to give a view of the spatial vegetation pattern, the H.I.I sought to determine the extent to which people have been able to alter the natural setting through farming. The indices put together imply that even though most parts of the State are well protected by vegetation, the rate at which people are clearing the ground may spell doom in the near future. This is further compounded by the increased influx of people from neighboring States along with internal migration of people from areas already degraded to those still very stable.

It is a known fact that the traditional agricultural practice of shifting cultivation is wiped out and same piece of land is repeatedly cultivated annually during the rainy season and quite recently during the dry season through irrigation system to maximize yields, a practice which greatly reduces soil fertility. Those bad lands associated with lower yields compel farmers to completely abandon the lands in search of better ones. The endless search for and limitation in acquiring virgin lands leaves the farmer with the struggle towards increasing

the productivity of his land by application of chemical fertilizer most of which are only useful in the first few years of use, and for certain crops. These agro-chemicals remain in soil over years, get compacted forming hard pan and further hardening soil as well as preventing water percolation to moisten soil for plant use. Bad land preparation and management in which heavy tools not suitable for our mature soil are used contribute to land degradation and subsequent fertility loss.

In the water cycle, vegetation is very important in the process of water loss into the atmosphere through enhanced humidity level and subsequent condensation of water vapor to fall back as rain. The magnitude of activities taking place at different parts of the State in clearing vegetation can seriously influence rainfall regime. Baregrounds that now abound are exposed to intense temperature that will further reduce soil moisture and reflective index increased. Open space increase wind speed such that convective currents that is responsible for convective cloud formations is affected which in-turn determines rainfall, setting in late and ceasing early making it inadequate for crop use. The role of vegetation spans through all spheres of the environment and is closely linked to the infiltration rate that is recorded. Plants hold soils in place and protects against run-off, soil moisture loss and storage enhancement which gets drastically reduced in unvegetated grounds.

Further implications of vegetation loss for the State is with regard to under ground water reserve that get recharged from volumes of discharge in rivers and streams. River beds are raised due to sediment loads resulting from severe

surface runoff eroded deposits reducing the basin's retention capacity as such rivers that used to have water all year round are now seasonal, drying up soon after the rains which in turn affects underground water reserve. These enormous implications are already being experienced in parts of the State where vegetal cover is very low.

Another serious issue for the State is at locations that are already degraded with its attendant consequence of low farm yield and fresh water depletion forcing people to migrate and resettle in areas that have higher vegetal cover.

The long term implications include the potentials for socio-cultural conflicts between the newcomers and the settlers arising from differences in language, religion, e.t.c.

CHAPTER FIVE

5.0 SUMMARY AND CONCLUSION

5.1 CONCLUSION

Natural environments are beautiful scenes to sight and besides a few natural factors, only man is able to greatly alter those looks. Niger State's location within the middle belt allows it the opportunity of a moderate and stable vegetation spread, neither too dense nor too sparse. It also enjoys a high degree of socio-economic stability and moderate population density despite its vast expanse of land.

These factors having recently attracted immigrants, makes it now vulnerable to instability from the population influx and its attendant consequences one of which is the rapid depletion of the state's natural vegetation cover towards meeting the needs of the growing population. This has serious implication for the state and even beyond.

Over the years, the author has been repeatedly reminded by relations from parts of the State of how unusually very hot it always become when it is still cold, windy and dusty in other States upper north, an experience observed as quite abnormal.

The trends of the events occurring when wanton destruction of vegetation becomes the order, as the State will continue to experience if concrete and decisive measures are not taken soon, are quite enormous. Bush clearing exposes an area wide to the wind, which dries up the ground leaving no moisture for plants' re-use, soils will break-loose and top soil will be carried away leaving a

degraded land that cannot further support plants as soil fertility is lost too. Hence, there is moisture in soil, rate of evaporation is increased. Evapotranspiration rate will also be near zero because water loss from plants unto the atmosphere in the hydrologic cycle cannot take place. Therefore the amount of rainfall can be drastically affected. Few inches of rainfall that is luckily recorded over the entire season is washed off immediately because the ground is uncovered with vegetation to intercept part of the heavy drops and infiltration will as well be very low as the ground is bare, loose and degraded. A serious agricultural condition of drought can also set in, in the light of reduced soil moisture and fertility along with early cessation of rainfall or late onset as the case maybe and even reduced rainfall during the season.

The extent of surface runoff and lack of infiltration taking place has an extended implication for underground water reserve. Ground water is recharged from infiltration process, which cannot effectively take place in the absence of adequate soil moisture and storage resulting from rainfall. In the end, surface water runoff can lead to flood event on its way to the ocean.

The rate of encroachment on vegetation from agricultural activities coupled with other development processes like major roads construction and the heavy, deep concrete drainages and pavements seen lining the major ways especially in the State capital can probably be the explanation for low ground water reserves being experienced recently, since wells have to be dug very deep to reach the water table and soon after a short while withdrawal, the reserve is

exhausted. This is evident as soon as a few weeks after cessation of rainfall in some parts of the State.

These series of events can be reduced and put under check if only the State government is interested in the long term mitigation measures and not just emergency relief measures as does happen in most disaster periods of droughts and floods. To avoid these, the following suggestions are put forward.

5.2 RECOMMENDATIONS

The Niger State government should as a mater of urgency institute environmental education and awareness programme as an effective means towards creating awareness and ensuring a positive change in knowledge, attitude and practice of the entire populace over the need to appreciate and conserve the vegetation reserves as best as possible bearing in mind the consequence. The public, if well informed and educated, will go a long way in the long run in avoiding further degradation of the environment. This could be achieved through the news media and public enlightenment agencies.

Environmental education programme that has also been incorporated in the mass literacy campaign programme, as well as in the school curriculum right from the primary level should be implemented without further delay.

Legislation:- Having created enough awareness, the law making arm of the State government should put forward legislative instruments that would serve to regulate all human activities as regards the State's forest reserves and ensuring strict compliance. The regulation should focus on:-

- Location where vegetal cover is naturally low. Here any form of tree felling should be completely banned. Any defaulter should be punished severely to serve as deterrent to others by severe penalty or fine, which should outweigh the expected benefit from the default. These places include localities identified under classes 4 and 5 in the VCI and those of the 1st and 2nd classes in the H.I. I. They include Kagara, Pandogari, Beji, Mariga, Kontagora all in the North and towards the east as well as Paiko and Maje to the south east.

  Annual tree planting should be made compulsory at all levels up to the individual households.

- For localities with moderate vegetation covering nearly 60% of the State as seen under class 3, laws to be enacted for these areas should be directed towards prevention of logging without adequate supervision from concerned forest authority.

- Persons in the business should be licensed, and heavily taxed to minimize the number of persons going into the business. Trees to be cut down should be limited per year and under no circumstance should the limit be exceeded. In like manner, not all forests in the State should be open to logging activities all year round. It can be arranged such that the reserves are rotated. If for instance there are ten forest reserves marked out for use in the State, then only one should be put to use annually. By this style of rotation, each reserve can be used only once in ten years allowing for natural regeneration and conservation.

- Before the forest reserve in use is closed down at the end of the year, re-forestation should take place, so that by the tenth year to come, when the reserve would re-open to users, it would have re-grown to its fullest.
- For whatever reason a tree is cut down, immediate replenishment should take place by two or more being planted in the place of one. This should apply to all prospecting for wood in any part of the State.
- This singular function is enough to keep forestry personnel busy away from redundancy that characterize their job.
- Regulating tree felling in highly forested areas of the 1 and 2 class such as Kaiama, Batako, Kampanin Dorawa Udara, Kudu, Labozhi, etc should be directed towards prohibiting cutting down young trees, and the economic ones. This would help in limiting the drastic loss of vegetation and the long-term consequences.
- Other legislation should include law prohibiting bush burning in the name of preparing for the next farming season. Vast areas covered with trees have been burnt down by fire from a small farmland making a hitherto beautiful forest an ugly sight as seen along major roads across the State. One such example being the road leading to Bida from Lambata. Other fires are merely for the search for game.
- The effectiveness of the above suggested regulations if promulgated is hinged on the State government's seriousness in sourcing for alternative energy means in order to divert attention from total dependence on fuel wood

for most energy needs, an activity that is largely responsible for depletion of the forest reserve.

- ⇨ Solar energy resource can be optimized as well as the use of abundant coal reserve from other States. These, if made available and at subsidized rate by government like it did on fertilizer in the beginning, would be largely embraced considering the advantages and our natural environment can be conserved further. In the process of transition, the State government can provide fuel wood stoves that use less wood to generate required energy. It should be subsidized and people taught how to produce them. This way the effect of shifting from wood would be largely minimised.

As a collective responsibility, it would be necessary to re-address the issue of traditional farming methods as against the modern, which utilizes heavy and sophisticated implements that are not good for our environment. This can be enhanced through the effective supervisory role of our agricultural extension workers to farmers in ground tillage. Only implements suitable for our soil type should be imported for use.

In line with the above, it is recommended also that adequate and sustained economic incentive as vital to the success of any programme, be put in place. Environmental resources conservation managers, agricultural extension workers as well as other related field supervisory officials should not be caught napping by all means in the course of doing their work. Meeting their needs when due is very paramount to the success of accomplishing the work ahead of the government.

To achieve this, more forestry officials should be employed and be adequately equipped with all necessary gadgets for their effective functioning. These include being mobile with at least a motorbike for easy and adequate coverage, protective clothing, communication facilities among others coupled with better salary delivered when due.

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APPENDIX 1

TABLE 3.1 RAW DATA

		1	2	3	4	5
S/NO	LOCATION	TREES FOREST (%)	SHRUB (%)	GRASS (%)	FARM LAND (%)	BARE GROUND (%)
1	Shambo	26.25	27.5	5	30	8.75
2	Rijau	42.5	18.75	5	12.5	21.25
3	Kontagora	25	6.25	6.25	26.25	36.25
4	New bussa	48.75	6.25	16.25	12.5	15
5	Kaiama	25	65	5	0	5
6	Lumma Baare	30	30	5	25	10
7	Niko	20	30	5	35	10
8	Swashi	33.37	18.75	10	28.75	8.75
9	Guffanti	15	40	10	25	10
10	Pasiri	25	10	5	40	20
11	Gallah	40	10	10	30	10
12	Agwara	35	35	5	10	15
13	Ndayako	13.75	32.5	5	22.5	12.5
14	Mariga	37.5	6.25	22.5	10	25
15	Kamfanin Bobi	27.5	10	6.25	17.5	38.75
16	Beri	37.5	16.25	7.5	21.25	28.75
17	Ibeto	25	31.25	6.25	18.75	16.25
18	Nasko	20	17.5	11.25	12.5	38.75
19	Saika	41.25	12.5	6.25	25	15
20	Mai Barimi*	33.75	46.25	7.25	5	7.5
21	Shadadi	35	18.25	5	33.75	8.75
22	Bangi	17.5	16.25	5	25	33.75

23	Kotonkoro	22.5	20	6.25	32.5	18.75
24	Udara	35	50	6.25	2.5	5
25	Dusai	15	28.75	5	36.25	15
26	Gulbin Boka	22.51	33.75	6.25	21.25	16.25
27	Kuta	18.75	30	6.25	12.5	32.5
28	Egwa	23.75	23.75	5	20	27.5
29	Gwada	36.25	10	5	16.25	31.25
30	Gunni	21.25	30	12.5	20	16.25
31	Shakwatu*	30	48.75	5	8.75	7.5
32	Gusuru*	40	43.75	5	3.75	7.5
33	Beji	20	5	15	20	40
34	Kaliko*	20	43.75	12.5	5.5	18.25
35	Zungeru	20	40.5	10	4.5	26.25
36	Yakila	31.25	43.75	6.25	0	18.75
37	Tegina	33.75	22.5	6.75	2	35
38	Pandogari*	32.5	1.25	4.25	12	50
39	Unguwan Dan Kaura*	25	23.75	10	36.25	5
40	Gidigori	31.25	26.25	5	18.75	17.5
41	Kesheriki	11.25	15	6.25	21.25	46.25
42	Maikujeri*	15	44.25	2.5	22	16.25
43	Kagara	12.5	28.75	1.25	0	60
44	Wushishi	40	17.5	9.5	3	30
45	Tungan Kawo*	16.25	66.25	5	1.25	11.25
46	Dukun Sakun	22.5	30	10	10	27.5
47	Lemu	30	40	5	3.75	21.25
48	Batako*	46.25	45	5	0	3.75

49	Bida	40	26.25	5	15	13.75
50	Edozdigi	52.5	32.5	6.25	2.5	6.25
51	Wuya Kyada*	26.25	20	5	23.75	25
52	Panti	33.75	48.75	5	0	10
53	Batati	35	40	6.25	2.5	16.25
54	Lanle*	42.5	42.5	5.75	3	6.25
55	Ktigi	28.75	33.75	12.5	0	25
56	Enagi	37.5	30	8.75	0	23.75
57	Labozhi	67.5	12.5	7.5	0	12.5
58	Kudu	28.75	55	5	0	11.25
59	Kpaki	68.75	13.75	7.5	0	7.5
60	Takuma	46.25	30	5	0	21.25
61	Mokwa	50	7.5	7.5	3.75	31.25
62	Jabba* (North)	40	10	7.5	0	43.75
63	Ndafu*	33.75	18.75	31.25	13.75	5
64	Tatabu	41.25	26.25	13.75	0	17.5
65	Dama	16.25	46.25	6.25	11.25	20
66	Gidan Kwano	18.75	37.5	8	18.75	17
67	Garatu*	21.25	45	6.25	8.75	18.75
68	Pisis*	18.75	17.5	6.25	15	42.5
69	Sabon Daga	32.5	23.75	5.75	3.75	31.75
70	Kataeregi	47.5	4.25	1.75	10.75	39.5
71	Badeggi	51.25	20	8.75	5	15
72	Agale	57.5	18.75	5	7.5	11.25
73	Lafiagi	51.25	6.25	8.75	30	3.75
74	Etsu Gaie	36.25	22.5	6.25	7.5	27.5
75	Kutirko*	39.75	7.75	6.25	5	30

76	Paiko*	35	8.75	16.25	6.25	33.75
77	Tungan Mallam*	30	43.75	9.5	10	6.75
78	Lemfa	32.5	37.5	7.5	12.5	10
79	Lapai	40	23.75	8.75	2.5	25
80	Nami*	27.5	60	2.5	0	10
81	Jip*	38.75	43.75	6.25	2.5	8.75
82	Dangana*	25	33.75	21.25	0	20
83	Nassarawa	38.75	27.5	10	6.25	17.5
84	Domi*	26.25	45	15	0	16.25
85	Tufa	23.75	25	10	21.25	20
86	Gawu*	16.25	62.5	5	3.75	13.75
87	Bonu*	41.25	41.25	8.75	1.25	7.5
88	Farindoki*	32.5	33.75	7.5	2.5	25
89	Izom	31.25	45	5	3.75	15
90	Maje	16.25	32.5	10	1.25	40
91	Dikko	12.5	62.5	5	0	20
92	Sabon Wuse	21.25	26.5	10	7.5	36.25
93	Madalla*	26.25	33.75	10	1.25	28.75
94	Suleja	6.25	71.25	6.25	0	16.25
95	Gworigwe*	31.25	45	10	2.5	11.25
96	Gutara falls*	65	23.75	5	0	6.25
97	Dagigbe	26.25	47.5	11.25	2.5	12.5
98	Kakaki	18.75	65	5	2.5	10
99	Kampanin Dorawa*	17.5	71.25	5	0	3.75
100	Kwakuti	48.75	32.5	7.5	3.75	7.5
101	Bukpesi*	48.75	30	13.75	11.25	6.25
102	Chimbi-Koro	20	12.5	17.5	33.75	16.25

103	Kafin-Koro	46.25	20	5	7.5	21.25
104	Adunu*	36.25	25	12.5	2.5	23.75
105	Ishau*	42.5	15	10	10	22.5
106	Shiroro	32.5	26.25	10	2.5	28.75
107	Asha*	15	63.75	5	12.5	2.75
108	Saho Rami	20	30	10	30	10
109	Duba	30	20	15	25	10
110	Daja	20	25.	30	15	10
111	Mashegu	25	15	53	15	10
	Mean	31.045 04505	30.078 829	8.6091 081	11.22972 973	19.0720720 7

APPENDIX 2

TABLE 3.2 DERIVED DATA

S/N	LOCATION	% A	% B	% C	%	% E_1	% E_2	% F_1	% F_2
1	Rijau	61.25	26.25	12.5	2.3333	35	1.52	22.5	0
2	Kontagora	31.25	42.5	26.25	0.73.52	-11.25	-44.73	-37.5	-60.27
3	New Bussa	55	31.25	12.5	1.76	23.75	-9.73	11.25	-11.52
4	Kaiama	90	10	0	9	80	46.51	80	57.23
5	Lumma Baare	60	15	25	4	45	11.52	20	-2.77
6	Guffanti	55	20	25	2.75	35	1.52	10	-12.77
7	Agwara	70	20	10	3.5	50	16.52	40	17.23
8	Mariga	43.75	47.5	10	0.9210	-3.75	-37.23	-13.75	-36.52
9	Kamfanin Bobi	37.5	45	17.5	0.8333	-7.5	-40.98	-25	-47.77
10	Beri	53.75	36.25	21.25	1.4827	17.5	15.98	-3.75	-26.52
11	Ibeto	56.25	22.5	18.75	2.5	33.75	0.27	15	-37.77
12	Nasko	37.5	50	12.5	0.75	-12.5	-45.98	-25	-47.77
13	Mai Barimi*	80	15	5	5.333	65	31.52	60	37.23
14	Shadadi	53.25	13.75	33.75	3.8727	39.5	6.02	5.75	-17.20
15	Bangi	33.75	38.75	25	0.8709	-5	-38.48	-30	-52.77
16	Kotonkoro	42.5	25	32.5	1.7	17-5	-15.98	-15	-37.77
17	Udara	85	11.25	2.5	7.555	73.75	40.27	71.25	48.48
18	Gulbin Boka	56.25	22.5	21.25	2.5	33.75	0	12.5	-10.27
19	Kuta	48.75	38.75	12.5	1.2580	10	-23.48	-2.5	-25.77
20	Egwa	47.5	32.5	20	1.4615	15	-18.48	-5	-27.77
21	Gwada	46.25	36.25	16.25	1.2758	10	-23.48	-6.25	-29.02
22	Gunni	51.25	28.25	20	1.7826	22.5	-10.98	2.5	-20.27
23	Beji	25	55	20	0.4545	-30	-63.48	-50	-72.77
24	Zungeru	60.5	36.25	4.5	1.6689	24.25	-9.23	19.75	-3.02
25	Yakila	75	25	0	3	50	16.52	50	27.23

26	Tegina	56.25	41.75	2	1.3473	14.5	-18.98	12.5	-10.27
27	Pandogari*	33.75	52.25	12	0.6221	-20.5	53.98	-32.5	-55.27
28	Kesheriki	26.25	52.5	21.25	0.5	-26.25	-53.98	-47.5	70.27
29	Maikujeri*	59.25	18.75	22	3.16	40.5	7.02	18.5	-4.27
30	Kagara	41.25	61.25	0	0.6734	-20	-53.98	-20	-42.77
31	Wushishi	57.5	39.5	3	1.4556	18	-15.48	15	-7.77
32	Dukun Sakun	52.5	37.5	10	1.4	15	-18.48	5	-17.77
33	Lemu	70	26.25	3.75	2.666	43.75	10.27	40	17.23
34	Batako*	91.25	8.75	0	10.4285	82.5	49.02	82.5	59.73
35	Bida	66.25	18.75	15	3.5333	47.5	14.02	32.5	9.73
36	Batati	75	22.5	2.5	3.333	52.5	19.02	50	27.23
37	Kutigi	62.5	37.5	0	1.666	25	-8.48	25	2.23
38	Enagi	67.5	32.5	0	2.0769	35	1.52	35	12.23
39	Labozhi	80	20	0	4	60	26.52	60	37.23
40	Kudu	83.75	16.25	0	5.1538	67.5	34.02	67.5	44.73
41	Kpaki	82.5	15	0	5.5	67.5	34.02	67.5	44.23
42	Takuma	76.25	26.25	0	2.9047	50	16.52	50	27.23
43	Mokwa	57.5	38.25	3.75	1.4838	18.75	-14.73	15	-7.77
44	Jabba* (North)	50	51.25	0	0.9758	-1.25	-34.73	-1.25	-24.02
45	Tatabu	67.5	31.25	0	2.16	36.25	2.77	36.25	13.48
46	Gidan Kwano	56.25	25	18.75	2.25	31.25	-2.23	12.5	-10.27
47	Kataeregi	51.75	41.25	10.75	1.2545	10.5	-22.98	0.25	-23.02
48	Badeggi	71.25	23.75	5	3	47.5	14.02	42.5	19.73
49	Agale	76.25	16.25	7.5	4.6923	60	26.52	52.5	29.73
50	Lafiagi	57.5	12.5	30	4.6	45	11.52	15	-7.77
51	Etsugaie	58.75	33.75	7.5	1.7407	25	-8.48	17.5	-5.27
52	Wuya Kyada	46.25	30	23.75	1.5416	16.25	-17.25	-7.5	-30.27
53	Paiko*	43.75	50	6.25	0.875	-6.25	-39.73	-12.5	-35.27
54	Tungan Mallam*	73.75	16.25	10	4.5384	57.5	24.02	47.5	24.73

55	Lapai	63.75	33.75	2.5	1.8888	30	-3.48	27.5	4.73
56	Dangana*	58.75	41.25	0	1.4242	17.5	-15.98	17.5	-5.27
57	Gawu*	78.75	18.75	3.75	4.2	60	26.52	56.25	33.48
58	Izom	76.25	20	3.75	3.8125	56.25	22.77	52.5	29.73
59	Maje	48.75	50	1.25	0.975	-1.25	-34.73	-2.5	-25.27
60	Dikko	75	25	0	3	50	16.52	50	27.23
61	Suleja	77.5	22.5	0	3.444	55	21.52	55	32.23
62	Kwakuti	81.25	15	3.75	5.4166	66.25	36.77	62.5	39.73
63	Bukpesi*	78.75	20	11.25	3.9375	58.25	24.77	47	24.23
64	Chimbi-Koro	32.5	33.75	3.75	0.9629	-1.25	-34.73	-35	57.77
65	Kafin-Koro	66.25	26.25	7.5	2.5238	40	6.25	32.5	9.73
66	Adunu*	61.25	36.25	2.5	1.6896	25	-8.48	22.5	0
67	Shiroro	58.75	38.75	2.5	1.5161	20	-13.48	17.5	-5.27
68	Asha*	78.75	8.75	12.5	9	70	36.52	57.5	34.73
69	Saho Rami	50	20	30	2.5	30	-3.48	0	-22.77
70	Duba	50	25	25	2	25	-8.48	0	-22.77
71	Daja	45	40	15	1.125	5	-28.48	-10	-32.77
72	Mashegu	40	63	15	0.6349	-23	-56.48	-38	-60.77