AN APPRAISAL OF THE STRATEGIES FOR MITIGATING DESERTIFICATION IN JIBIA AND KAITA LOCAL GOVERNMENT AREAS OF KATSINA STATE

BY

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AN

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DECLARATION

I hereby declare that the work in the thesis titled "AN APPRAISAL OF SOME STRATEGIES FOR MITIGATING DESERTIFICATION IN JIBIA AND KAITA LOCAL GOVERNMENT AREA OF KATSINA STATE" has been done by me in the Department of Geography, Ahmadu Bello University, Zaria. All information derived from the literature has been duly acknowledged in the text and a list of references provided, No part of this thesis has be previously presented for another degree or diploma at any university.

_____ _____

Omale Eche J. **Date**

CERTIFICATION

This thesis titled **"AN APPRAISAL OF THE STRATEGIES, FOR MITIGATING DESERTIFICATION IN JIBIA AND KAITA LOCAL GOVERNMENT AREAS OF KATSINA STATE"** by Omale Eche J.has Met the regulations governing the award of degree of Master of Science of Ahmadu Bello University, Zaria.

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DEDICATION

This thesis is dedicated to Almighty God and to Mr. Benedict Edo Amedu of Auke Ochekwu whom God used to save my life when I was a child.

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ABSTRACT

This study was conducted on the appraisal of some strategies to mitigate desertification in Jibia and Kaita local government areas of Katsina state.

The study covers four decades. Satellite imageries were used to obtain results for the study. The satellite imageries were landsat MSS of 1976, landsat TM of 1987, SPOT XS of 1995 and landsat ETM of 2006, with one satellite imagery for each decade.

Results obtained from these imageries show that desertification in the study area has reduced drastically; from 43.43% in 1976 to 1.29% in 2006, this can be attributable to an increase in the mitigation strategies. The major mitigation technique obtained from the imageries is afforestation. The major afforestation technique used in curbing the menace of desertification in the study area is the use of reserve forests. The satellite imageries shows that reserve forest covered only 2.57% of the land area of the study area in 1976 but increased over time to 66.53% in 2006.Shelter belt was 5.9% in 1987 but increased to 7.39% in 2006.It was also discovered that Dominant savannah shrubs/minor tree component/Dense grass,(DOSS/MTC/DG) was only 6.6% in 1976 but increased steadily to 46.30% in 2006.

The results also revealed that dominant savannah woodland/Agro forest/Ochard/ Riparian forest (DSW/AF/O/RF) also increased in its area coverage from 4.24% in 1976 to 17.77% in 2006.With these results it can be observed that the area coverage of desertification has reduced drastically over time in the study.

Questionnaires were also administered to the inhabitants of the study area and results obtained show that tree planting was the most effective means to curb desertification in the

study area.The result shows that 50% responded that tree planting is effective, 30% said it is fairly effective, 3% said it is not effective and 15% said it is very effective.

It was also revealed from this study that some organizations such as European Economic Community/Katsina State government EEC/KTSG, Katsina Afforestation Project Unit KTAPU and Local government Councils are the major agencies that are responsible for mitigating desertification in the study area.

It is recommended that afforestation programme should be intensified in order to stamp out desertification in the study area completely. Besides more water reservoirs should be constructed for the provision of water for irrigation purposes. Alternative source of fuel wood should be developed to reduce deforestation.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND TO THE STUDY

Desertification is the extreme deterioration of land in arid, and dry sub-humid areas due to loss of vegetation, and soil moisture. Desertification results chiefly from man made activities and is influenced by climatic variations. It is principally caused by overgrazing, over drafting of ground water and diversion of water from rivers for human consumption and industrial use. All these processes are fundamentally driven by over population (Wikipedia, 2007).

Campbell (1986) and Mortimore, (1989) define desertification as a process of sustained land degradation (loss of primary production) that results in the inability of the environment to sustain the demands being made upon it by socio – economic systems at existing levels of technology and economic development and under prevailing climatic conditions especially drought.

Nasiru (2009) also reported that desertification is the degradation of land in arid, semi-arid and sub-humid areas, caused by climatic change and human activities. It is accompanied by a reduction in the natural potential of the land, and depletion in surface and ground-water resources. Above all, it has a negative repercussion on the living condition and economic development of the people affected by it.

Desertification arises from the interaction between a difficult, unreliable and sensitive dry-land environment and man's use, in his efforts to make a living (United Nations Conference on Desertification, Nairobi, 1977).

Deforestation and the degradation of other vegetation, particularly near the margins of deserts have caused once fertile, vegetated land to become barren in a process called desertification.

It has been suggested that desertification should be regarded as an extreme form of land degradation occurring where vegetation cover falls below 35 percent on a long term basis (Binns 1990).

Although desert boundaries have shifted over time, deserts have always characterized the earth's subtropical zones. Global patterns of air circulation dictates that the subtropics are regions of subsiding air. When air subsides, it cools down and its capacity to hold moisture decreases, so inhibiting the formation of rain. This accounts for a prevalence of dry climates between latitudes 15^{o} and 30^{o} 'north and south of the equator. However, these dry climates are extended into other latitudes and their patterns complicated by additional factors, such as distance from the rain-supplying oceans, seasonal high-pressure zones of large continental areas linked with monsoon systems, or the presence of mountain barriers over which air spills on the Leeward side. Thus creating rain shadows, (United Nations Conference on Desertification Nairobi, 1977).

Desertification and its associated problems are devastating for many parts of the world, especially developing countries. More than 100 countries suffer from the consequences of desertification and it is estimated that the environmental impacts directly affect 900 million people (Whates and Jones, 1992).

The desert margins of the Sudan and Sahel regions, of the southern Sahara desert, the Gobi desert in China, and the Kalahari desert in southern African are all particularly prone to severe consequences brought about by desertification. The margins of these deserts have advanced by as much as 100km in the last couple of decades. The

United Nations Environment Programme (UNEP) estimates that land outside humid areas is affected to some degree by desertification (Owen and Pickering, 1997).

Jodhpor (1986) reported that the first alarm on the south ward movement of the Sahara desert into Nigeria was raised by Stebbing in (1935) partly in response to other environmental deterioration and desert encroachment. An Anglo-French forestry commission in 1937 investigated the evidence of desertification in the northern part of Nigeria, and found no evidence to support the report. However, this report created some concern in the colonial emirate. They embarked on tree planting to stop the southward drift of Sahara Desert, as far back as the 1940s.

Generally, areas most severely affected by desertification in Nigeria are the semi-arid areas lying roughly north of Latitude 12^{o}N, and these fall within the Sudan and Sahel zones of Nigeria (Sagua, et al, 1987).

The extent and severity of desertification in Nigeria is not fully established neither is the rate of its progression properly documented. However, it is generally agreed that it is by far the most pressing environmental problem in the northern part of the country. The visible sign of the phenomenon is the gradual shift in vegetation from bushes and occasional trees to grass and bushes and in the final stages, expansive areas of desert like sand (Ariyo, et al 2005).

According to the Federal Government of Nigeria (FOS, 1999) estimates, between 50% and 75% of Bauchi, Borno, Gombe, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe, and Zamfara states are being affected by desertification. These states, with a population of about 35 million people account for about 35% of the country's total land area.

Table 1.1: Spread of desertification in Nigeria (FOS, 1999).

States	Land area (km2)	%of Nigeria landmass affected
Bauchi/Gombe	64,605	6.99
Borno	70,890	7.67
Yobe	45,502	4.93
Kano	20,131	2.18
Jagawa	23,154	2.51
Katsina	24,192	2.62
Sokoto/Zamfara	65,735	7.12
Kebbi	36,800	3.98

In addition seven adjacent states to the south are reported to have about 10% to 15% of their land areas threatened by processes of desertification. It is estimated that the country is currently losing about 351,000 hectares of its landmass to desert conditions annually, and such conditions are estimated to be advancing south wards at the rate of about 0.6km per year (Ariyo et al 2005). In the absence of concrete remedial and mitigative measures, it is estimated that the total cost of environmental degradation in Nigeria would amount to about U.S. $5.110 billion per annum, 73% of which will result from land degradation alone (including desertification and erosion (Ariyo et al., 2005).

The United Nation Conventions to combat Desertification has called for actions involving International cooperation and a partnership approach. It focuses on improving land productivity, the application of land conservation and sustainable management and water resources, (UNCCD, 1997).

According to Njeru, (2007) sand dune stabilization is often done through the use of shelterbelt, woodlot and wind breaks. Wind breaks are made from trees and bushes and are used to reduce water erosion and evapotranspiration. They were widely encouraged by Development Agencies from the Middle East.

Another approach is the spraying of petroleum and Nano clay over semi arid crop land. This is often done in areas where either petroleum or Nano clay obtainable for example in Iran. In both cases the application of the materials coats seedlings to prevent moisture loss and prevent them from being blown away.

Community participation in controlling desertification is also encouraged by the United Nation Convention to Combat Desertification which calls for a bottom up participatory approach in identifying, implementing, monitoring and evaluating projects that combat desertification and mitigate the effect of drought. Project should be initiated and managed with maximum participation of local communities including women, youth, poor farmers, and pastoralists. The UNCCD offers local communities a very wide range of opportunities based on local communities, local circumstances, tradition, culture, norms, knowledge,and aspiration,(Msifiri 2009).

Katsina state is one of the states affected by desertification. It has both environmental and socio economic consequences. According to KTARDA (2006). all the farmlands within Kwangwalam area of Katsina state are severely subjected to strong northeasterly harmattan wind, and sheet erosion, which sweeps the top soils, leaving the land bare and unproductive for agricultural purposes.

Murtala (2003) reported that desertification in Katsina state has led to the reduction in the productivity of the land to the bearest minimum, thus eliminating the already meagre food and water resources for livestock.

Baba, (2003) reports that Katsina state has many desertification control projects.These include EEC/KTSG, Katsina Arid Zone Programme, FGN/World Bank Assisted Afforestation Project, Katsina state committee on drought and desertification

control, Federal Department of Forestry, Katsina State Ministry of Agriculture, and Katsina State Afforestation Project Unit, KTPU. Their major aim is afforestation, and land management to combat the menace of desertification.

1.2 STATEMENT OF THE RESEARCH PROBLEM

There have been some polices geared towards desertification control in Nigeria since in the 1930's, when the southward movement of the Sahara desert into Nigeria was observed.

In 1937, an Anglo-French commission investigates the issue on the southward movement of the sahara desert into Nigeria then the border emirates where directed to embark on tree planting to stop the encroachment.

By 1940, a small action programme in the form of tree planting campaign was launched, this is also to check the southward movement of sahara desert into Nigeria.

In the 1960's shelter belts were established in the northern fringes of Nigeria. In 1977 the federal government set up a National Committee on Arid zone afforestation project with the responsibility of examining the indepth problem of desertification and drawing suitable programme of action to combat it.

Furthermore, in 1985 a committee started a programme of shelter belts planting for the protection of adjoining agricultural lands,but its functions were later transferred to the Department of Rural Development and River Basin Development Authorities (RBDAs).In 1987, there was the establishment of Forestry Management Evaluation and Coordinating Unit (FORMECU) to coordinate the World Bank and African Development Bank (ADB) assisted forestry projects in the country (Ariyo, et al 2005).

Munnir (2009), reports that shelter belts, community and private wood lots, wind breaks establishment, natural tree regeneration are some strategies designed by EEC/KTSG to curb the menace of desertification in Katsina state. EEC/KTSG also involved the services of students and the introduction of mud stoves against the traditional three stones open fire.

The Katsina State Ministry of Agriculture and Natural Resources also carried out afforestation to check desert encroachment. It also has agencies such as, Katsina Afforestation Project Unit (KTAPU), whose sole aim is tree planting to check desert encroachment. Katsina Agricultural and Rural Development Authority (KTARDA), whose objectives is soil recovery, erosion control and other environmental problems.

Other agencies like the Katsina state Drought and Desertification Control Committee (DDCC), Ecological consultants, campaigns for the reforestation of Katsina state (CAREFOR), Katsina Environmental Protection Agency (KEPA), International Fund for Agricultural Development (IFAD), Community Based Agricultural and Rural Development Projects (CBARDP) and Local Environmental Empowerment Management Programme (LEEMP), are also actively engaged in desertification mitigation. So also are the Federal Government and the Wor1d Bank assisted projects, whose sole aim is to combat desertification.

All the agencies listed above are practically out to curb the southward drift of the Sahara desert in Katsina State. From personal observations and literatures obtained from these agencies,it shows that there programmes in checking desertification has been successful.

Auwal (2006), carried out a study on the appraisal of desertification in the arid zone of Bauchi state. He identified the main cause of desertification. He also identified its effects and control.He identified the main causes of desertification to include poor land use,over grazing,deforestation and poor irrigation practices.He also identified the effects of desertification in his area of study to include poor crop yield and insufficient feed for animals. He also identified the major control measure to be afforestation.

Baba (1999), observed the impact of desertification in Kaita Local Government Area of Katsina state. His work was focused on the socio-economic effects of desertification in Kaita Local Government Area of Katsina state. He identified the socio-economic effects of desertification in Kaita Local Government Area of Katsina State to include the drying up of drainages,livestocks becomes malnourished due to insufficient food and poor crop yield.He also identied the major control measure to be afforestation.

Babura (2001), carried out a research on desertification in Babura Local Government Area of Jigawa state. He identified the main causes of desertification in the study area to include insufficient rainfall,deforestation,and poor land management practices,furthermore he also discovered the consequences of desertification in Babura to include the migration of abled bodied men to urban areas and also insufficent food.

Natamri, Bagawa, Dauda and Jari (1998) carried out a similar research on the desertification in Borno state. They observed the socio economic effects of desert in the study area. They also observed community participation in controlling desertification and discovered that the best way to tacle the menace of desertification in the study area is to involve the immediate community in programmes of desertification control because the immediate community is part of the environment.

To the best of this researcher's knowledge, none of the studies highlighted above evaluated the strategies adopted to curb desertification in Katsina State. The various strategies adopted by EEC/KTSG and other Government and Non-Governmental Agencies are aimed at mitigating desert expansion in the study area. It is not known whether or not these strategies are achieving their aim. An appraisal of these strategies is important for the purpose of desert management in Katsina state and other parts of Nigeria.

1.3 AIM AND OBJECTIVES OF THE STUDY

The aim of this study is to evaluate the strategies designed to mitigate desertification in Jibia and Kaita Local Government Areas of Katsina State. To achieve this aim, the following objectives were tackled:

i. To determine the magnitude of desertification in Jibia and Kaita LGAs of Katsina state, Nigeria.
ii. To identify the various mitigation strategies employed in the LGAs.
iii. To assess the degree of success of the mitigation strategies adopted for mitigating the desertification problem in the LGAs.

1.4 SCOPE OF THE STUDY

The scope of the study covers Jibia and Kaita Local Government Areas of Katsina state. This is due to its location to the desert pruned region of katsina state,The study area also borders Niger republic directly. The study also observes the causes and implications of desertification and also the various techniques adopted to check it in the study area. GIS was also used in the studies. The study covers four decades from 1976 – 2006.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

Despite global concern about desertification and other forms of land degradation and, many years of efforts and investments made for prevention, cure or rehabilitation, the processes of land degradation persist. There are a variety of existing and potential prevention and mitigation strategies for the various desertification and land degradation process, such as physical measures and adaptation strategies integrating changing social, economic, institutional and policy factors. The mitigation of water-related land degradation is crucial in arid and semi-arid areas which are very prone to desertification and successful measures invariably depends on an improvement of water storage in the soil. (Njeru, 2005).

Desertification is a global problem, combating its menace is complex and difficult, usually impossible without the alteration of land management practices that lead to desertification, over-exploitation of land and climate variations can have identical impacts and be connected in feedbacks, which makes it very difficult to choose the right mitigation strategy. Investigating the historic desertification plays a special role since it allows better distinguishing human and natural factors(Wikipedia 2007).Recent research about historic desertification in Jordan questions the dominant role of man. It seems impossible that current measures like reforestation projects cannot achieve their goals if global warming continues, forests may die when it gets drier, and more frequent extreme events as testified in sediments from earlier periods could become a threat for agriculture, water supply and infrastructure, (Wikipedia 2007).

The literature review focuses on various mitigation strategies against desertification. It examine efforts put in place globally, the participation of some African countries to curb desertification is also reviewed, so also various efforts put in place in Nigeria and Katsina State, as well as the participation of the immediate community of the study area, in combating desertification is reviewed.

Other areas reviewed include the application of remote sensing in the study. The literature reviewed also includes the causes and impacts of desertification in the study area.

2.2 CAUSES OF DESERTIFICATION IN THE NIGERIAN ENVIRONMENT/THE STUDY AREA

The natural causes of desertification includes the poor physical conditions of soils, vegetation, topography as well as the inherent extreme climatic variability as evidenced in climatic droughts. Climate variation is the most important natural cause of desertification and drought in the dry lands of Nigeria. The history of the Sudan-Sahelian zone of Nigeria is replete with severe and prolonged drought events. The zone started the 20^{th} century with a prolonged droughts of 1903 culminating in that of 1911-1914, other droughts included those of 1919, 1924, 1935 and 1951-1954. Rainfall was relatively abundant in the late 1950s and early 1960s. since then average rainfall has fallen below the 1930-1960 mean for almost three decades with lows in both 1972-1973 and 1984-1985. The year 1984 was the driest in the Sudano-Sahelian region within the period of instrumental records and this was evidence from low rainfall, low river discharges and low water level in the Lake Chad, droughts has contributed immensely to desertification in the dry lands of Nigeria.(LCBC, 1990).

2.2.1 Rainfall Variability in the Study Area

The rainfall records obtained from the Emir's Palace in, Katsina, NIMET, Katsina Airport (2010) and Akintola (1986), shows the annual distribution of rainfall in the region under study from 1922-2009. This is presented in table2.1

Table 2.1: Rain fall distribution in the study area

Year	Total Rainfall in mm	Year	Total Rainfall in mm
1922	955.6	1966	730
1923	65.29	1967	802
1924	680.7	1968	442
1925	606.9	1969	454.8
1926	555.0	1970	707.8
1927	869.2	1971	555.0
1928	685.2	1972	474.6
1929	577.6	1973	440.9
1930	789.9	1974	630.9
1931	637.5	1975	553.9
1932	705.6	1976	567.9
1933	851.2	1977	597.0
1934	723.9	1978	526.0
1935	903.7	1979	776.3
1936	697.6	1980	773.4
1937	837.7	1981	554.8
1938	816.9	1982	495.4
1939	864.6	1983	425.2
1940	839.5	1984	390.0
1941	584.2	1985	417.0
1942	635.0	1986	563.8
1943	809.5	1987	399.3
1944	465.3	1988	684.1
1945	934.2	1989	548.1
1946	759.0	1990	541.5
1947	662.0	1991	357.6
1948	772.0	1992	332
1949	506.5	1993	262
1950	765.1	1994	473.2
1951	614.2	1995	431.1
1952	812.8	1996	259.8
1953	908.0	1997	437.9
1954	980.7	1998	431.6
1955	686.8	1999	416.3
1956	801.2	2000	676.6
1957	928	2001	699.1
1958	866	2002	726.2
1959	973	2003	605.6
1960	702.8	2004	698
1961	401.7	2005	726.6
1962	540	2006	711.4
1963	725.2	2007	704.1
1964	993.6	2008	558.1
1965	738	2009	439.9

Source: Emirs palace Katsina, NIMET, Katsina Airport (2010), Akintola (1986).

From the rainfall data shown in the table it can be deduced that rainfall variability is one of the major natural factors that causes desertification in the area under study Throughout the 88years of rainfall records kept in the area under study,no year did rainfall reached maximum of 1000mm.Some years are as low as less than 270mm. Average rainy days are between 50 to 60 days, usually between the months of May to September. This shows that inadequate rainfall is one of the major natural factor that causes desertification in the area under study.

2.2.2 Anthropogenic Activities in Causing Desertification

The anthropogenic factor is mainly the disruption of the ecological system and caused by poor land use and ever-increasing pressure put upon the available resources by the expanding population, over exploitation, overgrazing, deforestation and poor irrigation practices are some major anthropogenic activities that results to desertification, these are influenced by factors such as changes in population, climate and socio-economic conditions, which is obviously a complex interrelationship, which includes: poor physical conditions interms of soils, vegetation, topography and inherent extreme variability of climate and manifested in frequent drought. Also disruption in ecological balance caused by poor land use and ever increasing demand being made on the available resources by the expanding population and socio-economic systems of the affected areas LCBC, (1990). Other human activities that results to desertification in Nigeria includes, improper land use practices and poor land management. Bush burning, overgrazing, cultivation of marginal land, faulty irrigation management and poverty. (Ayobulu, 1997).

2.2.3 Anthropogenic Activities that Results to Desertification in Nigeria/the Study Area

Desertification is caused directly by some types of poor land use. These includes over cultivation, overgrazing, deforestation and poor irrigation practices.

All these factors are interrelated and the change in the location and intensity of one land use can affect other land uses, poor land use is accelerated by drought, it is also greatly influenced by various underlying social, economic and political factors. (Auwal, 2000).

2.2.4 Over Cultivation

Over cultivation occurs when farmers used the lands for the propose of crop production more intensively than permitted by its natural fertility and fail to compensate the removal of nutrients through cropping by using various land replenishing techniques or fallowing the land, so that its fertility can be replenished naturally.

Over cultivation is a very big environmental factor causing desertification in the study areas. This is aggravated by high population of farmers, poverty, social and political factors. Most farmers use the land intensively without providing adequate means of replenishing it also coupled with the fact that these region is a very dry region within the country. This factor play a vital role in the reduction in land capacity which in turn results to desertification in the study area.

2.2.5 Overgrazing/Overstocking

Overgrazing results when livestock density becomes excessive and too many animals are grazed on the same area of range land, leading to the degradation of vegetation and loosening of the soil, which lead to erosion.

Overstocking refers to the rearing of livestock on the land beyond its potential carrying capacity which brings about under vegetation. The arid lands in Nigeria are

overgrazed because majority of livestock (cattle, sheep and goats) inhabit the region and the goat is a particular feeder culprit in causing desertification (Musa, 1990).

(Musa, 1990) reported that "poverty prevents farmers and livestock owners in the developing countries from becoming more conservation conscious". Therefore livestock and their owners need to be provided with appropriate services within agricultural systems and access to vital resources, otherwise livestock husbandry practice will continue to place undue demands upon the environment.

The study areas harbours a large number of grazing animals e.g cattle, goat and sheep (Sani, 1996) says that 37% of animals rearers are mostly nomadic herders, in Jibia Local Government Area stayed temporally in the area during the wet season and migrate to the southern part of the country during the dry season. The remain 63% of animal rearers are sedentary, a large amount of these livestocks are kept at home and mostly owned by women. These livestocks are usually taken out to the bush to graze on available vegetation, according to the research, grazing has a big effect on the environment, the vegetation cover is no longer seen, so also they trample and loosen the soil, making agents of erosion to be active, thereby degrading the environment.

2.2.6 Deforestation (Wood Extraction for Fuel and Construction)

Without alternative sources of energy in the Sudano – Sahelian zone, the demand for fuel wood has been on steady increase by the increasing population and rapid urbanization, despite the existing felling of trees (control) Edict in various states. In addition, wood is also extracted for building, art and crafts in this environment. The United Nations Sudano – Sahelian office (UNSO) has identified forest depletion as the major agent of desertification in Nigeria. As a result of the demand for wood for construction, building, fuel, fishing, industry and other uses, the removal of trees,

shrubs, herbaceous plants and grass cover from the fragile land of the sahel will continue to accelerate the degradation of the soil to desert – like conditions (Bala, 2003).

The sale of wood is also a lucrative business to people in surrounding country sides to supplement their meagre cash incomes. It has been estimated that three – quarters of Kano city's yearly firewood requirement which is about 75,000 tones, are brought in by Donkeys, mainly within a radius of about 20km, the situation is compounded by the people, who clear areas for the purpose of making and transporting charcoal to urban centres for additional income, Pastoralists also contributes significantly to wood cutting as they cut foliage to feed their animals and use branches to build enclosures, (Bala, 2003)

Deforestation activities in Katsina state are necessitated by the need for firewood, fencing, poles for building and other domestic uses, more than 85% of the rural dwellers in Katsina state depends on fuel wood as the major source of energy for cooking, this is the major contributory factor that leads to desertification in Katsina State, as the land is left bare of vegetation totally, (Kabir, 2004).

2.2.7 Poverty

Perhaps the most subtle and often neglected causes of desertification is poverty. Although statistical data are hard to come-by, evidence seems to suggest that the vast majority of the inhabitants of the dry land of Nigeria live below poverty level. To a large extent they depend heavily on the natural resources of the area. Thus, the well-known interrelationship between poverty and environmental degradation obtains whereby poverty generates environmental degradation, (desertification) which in turn accentuates poverty. Most of the inhabitants of the dry land region of Nigeria are so poor that self-efforts to combat desertification is not possible, most rely on the

government and other agencies for the reclamation of degraded lands. For any conservation measure to be successful in this environment, it must address the issue of poverty squarely.

2.2.8 The Impacts of Drought and Desertification in the Study Area

From the survey conducted by Sani (1996) in Jibia L.G.A. He gathered that drought and desertification have affected so many aspects of human life, such as physical, economic and emotional aspect and are continuously affecting more. One of these aspects is in relation to the crop yield which is predominantly depended on rainfall distribution. Majority of the people in the study area are farmers therefore crop failure can be seen to be a great obstacle militating against their subsistence food production which is very essential for survival. The drought that occurred in 1972/1973 have affected this area and is said to have greatly affected the production of major crops in the area such as groundnut, beans, millet, guinea corn etc.

Due to the unreliability of rainfall, a lot of farmers have to plant seeds two or three times before the seeds germinates. This indicates that seed sown at the beginning of rainfall will be damaged before succeeding rain, even if seeds germinate it wilts because of infrequent rainfall, (Adamu, 2001).

Most of the livestock are usually dependent on free natural grazing crops residue and trees foliage. This makes them to be indirectly affected by inadequate rainfall. As stated earlier the area suffers from overgrazing, then the inadequate supply of rainfall in succeeding years inhibit the rapid growth of grasses. The end result of this is that the livestock will be under nourished and deterioration in their general health condition.

Office of the district head in Jibia L.G.A (2010) also reported that 4,500 people were reported to have been affected by hunger and related disease due to the 1972/73 effects of drought and desertification in Jibia, also over 1,200 children died as a result of Measles, which was accelerated due to inadequate food supply. This also makes the prices of food to sky rock beyond the reach of a common man. The prices doubled to about 100% this makes people to resort to certain edible plants such as (Zogala, Yakuwa, Rama, Tafasa e.t.c.)

The effects of drought and desertification of 1972/73 also makes some people to sell some or all their belongings such as farmlands, houses and animals in order to obtain food. Over 2,800 people at that time sold some or all their farmlands. About 1,500 people sold their houses and virtually majority of the people killed their animals for food or sold them. About 500 people migrated to urban areas, 3000 people migrated to Niger Republic in search of employment while some sought for employment in Jibia and Batsari towns, others engaged in making and selling mats, rope, firewood, pots etc., there was also a great record of livestock, death in which about 800 goats, 1,000 sheep, and 1,100 cattle were reported to have died from the effects of the 1972/1973 drought and desertification.

Table 2.2: Shows the summary of Causalities of the 1972/1973 drought and desertification in Jibia District.

S/NO	CASUALTIES	NUMBER
1	Number of people with hunger related disease	4,500
2	Number of children that died	1,200
3	Number of people that sold their farmlands	2,800
4.	Number of people that sold their houses	1,500
5.	Number of people that migrated to Niger republic	3,000
6.	Number of Goats that died	800
7	Number of Sheep that died	1,000
8	Number of Cattle that died	1,100
9	Number of people that migrated to urban centres	5,000

Source: Office of the District Head Jibia, 2010

This movement of people to urban centres has created so many problems which includes over utilization of the available infrastructures, spread of diseases, crime, slum development etc. there was also poor harvest and almost a similar problem caused by drought and desertification between 1984 – 1985 which also lead to hardship, but the records could not be obtained.

Another resultant aspect of desertifcaition in the study area is intensive heat in Jibia district. Most especially during the hot season and also the harmattern seasons, cold conditions with very great harmattern wind associated with dust, this reduces visibility to minimal.

According to Sani (1996), the animals found within Jibia district before the advent of desertification has disappeared completely.

So also the duration of rainfall has reduced drastically. So also the soil is heavily degraded, it was reported that there was a time when farmers around here never bothered with the use of fertilizers because the soil was always very fertile, shifting cultivation was the order of the day then. At the same time streams and small lakes and ponds that ran all year round are now difficult to find, they have almost disappeared, for example five streams within Jibia district measuring about 21km have disappeared completely.

In summary from records and personal observation, show few natural trees and some xylophytic plant sand shrub, but a lot of planted trees inform of shelterbelt, woodlots, e.t.c are common sites. No flowing rivers except when it rained heavily, after few hours the flowing will seized, rain is very scanty wild animals are not readily available, in some cases human settlements are rare in some areas. Desertification has brought a lot of hardship to people and the degraded environment itself.

In Kaita Local Government Area the menace of desertification is not different. It also affected many aspect of human life such as physical, economic and emotional effects, what was obtainable in Jibia district was almost the same with what was obtainable in Kaita Local Government Area. Also a record of the 1972/73 effects of drought and desertification was also kept in Kaita District, the summary is presented in table2.3.

Table 2.3: Break Down Of Number Of Shelter Belts Planted By The EEC/KTSG In Kaita Local Government Area.

S/N	Casualties	Number
1	Lack of food	1,500
2	Number of children that died from malnutrition	600
3	Number of people that sold their farmlands	800
4.	Number of people that sold their houses	700
5.	Number of people that migrated to urban centre	300
6.	Number of people that migrated to Niger Republic	200
7	Number of goats that died	500
8	Number of cattle that died	800

Source: Office of the District head, Kaita 2010

2.2.9 Geographical Information System and Remote Sensing

Peter Burrough defined GIS, as "a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world. Mark, (1989) said the main objectives of GIS are to allow the user of the systems to interact vicariously with actual or possible phenomena of the real world.

(Bonnie, 2005) refer to GIS as computer based systems for automation storage, retrieval, analysis and presentation of geographically related information, it is the ideal tool for extracting the patterns and trends inherent in location – based information. It is a technology that manages, analysis and disseminates geographic knowledge.

GIS forms a strong, reliable accurate and easily accessible micro – level data base system, such data base system will facilitate participatory planning and decision-

making at the grass root level. GIS, aided with remotely sensed data, Global positioning system and other media for information collection and diffusion, can play an effective role in the storage, retrieval, analysis and sharing of data. GIS is important as a media tool for gathering, storing disseminating, reporting, analyzing and sharing of quantitative data and other vital information about the natural and cultural resources. (Amos, 2009).

Table 2.4: Shows remote sensing images and their resolutions

Sensor	Year	Resolutions
Multispectra scanner MSS	1970s	78m
Thematic Mapper (TM)	1980s	30m
Spot (XS/Panchromatic)	1990s	30m-10m
Landsat	1980s	30m
Radar Sat	1990s	12m (variable)
Light detection and ranging (LIDAR)	1998	2m (variables)
Compact air born synthetic aperture Rada (IFSAR)	1990s	-
Polamrimetric synthetic aperture rada (PSAR)	1990s	6m
Ikonos	2000s	-
Quick Bird	2000s	0.6m

Source: Hwang and KU 2004

2.3 APPROACHES AND METHODS OF COMBATING DESERTIFICATION GLOBALLY

The International Community has long recognized that Desertification is a major economic, social, and environmental problems of concern to many countries in all regions of the world. In 1997 the United Nations Conference on desertification(UNCOD)adopted a plan action to combat desertification (PACD) unfortunately, despite this and other efforts, the United Nations Environment Programme Concluded in 1991 that the problem of land degradation in arid, semi-arid

and dry subhumid areas has intensified, although there were “Local example of success”. (UNCOD, 1991)

As a result, the question of how to tackle desertification was still a major concern for the 1992 United Nations Conference on Environment and Development (UNCED) which was in Rio de Janeiro. The conference supported a new, integrated approach to the problem emphasizing action to promote sustainable development at the community level. It also called on the United Nations General Assembly to establish an intergovernmental Negotiating committee in those countries experiencing serious drought and/or desertification, particularly in Africa. (Messat, 2010).

The United Nations Conventions to Combat Desertification in those countries experiencing serious drought and/or Desertification particularly in Africa gave the convention a full name on 17th June1994. The stated objective of the convention is “to combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification, particularly in Africa, to achieve this goal, the convention calls for action involving international co-operation and a partnership approach. It focuses on improving land productivity, rehabilitation of land, conservation and sustainable management of land and water resources. Such actions should also prevent the long-term consequences of desertification, includes mass migration, specie loss, climate change and the need for emergence of assistance to population in crises, “The convention’s entry into force offers an opportunity for the International community to turn its attention to the most impoverished people of the planet, (United Nations Department for Public Information 1997).

2.4 OTHER EFFORTS PUT IN PLACE GLOBALLY TO MITIGATE THE EFFECTS OF DESERTIFICATION

Desertification has been recognized as a major threat to biodiversity. Numerous countries have developed Biodiversity Action plans to counter its effects, particularly in relation to the protection of endangered flora and fauna. A number of methods have been tried in order to reduce the rate of desertification and regain lost land; however, most measures treat symptoms of sand movement and do not address the root causes of land modification such as overgrazing, unsustainable farming practices and desertification. In developing countries under threat of desertification, many people use trees for firewood and cooking, which has increased the problem of land degradation and often even increase their poverty. In order to gain further supplies of fuel the local population adds more pressure to the depleted forest adding to desertification process, (Mousa, 2005).

Sand dune stabilization is often done through the use of shelter belts, woodlots and wind breaks, wind breaks are made from trees and bushes and are used to reduce soil erosion and Evapo-transpiration. They were widely encouraged by development agencies from the Middle East.

Another approach is the spraying of petroleum or Nano clay over semi: arid cropland. This is often done in areas where either petroleum or nano clay is easily obtainable e.g Iran. In both cases the application of the material, coats seedlings to prevent moisture loss and stop them from being blown away (Njeru, 2007).

The soil is also enriched by restoring its fertility, this is done by planting legumes which extracts nitrogen from the air and fix it into the soil, food crops/trees e.g barley, beans and date palms are the most important.

At the local level individuals and governments can temporarily forestall desertification. Sand fences are used throughout the Middle East and the United States of America. In the same way snow fences are used in the north. Placement of straw grids each up to a square metre in area will also decrease the surface wind velocity. Shrubs and trees planted within the grids are protected by the straw until they take root. However some studies suggested that planting of trees depletes water supplies in the area. In areas where some water is available for irrigation, shrubs planted on the lower one third of a dune's wind ward side will stabilises the dune. This vegetation decreases the wind velocity near the base of the dune and prevent much of the sand from moving (Boulie, 1999).

A "green wall of china" which will eventually stretch more than 5,700kilometres in length, nearly as long as the great wall of china is been planted in north eastern china to protect "sand lands" desert created by human activity.

Africa, with co-ordination from Senegal, has launched its own "green wall" project. Trees will be planted on a 15km wide land strips from Senegal to Djibouti. Aside countering desert progression. The project is also aimed at creating new economic activities, especially thanks to tree products such as gum Arabic. (Wikipedia,2007)

On the global level much efforts are put in place to check desertification, this comes from the combined efforts of the United Nations Conference on desertification in partnership with government of the various countries affected by desertification..

2.5 NIGERIA PAST NATIONAL EFFORTS TO COMBAT DESERTIFICATION

In Nigeria, historical records, shows that the Federal and Northern States Governments have made efforts, established institutions and policies geared towards desertification control since in the 1930s, when major concern about the southward drift of the Sahara desert into Nigeria was observed.By 1937 an Anglo-French commission investigated the issue, the border emirates were directed to embark on tree planting to stop the encroachment.

1940 There was a small action programme in the form of tree planting campaign was launched.

1960 Bad situition of the affected area prompted the establisment of shelter belts in the northern fringes.

1977 Federal government set up a national committee on arid zones, afforestation project with the responsibility of examining the indepth problems of desertification and drawing suitable programme of action to combat it.

1985 Committee started a programme of shelter belt plantings for the protection of adjoining agricultural lands. But is functions were later transferred to the Department of Rural Development and River Basin Development Authorities (RBDA's).

1987 Establishment of Forestry Management Evaluation and Co-ordinating Unit (FORMECU) to coordinate the World Bank and African Development Bank (ADB) assisted forestry projects in the country (Ariyo et. al., 2005).

The Sahelian drought of 1972/73 set into motion the establishment of afforestation programmes, the construction of dams for irrigation and the establishment of appropriate national institutions, such institutions include the River Basin Development Authorities (RBDAs), the Forestry Management, Evaluation and Co-ordinating Unit (FORMECU), the Energy Commission of Nigeria and the National Co-ordinating, Committee on Desertification Control. FOS (2005).

Other efforts put in place by the Federal government of Nigeria to check the menace of desertification are discussed below

2.5.1 Nigeria National Policies Against Desertification

Government has taken cognizance of the multi-sectoral nature of the problems of desertification, in this regard; it has developed a number of policies and plans ranging from agricultural to energy. Some of the policies relevant to desertification control includes National Policies on the environment, water resources, energy, drought and agricultural.

In addition to these policies mentioned above some plans and strategies have been put in place. These strategies and action plans contains elements that address the problems of desertification. Some of these include the Nigerian National Environmental Action Plan (NEAP) and the State Environmental Action plans (SEAPs), The SEAPs were prepared for each of the 36 states of the federation and the federal capital territory through participatory process of planning and action, which seek to integrate socio-economic and ecological perspective into all the states policies plans and programmes as well as those stake holders and interest groups within the state for those state in the desert-proned region, their SEAP report priorities their environmental problems with desertification ranking as the most important problem. (Wikipedia,2009).

2.5.2 Institutional and Legal Framework on Desertification Prior to the Coming into Force of the UN Convention to Combat Desertification

Certain national and state laws and regulations which relate directly or indirectly to desertification control or related matters have been in force in Nigeria. In many situations these laws contains provisions that address the causes of desertification such as deforestation, overgrazing, over exploitation of natural resources, in appropriate agricultural practices, bush burning etc. Such laws include the Federal Environmental Protection Agency (FEPA) Decree, the National Parks Decree 101 of 1991, the Environmental Impact Assessment (EIA) Decree No 86 of 1992, the endangered species (control of international trade and traffic in fauna and flora) Decree 1985, the land use Decree 1978 and the National water resources decree No 101 of 1993, (FMENV 2001)

In efforts to implement these laws and regulations, several institutional arrangements have been put in place in the country for the management of matters relating to desertification, even before the advent of the United Nations Convention to combat Desertification, some of the institutions are policy making bodies while some are actually involved in the implementation of deliberate government policies and projects to prevent and mitigate the menace of desertification. (FGN, 1999).

The defunct Federal Environmental Protection Agency was set up in 1988 and charged with the responsibilities on environmental protection, biodiversity and natural resources conservation including policy matters relating to desertification control and was infact the National Focal Point for the Convention to Combat Decortications in Nigeria. (FGN,1999).

At the state level, there are series of forestry, agricultural and wild life laws as well as bush burning and grazing reserve regulations. These categories of laws are

directed at controlling the notable causes of desertification. The most significant of these laws relevant to desertification control are the forestry laws most of which derive their validity from the old Northern Region Forestry Law. Such laws empower each State to manage its forest estates and grazing reserves as well as reforest their desertified areas. Nevertheless, most of the state laws especially the forestry laws are out dated and required review. The lapses in the laws include weak penalty provisions, (Lawal, 2002),

2.5.3 Environmental Impact Assessment (EIA) Decree 86, 1992

The EIA Decree provides that all development projects should, from the onset, undertake environmental impact assessment to determine the possible environmental effects of proposed project before the project is commissioned. Among the projects covered by the provisions of this laws are agricultural and natural resources projects. Some of the projects are subject to mandatory environmental impact assessment and listed in the mandatory study list. (FGN,1999).The environmental impact assessment is mandatory for all agricultural projects involving 50 hectares and above, for other projects less than that hectarage, the project proponent shall apply to Federal Environmental Project Agency (FEPA) for scoping of the project, one aim of the EIA process on agricultural project is to avoid embarking on indiscriminate activities such as uncontrolled clearing of forest, removal of topsoil, indiscriminate bush burning, felling of trees etc. that might propel desertification (FGN, 1999).

2.5.4 National Parks Decree

The law established the 8 National Parks in the country and a Board for the National Parks Service, it is empowered to carry out in-situ conservation of both fauna and flora. Two of the National Parks, the Yankari, National Park and the Lake Chad Basin National Park are located in the Sudano-Sahelia Savanna ecological zone of

Nigeria. By virtue of their location, these parks are involved in activities relating to desertification control, especially through conservation activities in the parks, including the buffer zones and such activities assist in checking the menace of desertification. (FMENV, 2001).

2.5.5 Environmental Assessment, Monitoring and Research to Combat Desertification

This is an important activity in the NAP (National Action Programme) to combat desertification, consequently, Nigeria has embarked on an environmental assessment and monitoring programme, which has as one of its objectives to help determine the trends in desertification process in the country.

Nigeria has updated the land use and regeneration NAP to the country using satellite data and has established forestry resources information centre fully equipped with remote sensing and GIS facilities. This has been replicated in the Federal Ministry of Environment (FMENV) to monitor desertification and pollution issues. Research activities are on going through the FMENV linkage programme on Drought and Desertification located at the Centre for Arid Zone Studies, University of Maiduguri. This linkage centre is the country's. Convention to combat Desertification/National Action Programme Implementation centre CCD/NAP.

2.5.6 Centre for Arid zone studies (University of Maiduguri)

The Centre for Arid Zone Studies (CAZS) was established in 1986 to undertake studies and research on problems prevalent in Sahel and other semi-arid areas of the country and design remediation measures and mechanism to combat. Two of such problems prominent in the affected ecological zones are drought and desertification based at (CAZS) the linkage centre has developed pilot programmes on combating

desertification. Given adequate financial and technical assistance, the centre can substantially provide the required technical assistance to the various agencies and bodies involved in implementing programmes and projects on desertification control, (CAZS,1987).

2.5.7 The Federal Ministry of Environment's Intervention

The Federal Ministry of Environment was establish in 1999, the primary mandate of the ministry includes protection, biodiversity and natural resources conservation, including policy matters relating to Desertification Control and is also focal point for the Convention to Combat Desertification in Nigeria. The ministry also co-ordinates annual tree planting campaign throughout the country and implement projects on afforestation, woodlot plantations, plant nursery as measures towards combating deforestation and desertification(FMENV,2001).

2.5.8 Planned Programmes and activities against Desertification by the Federal Government of Nigeria

Given the magnitude and extent of desertification in the country, government future programmes will focus on arresting desertification by protecting desert prone areas, rehabilitate affected areas and institutionalize drought-ameliorating measures. This will be achieved through among others.

2.5.8.1 Shelter Belt development

In order to check the southward spread of the desert conditions and increase vegetative cover in the dry lands of the country. Government has approved the establishment of a shelter belt across the extreme strip of the Northern parts of the country (i.e from the Sokoto basin in the Northwest to the Lake Chad Basin in the North

East). This project which is estimated to cost about eleven billion naira (about US $95.6m) and it is spread over a period of five years, has take-off with the on going establishment of 51 standard nursery centres in the Northern states and Abuja. The bulk of the financial resources are expected to come from the ecological fund office in the presidency.(Ecological Fund Office,2001).

2.5.8.2 Capacity building against Desertification

As part of the efforts to combat desertification is also a planned programme and activities against desertification, this is to combat desertification and mitigate the effects of drought; government is working on a master plan to further strengthen its on going efforts in building the capacity of various institutions working in this area. This initiative will be geared towards the protection, development and sustainable management of the country's natural resources endowment particularly in the dry lands.

2.5.8.3 Development of Drought early warning system

A proposal for the development of a comprehensive early warning system has been submitted to the ecological fund office for funding. It is expected that this project will facilitate proactive management of drought thereby complementing the efforts of the Federal Department of Meteorology.

2.5.8.4 The development of alternatives to fuel wood

Another planned action by the federal government of Nigeria, is the development of alternatives to fuel, wood. A major threat to the afforestation and reforestation efforts is the cutting down of trees and other plants before they even reach the stage of harvesting. Under this project, efforts will be concentrated on providing in a sustainable way alternatives to fuel wood, which is the major cooking fuel in the dry

land zones. Energy related projects in the area would also aim at improving the lives of the people and empowering them economically, while also paying particular attention to gender needs. Consequently, the following activity have been lined out for execution, this will directly or indirectly curb the menace of desertification, (FGN,2001).

2.6 INTERNATIONAL ASSISTED PROGRAMMES TO COMBAT DESERTIFICATION IN NIGERIA, PAST AND PRESENT EFFORTS

The drought of the 1970s and 80s in the Sahelian zone of Nigeria led to the breakdown of biological processes, depletion of water supplies, slow growth of trees and loss of livestock and crop production. Government action led to harvesting of Lome funds through the European Economic Community (EEC) to support three programmes in the drought affected areas. There are:- (KSACDP), (NEAZDP), (SEP).

2.6.1 Katsina State Agricultural and Community Development Project (KSACDP)

This programme commenced in 1987 with the objective of combating desertification in Katsina State and with the view to contributing to improvement in agricultural productivity and provides forest resources such as poles and fire wood. The programme was funded to the turn of 90 Million. Katsina State government is currently sustaining the project. This project has aids a lot in the checking desertification in Katsina State ,(KSACDP)

2.6.2 North East Arid Zone Development Programme (NEAZDP)

It is also an international aid which commenced in 1988, it is also designed to cut down desertification in Yobe and and Borno States, it is responsible for agricultural development and preservation of unique habitats in Yobe and Borno States. The sum of N336 million drawn from Lome III funds was expended on the projects. Although

external funding has ceased, the project is still receiving funds from Yobe State Government (NEAZDP)

2.6.3 Sokoto Environmental Programme

It is also an international aid against desertification and other environmental problems, the project took off in 1989, it was funded with 294 million from Lome III funds. It was based on community participation for the purpose of creating environmental awareness and development of basic skills for the rehabilitation of desertified lands. The Sokoto State government continues to fund the project after the ceasation of external funding.

2.7 WORLD BANK FORESTRY 11 PROJECT

The forestry II programme came into existence in 1987 and ended in June 1996. The programme strengthen the structural base of forestry subsector stabilized soil/sand dunes and improved the supply of fuel wood, poles and fodder by supporting farm forestry and shelter activities. The programme covered ten states: Sokoto, Zamfare, Kebbi, Jigawa, Yobe, Borno, Katsina, Kano and Bauchi states. The physical achievement includes the establishment of 5, 566 ha of woodlots and 2,083 km of shelter belts. The programme was funded with US $95.4 million with the world bank contributing US $71.0 million, this programme has helped a lot in checking the menace of desertification, especially the stabilization of sand dunes in the areas.(Wikipedia,2007).

2.8 UNDP ASSISTED NATIONAL FORESTRY ACTION PLAN

The National Forestry Action programme prepared proposals for programme for translation into national policies and plans for action in area of forestry as it relates to

agricultural land improvement, fuel wood and wood energy, conservation of tropical ecosystems and industrial strengthening and development. The programme is plannsed to reduce the level of land degradation in the areas the projects will be affected.

2.9 THE HADEJIA-NGURU WET LAND CONSERVATION PROJECT

The Hadejia-Nguru wetlands conservation project is also an International assisted programme to Nigeria which is managed by the International Union for the Conservation of Nature (IUCN), it is located in Nguru, Yobe State. It was established in 1987 to maintain the ecological and economic integrity of the Hadejia-Nguru flood plain. The wetland which is about 3,500km constitutes a natural barrier to the southern movement of the sahara desert. The main activities of the project are research, public awareness and education, preparation of management plans and guide lines, advocacy and promotion of wise use of natural resources of the area. This project is currently been restructured to cover the whole of the Komadougu-Yobe system up to Niger republic, but with special emphasis on the Nigerian side of the basi(Wikipedia,2009).

All the efforts mentioned in the literature review are geared towards combating the effects of desertification and also to check its occurrence. Nigeria has done a lot to curb the menace of desert encroachment so also some internationally supported aids to check desertification in Nigeria,

2.10 APPROACHES AND METHODS FOR COMBATING DESERTIFICATION IN KATSINA STATE

Katsina State is among the II frontline states in Nigeria that is encroached by desert, especially northern Katsina State, i.e the areas bordering Niger Republic, the study area is located in this region.

The menace of desertification is great, the land is degraded, it capacity to produce is totally reduced, a lot of remedies are put in place in Katsina State and the study area to check the menace of the encroaching Sahara desert.

Some of the agencies that are involved in the mitigation of desert encroachment in Katsina State includes:

- European Economic Community EEC/Katsina
- Katsina State Ministry of Agriculture and Natural Resources.
- Katsina Agricultural and Rural Development Authority KTARDA . Katsina Afforestation Project Unit.
-. Campaign for the re-afforestation of Katsina state (CAREFOR)
- Drought and Desertification Control Committee
- Katsina Environmental Protection Agency (KEPA)
- International Fund for Agricultural Development (IFAD)
- Ecological Consultants
- Community participation

2.11 PAST EFFORTS IN COMBATING DESERTIFICATION IN KATSINA STATE (INCLUDING THE STUDY AREA)

Various efforts were put in place in Katsina state to combat desertification and also to conserve and reclaim degraded lands.

Land/soil conservation works started in Katsina State in what was then known as Katisna province by the Native Authority staff during the early 1940s. The oldest project was the Kwangwalam shelter belts, which was planted in 1940, with the aim of checking excessive hamattan wind erosion, and minimize desert encroachment.

1955 The Kandani soil and water conservation scheme for better farming was initiated.

1957	The Native Authority influence the Kandani project to cover Kandani, Ladanawa, Are, Faru and Kuka in Jibia local government and Riko and Rabobi villages in Kaita local government area. It also includes Iyatawa, Faduwa, Tashar Kadia etc. These particular village areas have large herds of goats, sheep, donkeys and cattle, the villages where heavily subjected to overgrazing, the soil where particularly made loose, tree planting was encouraged to check land degradation, sensitization of the farmers were carried out to plant individual trees and allow natural regenerated trees to grow. The extension workers also encourage the farmers to carry out contour ploughing.
1967	Katsina Native Authority enacted laws to prosecute all farmers that deliberately refuse to follow the contour pattern of ploughing.
1967-68	A teams of three soil and environmental experts from the United States of America International Development (USAID) were assigned to Katsina province. Katsina Native Authority Staff and one agric Superintendent from the Regional Government Ministry of Agricultural were attached to the experts, who were trained on strategies to conserve soil and water and to check the actions of the southward movement of the sahara desert.
1970	These experts influenced the establishment of shelter belts in Dankanjiba, Tagwan marke. land Reclamation was carried out in Rogogo, the area was semi desert with scanty vegetation and had low agric production, 1000 acres of land were earmarked for reclamation by improving the soil.

Apart from establishing shelter belts to control desertification. The project started with 100 acres pilot schemes, during the first season the project was planted with cowpea and alfafa, the cropped area became a grazing ground for domestic animals.

1975-1979 The Funtua Agricultural Development Project (FADP) was established. It is charged with the responsibility of the integrating the construction of feeder roads, Tube wells, open concrete wells, loan facilities, Dams for raising of fruits and agro-forestry seedling (Nurseries) and general improvement in agricultural production with soil/land and water conservation as its main target.

1987 With the creation of Katsina state in 1987 the ADP was re-named. Katsina Agricultural and Rural Development Authority KTARDA which is charged with responsibilities of

- Land management services
- Checking desertification
- Identify potential uses of land
- Develop and maintain Agro-forestry nurseries
- Assist farmers to develop community nurseries
- Develop soil map for the State.
- Advice farmers on the efficient utilization of land and water resources
- Advice and assist in implementing soil and water conservation programmes
- Assist in the growth and maintenance of shelter belts and woodlots. (KTARDA, 2006)

2.12 OTHER EFFORTS PUT IN PLACE BY VARIOUS AGENCIES TO CHECK DESERTIFICATION IN KATSINA STATE AND THE STUDY AREA

2.12.1 Katsina State Afforestation Project Unit (KTAPU)

The Project unit, (Federal Government Assisted) the Katsina State Afforestation Project Unit (KTAPU) came into being as a result of the Federal Government concern and substantial emphasis on afforestation for the deforested and degraded areas in northern states. The project was financed by the World Bank/Federal Government of Nigeria, during the period of implementation (1988-1996), the involvement of the World Bank was to supplement the efforts of the federal government in fighting the menace of desertification process and its environmental and societal impact. (KTAPU, 2009) since the withdrawal of assistance from the World Bank and the Federal government, the state government is still sustaining the programme till date (KTAPU, 2009).

Aim and Objectives

- To stabilize the soil conditions in desertification threatened areas, as from latitudes 12^0N in the state.
- To improve the supply of fuel wood, poles and fodder by supporting farm forestry shelter belts activities.
- To enhance proper management, training and research in forestry.
- Sand dune stabilization, especially in the extreme northern parts of the state.

For the project to achieve the mentioned objectives the following programmes were implemented as for the working document and midterms review

a. Nursery development to provide sufficient seedlings indigenous and exotic.

b. Establishment of shelter belts.

c. Farm Forestry Programme (farmers woodlots, trees on farm lands, boundary planting, ochard, windbreak, home gardening, amenity planting etc.

d. Establishment of trial and experimental plots.

e. Publicity and enlightment aimed at educating the general public on the need and benefit of additional tree cover with a view to saving the environment from further devastation and increase income.

f. Introduction and promotion of improved burning stove and promotion of coal as an alternative source of energy to firewood in an attempt to make a modest start at closing the deficit in the demand of fuel wood and sustainable supply.

g. Development and training of staff and farmers to improve their skills in various aspects, (KTAPU, 2009).

2.12.2 Achievements of KTAPU in checking Desertification

i. Establishment of 7 project nurseries with necessary facilities with three (3) bore holes.

ii. Establishment of 31km x 30m of shelter belts and 10 ha of trial and experimental plots.

iii. Training of 106 staff on various aspects on the environment, including foreign training

iv. Productions of 6,187,099 assorted seedlings as against a target of 7,180,000 this year (2009) not less than 5,00,000 were raised yearly since it inception for farm forestry programme, shelter belts woodlots etc.

v. Farm forestry models achieved.

vi. Woodlots, 4,178 was established as against the target of 4625.

vii. Orchards, 124 was established as against the targeted 150.

viii. Trees on farm, scattered, 6591 were raised as against the target of 6445.

ix. Boundary planting, 5169 were planted as against the target of 6235.

x. Home garden, 380 gardens were established as against the target of 450.

xi. Natural regeneration 1055 were counted as against 1700.

xii. Road side planting, 59km were planted as a against the target of 120km.

Since the withdrawal of assistance of the World Bank and the Federal government. The shelter belts were no longer established. (KTAPU, 2006).

2.12.3 The Role of KTAPU in Controlling Desertification in Jibia Local Government Area

The project helped to control desertification in the local government area under study, which includes production of seedlings, for instance in 2009, 500,000 seedlings, were raised in six different nurseries located in Daura, Dabiram, Katsina town, Jibia (the study area) and Kona Are. The seedlings are distributed to farmers to further promote roadside planting, boundary plantation on the farm and line fencing, some of the seedlings are used in the construction of woodlots, wind breaks etc. Since the inception of the programme 700,100 seedlings have been distributed to farmers in Jibia local government area (KTAPU, 2009).

Since the inception of the programme KTAPU has established 400 woodlots, and 8km of shelter belts established in paparawa, Kuka Jibiya and Daddara villages and also about 200,000 slips of vetiver grasses were planted at the North Eastern part of Jibia to control the Southward movement of the sand dune and also to demarcate farm boundaries.

In addition vehicles were provided to the farmers for the movement of the seedlings to various locations, the Ward Head is responsible for the distribution of the seedlings, the products belongs to the farmers.

Also extension workers are sent out to enlighten the farmers on how to plant the trees by demonstration, public enlightment campaign on the danger of desertification is also carried out.

Women are also enlightened to use local stoves from Niger Republic that consume less firewood, so also mud stoves are encouraged. (KTAPU, 2009)

2.12.4 The Activities of KTAPU in Controlling Desertification in Kaita Local Government Area

According to Albaba, (2000) KTAPU since its inception helped to control desertification in Kaita local government by the production of nurseries such as project nurseries and community nurseries. The seedlings produced are distributed to farmers to further promote roadside plantation, boundary plantation, on the farm and line servicing, some seedlings are used in the construction of shelter belts, woodlots Since the inception of the project 10km of shelter belts have been established at various locations in the local government area, and about 410,000 seedlings have been distributed to farmers in Kaita local government area.

Other activities such as movement of seedling to farmers, extension services etc were a duplicate of what is done in Jibia Local Government Area.

2.12.5 The Role Played by the Katsina Arid Zone Programme, European Economic Community/Katsina State Government.

The EEC came into being in 1987, it is an International community assistance in some northern states of Nigeria that is aimed at check the aridity of the and desertification in northern parts of the country. Katsina state is one of those states that benefited from the activities of the EEC.

In Katsina state it was formally called Katsina Arid Zone programme, but their activities were later transferred wholly to the EEC/KTSG. The EEC/KTSG carried out a lot of programmes to check desertification some are given below. Afforestation is one of the project carried out by the EEC/KTSG. It had impressive record of tree seedlings production, distribution and establishment of shelter belts, wind breaks, woodlots and trees on farm, these plantings contributes to soil the reduction in desertification, increase in conservation and sustainable agricultural production.(KAZP/EEC/KTSG,1995)

Shelter belts of 2000m long and 30m wide are planted at right angles to the prevailing dry season wind. 101 shelter belts were inherited from the Katsina arid zone programme, 50 more have been established.

A forestry extension network is promoting tree planting by the rural population of their benefits and aims at 9 million trees which will be planted by 30,000 farmers. Three planting options are open to the participating farmers; these are wind breaks, woodlots and farm boundary hedges and trees on farmlands. (KAZP/EEC/KTSG, 1995)

Table 2.5: Breakdown of seedling establishment in various nurseries at various parts of the state

Year	No. of seedlings
1987	250,000
1988	830,000
1989	1,129,000
1990	1,200,000
1991	1,700, 88,000
1992	2,000,000
1993	300,000
1997	1,900,000
2006	5,00,000
2003	250,000
2005	1,000,000

Source. Dept of Silviculture EEC/KTSG 2010.

The EEC/KTSG carried out a lot of activities to curb the menace of desertification in Katsina state and the study area.

The EEC/KTSG carried out the establishment of shelters belts, which are planted with drought resistant species of trees such as Neem Eucalyptus, Albezia, Lebek, Delbajia siso, etc. With the aim of checking the encroaching desert and to serve as wind break, fire wood is also obtained.

The state government acquire the land and pay compensation, the land is handed to the Ministry of Agric and Natural Resources, Forestry Department will undertake the establishment of the shelter belt along with weeding, protection and patrolling, the EEC/KTSG gives the planting options as mentioned below.

Private Woodlots

Interested farmers can set aside.09 hectare of his farm land for the establishment of the private woodlots, 400 number of tree seedlings will be given to the farmer for planting at the spacing of $1.5m^2$.

The programme also assist the farmer with fencing wire, and fencing post as well as technical assistance from the village extension workers free. The forestry products derive belongs to the farmer.

The tree harvest is done on yearly basis of 100 trees per each year, this is done in a circle until the circle is completed.

The tree species planted by the farmer depend on the farmers choice.

Community Woodlots:

This comes from the acceptance of the community concerned, a portion of land is set aside by the community, the EEC also provides the seedling, but the community decides on which to plant. Extension workers are also attached to the community to demonstrate how to plant the trees, protection is done by the community, the product of the woodlot also belongs to the community, EEC/KTSG only advice on the mode of tree harvesting which should be done in circles until the harvesting is completed.

Trees on Farmlands

Trees on farmland consists of mainly economic trees, e.g guava, mango, cashew, lemon etc. 65 no of economic trees is given to the farmer to plant on his farm as well as protective basket are given to guide the trees, from animals browsing and other vandals, all the trees and other products belongs to the farmer, all the technical assistance is given to him by the EEC/KTSG.

Natural Tree Regeneration

These trees grows naturally on the farms, the number of regenerated trees are asked to be known, the regenerated trees are marked with paints, if 100 trees are discovered, the farmer is given money for each and also to buy baskets to protect the trees, the paints is used to mark this tree year after year and records are kept.

Other strategies used by EEC/KTSG is to involve schools and women in carrying out afforestation, both primary, secondary and tertiary institution students are recruited into young foresters clubs (YFC). They are now taught on how important tree planting is, pilot schemes are now set up by various schools inform of woodlots, windbreaks and orchards, they are also encouraged to plant trees in their parents houses and farms, the programme is termed as catch them young.

In the women's programme, it is the introduction of local stoves that consumes less firewood against the traditional three (3) stones open fire (Munir, 2009).

2.12.6 Efforts put in place by the EEC/KTSG to check desertification in Jibia L.G.A

Range Management: Most of the areas observed and surveyed in the north extreme regions of Katsina state have degraded lands caused by over cropping and over grazing. In many places degradation is so advanced that recovery appears hopeless, with community agreement the programme has fenced 10 ha block on the Tsagero and Riko grazing reserves (in the study area) to demonstrate the effects of protection from grazing, contour ripping and seedling with grasses and legumes. *Vertiver* grasses are used to stabilize sand dunes drift and also to control erosion at Tsagero. About 5,000 splits were planted, folder trees were also planted within the fenced areas, this is aimed at replenishing the lost quality of the soil, (EEC/KTSG, 1999).

Four nurseries have been established to produce vetiver planting materials and tree seedlings for use in the grazing reserves. Below are sites and the number of vetiver splits planted.

Tsagero 1.60ha 100,000 splits

Daddara 1.56ha 150,000 splits

Ruma 1.66ha 65,000 splits

Kabakawa 2.00ha 300,000 splits

Irrigation facilities were also provided at the nursery sites by EEC/KTSG.

2.12.7 Conservation cropping to check land degradation

According to Munir (2009), conservation cropping was one of the cropping practices the ideas was sold by the EEC/KTSG to farmers in Northern Katsina State with Jibia and Kaita Local Government Areas inclusive, here the farmers were advised through the extension workers to carryout cropping practices that will protect the land from any form of deterioration and increase or maintain farm production at the highest possible level to the benefits of the farmers, such practices includes the use of manures and fertilizers, multiple or row cropping, crop rotation, intercropping, which usually includes the growth of legumes, strip cropping, mulching, mulching is not practicable in these areas of the state due to the intense animals feeding. Feedings habits reports from the extension workers over the years shows a tremendous improvement in land conservation and crops improvement.

2.12.8 Training Programmes on Desertification Control

The EEC/KTSG carried out short duration training programmes which was organized in Mashi, Jibia, Daura, Kaita and Zango local government areas, here the extension workers and their supervisors gave special trainings to selected people, such as village heads, contact farmers or active members of youth clubs, these special

training includes checking desertification on individual levels, land conservation principles techniques and crop management were carried out, practical demonstrations was also done. Plots of lands were requested from the rural communities for the establishment of demonstration areas.

2.12.9 Tree Planting by EEC/KTSG in Jibia Local Government Area

Seedlings were raised by the EEC/KTSG and distributed to farmers free, the planting options are given to the farmers, which includes wind breaks, woodlot and trees on farmlands.

Table 2.6: Is a breakdown of the number of shelter belts planted by EEC/KTSG since its inception in Jibia L.G.A

Year	No of shelter belts
1987	2 blocks
1988	3 blocks
1989	2 blocks
1991	3 blocks
1991	1 blocks
2005	9 blocks

Source: Silviculture Dept EEC/KTSG (2010)

A total of 40km of shelter belts has been planted in Jibia LGA by the EEC/KTSG since its inception.

Since the inception of the EEC/KTSG a total of about 215 wind breaks and 56 woodlots were established in Jibia Local Government Area. This was between 1987 and 1990, none was established since 1990.

2.12.10 Acquisition of Base Data that is Relevant to Combating Desertification by the EEC/KTSG in the Study Area.

Several types of data have been collected to facilitate the production of good conservation master plan in the study area, (Jibia, Kaita) Mashi, Baure, Zango, Mai Adua and Katsina.

These includes climatic data which is invaluable in understanding the moisture stress of the environment, also the compilation of possible plants species, the drainage characteristics of rivers and underground water level will provide information relevant to damming, irrigation and acquifer exploitation.

Satellite imagery of the area will give the type of land use activities in the study area. The soil survey reports is also very important, so also land capability classification are all very useful, because it will give the conservationist the understanding of all the degraded areas in northern katsina state with the study area inclusive. From these records one can have a birds eye view of the environmental problems (desertification) and appreciate its magnitude, then a quantification of the degraded terrain can now be made, (Manir, 2009).

2.12.11 Activities of EEC/KTSG in checking Desertification in Kaita Local Government Area

The EEC/KTSG also carried out some programmes in Kaita Local Government Area of Katsina State, from the literature available and the oral interview carried out with the chief extension officer of the EEC/KTSG, the activities were almost in a duplicate with Jibia LGA, these may be attributed to the fact that Kaita and Jibia Local Government Areas are directly adjacent to each other, the type of environmental degradation (desertification) is similar, so also activities to check its menace are also

similar, but the intensity of these efforts by EEC/KTSG was higher in Jibia Local Government Area.

Conservation cropping methods, to mitigate effects of desertification was also an idea sold to farmers in Kaita LGA by the EEC / KTSG, this was done through the extension services, so also short duration training programmes were carried out on selected people in Kaita Local Government Area to check desertification. Demonstration areas were also established in Kaita Local Government Area:

2.12.12 Tree planting by EEC/KTSG in Kaita Local Government Area

The EEC/KTSG also assisted farmers, and others with free seedlings, also planting options were given to the farmers, but he chose the one he likes. Options of windbreaks, woodlots, trees on farmlands were given to the farmers.

Table 2.7: Is a break down of number of shelter belts planted by the EEC/KTSG in Kaita local government Area.

Year	No of shelter belts
1987	2 blocks
1988	2 blocks
1989	1 block
1991	4 blocks
2005	7 blocks

Source: Silviculture Dept EEC/KTSG (2010)

The table above shows that a total of about 32km of shelter belts has been planted by the EEC/KTSG in Kaita Local Government Area since its inception.

Also extension services were carried out in planting procedures and how to maintained the tender seedlings to maturity. Baskets were also given out for protection or money to buy the baskets, fencing poles and wire nets.

Women were also sensitized on the dangers of using much wood, to the environment, they were advised to use local stoves that consumes less fire wood, to replace the traditional tree stone open fire that consumes much wood.

2.13 THE ROLES OF (KTARDA) KATSINA STATE AGRICULTURAL AND RURAL DEVELOPMENT AUTHORITY, IN CONTROLLING DESERTIFICATION

KTARDA is a major agency and centre of activity in agricultural sector, the responsibility of KTARDA are extension services, Agro-forestry and soil conservation services, desertification control, land use planning, rural infrastructural development, comprising of rural roads, water supply and development of fadama irrigation and the distribution and sales of implements, farm inputs and sprayer.

The project came into full operation in 1988 following the creation of Katsina State, the main objective of the Agro-forestry and soil conservation services is to provide material and services to support adaptive research and extension efforts for effective transfer of technology to farmers. The activities of this particular department are, the establishment of woodlots, boundary planting, constructions of contours on farmers farmlands, divergence construction of terraces on farmlands, check dams construction, production of forestry seedling for distribution to farmers, production of fruit seedlings for sale to farmers at subsidies rates for the establishment of orchards and the production of vetiver grasses for sand dune stabilization and erosion control (Dikko, 2002).

2.14 THE ROLES OF KTARDA IN CHECKING DESERTIFICATION IN JIBIA LOCAL GOVERNMENT AREA.

KTARDA in its efforts to check desertification has established 10 shelter belts, 90 hectares of badly eroded areas were reclaimed, mostly by tree planting 8 woodlots were established, 400 hectares of land were planted through the construction of contours. Divergence construction carries about 500 hectares. 360 hectares were constructed by means of terrace construction and also 5 hectares of land experiences check dams (KTARDA, 2006).

About 13,000 fruit seedlings was produced and were sold to farmers at a very subsides rate, in the case of vetiver grasses about, 200,000 slips were produced and distributed to farmers (KTARDA,2006).

Personal observation shows nonfunctional bore holes at various locations with the label of KTARDA, also were open wells with the same labels bearing KTARDA, this were all put in place to provide water for some of the established project in the study area.

As at the time of writing this reports the records of activities done by KTARDA in Kaita Local Government Area, to check the menace of desertification could not be found, but personal observation in Kaita Local Government Area showed a shelter belt bearing KTARDA on the sign post, and some woodlots. So also some abandoned open wells were seen bearing KTARDA on them.

2.15 THE ROLES OF JIBIA DAM IN CONTROLLING DESERTIFICATION IN JIBIA AND ENVIRONS

The Jibia dam is located in Jibia Local Government Area, it is part of the development plan for the Sokoto Rima Basin, being carried out by the Federal Ministry

of Water Resources through the Sokoto Basin Development Authority, the project was meant to provide water for agriculture all year round, also the supply of potable water to the town of Jibia and the neighbouring villages and also to create a barrier against the encroaching Sahara desert (Sani, 1996).

There are three fundamental features, the dam itself, the irrigation network and the water supply system. The homogenous earthful dam is 3.68km long and 21.5m high and lies over the Gada river, a tributary of Rima river.

Water is stored during the brief rainy season in the reservoir, which have a capacity of 142 million cubic metres. A 105m long intake tunnels passes through the body of the dam and carries the stored water from the reservoir to the irrigation outlet. (Federal Ministry Of Finance And Economic Development, 1991).

Most of the water in the reservoir is intended for the irrigation of 3,500 hectares of very fertile soils during the dry season.

The irrigation system consists of an in pumping stations, two compensation reservoirs, about 200km of canals (both concrete lined trapezoidal canals precast, cast-concrete parabolic canals) and over 100km of drainage canals, the Dam was completed and commission in 1992, (Sani, 1996).

The Dam has a lot of impacts on the environment it is located, it provides water to woodlots and shelter belts that are close to the reservoir, irrigation activities also have a tremendous improvement, water is also provided for domestic uses and to both plants and animals, it is also a good barrier against the occurrence of drought and desertification (Sani, 1996).

Personal observation shows that the dam has a positive effect on the environment as at the time of the observation (March, 2010). At the time of the year, lands within the extreme north of Katsina state is also bare of vegetation, but coming to Jibia dam at that period of the year, gave a different scenario, because trees, shrubs grasses where seen flourishing, the land within the eastern part of dam seems to be very fertile.

The cultivated areas for irrigation also were greenish. Shelter belts, woodlots, trees on boundaries and a section of grasses closed to the Jibia dam proves to be different from other plants far away from the dam.

On engaging some people in discussion, it proves that the dam is playing a very important role in the lives of people within the area. Desertification according to one person interviewed has stopped totally in the area for the past 10 years. The researcher`s observation shows that the dam has helped greatly in controlling the menace of desertification in Jibia and its environs.

People were also seeing fishing on canoes and on calabashes. Jibia dam has not only checked desertification in that area, it has also alleviated poverty.

2.16. THE ROLES OF JIBIA LOCAL GOVERNMENT COUNCIL IN CHECKING DESERTIFICATION

Desertification is an environmental problem that is of great concern to Jibia local Government council. The Local Government Area since its creation has planted 9 shelter belts of 2000m by 30m located in Zandam, Dambarewa, Kula, Kuka Babangida Block I Kukan Babangida Block II Yanono Makamawa and Dan Tambara villages.

Jibia Local Government Council has also established 40 woodlots in various locations. The Local Government council also provides shelter belts demarcation, and fencing materials to farmers to check animals browsing.

Mobilization of Youth Associations, Religious bodies and any relevant association to have tree planting sites.

The Local Government Council also selected key workers from other departments other than the forestry unit to help in promoting tree planting to check desertification.

The chairman of the local council has recently set up a standing committee, this committee is tasked with the responsibilities of examining the successes of various programmes set up to check desertification in Jibia Local Government Area.

Also sensitization programmes are carried out to involve people to check the menace of desertification in Jibia local Government Area. (Dahiru, 2010).

2.16.1 The Roles of Kaita Local Government Council in Controlling Desertification

Kaita Local Government Council has put in place several measures to check desertification in the local government area. These includes:

- The raising of seedlings
- Matured seedlings are distributed to various people across the local government area through village heads, seedlings are collected from the village heads to be planted by individuals.
- The local government council set up standing committee for the protection of vegetation within the local government area with the supervisory councilor in

charge of agriculture as the head and other members. The committee term of reference is to ensure all the plantation are protected against destruction and to stop all manners of encroachment.

- The committee is to advice through experts the best ways to plant trees. (demonstration)
- The committee is also to enforce the services of forest guards and should give all modalities to enhance their performance.

From 2008 the state government ordered Kaita Local Government councils to plant between 15-30 hectares of woodlots yearly.

The state government also ordered the district heads to plant trees in their domains.

- The state Government also ordered the seedlings should be protected to maturity, watering, fencing etc should be done.
- The state government also ordered Kaita Local Government Council to employ watchmen and 23, people to take care of other activities (Garba,2010)).

2.17 COMMUNITY PARTICIPATION IN CONTROLLING DESERTIFICATION IN THE STUDY AREA.

The United Nations Convention to Combat Desertification calls for a bottom-up and participatory approach in identifying, implementing, monitoring and evaluating projects that combats desertification and mitigate the effects of droughts. Projects should be initiated and managed with the maximum participation of the local communities including women, youth, poor farmers and pastoralists. The UNCCD offer local communities a very wide range of opportunities based on local circumstances, traditions, culture norms, knowledge, aspirations and priorities (Msafiri, 2009).

Rural peoples knowledge about their environment is often superior to that of outsiders, examples can be found in mixed cropping, knowledge of the environment, abilities to observe and discriminate and results of rural people's experiment. Rural people's knowledge and modern scientific knowledge are complementary on their weakness, combined, they may achieve what neither would alone, (Chamber, 1993).

The UN convention to combat desertification also aims to improve the environment affected by desertification in developing countries by coordinating donors efforts, and encouraging affected countries to set up National Action Plans to combat desertification with grass root participation. Particularly with people who live off land, the convention framers believed that the local people, who are often poor, know more than anyone else about the fragile ecosystems in which they live and work. Thus, in best position to contribute to the fight against desertification UNCCD, (1997).

Farmers in the dry lands of Nigeria have always existed in a precarious balance with the harsh and in hospitable environment, dominated by risk and uncertainty. They have evolved over the years some traditional response mechanisms of copping with such risk and uncertainly in managing their environment. Emphasis should therefore be building on existing knowledge and capacity.

The Local Government of the study area, Jibia and Kaita Local Government Areas have various means in copping with the deteriorating environment. Records about community participation in checking desertification was not readily available, but personal observation, and interviews shows that the local communities one way or the other put in effort to check desert encroachment, some of the activities were unconsciously done without knowing the consequences, i.e checking desert.

Information on environmental (land) degradation is usually noticed by individuals, these degradation may be associated with desertification are usually reported to the district head, who in turn report such issues to the representative at the local government level (councilor) before such case is reported to the chairman of the LGAs, the chairman will now use his initiatives to combat such environmental problems if it is not beyond his capacity. But if it is beyond his capacity, then reports are made to the appropriate agencies at the state level. Who may now control such environmental menace with desertification inclusive, these methods of approach to environmental issues is done in both Jibia and in Kaita LGAs.(Interview with Mallam Hassan Musa,2010).

Personal observation also revealed some irrigation activities carried out by individuals on the banks of River Gada at Malamawa, Gangara and Zandam villages in Jibia local government area, various irrigation techniques were involved, so also some villages like Sawariya Lalaioni and matsai where observed in Kaita Local Government Area, some irrigation techniques where also involved, this villages are located by the river Tagwai in Kaita Local Government Area.

The observation shows that the beds of rivers Gada in Jibia LGA and river Tagwai in Kaita LGA, was dry and very sandy at the time of the observation but the local people dugged open wells on the beds of these rivers, the water is used to irrigate the lands by the rivers through various irrigation techniques, the old shaduf method of irrigating the dry land was observed in the study areas. So also pumping machines were also used to water the lands by those rivers in the study areas, vegetations observed by these areas were growing very well. These includes some woodlots personal farms, etc.

Personal by the locals efforts in creating water channels on farms by these rivers where also observed those that can afford cement used concrete channels.

Grass Hedging especially around farms to serve as boundary on the farms are also some efforts put in place to check erosion, and sand dunes movement, these method is observed in both Kaita and Jibia Local Government Areas

Interviews with the locals also shows that even the planted trees were usually harvested for fuel wood, under this condition careful harvesting is done towards the begining of the wet season the trees harvested will regenerate easily.

At the government secondary school Kaita some nurseries were seen, this were usually planted around the school compounds on some occasions, the communities around the school were given some to plan,The school also urge students to plant trees at home and their various farms.

Manure of various types were seen been transported on local Ox driven carts, to various farms. Some were seen distributed on the uncultivated farmlands this is to replenish the degraded land.

Sacks filled with sand are seen at various locations mostly on erosion sites, these were done to check land degradation by water erosion. It is observed in both Kaita and Jibia Local Government Areas. It is also used to check the movement of sand dune especially around productive lands.

Communities within Jibia and Kaita Local Government areas also have community woodlots at various locations, plots of land were also donated by the community to various agencies that are checking desertification by, these are used either

for wood lots establishment, or shelter belts establishment and also for experimental demonstration.

Various communities through the traditional rulers and other organizations are involved in sensitization campaigns on the dangers of desertification and deforestation to their communities, this has yielded a lot of results (authors survey March 2010).

2.18 SUMMARY OF THE LITERATURE REVIEW

The literature review focuses on the various ways desertification is mitigated globally, sub-Saharan Africa (Nigeria), Katsina state and the local government areas of the study area. The literature review also observed community participation of the study area in combating desertification, there various activities on curbing desertification is also received.

From the literature reviewed, it is observed that the major mitigation strategy adopted to check desertification in Nigeria and the study area in particular is afforestation. The causes and implications of desertification in the Nigerian environment and the study area are also reviewed.

CHAPTER THREE

THE STUDY AREA AND METHODOLOGY

3.1 THE STUDY AREA

3.1.1 Location, Position and Size

The study area covers Jibia and Kaita Local Government Areas. boths Local Government Areas are located adjacent to each other. They are located approximately between latitudes 12,^{0}45N and 13,^{0}15N and longitudes 7,^{0}00E and 8^0,30E.The area is located in the extreme north western part of Katsina State. It borders Niger Republic to the north and Mashi Local Government Area to the East, then Batsari, Batagarawa, Katsina, Rimi and Mani Local Government Areas to the South and Zamfara State to the West. The size of the study area is 1278km$^{2.}$

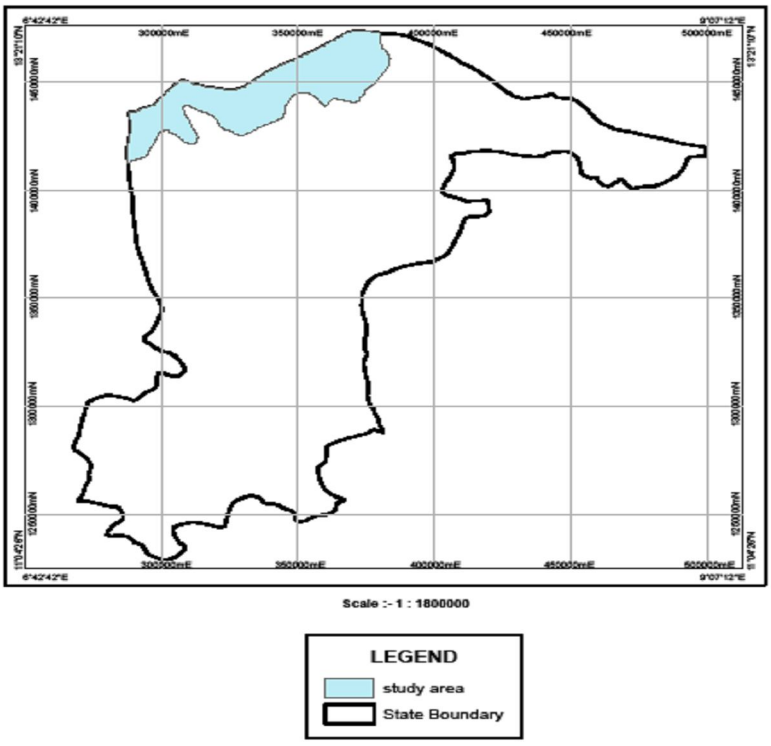


Figure 3.1: Map of the study area

3.1.2 Climate

The climate is seasonally wet and dry. It is dominated by two air masses. These are the rain bearing south-westerly winds and the cold, dry and dusty north-easterly winds, locally known as the "harmattan." At different times of the year, when one or the other winds prevails, the area experiences either rainfall or dry harmattan depending on the advance or retreat of the other (Nyong and Kanarogou, 1999).

3.1.3 Vegetation

The vegetation here is Sudan savannah type. It it is composed of trees scattered over an expanse of grassland. The trees are usually characterized by broad canopies e.g the baobab with large trunk. It is taller and larger than the others species or types found here. It also includes various types of acacias (Nilofica, Albida and Seyal). Others are Neem (Azadrita indica) etc and various types of scattered shrubs such as plastima Cassia Sigrana, occasionally forming woodlot. Most of these trees are xylophytic in nature i.e the ability to resist drought conditions, this is through having long roots, leathery leaves and tiny leaves, as well as development of spines to reduce excessive transpiration. The drought resistant plants do not shed their leaves, but other trees shed their leaves during the dry season.

The blades of the grasses wither and dry off during the dry season. Their underground stems develop new roots during wet season. Grasses in the area hardly grows up to 1m at maturity. Pasture in the area is very low and grazing fields are diminishing due to intensive cultivation by the growing population and shrubs usually dry off in the dry season leaving the soil bare, man-made plantations forms a significant portion of vegetation in this area. Shelter belts woodlots and wind breaks are all found in the area, (Shittu, 1999).

3.1.4 Geology, Relief and Soils

The study area falls within the Chad formation which is made up of sedimentary rocks of Cretaceous origin. The relief of the area is of the lower Chad plains. The relative relief falls within the average of about 15 to 20 metres, the landform in the study area is sandy plains. Where great sand sheets occupy most of the area. However, it is not uncommon to find deposits of sand dunes of varying degrees especially when you move towards Daddara Kusa, Kaga villages in Jibia local government Area and Dankama, Duma, Jiki Gisgerewa villages in Kaita Local government area northwards. The dunes are formed from the deposition of eroded materials carried along by strong winds from across the Sahara desert, especially during the dry season, (Shittu, 1999).

The soil consists of mostly unconsolidated sediments which are predominantly sandy, silt to sandy loam, it is brown or reddish brown in nature. This type of soil is formed from the deposition of eroded materials over sedimentary formation. They are less acidic and well drained, with fairly low clay content.

3.1.5. People and Economic Activities

Jibia Local Government area has a population of 167,435 people, while Kaita Local Government Area has a population of 182,405(National Population Commission 2006). The people of Jibia and Kaita Local Government Areas are predominantly Hausa and Fulani living together, Majority of the inhabitants of the areas are farmers, (Subsistence). They also keep animals; almost every family keeps grazing animals like cattle, Goats, and sheep. These are usually moved by herders from one place to the other in search of pastures especially during the dry season. Some owners of these animals move then to areas south of Katsina state especially the middle belt region of the country during the dry season in search of pasture.

Much of the rural settlers (men) also carry out irrigation agriculture by the banks of the major rivers in the study area, to augment their income. Small scale businesses are also done in this area such as furniture making, mechanic services trading of all sorts. Some banks are also located in this area especially in Jibia area, with banks like the Union Bank, as at the time of this study. Oceanic and First Bank have their structures ready to start operation in Jibia.

3.2 METHODOLOGY

3.2.1 DATA COLLECTION

Methods and Procedure of Data Collection

In order to achieve the stated objectives of this study, the following data were collected in line with the stated objectives of the research.

(i) To determine, the magnitude of desertification in the study area. The Normalize Difference Vegetation Index (NDVI) statistics were collected from satellite imageries.

Normalize Difference Vegetation Index is a simple numerical indicator that can be used to analyze remote sensing measurement, typically but not necessarily from a space platform, and assess whether the target being observed contains live green vegetation or not (Wikipedia, 2007).

The NDVI statistics were derived from the following satellite imageries, LANDSAT MSS of 1976 50m, LANDSAT TM 30m of 1987, 1995 SPOT XS 20m and 2006 LANDSAT ETM 15m.

These imageries covered four decades with one image for each decade. From the NDVI statistics collected, the percentage area coverage of desertification in M^2 was determined.

Three types of vegetation cover were identified. These are, *Discontinuous savanna shrubs/minor grass components. Dominant savanna woodland shrubs/minor tree component / dense grasses. Dominant savanna wood land/agro-forest/orchard/riparian forest*.

(ii) To assess the various mitigation strategies adopted to curb desertification in the study area, was also determined from the satellite imageries, LANDSAT MSS of 1976, 50m, LANDSAT TM 30m of 1987, 1995 SPOT XS20m and 2006 LANDSAT ETM. These imageries also covered four decades with one for each decade.

The percentages land mass covered for each of these variables was determined and estimated in M^2.

The imageries used to achieve these objectives, where analyzed by visual interpretation of the imageries.

Digital image processing of the satellite data and analysis of the stated objectives of the study were carried out using the basic software's. Earth Resource Data Acquisition System (ERDAS imaging version 8.7), Arc view 3.2 and Arc info software.

These digital data on CD ROMS were procured from Federal Department of Agriculture and Land Resources, Livestock House Mando, in Kaduna and the National Space Research and Development Agency, Abuja.

(iii) To assess the success rates of the mitigation strategies used for combating desertification in the study area. This was determined from structured questionnaire, which was administered to respondents. Sixty close ended copies

of the Questionnaire were administered in the area under study. Purposive sampling method of administering questionnaires was adopted.

In addition to the data obtained from the satellite imageries and questionnaire administered, literature was also obtained from various agencies which were responsible for desertification control in Katsina state. Some of the agencies are European Economic community EEC/Katsina state Government (EEC/KTGS), Katsina State Agricultural and Rural development Authority (KTARDA and the afforestation Project unit (KTAPU).

Literature was also obtained from published and unpublished works done on desertification. Dissertations, conferences and seminar papers, books of proceedings Journals, textbooks, United Nations Reports on desertification and other relevant secondary data were consulted.

3.2.2 TECHNIQUES OF DATA ANALYSIS

Analysis of Satellite Imageries

The (NDVI) Normalized Difference Vegetation Index was defined by standard methods of analysis of remotely sensed data, followed by verification and visual interpretation of satellite data. For this purpose digital data on CD ROMs were procured from Federal Department of Agriculture and Land Resources, Livestock house in Mando-Kaduna and National Space Research and Development Agency Abuja.

Development of Classification Scheme

The Digital image processing of the satellite data and analysis were done using the Remote sensing software, Earth Resources Data Acquisition System (ERDAS), Imaging version 8.7. The raw satellite image was changed from Tag Image File Format

(TIFF) to IMG format using ERDAS in order to be compatible with other ERDAS imagine files. The layers were stacked and subset to delineated the study area for classification (Boakye et al, 2008). The UTM Zone co-ordinate was used to geocode the imported image. This was followed by georeferencing using Traverse Mercator Projection with reference units in meters to allow compatible positioning of others other meters.

Similar to the work carried out in Ghana by Boakye, et al (2008) The research made use of the visible portions of the electromagnetic spectrum. Band of combination of red, blue and green was used to display the raw images in standard colour composites.

The spectra band combination for displaying images often varies with different applications (Trotter, 1998). This was necessary for the visual interpretation of the images. A band combination of red blue and green. (RGB) is often used to display images in standard colour composites land used and vegetation mapping, (Trotter, 1998). In this study, the LANDSAT TM and ETM images and SPOT Xs were displayed in a band combination of 1, 2, and 3 (red, blue and green) which is the standard for visual interpretation of vegetation mapping in the tropics (Prakash and (Gupta, 1998, trotter 1998).

Also, Arc view 3.2a software was used to open the subset image, which alter the colour bands to enhance the image and subsequent interpretation of the various vegetation cover.

Arc Info software was used to correct the delineated vegetation cover by eliminating “overshoot” and “undershoot”. This was made possible after the shaped files have been converted to Arc in files. Then the converted files were “clean,” files were

built as lines and polygon that resulted to establishing a topology .Finally the built lines and polygons was restored to Arch view software's to create a data base.

These operations were performed:

- Coding of the polygons and describing them
- Symbolizing the classes developed
- Composite map of the various years was laid for vegetation cover change detection analysis.

The statistics of the various classes of vegetation cover were generated using the arc view 3.2a programme. Finally maps were composed; using Arc View (version 3.2a) programme.

Change Detection

The most commonly used land use change detection methods include

i. Image overlay
ii. Classification and comparison of land cover statistics
iii. Change Detector Analysis
iv. Principal Component Analysis
v. Image Rationing
vi. The Differencing of Normalized Difference Vegetation Index (NDVI) (Duadze, 2004).

The method used in this research was differencing of Normalized Difference Vegetation Index. This study sought to find out the quantitative changes in the areas of the various vegetation cover categories using the post-classification procedure. The area statistics for each of the various vegetation cover categories was derived from the classification of the images for each decade (1976, 1987, 1995, 2006) separately, using

functions in the arc view and the arc info software's. The areas covered by each category of vegetation cover were compared.

A total of three vegetation cover were identified these are; Discontinuous savanna shrubs/Minor grass components. Dominant savanna shrubs/minor tree component/dense grasses. Dominant Savanna wood land / agro forest/orchard/riparian forest.

Statistical Analysis

Descriptive statistics such as tables, mean, graphs, percentages, frequency, pie chart,bar graphs and line graphs were used for data analysis and presentation.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter examines the objectives of the study by analysing the secondary and primary data collected. The secondary data were collected using satellite imageries while the primary data were collected using the questionnaire.

4.2 MAGNITUDE OF DESERTIFICATION IN THE STUDY AREA

To determine the magnitude of desertification in the study area, the Normalized Difference Vegetation Index (NDVI) statistics were collected using the satellite imageries. The data collected from these imageries as well as percentages for all the variables are presented in table 4.1.

Table 4.1: NDVI Statistics (m^2) for the study Area (Jibia and Kaita LGAs)

Year	BS/BUP/WB (m^2)	%	DSS/MGC (m^2)	%	DOSS/MTC/DG (m^2)	%	DSW/AF/O/RF (m^2)	%	Sum total of NDVI (m^2)	Total %
1976	879741863.01	43.34	1014662674.49	45.98	134548655.73	6.62	860911.86	4.24	2029814105	100.0
1987	282051876.46	13.89	1123661578.53	55.35	597665049.19	29.44	26577703.99	1.29	2029956207	100.0
1995	260231980.43	12.81	802142391.43	39.51	891602596.18	43.92	76043013.98	3.74	20300019982	100.0
2006	23476485.77	1.29	630011305.26	34.62	842529994.04	46.30	323431376.77	17.77	1819449162	100.0

Note: BS/BUP/WB = Bare surface/built-up areas/water bodies; DSS/MGC = Discontinuous savanna shrubs/minor grass component; DSS/MTC/DG = dominant savanna shrubs/minor tree component/dense grasses; DOSW/AF/O/RF = Dominant savanna woodland/Agro-forest/Orchard/Riparian forest

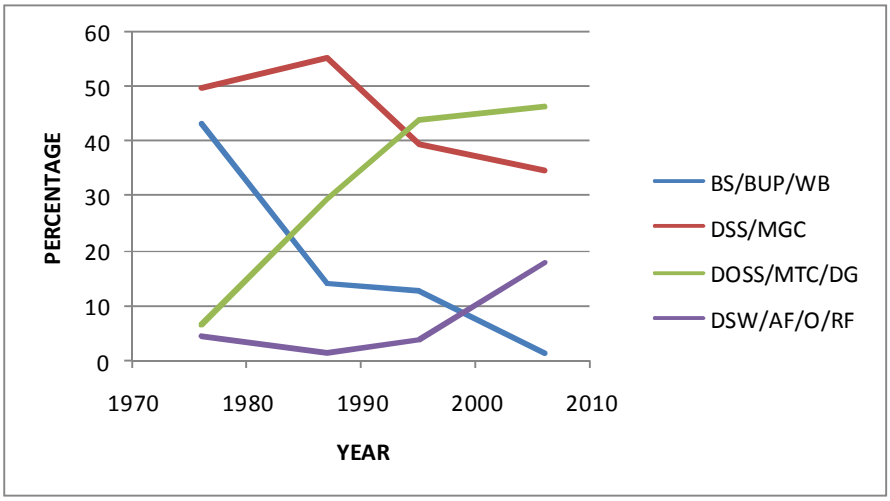


Figure 4:1: Trend of NDVI for Vegetation cover in the Study Area

The line graph showing the trend of the variables over the sample period in percentage is shown in fig 4.1

Figures 4.2, 4.3, 4.4, and 4.5 represent the satellite imageries of the study area. The figures show the vegetal cover of the study area for 1976, 1987, 1995 and 2006. The NDVI statistics used for the determination of the area coverage of the various classes of vegetal cover in the study area such as Bare surface/Built-up areas/water bodies, Discontinuous savannah shrub / minor grass components, dominant shrubs / minor tree component/dense grasses, dominant savannah woodlands/agro forest/orcharch/riparian forest were determine. The vegetal maps shows a gradual increase in the green coloration of the study area from light green in 1976 through to deep green in 2006. This may be interpreted as an appreciable increase in the vegetation cover of the study area.

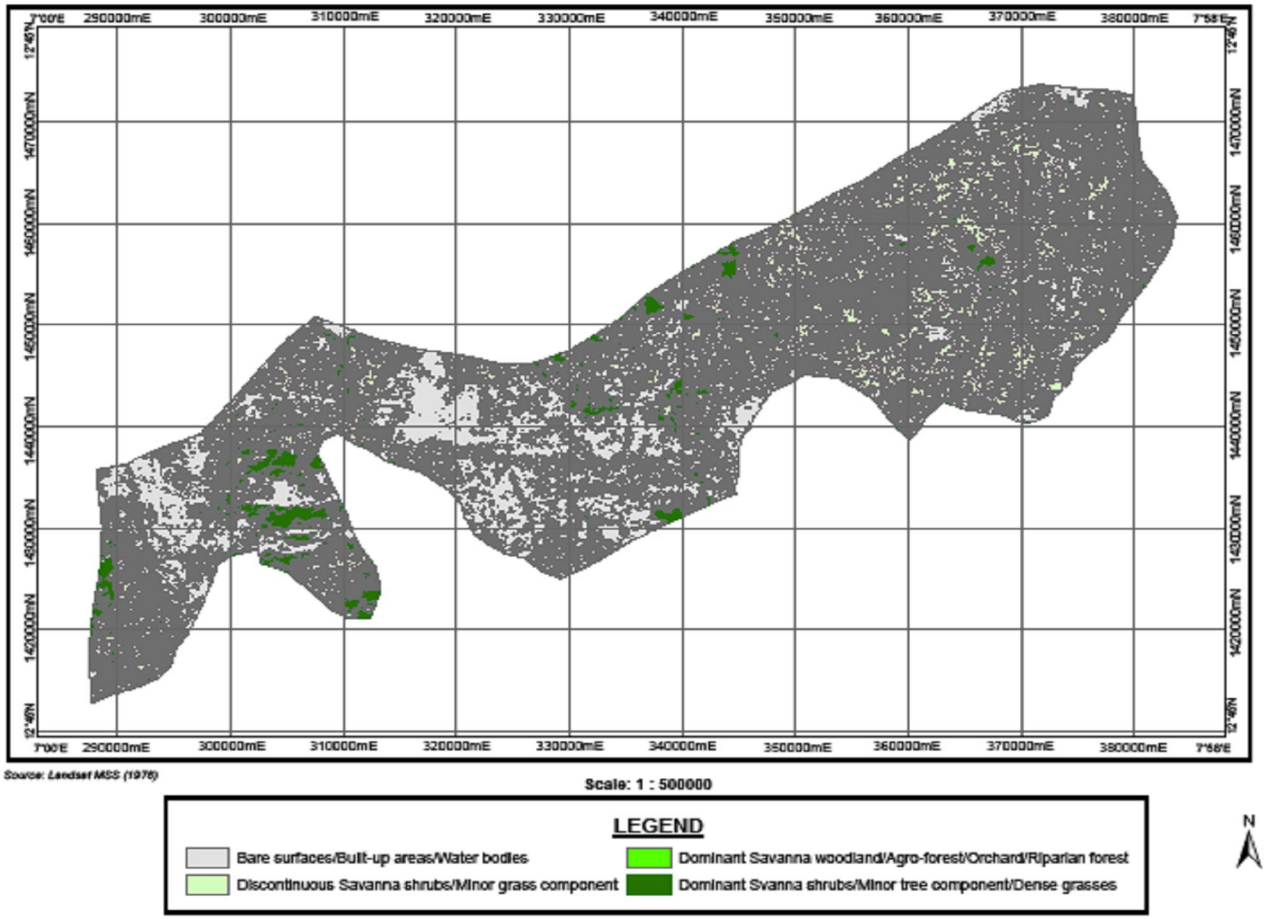


Figure 4.2: Vegetal cover in Jibia and Kaita Local Government Areas of Katsina State (1976)

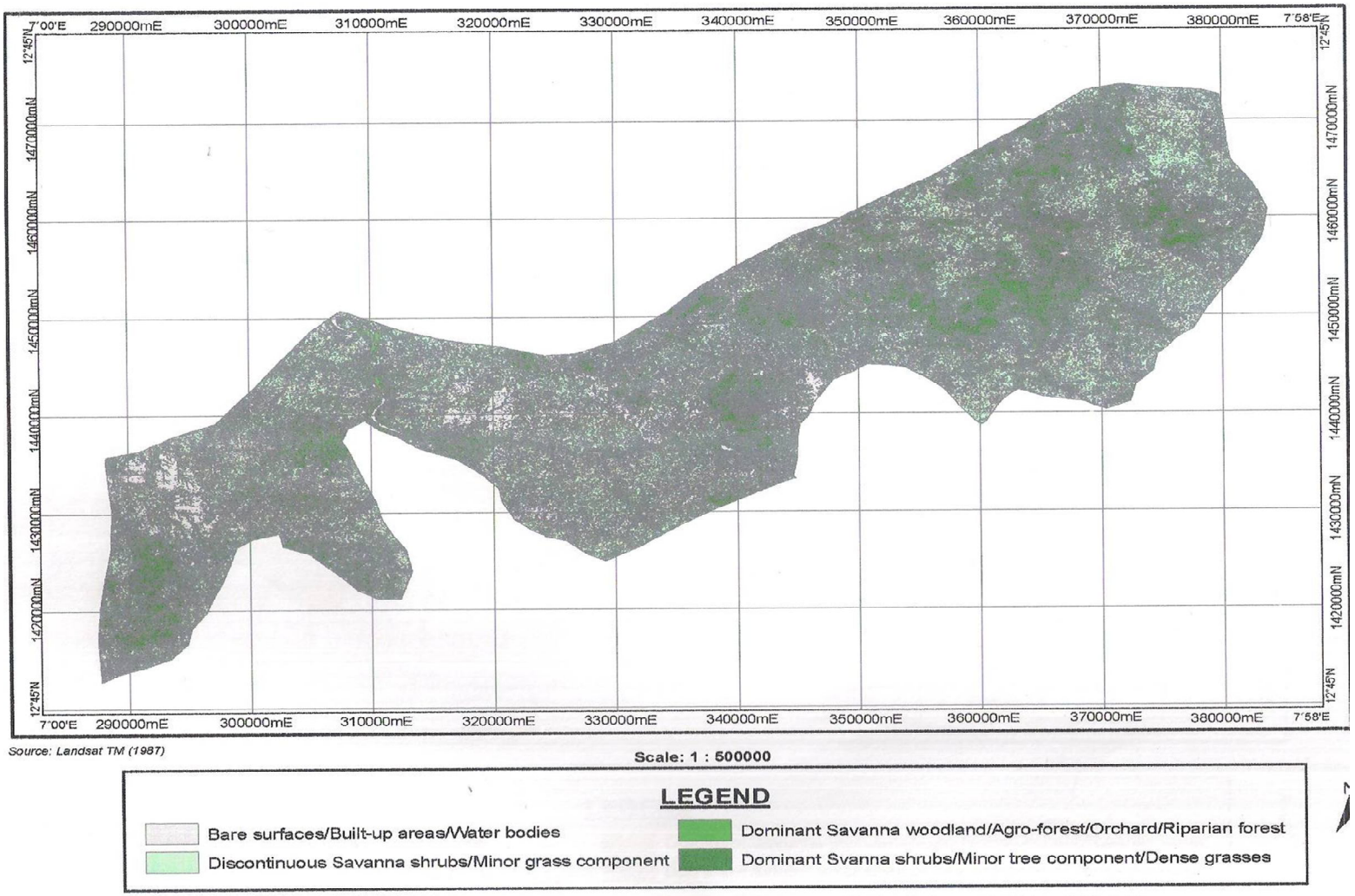


Figure 4.3: Vegetal cover in Jibia and Kaita Local Government Areas of Katsina State (1987)

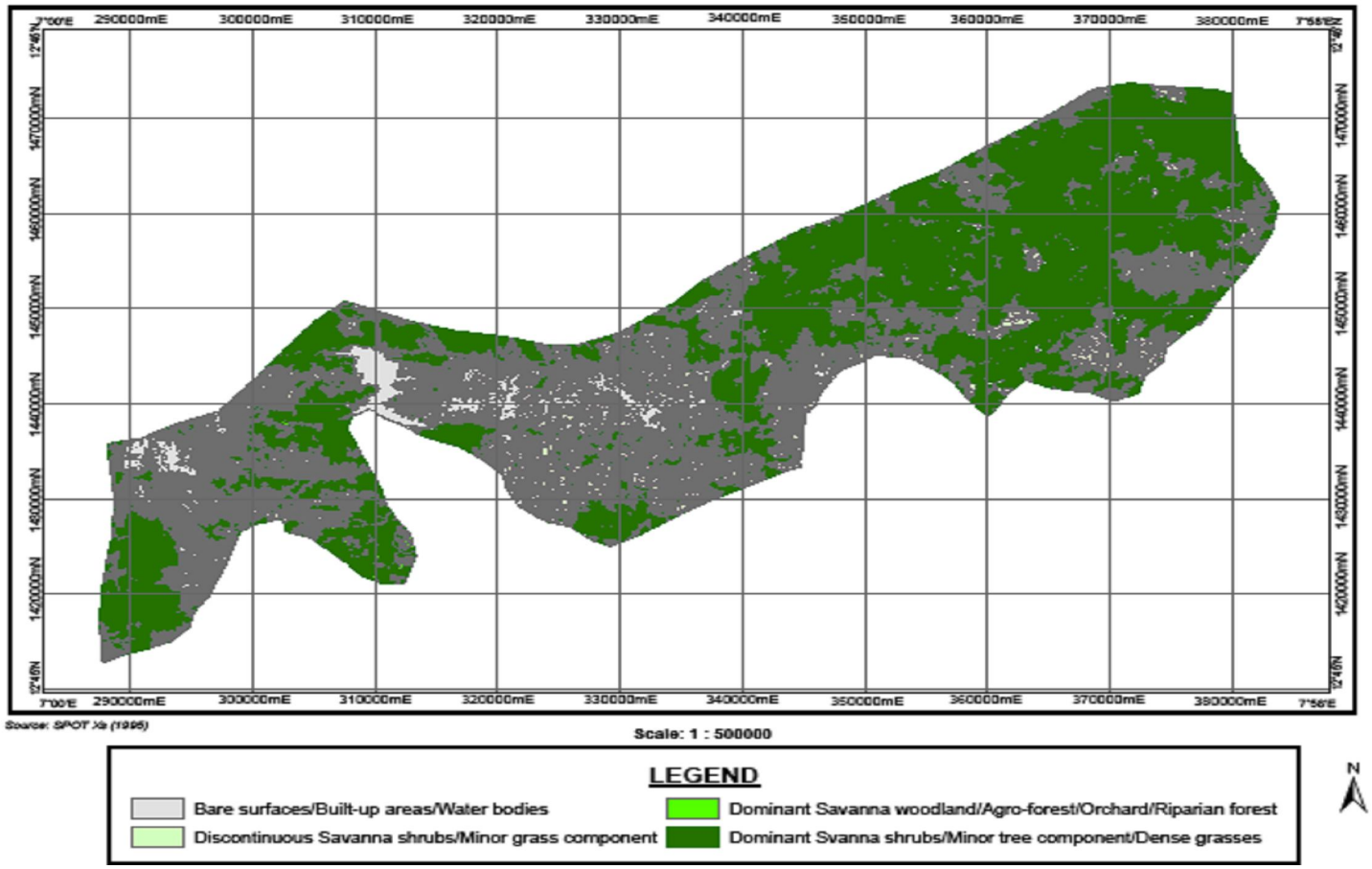


Figure 4.4: Vegetal cover in Jibia and Kaita Local Government Areas of Katsina State (1995)

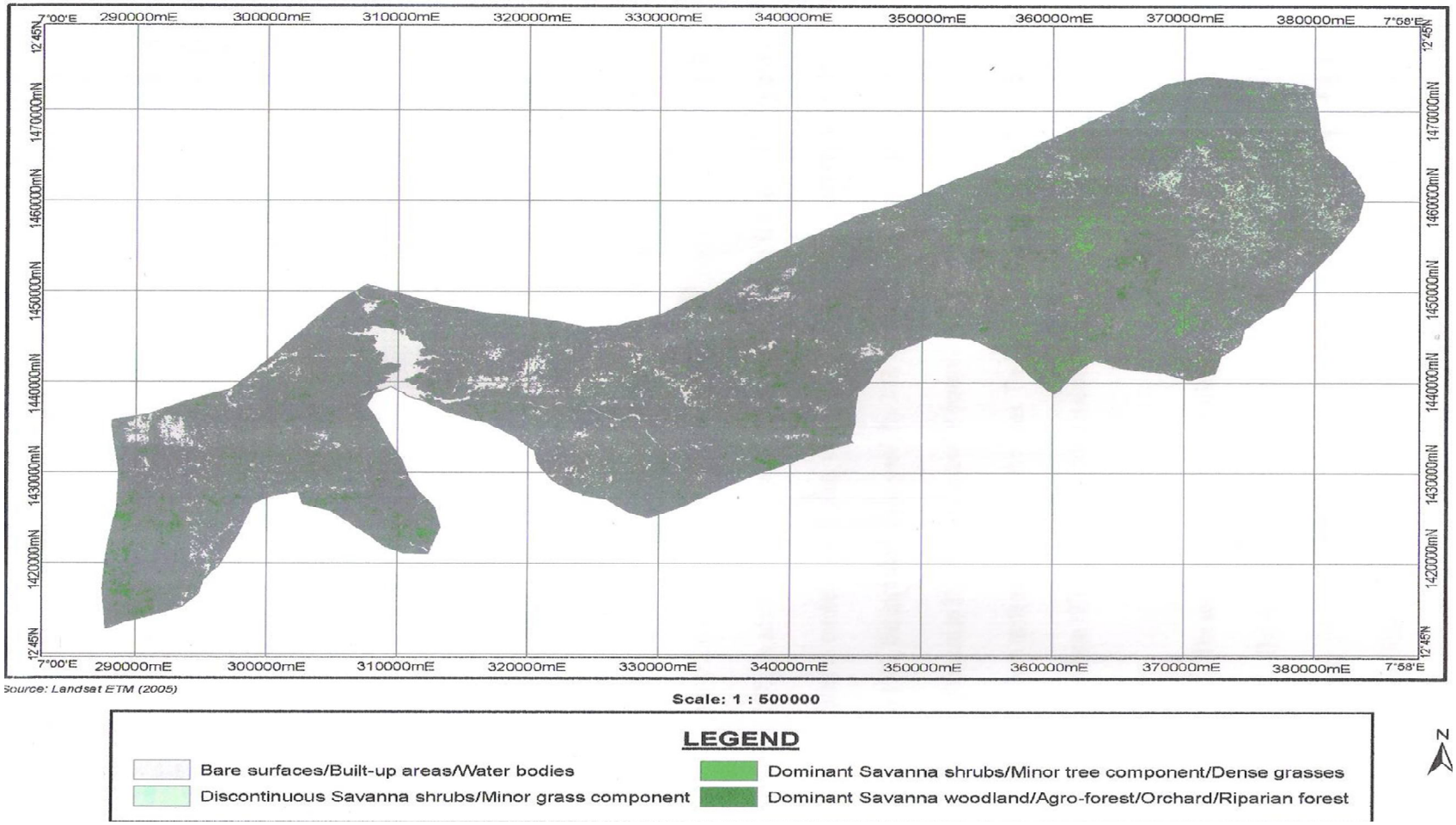


Figure 4.5: Vegetal cover in Jibia and Kaita Local Government Areas of Katsina State (2006)

The NDVI statistic for the BS/BUP/WB showed that the bare surface land mass in the study area was high (about 43.34 percent) in 1976 but decreased over time to 1.29 percent in 2006. This indicates that the magnitude of desertification, has reduced drastically. There has been an appreciable effort in fighting desertification.

DSS/MGC variable showed that the discontinuous savanna shrubs land area increased from(49.98 percent) in 1976 to(55.35 percent) in 1987. It however declined to (39.51 percent)in 1995 and later to(34.62) percent in 2006. The decline in area covered by DSS/MGC variable in the third and fourth decade can be attributed to man's interference in the DSS/MGC, this can come from land clearing for agriculture, and other activities. It can also come from the grazing of animals and increase in human population. The Dominant savanna shrubs/minor tree component/dense grasses DOSS/MTC/DG variable rose steadily through out the four decades under study. Significant effort have been achieve through DOSS/MTC/DG in combating desertification. The NDVI statistic for dominant savanna woodland/Agro-forest/Orchard/Riparian forest variable however, shows a steady increase in its spread, rising almost geometrically over the four decades. It implies that significant effort have been achieved in recent times in combating desertification through DSW/AF/RF.

The major indicator for desertification is bare land surfaces, which may be devoid of vegetation. Results obtained in the study from the satellite imageries show that the magnitude of desertification in the study area has reduced drastically over time, from 43.34% in 1976 to 1.29% in 2006. This shows that there has been appreciable efforts to check desertification in the study area.

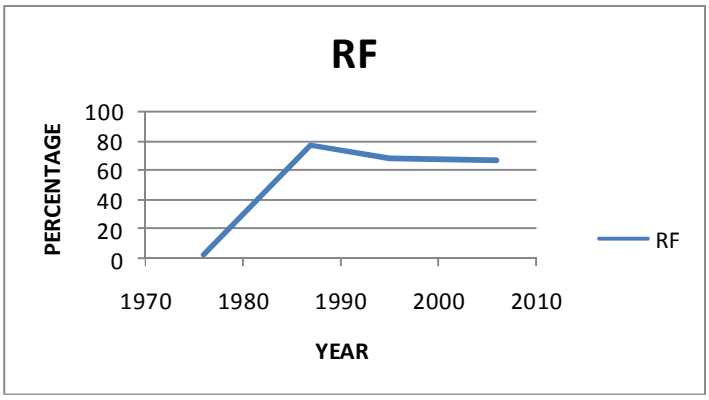
4.3 TO IDENTIFY THE VARIOUS STRATEGIES ADOPTED TO COMBAT DESERTIFICATION IN THE STUDY AREA

Available statistics show that the strategies used to combat desertification in the study areas are: through reserved forests, Reservoirs for irrigation purposes, tree planting in the form of Shelter belts, Woodlots, trees on boundary, the use of *vertiver* grasses, natural tree regeneration, community and private woodlots (i.e. wind breaker). From the satellite imagery, the estimated land mass (in meter square) was estimated for each of the strategies in four decades: 1976, 1987, 1995 and 2006. Percentages and line graphs were then used to analyse the data. The data extracted are presented in table 4.2

Table 4.2: Afforestation Statistics in Jibia and Kaita LGA

Year	Reserved Forest (RF) in M^2	RF (%)	Reservoir (R) in M^2	R (%)	Tree Planting e.g woodlots, Natural regeneration, trees on farmland (TP) in M^2	TP (%)	Shelter Belt (SB) in M^2	SB (%)	Aforestation total	Total
1976	1276564.019867	2.57			48331705.96	97.43			49608269.88	100.0
1987	164925844.03604	76.48			49446684.16	22.93	1276564.02	5.91	215649092.2	100.0
1995	193411475.14774	67.05	23312072.56	8.08	68566593.32	23.77	3164720.65	1.10	288454861.6	100.0
2006	199901900.712514	66.54	22958856.09	7.64	75342483.75	25.08	2220605.66	7.39	300423846.2SSSSSSS	100.0

Source: Satellite Imagery Extract



Source: Author's Presentation

Figure 4:6: Trend of Reserved Forest Area in the Study Area: 1976 – 2006.

4.3.1 Forest Reserve

For reserved forest, in was found that in 1976 the percentage of reserved forest was 2.57percent. In 1987 however, it increased by 73.9percent to 76.47percent. By 1995,it declined by 9.42percent to 67.05percent.By 2006 it further declined by 0.52percent.The decline in forest reserve is small compared to the much increase observed. Effort to combat desertification through the use of reserved forest has been quite significant over the years. The line graph, showing the trend of reserved forest from 1976 to 2006 (in decades) is shown above. The evidence for these changes are seen on figures 4.7, 4.8, 4.9, 4.10, this is found in the coloration and sizes of the area coverage of the forest reserve areas, shown on the map, it is from these maps that the statistic for the area coverage of reserved forest where determined.

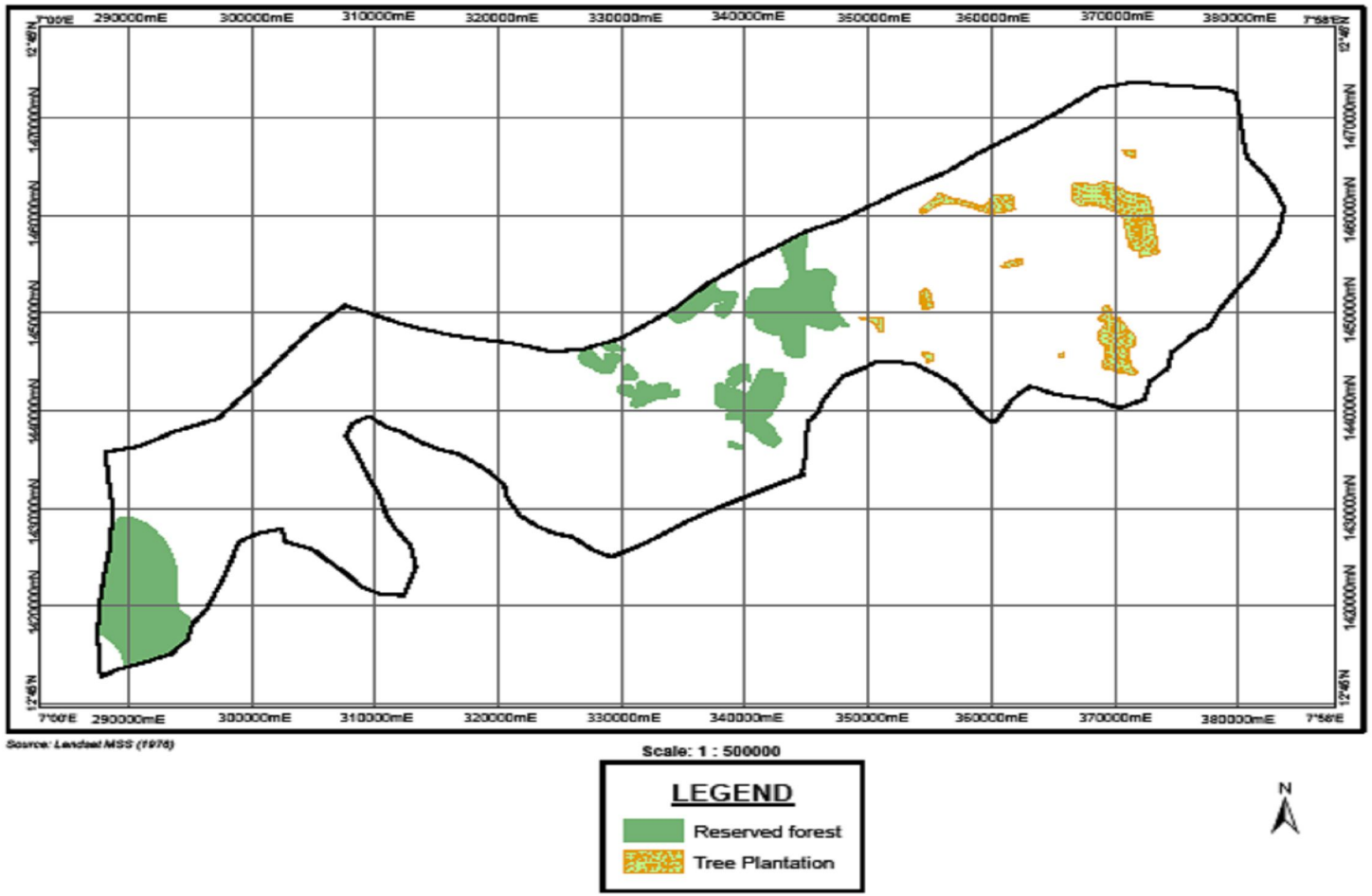


Figure 4.7: Afforestation in Jibia and Kaita Local Government Areas of Katsina State (1976)

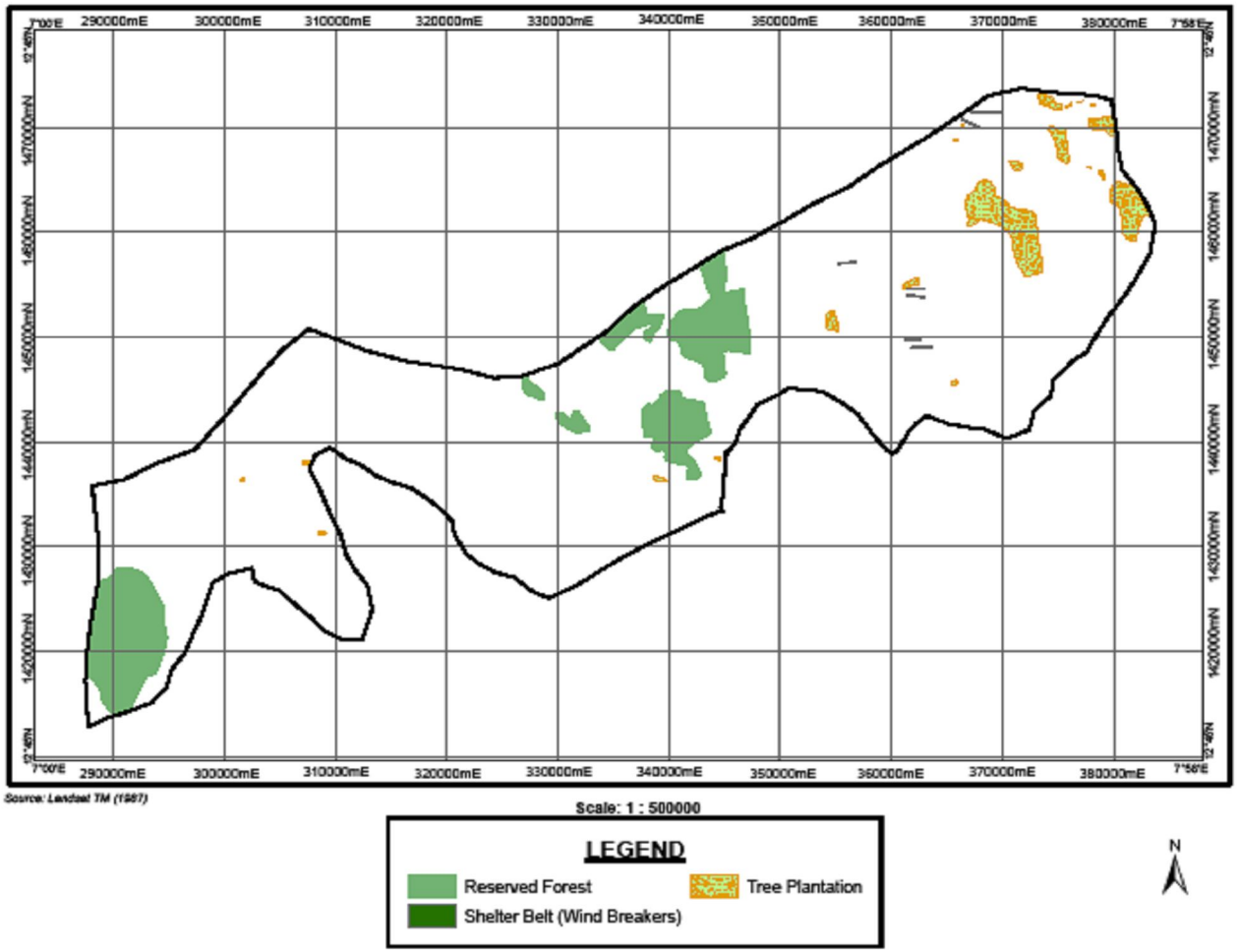


Figure 4.8 **Afforestation in Jibia and Kaita Local Government Areas of Katsina State (1987)**

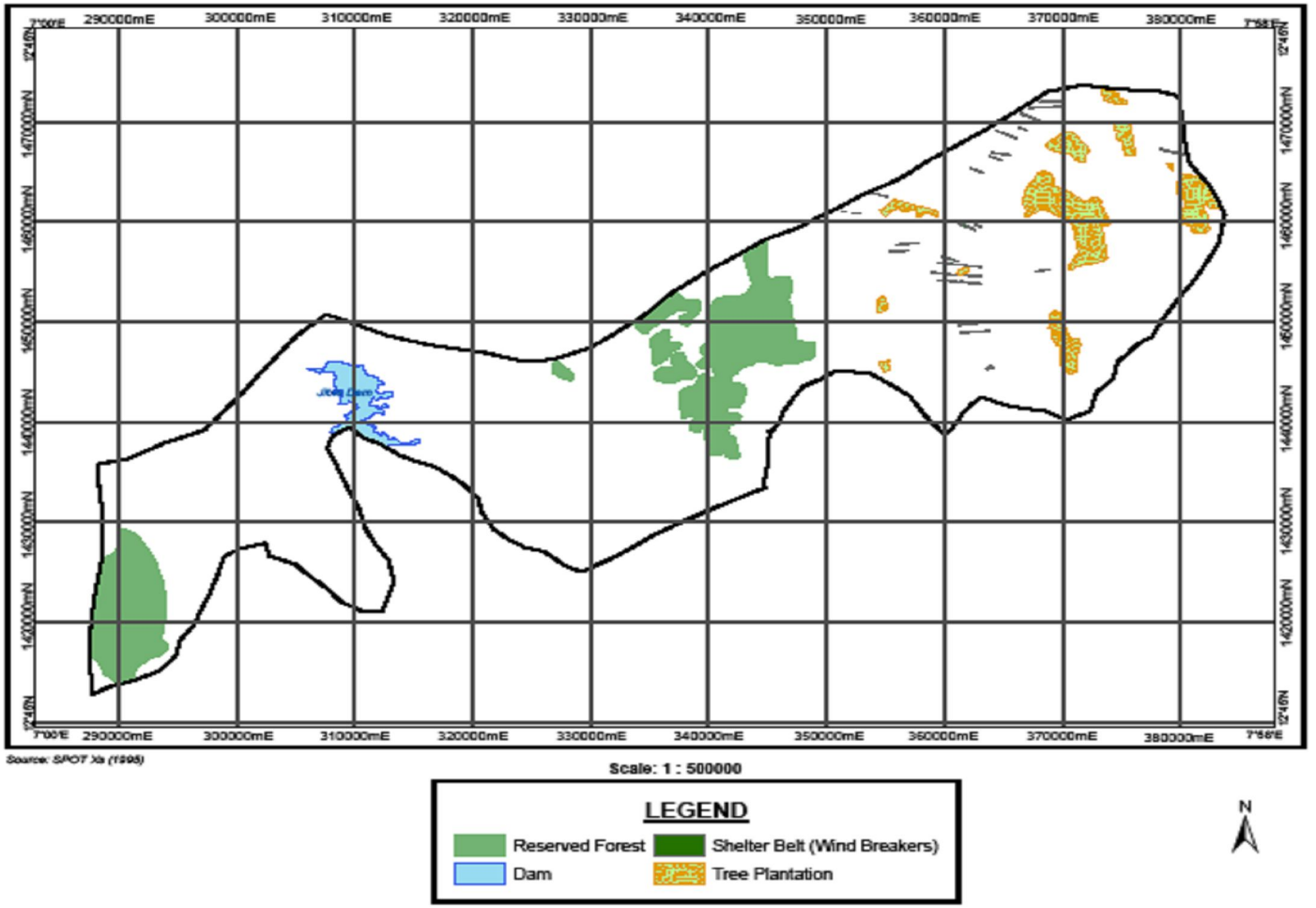


Figure 4.9 Afforestation in Jibia and Kaita Local Government Areas of Katsina State (1995)

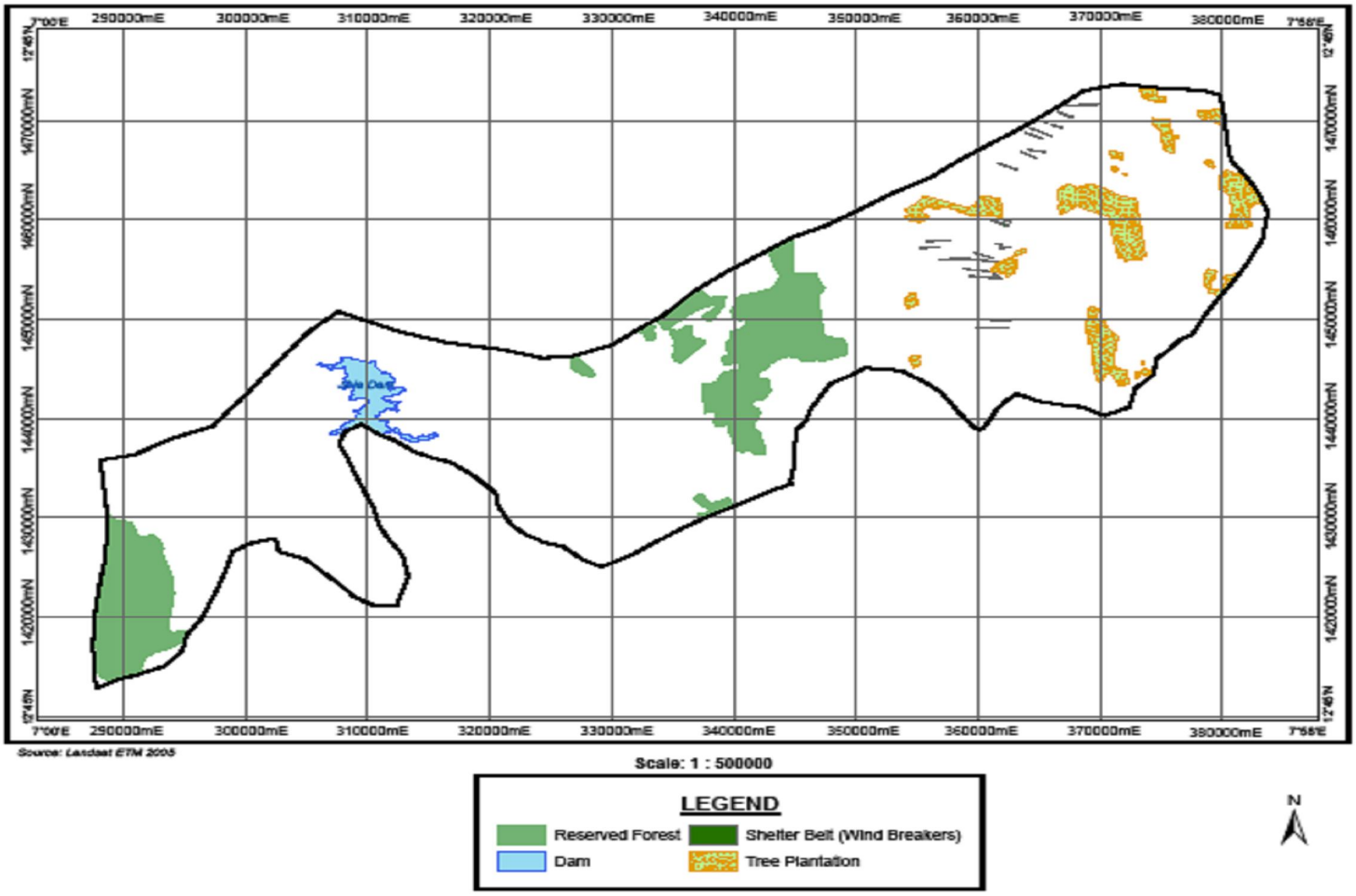


Figure 4.10: Afforestation in Jibia and Kaita Local Government Areas of Katsina State (2006)

4.3.2 The use of Reservoirs for Irrigation Purposes

The result for reservoirs for irrigation also revealed that it declined in size between 1995 and 2006 by 0.44 percent. The decline in the area coverage of water bodies (Jibia dam in particular) between 1995-2006 was as a result of various purposes, the dam is used for e.g domestic purposes. The shrinking size also is attributable to the building up of sediments in the dam. Vegetation is also gradually taking over the immediate surrounding of the dam, thereby reducing its size, the shrinking size of the dam may also be attributed to the amount of rainfall, of the particular year the imagery was taken, the amount of rainfall may be small.

The dam however has played a very vital role in the irrigation of the vegetation of its immediate surrounding. This has helped to reduce desertification in the area drastically.

Figures 4.9 and 4.10 shows the dam with a little decrease in the area coverage of the dam, in plates A and B are different views of the dam which is used for irrigation purposes and also supply water for shelter belts, woodlots, etc. Figure 4.11 shows a decrease in the area coverage of the dam.

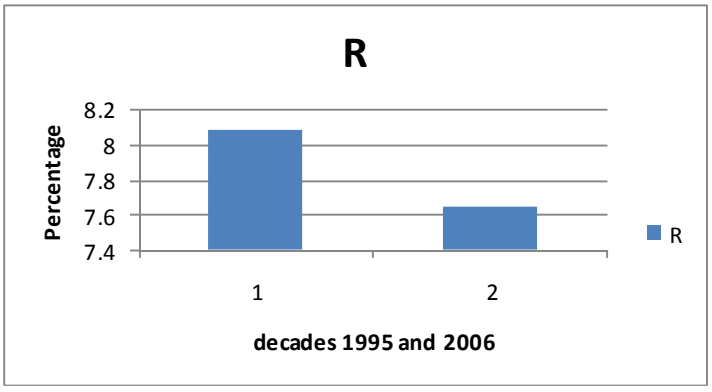


Figure 4.11: Reservoir Area. 1995 and 2006



A



B

Plate A and B: Different views of Jibia Dam which is used for irrigation in Jibia.

4.3.3 Shelter Belts

The total aforestation area reserved as shelter belt or wind breaker in the study area is small. It decline from 5.91% in 1987 to 1.097% in 1995 however, a shot up to 7.39% in 2006, the drop in the area coverage of shelter belt in the second decade result from poor maintenance and human interference.

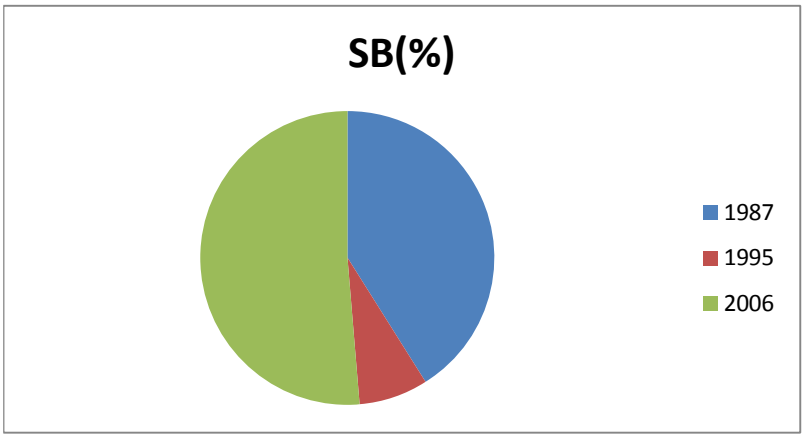


Figure 4.12: Shelter Belt Area.1987, 1995 and 2006

This evidence is also shown on the vegetal map, of the study area in figures 4.8, 4.9 and 4.10. Figure 4.7 has no shelter belts on it, this is because shelter belts were not established in the first decade of this study. Plates C, D, E and F show evidence of aforestation in the study area.



C



D

Plate C and D: Grass hedging in Kwana Shagari and Gidan Saidu Buzu in Kaita Local Government Area of Katsina State (Evidence of aforestation in the study area)



E



F

Plate E and F: Aforestation e.g. Shelter belt in Kurya in Kaita Local Government Area of Katsina State and H in Magama in Jibia Local Government Area of Katsina State

4.3.4 Tree Planting e.g Woodlots, Natural tree Regeneration, Trees on Farmland, Trees on Farm Boundaries etc.

From the satellite imagery, the data collected to assess tree planting as a strategy to combat desertification shows a decreasing trend in the effort towards tree planting, all through the sampled period. The decline in tree planting may be attributable to poor maintenance of the seedlings to maturity and also human interference and animals browsing.

4.4 DETERMINATION OF THE SUCCESS RATE OF VARIOUS STRATEGIES USED FOR COMBATING DESERTIFICATION IN THE STUDY AREA

The third objective of the study is to determine the success rate of the various strategies used in combating desertification in the study area. From the literature, the following strategies were identified: the use of water dams for irrigation purposes, establishment of shelter belts, woodlots, wind breaks, trees On farm lands, natural tree regeneration and the planting of *vertiver* grasses for sand dune stabilisation. For the study area 60 questionnaires were issued to selected respondents. From the frequency analysis, a 100 percent response rate was recorded. This was because of the interest of the respondents on the issue of desertification.

When asked if they knew what desertification was, all the respondents said yes. The frequency table is also shown table 4.

Table 4.3: Knowledge of the term desertification in the study LGAs

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	60	100.0	100.0	100.0

Source: SPSS Output

4.4.1 Effects of Desertification in the Study Area

They were further asked what effects they would associate with desertification, 33.3 percent said that it makes productive lands to become unproductive; 10 percent said it covers roads with sand; another 10 percent said it makes agricultural land to become unproductive; yet another 10 percent said it bring sand to cover their houses, and 36.7 percent said it leads to the disappearance of trees. The frequency table is shown in table 4.4

Despite the much efforts put in place by various organisations to reduce desertification, there are still some areas where desertification is still a problem as shown in plates G and H.

Table 4.4: Effects of desertification in the study LGAs

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Productive lands become unproductive	20	33.3	33.3	33.3
Roads covered by sand	6	10.0	10.0	43.3
Poor agricultural productivity	6	10.0	10.0	53.3
Bring sand to home	6	10.0	10.0	63.3
Trees disappeared	22	36.7	36.7	100.0
Total	60	100	100	

Source: SPSS Output

As to whether there are any organizations responsible for the mitigation of desertification in the study areas, all the respondents said yes. The organizations were stated to include: EEC, KTAPU, local government and state government. This is displayed in table 4.5

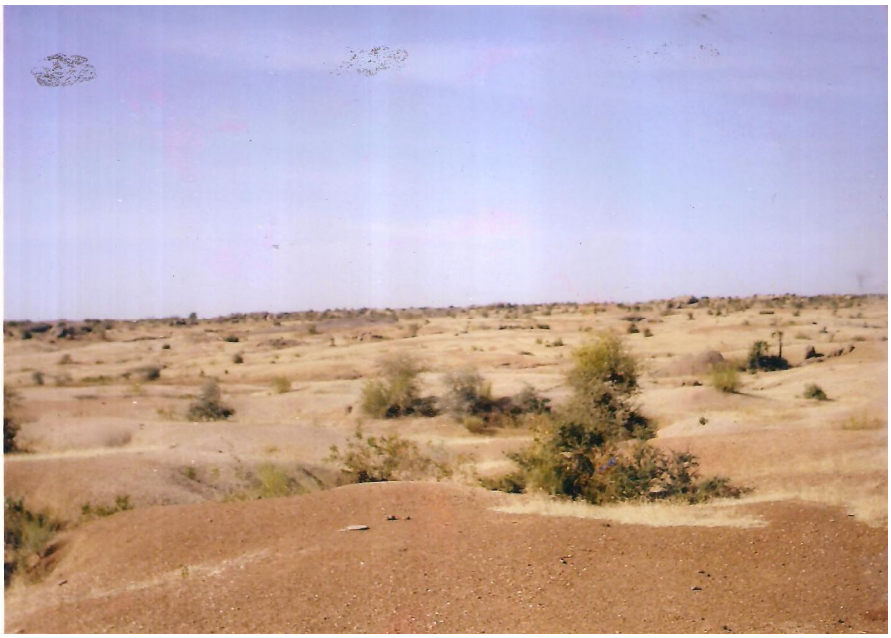


Plate G: Evidence of desertification in Magama, in Jibia Local Government Area of Katsina State, Nigeria.



Plate H: Evidence of desertification in Dankama, in Kaita Local Government Area of Katsina State, Nigeria.

The evidence to prove these are shown on plates C, D, display in table E and F where various organizations that are involves in curbing desertification in a had their projects on grounds in the study area.

Table 4.5: Organisations involved in mitigating desertification in the study LGAs

	Frequency	Percent	Valid Percent	Cumulative Percent
EEC	27	45.0	45.0	45.0
State government	2	3.3	3.3	48.3
Local government	2	3.3	3.3	51.7
KTAPU	29	48.3	48.3	100.0
Total	60	100.0	100.0	

Source: SPSS Output

4.4.2 Strategies for Combating Desertification

On the various strategies adopted to combat desertification, 88.3 percent said tree planting was the dominant strategy employed e.g woodlots, trees on farmlands and natural tree regeneration. 11.7 percent said providing shelter belt (another means of tree planting that also serves as wind breaker) was the other strategy employed. The frequency table is shown in table 4.6

Table 4.6: Strategies for combating desertification in the study LGAs

	Frequency	**Percent**	**Valid percent**	**Cumulative percent**
Tree Planting e.g woodlots, trees on boundary	53	88.3	88.3	88.3
Shelter belt	7	11.7	11.7	100.0
Total	60	100.0	100.0	

Source: SPSS Output

To determine the success rate of tree planting as a strategy of combating desertification, the respondents were asked to rate the effectiveness of the strategy; 15

percent said very effective, 50 percent said effective, 30percent said fairly effective, while 5 percent said not effective. The frequency table is presented in table 4.7

Table 4.7: Effectiveness of the strategies adopted to Combat Desertification in the study LGAs

	Frequency	Percent	Valid Percent	Cumulative Percent
Very effective	9	15.0	15.0	15.0
Effective	30	50.0	50.0	65.0
Fairly effective	18	30.0	30.0	95.0
Not effective	3	5.0	5.0	100.0
Total	60	100.0	100.0	

Source: SPSS Output

Based on this response it can be said that tree planting as a strategy for combating desertification in the study area is effective. There are also efforts been made on the part of the local government, community members to arrest desertification in the study area. Some the efforts include: campaigning against tree felling, and by tree planting as well. The frequency table for this response is presented in table 4.8

Table 4.8: Community Efforts at Combating Desertification

	Frequency	Percent	Valid Percent	Cumulative Percent
Campaign against tree felling	27	45.0	45.0	45.0
Tree planting	33	55.0	55.0	100.0
Total	60	100.0	100.0	

Source: SPSS Output

By way of suggestion, 48.3 percent of the respondents further suggested that stoppage of tree felling would contribute to combating desertification in the study area. Another 33.3 percent suggested that construction of dams for irrigation purposes would

also be effective in combating desertification. Lastly, 18.3 percent added that tree planting would be useful in combating desertification in the study area. The frequency this response is shown in table 4.9.

Table 4.9: Suggestions for combating desertification in the study LGAs

	Frequency	Percent	Valid Percent	Cumulative Percent
Tree planting	11	18.3	18.3	18.3
Construction of water dams	20	33.3	33.3	51.7
Stoppage of tree felling	29	48.3	48.3	100.0
Total	60	100.0	100.0	

The result obtained from the questionnaire, administered shows that the strategies adopted for the mitigation of desertification in the study area are effective. Though results obtained from questionnaires may not be a very empirical judgment in arriving at the results obtained, which says that the strategies adopted for the mitigation of desertification in the study area are effective.The result obtained from the use of questionnaire corroborated with the empirical findings adopted earlier in the first and the second objectives of the study, it shows that desertification as an environmental problem of the study area has reduced drastically from 43.34% in 1976 to 1.29% in 2009. These findings are scientific in nature, it now substantiates the result obtained from the use of questionnaire.

Personal observation of the researcher, who has lived in study area for close to a decade, also is a proof to substantiate the results obtained from the questionnaires. The observations shows that afforestation as a means of curbing desertification, is the major technique adopted in the study area, and it is effective. This evidence is also seen by the

various photographs of the projects carried out by various organizations to curb desertification in the study area.

4.5 DISCUSSION

From the evidences provided by the satellite imageries used for the research, and the literature review, and also the results obtained, and personal observations of the researcher, whom has lived in the area on which this research was carried for close to a decade. It shows that desertification as an environmental problem of that region is gradually been phased out totally. This evidence is from various activities put in place to check desertification in this region. There has been Internationally assisted programmes from the World Bank, Katsina Arid Zone Programme which was later called European Economic Community/Katsina State Government, (EEC/KTSG). International fund for Agricultural Development (IFAD). Katsina State Agricultural and Community Development Project (KSACDP).This are all internationally assisted programmes to combat desertification in Katsina state, with the study area inclusive. This evidence also correlated with the (UNCCD, 1997) which called for international cooperation and a partnership approach in checking desertification. It focuses on improving land productivity, application of land conservation and sustainable management of water resources.

The Federal Government of Nigeria also plays a very big role in combating desertification in the study area, through the Federal Ministry of Environment, Ecological Fund, Katsina Afforestation Project Unit/Federal Government Assisted, Though KTAPU is now funded by the katsina state government. The establishment of the Jibia dam which has totally erased desertification on its immediate surroundings are

some federal government programmes, currently on ground in Katsina state. Their major roles is to check desertification.

These evidences will support the result gotten in this research that shows that desertification has reduced drastically from about (43.34%) in 1976 to about 1.29% in 2006. All these are efforts put in place by the federal government with the study area inclusive, these programmes has aids in reducing desertification in Katsina state drastically. These are practical phenomenon that are observed by the researcher.

The state government also has been playing a very big role in desertification control, it involves programmes like the Katsina Afforestation Project Unit, (KTAPU). Katsina Agricultural and Rural Development Authority, (KTARDA). Katsina State Ministry of Agriculture and Natural Resources, Campaign for the re-afforestation of Katsina State, (CAREFOR). The Drought and Desertification Control Committee, Katsina Environment Protection Agency, Katsina State Ministry of Environment. All these agencies are geared towards the eradication of desertification in Katsina state. From literature available and personal observation shows that these agencies have done much to combat desertification in Katsina state, with the study area benefiting immensely. This relates to the work done by Baba (2003), who reported that various agencies has desertification control projects on ground in Katsina State. These includes the EEC/KTSG, World Bank Assisted Afforestation Project. Katsina Committee on Drought and Desertification Control, Katsina Afforestation Project Unit KTAPU, Katsina State Ministry of Agriculture etc. Their major aim is afforestation and land management to combat the menace of desertification, as an environmental problem.

However, there are some contradictory researches carried out by Murtala (2003), and Auwal (2006),they reported that desertification in Katsina state has lead to the

reduction in the productivity of the land to the bearest minimum. Thus eliminating the already meager food and water resources.

The mitigation strategies used

Afforestation is the major mitigation strategy used to combat desertification in the study area. This is done through reserved forests, tree planting in the form of woodlots, natural regeneration, trees on farmland shelter belts establishment ,Orchards The use of vertiver grasses and trees on farm boundaries.

The personal observations of the researcher and the literature reviewed shows that the major mitigation strategies used in the study area by Katsina Afforestation Project Unit, (KTAPU). Katsina Agric and Rural Development Authority, (KTARDA). European Economic Community / Katsina State Government, EEC/KTSG. Etc adopted afforestation as the major mitigation strategy in checking desertification in the study area. This correlated with the findings by Baba (2003), Munir (2009), Auwal (2006) and Babura (2001) who all identified afforestation as the major means of controlling desertification in the study area.

The Jibia dam.

The Jibia dam is another means that was use to mitigate desertification in the study area. It is located in Jibia Local Government Area. It is part of the development plan for the Sokoto Rima Basin, being carried out by Federal Ministry of Water Resource,through the Sokoto Basin Development Authority. The project was mean to provide potable water to the town of Jibia and neighbouring villages, and also to create a barrier against the encroaching Sahara desert (Sani, 1996).

The Jibia dam also plays a very important role in checking desertification in the study area. This was supported by findings done by Sani (1996). He reported that the

dam has a lot of impacts on the environment it is located, it provides water for woodlots and shelter belts, that are located closely to the reservoir. Irrigation activities also have tremendous improvement, water is also provided for domestic uses and to both plants and animals. The dam is a good barrier against the occurrence of drought and desertification.

All the evidences given from the results obtained from the research and personal observations of the researcher has justified the findings which said desertification has reduced drastically in the study area.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

This study focuses on the various strategies adopted to check desertification in Jibia and Kaita Local Government Areas, of Katsina state overtime. To determine the magnitude of the spread of desertification in the study area, satellite imageries of 1976 (Landsat MSS), 1987 (Landsat TM), 1995 (spot XS) and 2006 (Landsat ETM) were used for the analysis. They were analysed using appropriate GIS software. The area coverage of desertification was deduced from the Normalise Difference Vegetation Index(NDVI) statistics.

The NDVI statistics was decomposed into various categories for easier understanding, and the results obtained, show that desertification spread in the study area from 1976 has reduced drastically, because the area coverage of desertification has declined appreciably.

An assessment of the various strategies adopted to combat desertification, was also determined from the satellite imageries. The area coverage of the various efforts to check desertification was assessed from the satellite imageries 1976 (Landsat MSS), 1987 (Landsat TM), 1995 (SPOT XS) and 2006 (Landsat ETM).It was observed that the efforts put in place to check desertification in the area under study was mainly afforestation, and from the statistics obtained, it shows a steady increase in Afforestation.

The result of this study revealed an increase in forest reserves area from 1976 to 2006, It can be concluded that reserve forests as a means of checking desertification in the area is very effective.

The major water reservoir in the study area is the Jibia dam, this has played a very significant role in checking desertification in the area. It is the major source of water for irrigation of farmlands as well as the planted trees.

The success rate of the various strategies adopted to check desertification in the study area was achieved through the use of structured questionnaire. These were issued to respondents. From the results obtained it shows that the respondents have idea on what desertification means, this is because it is affecting them directly. They also pointed out that it has a negative effects on their environment. The respondents also established that afforestation is the major strategy adopted to curb desertification in the study area.

Various organisations, were identified to be playing vital roles in checking the menace of desertification and these include the European Economic Community (EEC), Katsina Afforestation Project Unit (KTAPU), Katsina Agricultural and Rural Development Authority KTARDA State and Local government. It was also observed that the roles they are playing to check desertification in these areas is effective, the major means used by these agencies is afforestation.

5.2 CONCLUSION

The assessment of the success of the strategies used in combating desertification in the study area revealed that there has been an appreciable effort put in place to mitigate the effects of desertification. The area coverage of desertification determined

from the satellite imageries shows that the spread was much at the first decade of the study, with an area coverage of about 43.34% in 1976 but it shrinked in size overtime to about 1.29% in 2006.

This reduction in the area coverage of desertification in the study area is attributable to various efforts put in place, such as afforestation, to check the menace of desertification in the study area.

The Normalize Difference Vegetation Index NDVI statistics from the satellite imageries of the study area also shows that the bare surfaces kept reducing almost through out the period of study. Dominant savanna shrubs/Minor tree component/Dense grasses (DOSS/MTC/DG)was 6.62percent in 1976 but increased to 46.30% in 2006.

Dominant Savanna Woodland/Agro-forest/orchard/Riprian forest (DSW/AF/O/RF/) was 4.24percent in 1976 but increased in size to 17.77% in 2006.

Afforestation statistics derived from the satellite imageries also shows reserve forest which the area coverage in 1976 was only 2.57percent but increased overtime to 66.53percent in 2006.

The area coverage of shelter belt was 5.91% in 1987 and 7.39 in 2006. With the evidences given, it can now be considered that desertification in the study area has reduced greatly.

Results obtained from this research, shows that the major strategies for checking desertification in the study area is afforestation and the strategies are effective.

This research was carried out at a particular location (Jibia and Kaita) local government areas of Katsina state. In extreme northern part of Nigeria where it is believed that desertification is the major environmental problem of the area because of

its location. This research to some extent has proved such notions not to be totally right ,especially the Food and Agricultural Organization (FAO) report on desertification in Nigeria which shows that desertification is increasing at an alarming rate of about 0.6km into Nigeria. But in this case it is reducing drastically.

5.3 RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made, Publicity and enlightenments campaigns on the dangers associated with desertification should be intensified, people should be persuaded to actively participate in the programme. These can be achieved through the intensification of the campaigns using mass media, both print and electronic media.

The present afforestation and the re-afforestation programmes are worthwhile, but it should be intensified.

From observation, the major and only technique used to combat desertification in the study area was afforestation, other ways of curbing desertification should also be employed. Such as the building of walls around sand dunes areas especially by the roadsides

Other methods of checking desertification, such as the use of Nano clay or spraying petroleum over arid crop lands, this is usually done where petroleum or Nano clay is easily obtainable.

Since the effects of desertification is felt mostly on the land surface, other ways of replenishing the land such as application of manure, planting of legumes that fix nitrogen into the soil can be adopted.

More water reservoir should be created at strategic locations in the study area this will solve the problem of insufficient water used for irrigation.

The Agencies charged with the responsibility of supervision and establishment of shelter belts, woodlots e.t.c. should have a strong legal backing, so that it can take legal actions on individuals involved in indiscriminate felling of trees. So also punishments should be meted to such individuals. The government should also create more agencies for combating desertification.

The government idea on the use of alternative to firewood is illusive. This is due to the fact that alternatives to firewood such as kerosene, gas, electricity and solar powered devices, besides being expensive, are difficult to obtain in the rural areas and are also exhaustible and non-renewable. Therefore the government should encourage families, organizations, schools, Bakeries ,prisons, training institutes etc, that consume a great tonnage of wood daily to establish their own source of firewood.

Efficient wood burning stoves should be developed more in numbers and the usage should be encouraged, because it cooks faster, with less quantity of firewood. This should replace the traditional three stone open fire, which consumes more firewood.

The past programmes by EEC/KTSG involving schools should be awaken, school children especially the post primary schools should be made to understand the causes and effects of desertification. They can be made to be involved in grass roots tree planting activities small tree nurseries and woodlots should be established in each school for practical demonstration. The students should also be involved in shade and amenity planting around schools and their homes. The executing organizations should assist the efforts of the students by providing all material inputs and technical services.

Also periodic lectures should be presented to the students on the dangers of desertification and the importance of environmental conservation.

Money is also very important in executing all the programmes mentioned above for desertification to be controlled effectively, money is needed, so financial assistance from the local, State, and Federal government is highly needed, adequate monitoring should be done to ensure the efficient use of money voted for desertification control programmes considering the of poverty of the rural populace.

Above all, community participation is highly essential; the immediate community of the affected areas should be part and parcel of programmes of desertification control, the community knows their environment better than any other person outside the community, the effectiveness of programmes aimed at checking desertification in the study area however will depend on the intensive use of the local populace.

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APPENDICES

QUESTIONNAIRE

My name is _____ a student from the Department of Geography. Ahmadu Bello University Zaria, I am undergoing an MSC Research titled, An appraisal of some strategies for mitigating desertification in Jibia and Kaita Local Government Areas of Katsina.

You have been selected to be interviewed; your response will be confidential, no names, address or anything that could identify you will be used in the results. I also appeal to you to give honest opinions to the questions.

Thank you for your understanding and cooperation.

1. How old are you (completed years) (15-20), (21-25), (26-30), (31-35), (35 and above)
2. Sex: Male ( ) Female ( )
3. Occupation: civil service ( ), farming ( ) Business/petty trading ( ) professional/managerial ( ) unemployed ( )
4. Marital Status: Single ( ), Married ( )
5. Highest education attainment, primary ( ), secondary ( ), Tertiary ( )

   Others specify _____

SECTION B

1. To your understanding, do you know what desertification is? Yes ( ) No ( )
2. What do you observe as Desertification?
3. What do you observed as the effects of desertification in your locality? _____ Productive lands becomes on productive ( ) roads covered by sand ( ) poor agricultural productivity ( ) others specify ( )

4. Has there been changes in the natural vegetation of your locality in the last 20 years? Yes ( ) No ( )
5. Has there been any organization that is responsible for the mitigation of desertifications in your area? Yes ( ) No ( )
6. If yes, name them: European Economic community ( ), Katsina Afforestation project unit ( ), KTARDA ( ) others specify _____
7. From your observation what were the various strategies put in place by the government or other agencies for the mitigation of desertification in your locality: Tree plating in the form of woodlots, trees on boundary, trees on farmlands ( ), tree planting in the form of shelter belts ( ) reservoir constructed for irrigation purposes ( ), others specify _____
8. From your observation, are the various strategies effective agencies desertification? Very effective ( ), effective ( ) fairly effective ( ) Not effective ( )
9. Are the evidences on ground now shows that desertification mitigation processes was once carried out in your area? Yes ( ) No ( )
10. Has there been your community participation in checking desertification? Yes ( ) No ( )
11. If yes, what are the possible remedies put in place: tree planting ( ) construction of water reservoir for irrigation ( ) stoppage of tree felling ( ), others specify _____
12. Do you as an individual or community supports the agencies or government in controlling desertification in your area? Yes ( ) No ( ).
13. What is the support: provision of land ( ), Sensitization campaign ( ) planting of trees ( ) other specify _____

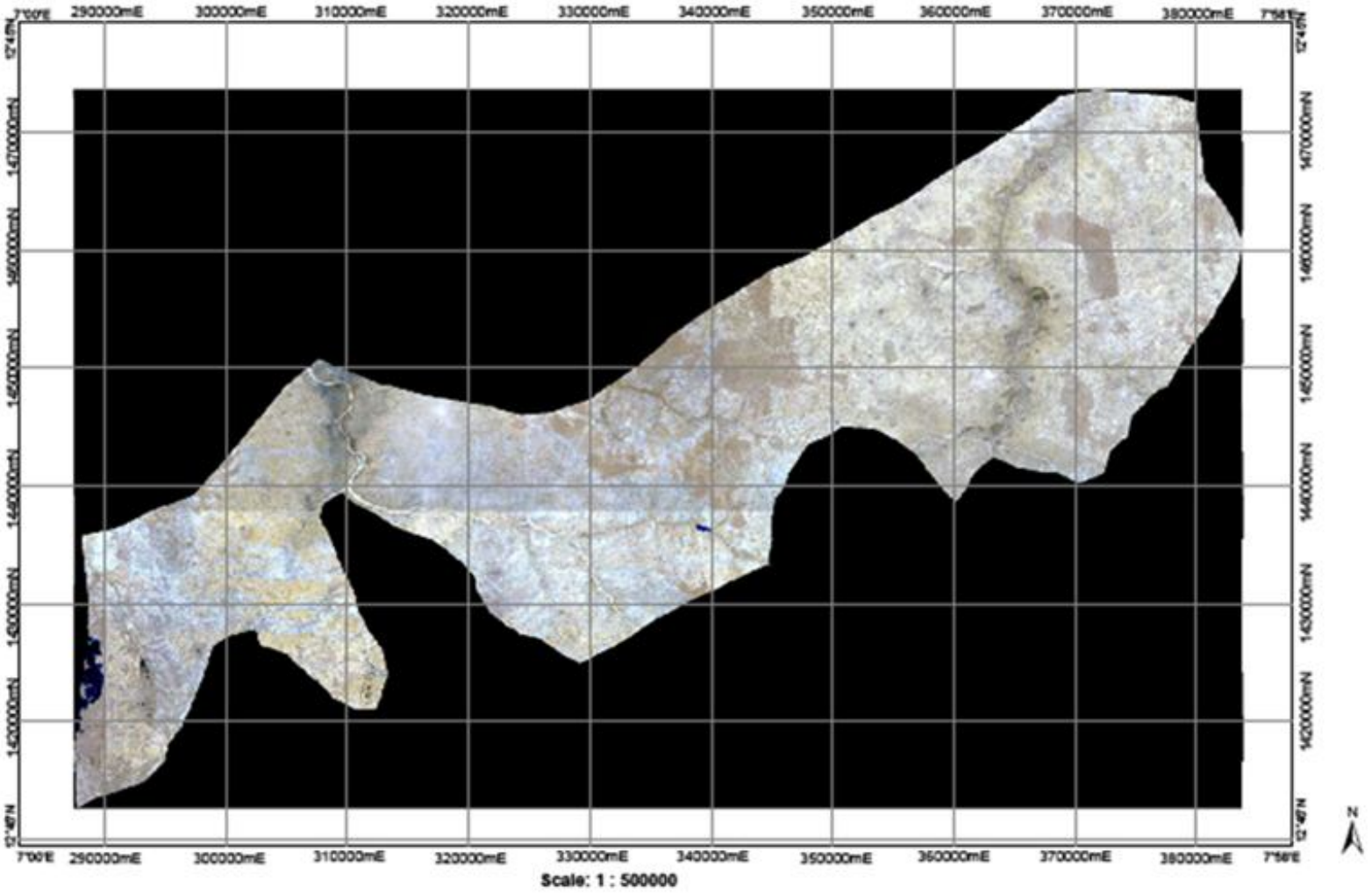
ANNUAL RAINFALL (mm) – THE STUDY AREA 1922-2009

Year	Months												Total Rainfall	Av. Monthly	No. Rainfall Days
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep.	Oct.	Nov.	Dec.			
1922	0	0	1.3	13.2	7.6	54.6	213.6	425.5	224.5	16.5	0	0	955.6	79.6	50
1923	0	0	0.3	23.6	74.9	71.7	121.9	150.4	81.0	29.2	0	0	65.29	54.4	60
1924	0	0	0	4.6	57.2	55.6	237.7	281.2	29.2	15.2	0	0	680.7	56.7	50
1925	0	0	0	0	57.9	67.8	124.7	231.1	96.3	25.4	0.1	0	606.9	50.6	
1926	0	0	0	0	131.3	209.3	58.4	141.2	14.7	0	0	0	555.0	46.2	
1927	0	0	0	0	14.7	225.7	171.7	149.1	117.6	21.3	0	0	869.2	72.4	
1928	0	0	0	0	26.4	57.4	215.7	307.3	67.3	5.1	0.5	0	685.2	57.1	54
1929	0	0	0	0	56.1	50.0	117.1	250.4	102.4	1.5	0	0	577.6	48.1	54
1930	0	0	0	4.1	46.7	118.4	163.3	348.5	108.2	0.8	0	0	789.9	65.8	59
1931	0	0	0	4.3	96.5	80.0	156.0	137.2	162.8	0	0	0	637.5	53.1	52
1932	0	0	0	0	66.0	62.0	149.6	199.4	206.2	21.0	0	0	705.6	58.8	49
1933	0	0.5	0	32.0	64.0	190.3	144.0	245.6	171.5	0	3.3	0	851.2	70.9	63
1934	0	0	0	4.1	199.3	52.6	156.5	368.8	41.7	0.0	0	0	723.9	60.3	53
1935	0	0	0	0	71.1	119.6	160.0	345.7	198.4	8.9	0	0	903.7	75.3	52
1936	0	0	0	10.6	40.1	46.2	222.4	265.9	205.2	7.1	0	0	697.6	58.1	52
1937	0	0	0	0	140.5	151.6	184.2	273.1	88.4	0	0	0	837.7	69.8	41
1938	0	0	0	0	31.8	49.0	310.4	335.5	90.2	0	0	0	816.9	68.1	62
1939	0	0	0	26.7	89.9	125.5	278.3	233.4	207.0	3.8	0	0	864.6	72.1	71
1940	0	0	0	1.5	89.9	125.5	178.3	233.4	207.0	3.8	0	0	839.5	70.0	58
1941	0	0	0	25.7	62.2	117.1	239.3	120.7	19.3	0	0	0	584.2	48.7	57
1942	0	0	0	0	73.4	22.6	278.9	214.4	43.2	2.5	0	0	635.0	52.9	58
1943	0	0	0	0	26.4	130.1	85.1	249.2	316.2	2.5	0	0	809.5	67.5	

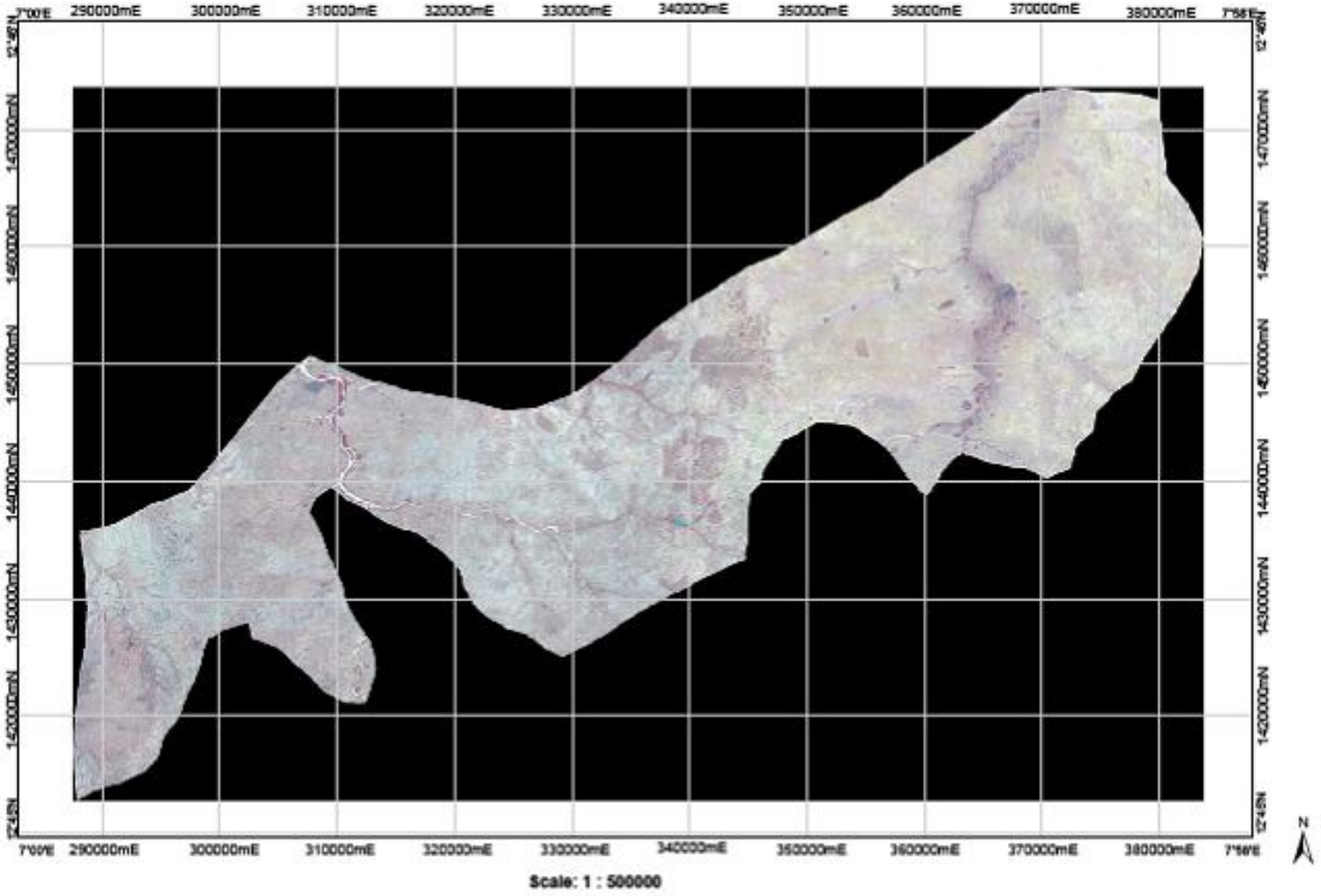
1944	0	0	0	0	4.3	1.0	57.1	122.9	170.7	89.2	20.1	0	465.3	38.8	
1945	0	0	0	5.6	29.5	113.8	271.0	375.9	127.0	11.4	0	0	934.2	77.9	
1946	0	0	0	3.6	79.8	63.5	240.8	193.6	23.6	0	0	759.0	63.2	72	
1947													662.0		
1948													772.0		
1949	0	0	0	0	38.4	63.0	182.1	119.9	103.1		0	0	506.5		
1950	0	0	0	0	17.5	40.6	201.9	305.6	189.1	10.4		0	765.1		57
1951	0	0	0	0	42.4	86.6	139.5	204.7	122.4	18.5	0	0	614.2	51.2	56
1952	0	0	0	0	58.2	34.5	159.8	284.7	210.3	65.3	0	0	812.8	67.7	66
1953	0	0	0	0	126.5	151.4	151.9	199.4	180.6	96.3	0	0	908.0	75.7	67
1954	0	0	0	0	76.7	78.2	78.2	275.8	357.6	113.5	0.5	0	980.7	81.7	54
1955	1.8	0	1.8	5.3	31.5	42.3	42.3	159.5	272.3	130.3	3.3	0			
1956	0	0	1.3	0	0	55.1	35.1	307.9	260.2	141.7	0	0	801.2	66.8	54
1957	0	0	0	0	82.6	80.8		184.7	419.1	134.6	22.4	0	928		64
1958	0	0	0	0	0	138.2		225.1	409.9	93.7			866		53
1959	0.8	0.8	0.8	2.5	59.2	40.6		214.9	228.1	198.9			973		65
1960	0	0	0	8.1	26.4	83.3		208.0	323.1	198.9			702.8		61
1961	0	0	0	1.3	3.6	114.6		126.2	410.2	114.8	0	0	401.7		61
1962	0	0	0	11.7	58.5			205.2	177.8	123.4	11.7	11.7	540		58
1963	0	0	0	0	3.8	99.1		278.4	255.0	88.9	0	0	725.2		61
1964	0	0	0	0.5	80.3	141.7		334.5	322.8	113.8	0	0	993.6		59
1965	0	0.3	0	1.8	23.6	162.1		139.4	310.1	101.3	0	0	738		53
1966													730		
1967													802		
1968													442		
1969	0	0	0	0	17.8	45.2	99.1	200.7	81.3	10.7	0	0	454.8		53
1970	0	0	0	0	23.6	23.6	198.6	318.7	142.5	0.8	0	0	707.8	37.9	53

1971	0	0	0	0	55.9	16.5	94.0	316.7	71.9	0	0	0	555.0	59.0	
1972	0	0	0	11.2	34.0	122.9	117.3	148.6	40.6	0	0	0	474.6	46.3	51
1973	0	0	0	0	0	39.9	94.7	235.2	70.6	0.5	0	0	440.9	39.6	37
1974	0	0	0	0	51.6	53.6	136.7	261.1	116.1	11.4	0	0	630.9	36.7	38
1975	0	0	0	0	79.0	31.0	176.8	183.4	93.7	0	0	0	553.9	52.6	55
1976	0	0	0	0	20.3	67.6	69.6	172.2	174.2	64.0	0	0	567.9	47.0	50
1977	0	0	0	0	10.2	54.2	168.3	276.8	87.5	0	0	0	597.0	47.3	47
1978	0	0	0	0.6	16.2	62.3	187.5	111.8	111.5	36.1	0	0	526.0	49.8	47
1979	0	0	0	7.2	30.2	111.0	297.2	249.3	81.4	0	0	0	776.3	43.8	47
1980	0	0	0	0	78.2	66.7	341.0	202.4	58.2	26.9	0	0	773.4	64.7	47
1981	0	0	0	11.0	37.5	78.5	186.0	1128.7	113.1	0	0	0	554.8	46.2	47
1982	0	0	0	1.6	14.5	97.4	129.8	213.7	26.1	12.3	0	0	495.4	41.3	43
1983	0	0	0	0.4	113.1	109.4	101.1	101.2	0	0	0	0	425.2	35.4	
1984	0	0	0	0	16.4	81.6	131.4	76.4	68.1	16.1	0	0	390.0	32.5	
1985	0	0	11.2	0	33.7	77.2	98.8	123.1	73.0	0	0	0	417.0	34.8	
1986	0	0	0	0	0.4	3.4	318.1	177.4	64.5	0	0	0	563.8	47.0	
1987	0	0	1.0	0	1.0	16.2	41.5	107.5	149.7	83.4	0	0	399.3	33.3	37
1988	0	0	0	15.3	6.4	120.7	103.9	244.7	193.1	0	0	0	684.1	57.0	52
1989	0	0	0	0	2.9	79.8	151.3	24.7.7	66.4	0	0	0	548.1	45.7	38
1990	0	0	0	0	29.9	57.9	198.8	220.2	34.7	0	0	0	541.5	45.1	41
1991	0	0	10.8	12.2	73.5	58.8	71.5	108.3	21.1	01.4	0	0	357.6		
1992	0	0	0	0	33.6	19.9	82.3	119.4	70.7	0	0	0	332		
1993	0	0	0	0	4.5	42.3	69.0	94.5	51.7	0	0	0	262		
1994	0	0	0	3.1	12.3	42.3.	107.9	174.2	113.1	20.3	0	0	473.2		
1995	0	0	0	12.6	7.7	60.6	149.8	129.4	70.0	1.0	0	0	431.1		
1996	0	0	0	0	42.6	44.5	38.1	66.8	67.8	0	0	0	259.8		
1997	0	0	7.2	9.5	89.5	30.4	91.1	153.7	56.5	0	0	0	437.9		

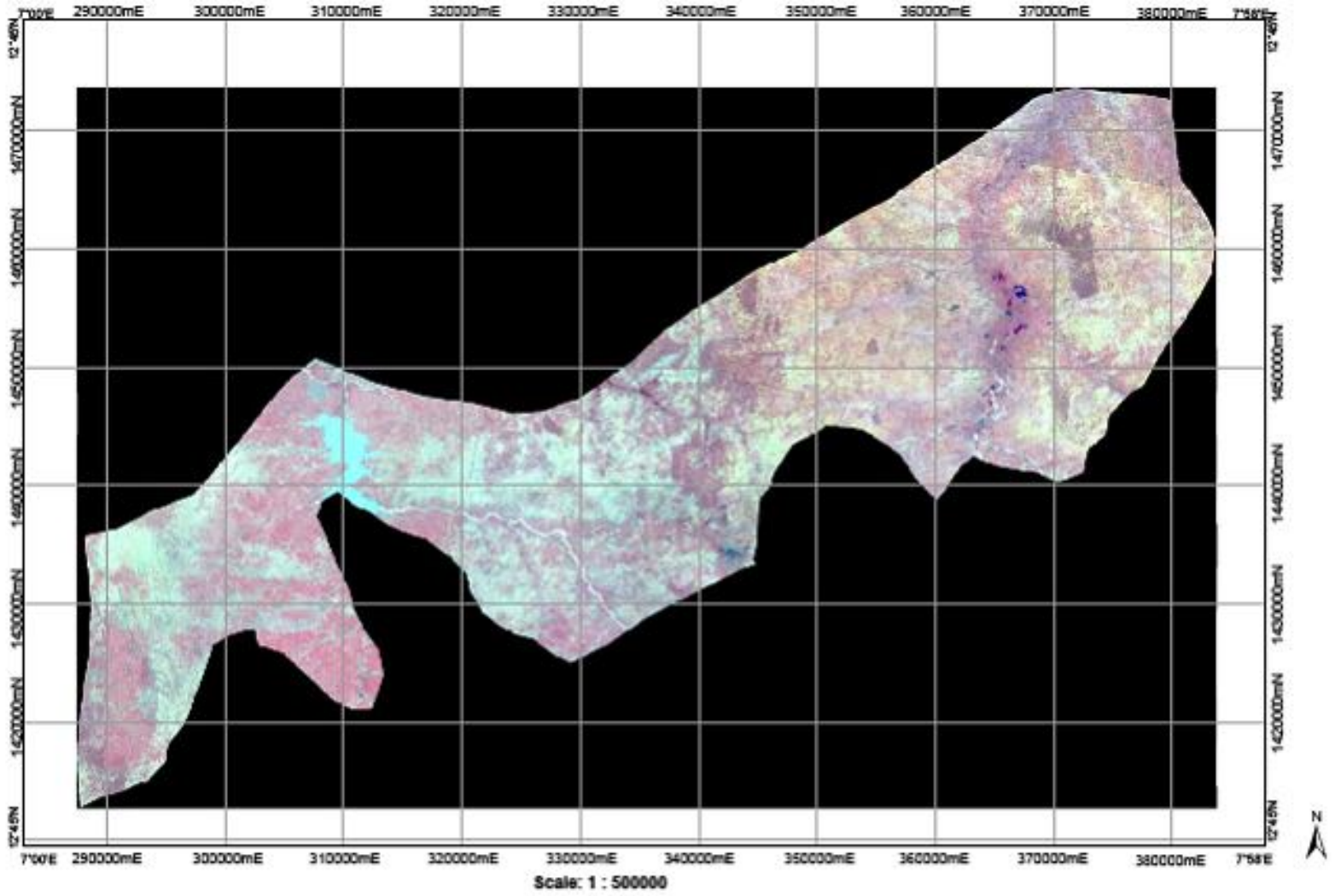
1998	0	0	0	10.1	11.4	43.4	114.1	116.6	135.2	10.8	0	0	431.6		
1999	0	0	0	0	4.2	22.4	149.2	89.8	102.3	18.4	0	0	416.3		
2000	0	0	0	0	1.6	106.8	299.9	160.2	63.1	45.0	0	0	676.6		
2001	0	0	0	16.9	83.9	110.8	176.0	240.9	70.6	0	0	0	699.1		
2002	0	0	0	0	2.9	141.3	170.4	149.7	199.1	62.8	0	0	726.2		
2003	0	0	0	4.0	52.8	57.2	118.2	275.5	75.5	16.4	0	0	605.6		
2004	0	0	0	0	74.90	151.2	161.1	268.8	42.0	0	0	0	698		
2005	0	0	0	14.8	18.4	83.2	173.7	216.1	194.0	26.4	0	0	726.6		
2006	0	0	0	0	26.1	69.9	155.8	314.9	129.76	15.0	0	0	711.4		
2007	0	0	0	6.2	84.9	135.2	117.4	314.9	45.9	0	0	0	704.1		
2008	0	0	0	16.6	8.5	63.3	182.9	213.9	67.7	4.2	0	0	558.1		
2009	0	0	0	0	95.0	57.9	96.5	123.3	38.3	28.9	0	0	439.9		



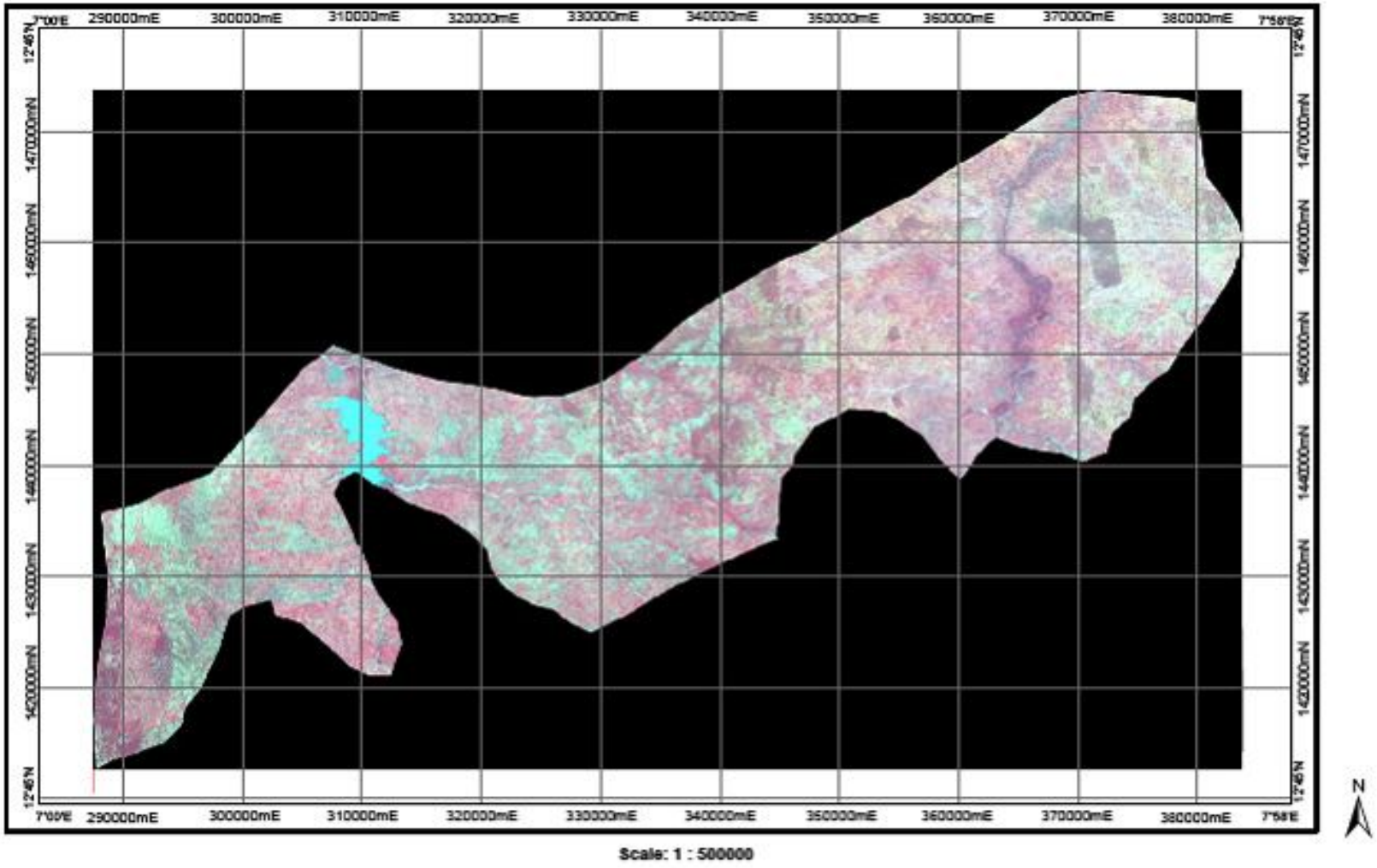
Jibia and Kaita Local Government Areas of Katsina State (Landsat MSS 1976)



Jibia and Kaita Local Government Areas of Katsina State (Landsat TM 1987)



Jibia and Kaita Local Government Areas of Katsina State (SPOT XS 1995)



Jibia and Kaita Local Government Areas of Katsina State (Landsat ETM 2006)