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ESTABLISHING THE RATES OF DEFORESTATION USING GIS AND REMOTE SENSING TOOLS IN SHENDAM DISTRICT, PLATEAU STATE, NIGERIA

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ABSTRACT
This study presents an estimate of deforestation rates in Shendam district, geographically located at latitude 8º53'43.88"N and longitude 9º27'13.41"S, in Shendam Local Government Area of Plateau State, Nigeria. The study was carried out using Geographic Information System (GIS) tools/ Remote Sensing Applications and field observation to establish the rates and extend of forest resources depletion within the study area. The Center for Remote Sensing, Jos, Plateau State, generated the Land use Cover Data for the years, 1994, 2004, 2014,using Landsat Thematic Mapper (TM) at 30m Resolution. The results from (1994-2014) shows 173.3 hectares of forest lost and (2004-2014) shows 128.3 hectares of forest cover lost annually. In1994, the vegetation cover of the study area was characterized by forest (39.3%), shrubs (31.9%), farmlands (20.8%) and built-up area had (8.0%) which implies that there was less farming activity in the study area at that time. In 2014, however, forest cover decreased to 11.2%, shrubs reduced to 25.6% farmlands increased to 38.1%, while built-up area rose to 25.1%. This indicates an increase in human settlement and farming activities in shendam district. The following recommendations were offered: Afforestation policy should be reviewed to strengthened forest management and Social investment programmes should be introduced to empower the less privileged. The policy of cut one-plant five trees initiative should be embraced for the purpose of environmental sustainability in Shendam District.
KEYWORDS: Deforestation, GIS and Remote Sensing, Settlement, Sustainability

1.0 INTRODUCTION

Generally, deforestation is the process of cutting down or removal of trees in an area without replacement or without any intention of re-planting. Forestation refers to planting new trees to replace the trees that have been cut down due to activities like farming, fuel wood collection and construction. The anthropogenic activities of humans are factors rapidly depleting trees and there by affecting the land's protective and regenerative capabilities. According to Lee (2002), deforestation accounts for approximately 30 percent of the atmospheric buildup of carbon dioxide over the past century, and rainforests are being depleted by approximately 160,000 square kilometers annually.

The concept of sustainability ensures using the earth's natural resources in providing the needs of the present generation without compromising the needs of the future generations. The rapid increase of Nigerian future population, still poses problems as more pressure will be on the available trees in the environment due to increasing housing constructions, fuel wood and farming activities among others. Other States in Nigeria are facing similar consequences of deforestation and this need to be addressed through sustainable measures.

Landuse, land cover and its pattern of change is a major element that is very important in the history of global expansion and landuse cover change (LUCC) with its impacts on the environment has been one of the increasing focus of global changes (Chase et al., 2000). Over the past years, data from Earth sensing satellites has become vital in mapping the Earth's features and infrastructures, managing natural resources and studying environmental change, Bankole (2011). The collection and use of remotely sensed data facilitates the analyses of Earth - system function, patterning, and changes at the local, regional and global scales. Such data also provide an important link between intensive, localized ecological research, regional, national and international conservation / management of biological diversity (Wilkie and Finn,1996).

However, this study focused on establishing the rates of deforestation in Shendam District and its environs, using Geographic Information Systems and Remote sensing Applications. Since the creation of Shendam L.G.A in 1976, there has been continuous cutting of trees in Shendam L.G.A most especially Shendam District where the deforestation activities are being carried out by the inhabitants. The few existing species of trees and animals in the environment will soon be extinct entirety, if necessary measures are not taken. The issues of deforestation in

Shendam District calls for a great concern from Government, Environmentalists, Institutions and Stakeholders for sustainable mitigation measures in Shendam L.G.A and other parts of Plateau State.

1.1 AIM AND OBJECTIVES OF THE STUDY

The aim of the study is establish the rates and extend of deforestation in Shendam District using GIS and Remote Sensing. The specific objectives were to:

i. Examine the major causes and effects of deforestation in Shendam District.
ii. Outline the Significance of Forest Conservation
iii. Establish the rates of deforestation in Shendam District using GIS/RS tools.

1.2 DATA ANALYSIS

Personal observation and the use of Geographic Information Systems and Remote Sensing Applications were used in conducting this study to establish the rate of deforestation in the study area. The remote sensing information was obtained from the Center for Remote Sensing, Jos, Plateau State using a Landsat Thematic Mapper (TM) 30 meter Resolution in obtaining the Land use Cover Data for the years, 1994, 2004, 2014 at ten years interval.

2.0 CONCEPT OF THE STUDY

2.1 Causes of Deforestation

The deforestation taking place in the African rainforests has many causes, including logging, which is responsible for 20 to 25 percent of the deforestation, cattle ranching, cash crops, construction, population growth, economic development, clearing for cultivation, and by government policy (Branson, 2003).

2.1.1 Land Cover Changes

Land cover changes may occur due to various factors, which may be broadly divided into natural and human induced or anthropogenic causes. United States Environmental Protection Agency (EPA, 1999 report), identified the general causes of land use and land cover changes, which are: (1) natural processes, such as climate and atmospheric changes, wildfire, and pest infestation; (2) direct effects of human activity, such as deforestation and road-building; and (3) indirect effects of human activity, such as water diversion leading to lowering of the water table. Even though, natural processes may also contribute to changes in land cover, the major driving force is human induced land uses (Allen and Barnes, 1985). These human induced causes of land cover change, which are critical and currently increasing in alarming rate; and can be categorized into two broad divisions: proximate and driving causes. The proximate causes leads to immediate land cover change; while driving causes are the drives behind the immediate causes.

2.1.2 Farming: Population growth in developing countries during the 1970s and 1980s led to substantial encroachment on forests throughout the tropics (Hiemstra-van derHorst and Hovorka 2009). For most regions of the world large commodity agriculture is the major driver of tropical deforestation. About 60 percent of deforestation in Africa is due to conversions of subsistence to commercial agricultural lands.

2.1.3 Fuel Wood Collection

In Africa, 90 percent of the population uses wood for fuel. Wood is used in Africa for 52 percent of all energy sources. The deforestation in Africa is a major contributor to global warming, erosion, annual flooding and medicinal compound/food shortage in Africa (Branson, 2003). Joel (1991) stated that forest plays a significant role in the overall balance of carbon content in the atmosphere and forest carbon sequestration can reduce the accumulation of green house gases in the atmosphere. In the West Africa sub-region: in Nigeria, Togo, Zambia, Tanzania and Uganda, several cases of illegal exploitation of wood and forest products have been reported (Uchegbu, 2002). (Plates 2.1, 2.2, 2.3, and 2.4).

Beginning in the mid-1990s, however, researchers began to study the “fuel wood crisis” and discovered that for the most part of the world. Although fuel wood is part of the major drivers of deforestation on a global scale, it can have significant effects at the local level (FAO 2010). Fuels wood have long been a major source of energy and are expected to remain so for some time. Fuel wood use is expected to remain relatively level over the next 20 years. The increase in charcoal demand correlates with the expected increase in urbanization, as urban dwellers use charcoal more than rural people.

Plate 2.1 Participation of men in Deforestation **Source:** (Bernice, 2011)

Plate 2.2. Women from African Rift Valley, Kenya. (Source- Girard 2002)

Plate 2.3. Fuel wood collection in Basankusu, Democratic Republic of Congo

(Source- Girard 2002)

Plate 2.4. Gbagyi women of Abuja, Nigeria (Source: Jim, 2013)

In Nigeria, the situation relating to deforestation looks pathetic as the most vulnerable groups in the society (female/poor solely depend on the forests for the supply of their fuel wood (Hagan, 2006). Ocholi (2007) described the condition as a form of drawback with pronounced consequences on future generation.

2.2. Effects of Deforestation

Deforestation is among the global environmental challenges affecting the whole world and it requires concerted responses from the international community to address such problems that is affecting every nation and causing a serious adverse long term effect on the lives and health of the populations. The eradication of millions of species and the depletion of the rainforest is occurring at such a rapid rate that scientists predict that 42 percent of the region will be totally deforested by 2020 (Roads, 2001). Disregard of ascribed value, careless forest management and deficient environmental laws are some of the factors that allow deforestation to occur on a large scale. In many countries, deforestation, both naturally occurring and human induced, is an ongoing issue. Deforestation causes extinction, changes to climatic conditions, desertification, and displacement of populations as observed by current conditions and in the past through the fossil record. More than half of all plant and land animal species in the world live in tropical forests. The tropical rainforests are the most diverse ecosystems on Earth and about 80% of the world's known biodiversity could be found in tropical rainforests, removal or destruction of significant areas of forest cover has resulted in a degraded environment with reduced biodiversity. (Marlon Henkel, 2015).

2.3. Significance of Forest Conservation

2.3.1 Medicine: The resources of the Amazon include the tree and animal life. The plants of the Amazon have provided greatly in terms of medicinal compounds, and are expected to contribute far more in the future, and the possibility of getting life-saving compounds for cancer, Acquired Immune Deficiency Syndrome (AIDS) and Ebola. **2.3.2 Temperature Regulation:** Trees play a vital role in regulating our atmosphere, ecosystem and weather systems and they recycle carbon dioxide and the accumulation of carbon dioxide in the atmosphere contributes to global warming. The trees help in releasing moisture to the air regulating local and global climate which also contributes to rainfall The greatest resource of the Amazon rain forest is its contribution to the world's oxygen supply. Forest burning by itself contributes 20 percent of the carbon dioxide in the atmosphere, resulting to global warming (Richard, 2007).

Forests conservation is very important and it plays a significant role in the ecosystem as different species of plants and animals use them as habitats. In the People's Republic of China, where large scale destruction of forests has occurred, the government has in the past required that every able-bodied citizen between the ages of 11 and 60 plant three to five trees per year or do the equivalent amount of work in other forest services. The government claims that at least 1 billion trees have been planted in China every year since 1982, and March 12 of every year in China is the Planting Holiday. (Chaitanya, 2009). Forests also serve as green frontier for mankind since creation. The trees also nurture traditional cultures by giving shelter, food, wood, medicine, reduced soil compaction and improves soil fertility. These benefits are lost when the trees are destroyed.

3.0 THE STUDY AREA AND METHODOLOGY

3.1 THE STUDY AREA AND LOCATION

The creation of Plateau State in 1967, paved way for the creation of Shendam L.G.A and other Local Government Areas within the State in 1976. Shendam is a district in Shendam L.G.A and is geographical location of Shendam District is between latitude 8º53'43.88"N and longitude 9º27'13 of the meridian covering about 123.35 Km² (12,335 Hectares), out of 2,477 Km² (247,700 Hectares) of the entire Shendam L.G.A. The Shendam L.G.A shares boundaries with Qua'an Pan Local L.G.A to the West, Mikang L.G.A. to the North and Langtang South L.G.A to the East. It also shares boundaries with Ibi L.G.A of Taraba State, and Awe L.G.A of Nasarawa State to the South and South West respectively. The natives of Shendam are the Goemai who originated from the Kwararafa Kingdom of Taraba State. According to the 2006 population census Shendam L.G.A has a total population of 208,017 (109,519 males and 97,498 female) about 2.27% of Nigerian population. Shendam Local Government is under the ruling of the Long Goemai (Chief) who has four districts under his jurisdiction namely; Shendam District, Dorok District, Derteng District and Dokan Tofa Districts. The Shendam District (study area) has three wards namely Shendam Ward A, Shendam Ward B and Pangwasa Ward, all with a population of 61,310 (2006 NPC). (Figures 3.1, 3.2, 3.3 and 3.4).

Figure 3.1 Nigeria showing Plateau State (Latitude 10º 00' N, Longitude 8º 00' E)
Source: Plateau State Ministry of Lands and Survey, 2014

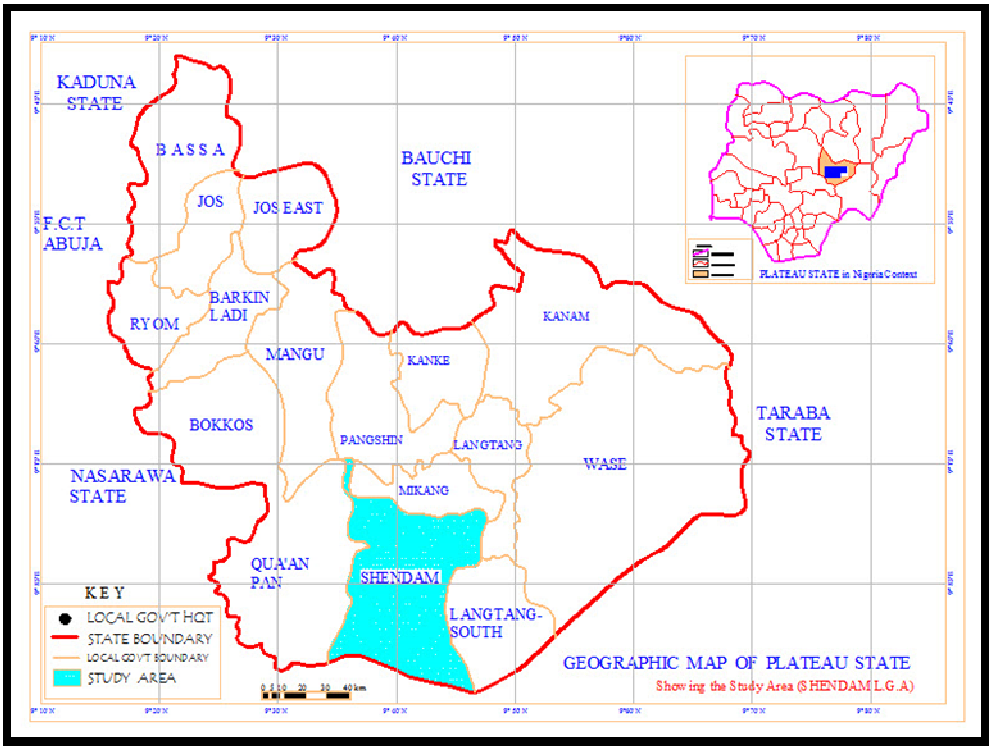

Figure 3.2 Plateau State showing Shendam L.G.A (Lat. 9º 10' 0"N , Long. 9º 45' 0" E)
Source: Plateau State Ministry of Lands and Survey, 2014

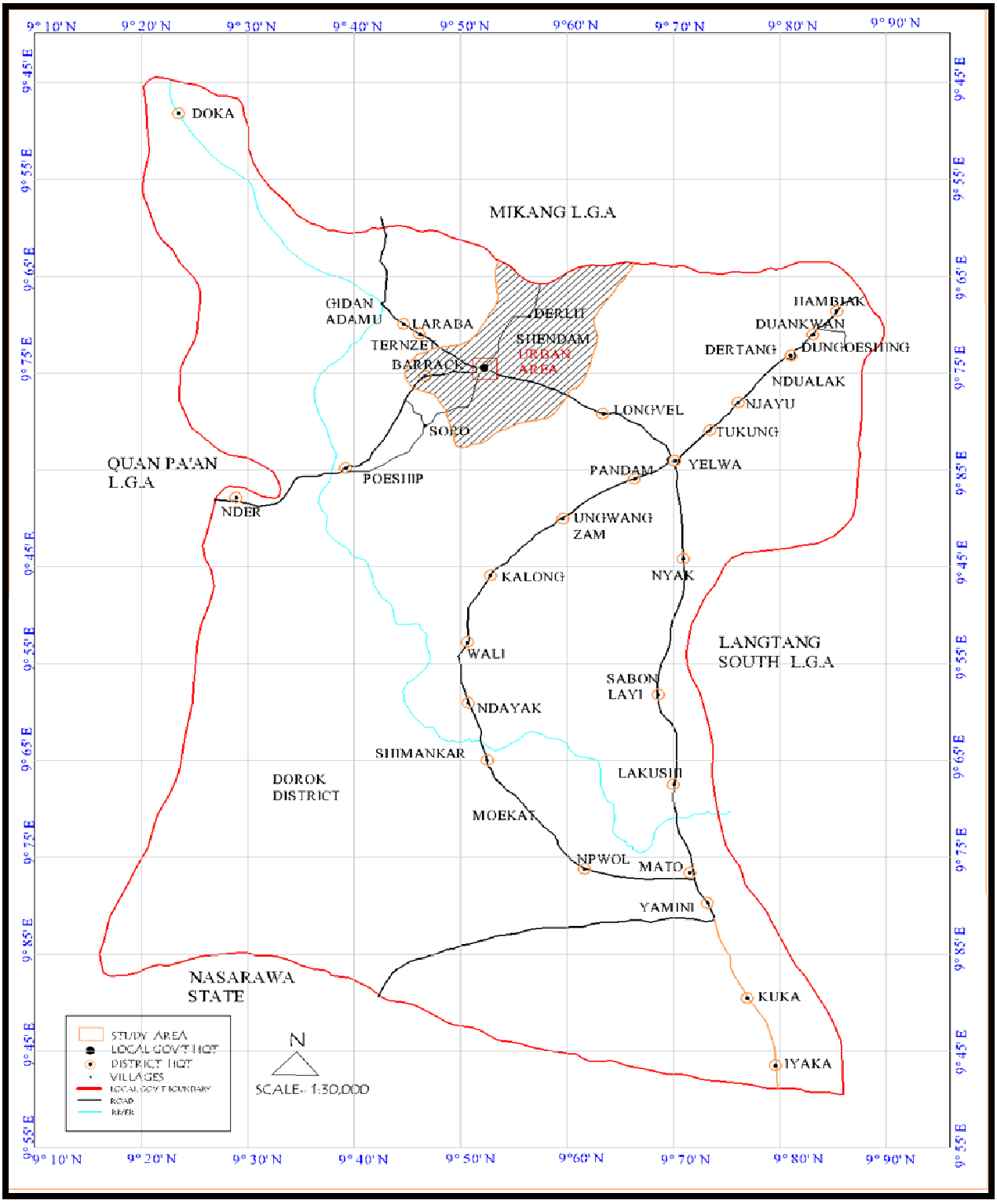

Figure 3.3 Shendam L.G.A **showing Shendam District**
(lat. 8º53'43.88"N, long. 9º27'13.41" E)
Source: Plateau State Ministry of Lands and Survey, 2014

3.1.1 TOPOGRAPHY

Plateau State has an elevation of about 1500m – 1800m which descends gradually in a series of steps to the low land area of plateau where the study area is located within the plains of River Benue. The terrain is relatively flat

with few dispersed mountains. (Source: Uriah, Ezekiel, Tochukwu & Jesse 2014). The basement rocks are granite, basalt and magmatides, found at 1702 metres deep below the ground surface. Other are sedimentary and metamorphic rocks and the ground level contains water (Aquifer). The soil are ferruginous soils (ferrisols), gravel and sandy loamy soils which is suitable for construction and Agriculture. (Source: Lar Uriah et al. 2014).

3.1.2 CLIMATE

The harmattan period (dry and dusty season) blowing from Sahara Desert from the month of November to March. The wet season (rainy season) starts from the month of March to the month of October. Shendam has an annual rainfall variation between 1000mm to 1450mm with an annual mean of 1250mm. The rainy season peak is in the month of August and September (Source: http://en.climate-data.org/location/399975/).

Plate 3.1- Huge Hectares of forest Land cleared by farmers in Shendam.
Source: (Field Survey 2014)

3.1.3 TEMPERATURE

The highest mean temperature is in the month of March with an average daily maximum temperature of 36º C. The study area is characterized with abundant sunshine and the lowest temperature is from the month of November to January with an overall annual mean of 23 º C. (Source: http://en.climate-data.org/location/399975/).

3.1.4 VEGETATION

Shendam District is within the southern guinea savanna that characterized with dispersed vegetation and relatively uniform carpet of tall grasses, scattered trees, shrubs, oil bean trees, shear butter, locust bean and baobab trees. Many trees shed their leaves but quickly regain their bush appearance at the commencement of wet season. The issue of bush burning is also common. The vegetation of Shendam District and environs is characterized by presence of tall grasses, scattered deciduous tall trees with broad leaves and the trees sheds their leaves during dry season. Forests are still found along streams and low lying areas in which surface water accumulates, such places are usually called Fadama low land. (Ogezi A.E, T. Aga, and I. Okafor , 2010). Plate 3.1

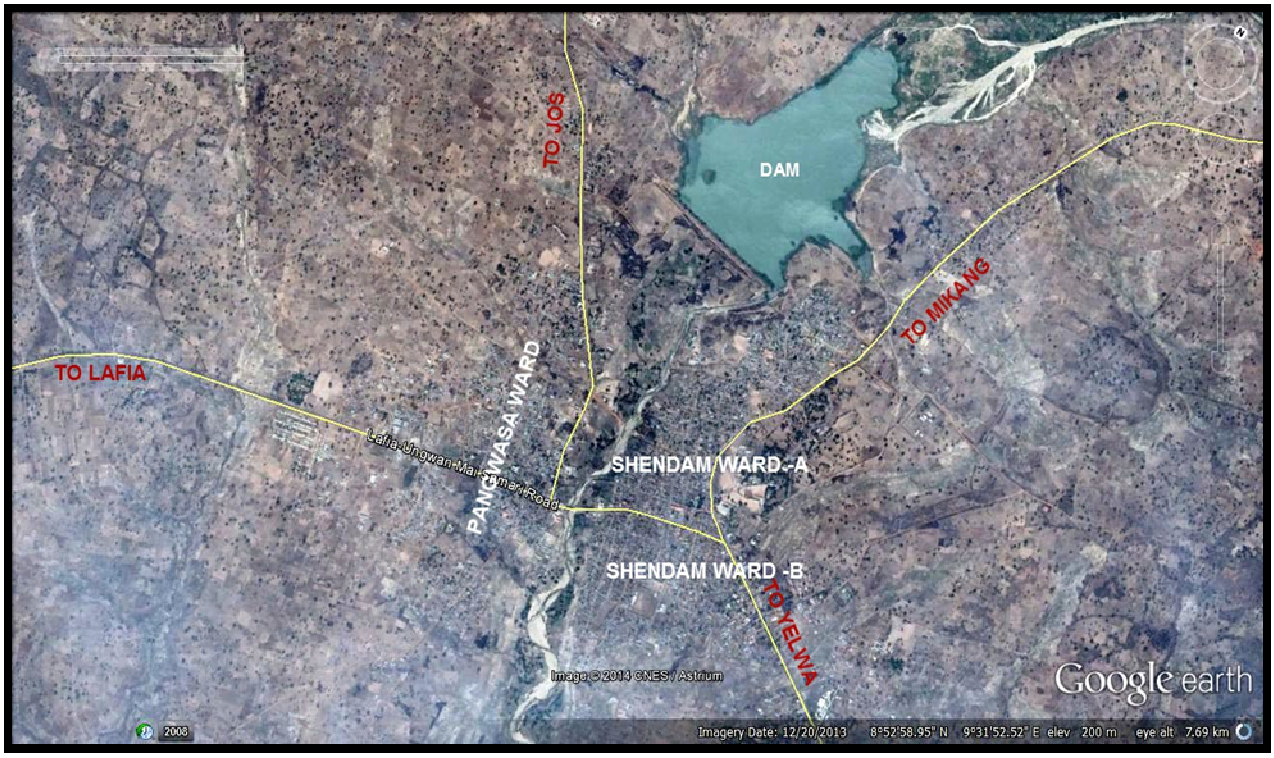

Figure 3.4 Satellite imagery of Shendam District **Source:** Google Earth (2014)

3.2.0 METHODOLOGY OF THE STUDY

3.2.1 Primary Sources of Data

Three sets of satellite raw imagery of Shendam District for 1994, 2004 and 2014 were acquired from the National Center for Remote Sensing Jos using Land-sat Thematic Mapper at 30 meter Resolution.
Table 3.1 Land -sat Data for 1994, 2004 2014

Data type	Data Resolution	Date
Landsat 7	30 Meter Resolution	08/09/1994
Landsat 7	30 Meter Resolution	14/06/2004
Landsat 8	30 Meter Resolution	05/03/2014

Source: Center for Remote Sensing Jos (CRS) 2014

3.2.2 Secondary Sources of Data

The secondary sources involved review of literature, published/ unpublished dissertation, Journal publications, Google earth, internet, population data and base maps.

3.2.3 Software used for the Study

The software used for this study involves Global Positioning System (GPS), Geographic Information System and Remote Sensing Applications tools/ softwares such as ArcGis 10.0, ILWIS 9.3, ERDAS Imagine 9.1, IDRISI Andes, Global Mapper, Snagit 10.0, Microsoft word and Excel.

3.2.4 Data Presentation and Analyses

The data are presented in histograms, bar charts, figures, plates, imageries and tables using descriptive method of statistics.

3.2.5 Population of Shendam L.G.A and Estimation for 2014

The study involves the use of population data for 2006 NPC Population (61,310 at Growth Rate 3.0%) as the base year population for year 2006 to obtain the estimated population for 2014 of Shendam District.

Population Projection formula $P2 = P1 (1+r)^n$

(Source: Jennifer H. L. et al. 2007)

P1 (Previous year population) = 61,310 (2006 NPC)

P2 (Present year Population) =? (2014)

r (Growth Rate) = 3.0%

n (Number of years) = 8 years (2006 – 2014)

$P2 = P1 (1+ r)^n$

$P2 = 61,310 (1+ 0.03)^8$

P2 = 61,310 x 1.26677008139

P2 = 77,665 Approx. Projected Population 2014.

4.0 RESULT AND DISCUSSION

The three set of imageries for 1994, 2004 and 2014 were used and analyzed using time series analysis to establish the rate of changes over time in Shendam District.

4.1 RATE OF DEFORESTATION IN THE STUDY AREA

The indiscriminate cutting down of trees in Shendam District and its environs without any effective tree management policy or regulations to control the human activities in the study area, has destroyed a lot of tree species making the area prone to erosion. Landuse Cover Map of Shendam District from 1994, 2004 and 2014 using Geographic Information Systems (GIS) and Remote Sensing Applications was carried out to estimate the rate of deforestation in Shendam. From the analysis, about 173.3 hectares of forest is lost annually (1994 - 2014) in Shendam District and its environs (Figures 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7 and 4.8).

4.1.1 LANDUSE COVER ANALYSIS OF SHENDAM DISTRICT AND ENVIRONS.

Deforestation activities have been in existence over a long period of time in Shendam District but the rate of deforestation was minimal in those days. Figure 4.1 shows the Landuse Cover nature of Shendam District and its environs in 1994 through the use Landsat Thematic Mapper at 30m Resolution. The imagery shows that Shendam District was mostly covered with green representing forest (39.3%) and shrubs (31.9%), followed by farmlands (20.8%) scattered all over the Shendam District. Baresurfaces (0.0%) was not visible, the water body (4.8%) was much visible at the dam and was higher than the settlement (3.2%). During the period there were less farming activities, less construction and less population (Figure 4.2).

From the imagery of 2004 (Figure 4.3)shows decrease in the green colour signifying increase in deforestation, cutting down of trees for farming activities or farmland expansion and for fuel wood collection due to population increase and increase in demand. The landuse Analysis shows that forest has decreased to (21.6%) due to deforestation, waterbody decreased to (4.5%) due to evaporation and increased demand of water by the increasing population. The percentage increase was on shrubland (32.4%) The cleared trees creates way for shrubs grow and be visible (indicated in light green colours), Farmland also increased to (27.0%) due population increase and demand, Settlement increased to (5.2%) due to population increase and constructions, Baresurface increased significantly form (0.0% to 9.3%) due to infertile farmland that were left to regain its nutrients in the process known as shifting cultivation (Figure 4.4).

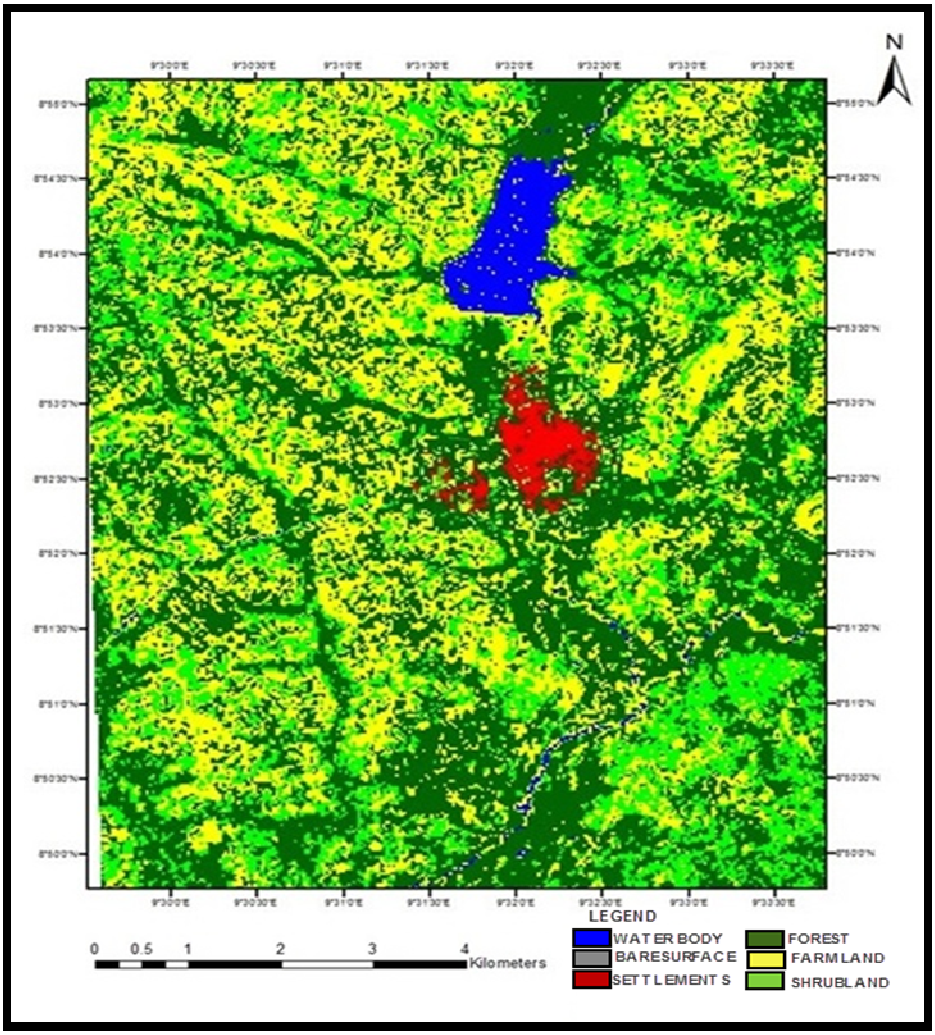

Figure 4.1 - 1994 Landuse Cover of Shendam District and its Environs
(**Source**: Center for Remote Sensing Jos, Plateau State 2014)

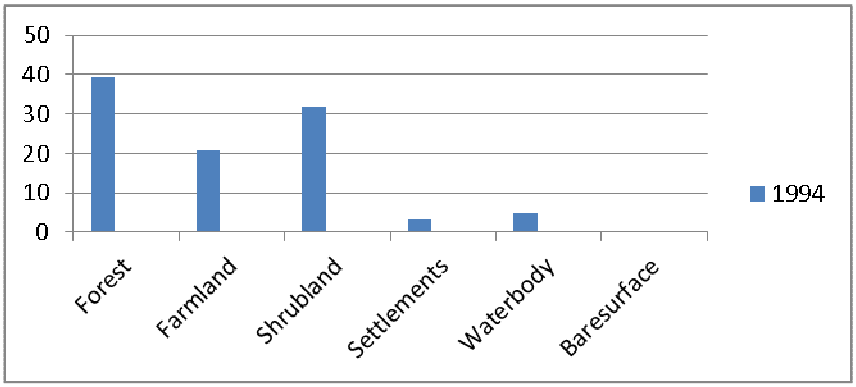

Figure 4.2 Landuse Analysis of Shendam District in 1994
(**Source**: Center for Remote Sensing Jos, Plateau State, 2014)

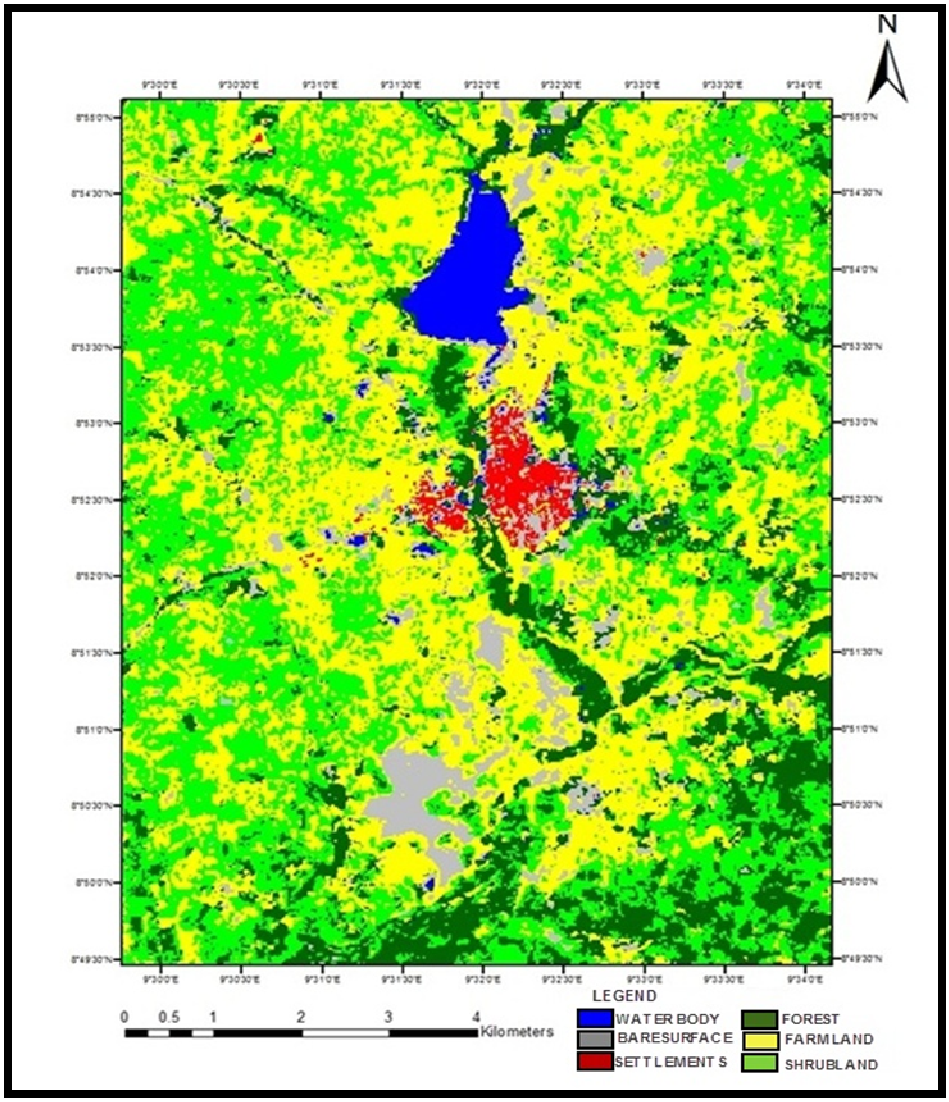

Figure 4.3 - 2004 Landuse Cover of Shendam District and its Environs
(**Source**: Center for Remote Sensing Jos, Plateau State, 2014)

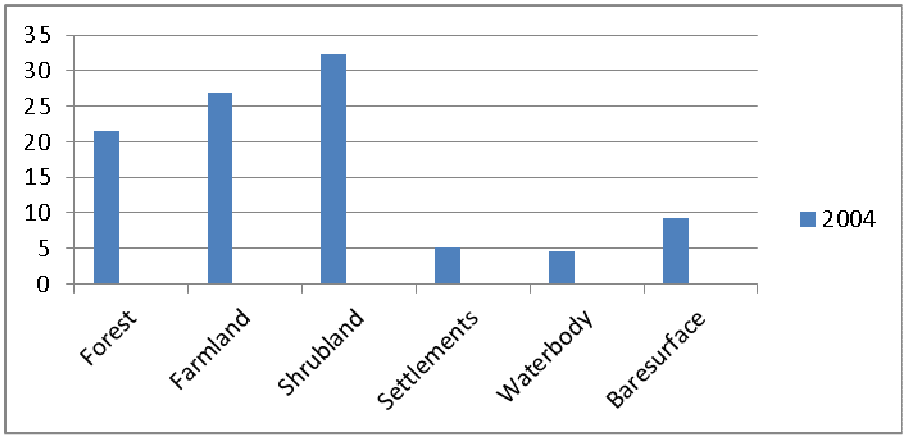

Figure 4.4 Landuse Analysis of Shendam District in 2004
(**Source:** Center for Remote Sensing Jos, Plateau State, 2014)

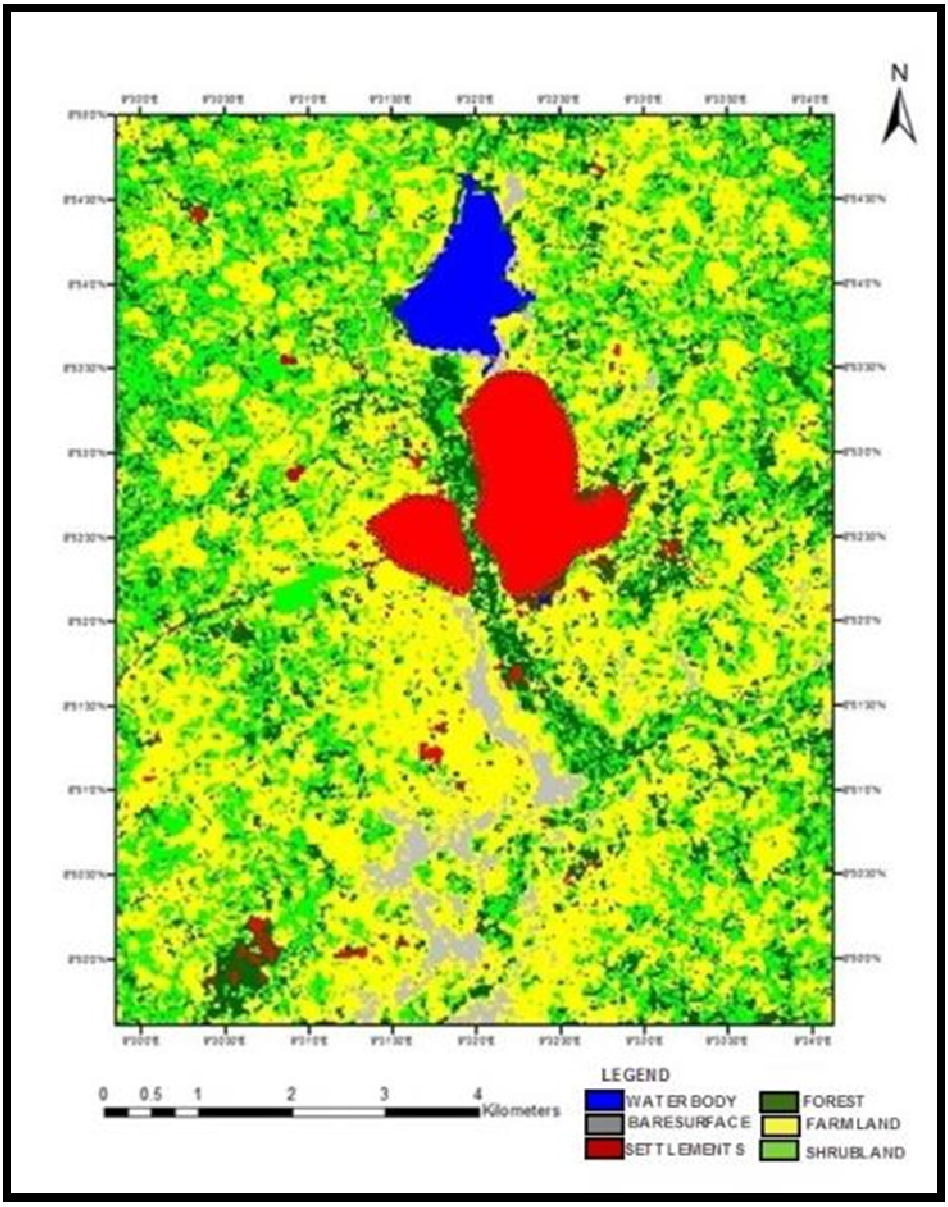

Figure 4.5 2014 Landuse Cover of Shendam District and its Environs
(**Source**- Center for Remote Sensing Jos, Plateau State, 2014)

The 2014 Landuse imagery (Figure 4.5)shows continuous decrease in the green from 1994 to 2014 signifying a high rate of deforestation in Shendam District and its environs. Forest decreased significantly to (11.2%) due to continuous and increasing rate of deforestation in Shendam District as a result of population increase (birth, migration), farming, fuel wood collection, unemployment, furniture works and construction (of houses, schools, office complexes, roads), (Figure 4.5 and 4.6). Farmland increased to (38.1%) due to population increase, the unemployed engaged in farming to earn income and migrants from upper Plateau come to Shendam District and engaged the farming activities through leasing, hired or borrowed farmlands.

Shrubland also decreased to (25.6%) due to farming and construction activities while the Settlement increased significantly within the short period due to population increase through birth, migration of people as a result of increased Government establishments / Transfer, increased Commercial activities which creates the needs for the construction of houses, offices and schools in Shendam District. Some settlements emerged over time and scattered all over Shendam District in the form of farmhouses, hamlets and small communities, represented with red colour on the imagery. The decrease in the waterbody was insignificant (4.3%) while the baresurface land also decreased to (7.5%) because some baresurface land scattered within the district regained their nutrients and allowed plants to grow while other baresurface land were part of construction land (Figure 4.5, 4.7 and Table

4.1).

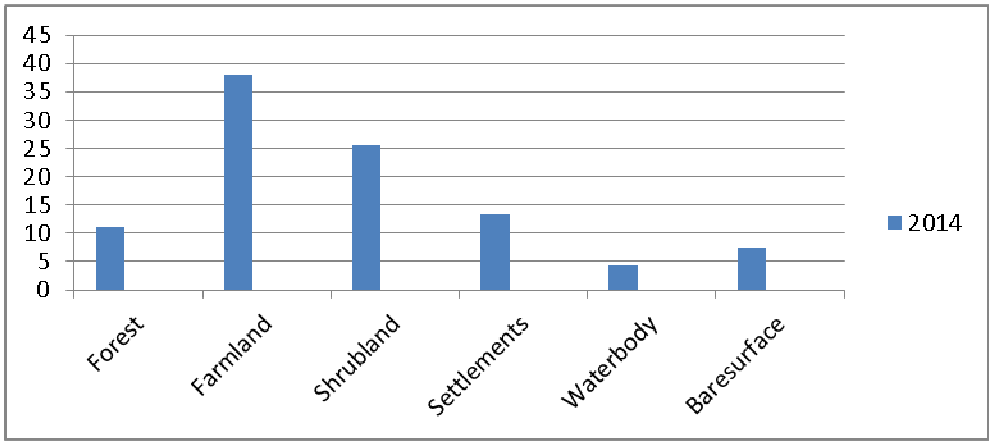

Figure 4.6 Landuse Analysis of Shendam District in 2014
(**Source:** Center for Remote Sensing Jos, Plateau State, 2014)

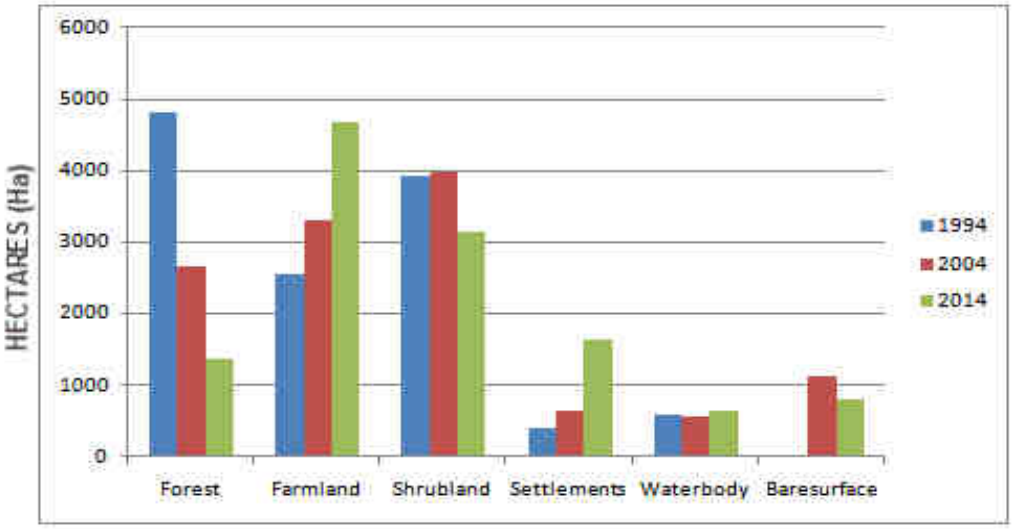

Figure 4.7 Shendam District General Landuse Analysis of 1994, 2004 and 2014.
(**Source:** Center for Remote Sensing Jos, Plateau State, 2014)

Table 4.1 Shendam District Landuse Analysis of 1994, 2004 and 2014

	1994		2004		2014	
Class Name	**Hectare**	%	**Hectare**	%	**Hectare**	%
Forest	4,847.7	39.3	2,664.3	21.6	1381.5	11.2
Farmland	2,565.7	20.8	3,330.5	27.0	4699.6	38.1
Shrubland	3,934.9	31.9	3996.5	32.4	3157.8	25.6
Settlements	394.7	3.2	641.4	5.2	1640.6	13.3
Waterbody	592.0	4.8	555.1	4.5	530.4	4.3
Baresurface	0.00	0.0	1147.2	9.3	925.1	7.5
Total	**12,335.00 Ha**	**100**	**12,335.00 Ha**	**100**	**12,335.00 Ha**	**100**

(**Source:** Center for Remote Sensing Jos, Plateau State, 2014)

4.2. CALCULATING THE RATE OF DEFORESTATION IN SHENDAM DISTRICT AND ITS ENVIRONS

More emphasis is given to forest, to get an estimate of forest lost in shendam and its environs from 1994-2004-2014 Landuse cover data.

Class Name	**1994**	**2004**	**2014**
Forest	4,847.7 (39.3%)	2,664.3 (21.6%)	1381.5 (11.2%)

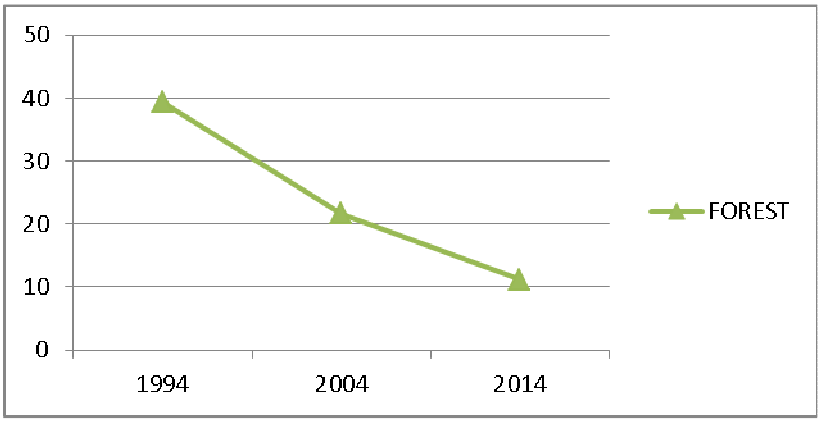

Figure 4.8 Forest Decrease in Shendam District from 1994 – 2004 - 2004
(**Source:** Center for Remote Sensing Jos, Plateau State, 2014)

1994 - 2004 = 4,847.7 Ha – 2,664.3 Ha = 2,183.4 ha divided by 10 years to arrived at 218.3 Ha lost annually within the period.
2004 – 2014= 2,664.3 Ha - 1,381.5 Ha = 1,282.8 Ha divided by 10 years to arrived at 128.3 Ha of forest lost annually within the period.
1994 – 2014= 4,847.7 Ha - 1,381.5 Ha = 3466.2 Ha divided by 20 years to arrived at 173.3 Ha of forest lost annually within the period.
(**Source:** Center for Remote Sensing Jos, Plateau State, 2014)

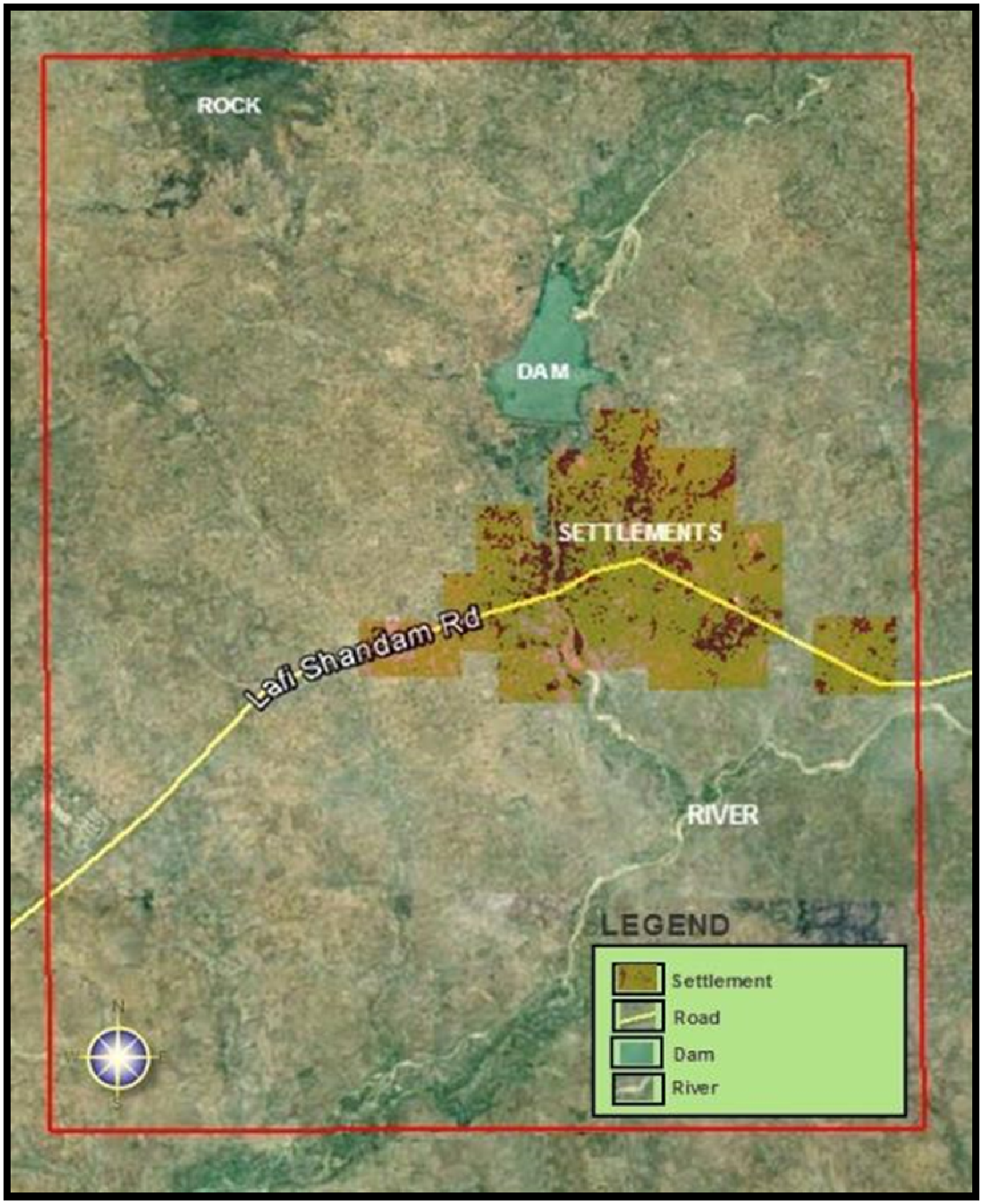

Figure 4.10 –The Study Area Showing the Scope and its Present Nature
(**Source**: Google Earth Satellite Imagery 2014)

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The Land Use Cover Map of Shendam District and its Environs from 1994-2004-2014, obtained from the Center for Remote Sensing revealed an approximated value of 128.3 hectares (2004 -2014) and 173.3 hectares (1994–2014) of forest lost annually, within the period. The process of deforestation in Shendam is continuous on daily basis, and the few scanty species of trees will soon be extinct if sustainable measures are not applied. Anthropogenic activities such as farming, construction and fuel wood collection are the main socio-economic depleting forest regeneration in shendam district, which are the factors are deeply rooted in the daily needs of the people. The irreversible loss of these natural resources and the ignorance of the effects of deforestation and consequences to the environment is more than the immediate social and economic gains.

5.2 RECOMMENDATIONS

there is need for sustainable measures to address means of livelihood, provision of alternative sources of energy, sustainable farming practices and good governance for the benefit of all the people in Shendam. Other sustainable measures are:

- Promote Rural/Urban Afforestation Programmes equipped financially to carry out tree planting and also educate the people on the significance of tree planting in the urban centers and villages. The policy of cut one tree- plant five trees should be enforced and rewards system for environmental services should be implemented.
- The governments should train/employ more staff in forest management and formulate policy measures on forest management.
- Entrepreneurship Initiatives Capacity Building for human empowerment such as training of artisans in skill acquisition of different trades, should reach the Local Government Areas/ villages for alternative means of livelihood.
- The government should provide stable electricity readily accessible and affordable by the community through public private partnership (PPP), as a drive to minimize the use of fuel wood.
- The natural environment should be used wisely and the natural resources should be protected and preserved for the future generation. The sustainable development guidelines, principles and strategies should be incorporated in the future Master Plan or National Development Programme.
- The Plateau State Government needs to expand the urban observatory for land information management system to cover; forest management, urban growth and flood monitoring in the Local Government Areas. The information on environment can be monitored or acquired remotely from the Local Government Areas.
- Plateau State should strengthen the enforcement capacities on forest protection law within its mandate to checkmate and regulate forest depletion. The forest law and regulations, made known to the general public with no exemption; that offenders will be fined and punished accordingly.

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