

LAND USE AND ITS IMPLICATION ON NATURAL ENVIRONMENT OF DONGA LGA, NIGERIA

Abstract:

The study assessed land use and land cover changes and its effect on the communities in southern Taraba specifically in Donga. The paper identify and delineate different LULC categories, evaluates the rate of change that occurred and examine the implication on incessant flooding using multi-temporal satellite imageries of two different time periods, i.e Landsat Thematic Mapper (TM) of 2000 and 2016 acquired from USGS sites. Area calculations of the arc GIS 10.1 software were used to derive the trends, rates, and magnitude of changes while map overlay was employed for assessing the nature and location change. The images of the study area were categorized into five different classes namely water body, built up, vegetation, bare land and rock outcrop. The implication of LULC change on flooding incidence in the study area was analyzed by an interaction with local communities through personal interaction with focus group. The results reveal that barely two decades, built- up and bare land have been increased by 4% (137.7021 km²), and 12% (409.8324 km²) while vegetation, water body and rock outcrop have decreased by 16% (541.1142 km²), 0.08% (2.5924 km²) and 0.1% (3.8279 km²) respectively. The analyzed imageries show that between the spaces of 16 years, the present built up area is fifth times of the capture in the year 2000 and that 16% of the vegetation cover has disappeared for other use. The understanding of the intricacy of nature and the influence of land use and land cover change on the farming community is of necessity, more especially as the climate change and the government look inward to divert from mono economy. The dependency on land and land cover could increase in order to get out of this present recession as agricultural sector top the recovering agenda in the Nation.

Keywords: Land Use/Land Cover, Deforestation, Encroachment, Flooding, Recession, Nigeria

1. Introduction

Human beings have been modifying land for her succor to obtain food, fuel and shelter and other essentials of life for thousands of years. The modification manifest in indiscriminate clearing of forest areas; shifting agriculture; forest and bush burning; cultivation of hill slopes without any anti-soil erosion measures; reckless housing site development; faulty road construction methods and indiscriminate quarrying which have been associated to flooding (Fernando, 2007). Naibbi et al. (2014) posited that, the vegetation of North-eastern Nigeria has been drastically reduced since the 1970s through the exploitation of natural forests for timber production or firewood and conversion to agricultural land. The observed pattern of change in land use has multifarious implications in these areas itself and the global environmental sustainability at large.

Understanding the complexity of Land Use and Land Cover (LULC) changes and their drivers at local level is essential to better understand the relationship between human and the environment (Bhawana, 2015). The land covers are natural resources, natural biofilters, and erosion stabilizers protecting the land from direct punch of rainfall there by reducing the sedimentation load that would have find their course unto the river resulting to ache to aquatic animals consequently leading to flooding. There is need to understand the biophysical and human causes of land use and land cover change, because land use and land cover pattern and dynamics affect the structure and function of the earth ecosystem (Hersperger et.al., 2010). It could lead to a decreased availability of different products and services for human, livestock, agricultural production and damage to the environment. Such changes also determine, in part, the vulnerability of places and people to climatic, economic or socio-political perturbations (Lambin and Geist, 2006). Other effect includes road submergence preventing easy transportation of goods and services. Still in this axis it was submitted that flooding as a result of Land use change could have link with Skirmish (Adelalu, 2012; Jack 2012).

Irrespective of location, erosion losses as a result of flooding are usually very small from forestland or permanent pastureland and reverse is the case when it is denuded. According to Bradshaw, (2007), factors contributing to the frequency and severity of flooding in an area include: Rainfall intensity and duration; antecedent moisture condition; changes in landscape resulting from wild fires, the existence of attenuating features, like levees and flood control channel; velocity of flow; availability of sediment for transport, and the erodibility of the bed and

banks of the water course; watershed conditions, such as steepness of terrain, soil types, amount of vegetation, and density of development.

In Nigeria, Adepoju et al. (2006) have assessed the land use/land cover change in Lagos for the period of 20 years due to rapid development. Zemba, (2016) analysed the land use and land cover dynamics in Jalingo with a view to highlight the implications on the existing arable lands and food security. Only few researches have been done on the effect of the surrounding LULC change has on local and regional precipitation and consequent flood especially in Donga.

In Donga, flooding is now an annual occurring event especially after heavy rainstorm which is further worsened by the nature of the topography of the area (Oyatayo et. al, 2015). This suggest, a need for a detailed and methodology- proven regional assessment of many areas especially the North –East and specifically Donga. This will exhibits the region’s status to vulnerability to climate change (flooding) as this seems to have alliance with the Land use. The focus of this paper is to consider the configuration (shape and spatial arrangement) of land uses/land cover types, causes of the land use changes and its contribution to incessant flooding in Donga using geospatial technique.

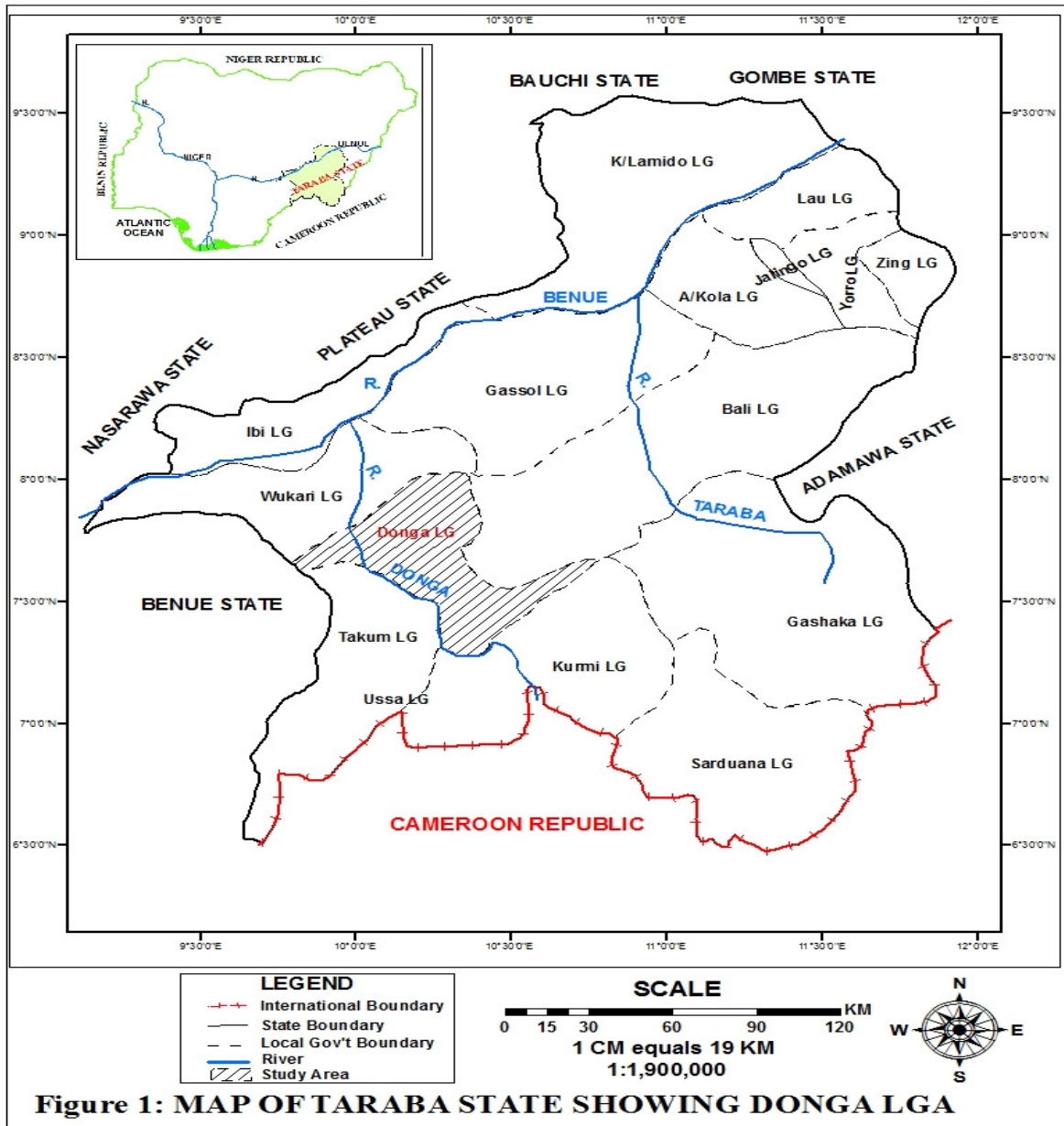
2. Study Area

Donga is a local Government Area in Taraba State, Nigeria. Its’ headquarter is in the town of Donga on the Donga River at 7° 48¹ 00¹¹ N 10° 03¹ 00¹¹ E and 7.71667° 10.05000°E (Figure 1). It has an area of about 3,420 km². It is a commercial centre which attracts people from many parts of neighboring local government of the state like Takum, Wukari, Bali, Gassol. Not only that, it is also centre for administrative activities. Donga is well connected to the other part of the state with good transportation networks. These networks also give room for interstate trading in hide and skin especially fish business from River Donga.

The Donga River arises from the Mambilla Plateau in Eastern Nigeria, form part of the international border between Nigeria and Cameroon, and flows northwest to eventually merge with the River Benue. The Donga watershed is about 20000 square kilometers in area. At its peak, near the Benue the river delivers 1800 cubic meters of water per second (Inger, et. al, 2005). The watershed fall within the Guinea Savanna Zone with thick vegetation cover with tall grass and tree. The vegetation patterns show faithful reproduction of rainfall pattern. Like the

86 rainfall, which is higher in the south and reduces as one progress toward the north, the vegetation
87 is also so pattern (Iloeje, 1981) with annual rainfall of between 1000mm and 1200mm.
88 According to Iloeje, heavy rainfall promotes leaching and corrosion in the area. These two
89 processes, he added that during the dry and wet season gives rise to lateritic soil. However, soil
90 and hydrology of the place allow the cultivation of most staple foods and grazing lands for
91 animals.

92 From 1999 to 2006, population of this area rose from 84,626 and the total population on board
93 was 134,111 at the 2006 census, with overall density of over 43 persons per square kilometers.
94 (Iloeje, 1981) submitted that soil fertility which is obtained through fallow period has been
95 continuously shortened through increase in population and continuous cropping of the land.
96 Increased population could generate increased pressure on the sustainability of land resources
97 and environmental condition.



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99 3. Data Sources and methodology

100 3.1 Data Sources and Type

101 The main images that were acquired for the assessment of the land use and land cover change are
 102 that of 2000 and 2016 (Table 1). These were obtained from earth explorer site
 103 (<http://earthexplorer.usgs.gov/>). The two images were acquired in July, which is on-season and

also fall within the period of wet season, hence the vegetation cover and land-use types appear the same on the images regardless of the year they were obtained (Olokor, 1995 cited in Jijingi et al, 2016).

Table 1: Date Type and Sources

Type	Acquisition date	Dimension (in pixel)	Actual spatial resolution	Acquisition source
Landsat 7 (Thematic Mapper)	July 2000	379 × 279	30 × 30	USGS
Landsat 8 (Thematic Mapper)	July 2016	379 × 279	30 × 30	USGS

Source: Compiled by the Authors

3.2 Image Classification and change detection Analysis

To Classify the images into the respective themes, the supervised approached to classification was adopted using Arc GIS 10.1 software. The images were classified into five major classes: water body, built up, vegetation, bare land and rock outcrop. Maximum likelihood classification algorithm technique was adopted. Area calculations of the arc GIS 10.1 software was used to derive the rates and magnitude of change. The extent and nature of change for the period of 2000 to 2016 years was ascertained by map overlay. Following Ikusemoran and Olokor (2014), the following steps were carried out for the derivation of the changes in the study area:

i) Calculation of the magnitude of change. This was derived by subtraction of observed change of post from the previous period of years.

ii) Calculation of the trends: The percentage change of each of the land-use. This was done by subtracting the percentage of the previous land-use, from the present land use. Then the difference divide by the total land area multiplied by hundred.

iii) Finally, calculation of the annual rate of change was by dividing magnitude change by number of study years.

4. Results and Discussion

4.2 Changes in Land Use/ Land Cover (2000-2016)

Table 9: Land Use/Land Cover (LULC) classification and Area Extent change between 2000 and 2016 in Donga

LULC classes	2000	%	2012	%	2016	%
	Area (Km ²)		Area (Km ²)		Area (Km ²)	
WATER BODY	20.7368	0.6	20.6352	0.6	18.1443	0.5
BUILTUP AREA	34.3099	1	83.8213	2.4	172.0121	5.1
VEGETATION	1770.9421	51.7	1496.7472	43.7	1229.8279	35.9
BARELAND	1380.2624	40.3	1605.2726	46.9	1790.0948	52.3
ROCK OUTCROP	213.8568	6.4	213.6316	6.2	210.0288	6.2
TOTAL	3420.1080	100	3420.1080	100	3420.1080	100

Source: Fieldwork, 2017 classified satellite imageries

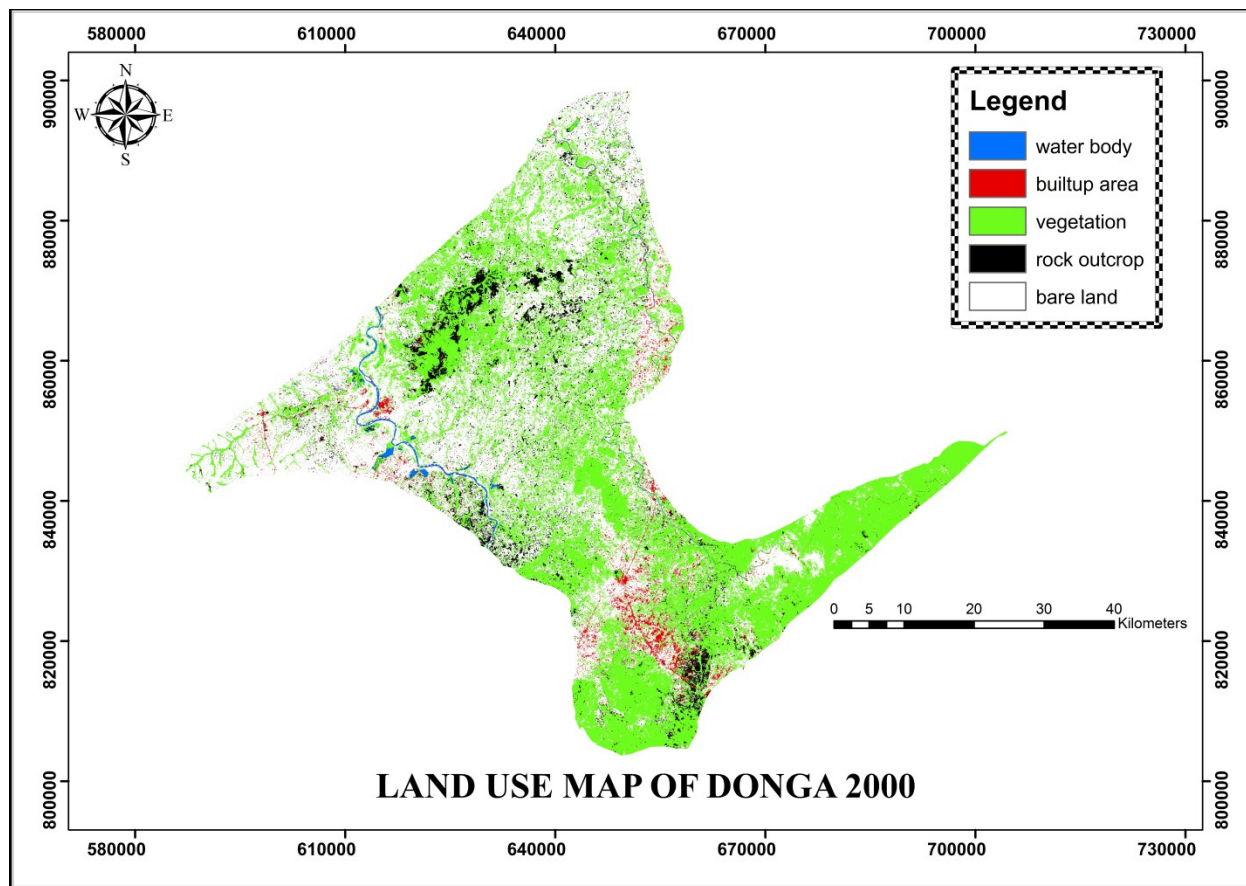


Figure 2a: Land use/cover status of Donga in 2000 (Based on Landsat Thematic Mapper Satellite Imagery).

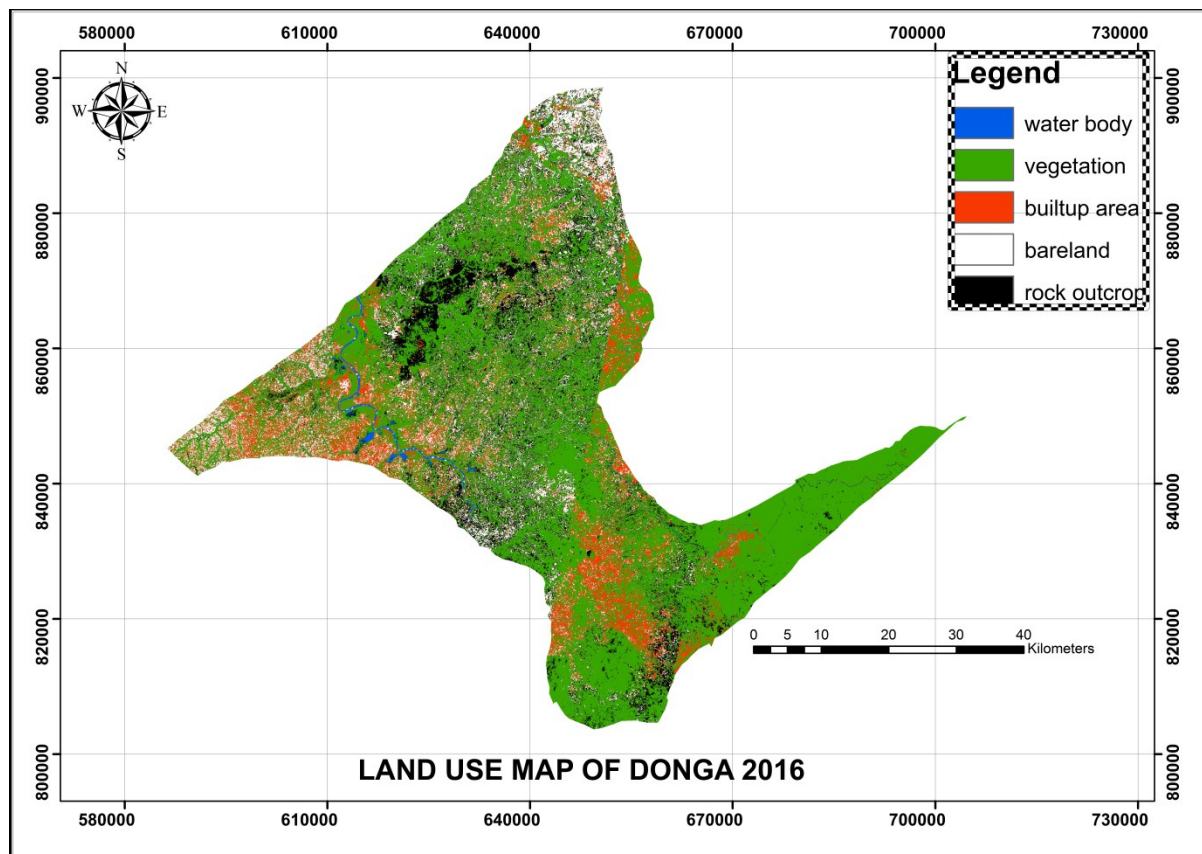


Figure 2c: Land use/cover status of Donga in 2016 (Based on Landsat Thematic Mapper Satellite Imagery).

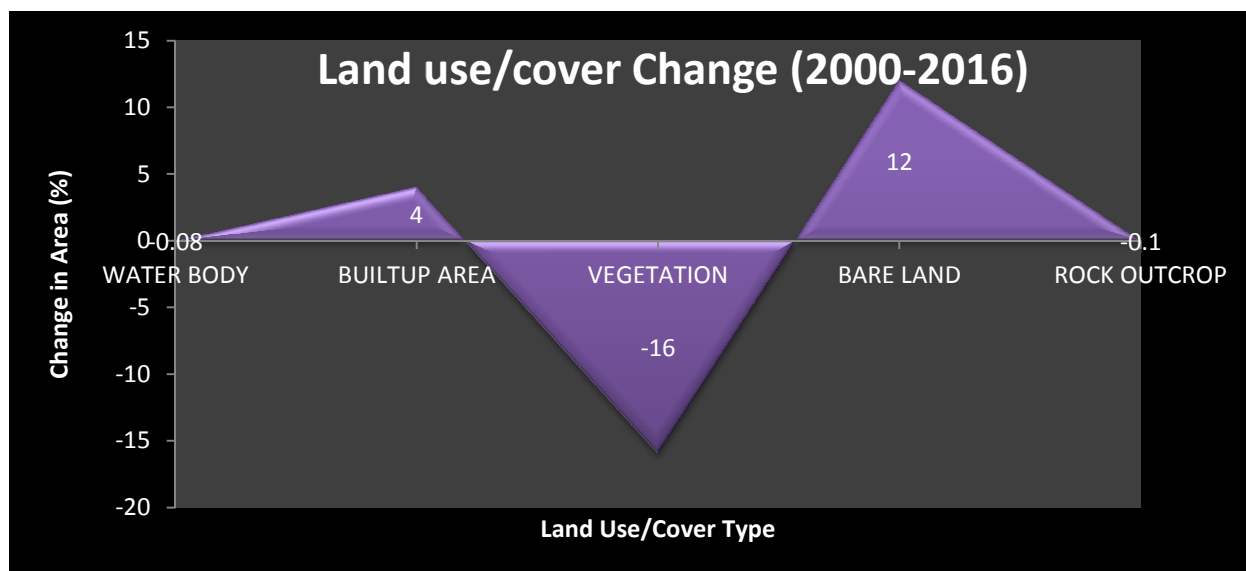


Figure 3: Diagrammatic illustration of land use/land cover change in percent between (2000 and 2016) in Donga

Table 10: Area and total change in land use/land cover categories in Donga during the year 2000-2016.

LANDUSE	2000(Km ²)	2016 (Km ²)	CHANGE(Km ²)	%
WATER BODY	20.7368	18.1443	-2.5924	-0.0800
BUILTUP AREA	34.3099	172.0121	+137.7021	4.0000
VEGETATION	1770.9421	1229.8279	-541.1142	-16.000
BARE LAND	1380.2624	1790.0948	+409.8324	12.000
ROCK OUTCROP	213.8568	210.0288	-3.8279	-0.1000
TOTAL	3420.1080	3420.1080	0.0000	0.0000

Source: Authors' Data Analysis

161 Table 11: The magnitude, percentage and annual rate of change in Donga (2000-2016)

LANDUSE	2000(Km ²)	2016 (Km ²)	CHANGE(Km ²)	%	Annual rate of change	Remark
WATER BODY	20.7368	18.1443	-2.5924	-0.0800	0.1620	Negative
BUILTUP AREA	34.3099	172.0121	+137.7021	4.0000	8.6064	Positive
VEGETATION	1770.9421	1229.8279	-541.1142	-16.000	33.8196	Negative
BARE LAND	1380.2624	1790.0948	+409.8324	12.000	25.6145	Positive
ROCK OUTCROP	213.8568	210.0288	-3.8279	-0.1000	0.2392	Negative
TOTAL	3420.1080	3420.1080	0.0000	0.0000	0.0000	

162

163 **Source:** Authors' Data Analysis

164 In this research, the imageries of 2000 and 2016 were evaluated and the obtained data depicting
165 the changes involved are summarized as follow:

166 4.3 Changes in Land Use/ Land Cover, 2000-2016

167 During this period, the built-up area increased by 137.7021 Km² (4%) with an annual rate of
168 change of 8.6064 Km². The bare land also increased by 409.8324 Km² (12%) This increased
169 were lost from the vegetal cover. Vegetal cover thus, lost as much as 541.1142 Km² (16%) with
170 annual rate at 33.8196 Km². There is also change in the rock outcrop of about 3.8279 Km²
171 (0.1%) with an annual rate of 0.2392 Km². The least change was in water body with decrease of
172 about 2.5924 Km² (0.08%) having annual rate of change of about 0.1620 Km² (Table 11). The
173 change trends are also graphically presented in figure 3.

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175

5. Conclusion and Recommendation

The study reveals that the major land use in the study area is vegetation. The area under vegetation has decreased by 16% (541.1142 Km²) this is possibly not unconnected to logging and construction purposes. Logging with the common motor power handsaw is generally the daily notable activity of the teaming unemployed youths in Donga of recent. During the study period i.e (2000-2016), built up area has increased by 4% (137.7021 Km²). This could be attributed to the on-going expansion. Construction of Donga bridge and rural roads by the Danbaba Danfulani Suntai administration with accumulation of income opportunities, and facilities along the road head were found as pull factors leading to increase in built up area. Closely follow to this is the bare land. Bare land area account for about 12% (409.8324 Km²) for the same reason that may not be too far from above discussed and as a result of some serious mining of granite for road construction.

As the amount of vegetation decreases and density of development increases, especially as the nation diversifies now, there is likelihood of increased erosion and flooding. The land covers are natural resources, natural biofilters, and erosion stabilizers protecting the land from direct punch of rainfall, reducing the sedimentation load and runoff that would have find their course unto the river consequently leading to flooding. Understanding the fact that Land use affects land cover and changes in land cover affect land use then, change from the inception of oil mania to realization of agricultural prospect will pose adverse circumstances if not holistically administered. The saying that Agricultural sector will be the panacea to getting us out of the present economic recession and even create a more stable and sustainable economic development is a welcome idea, but there should be check and balances. The poor community farmers in Philippines have deconstructed the oppositional thinking inherent in the conventional literature: if one is poor, then one degrades. The poor, unemployed and the rural farmers can be positive agents of environmental sustainability. Robin, (1994), gave scenarios and conditions where wise use of land can be put in place despites innumerable socio-economy lag, depression or hardship.

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