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AN ASSESSMENT OF LAND USE AND LAND COVER CHANGE IN MANGA GRASSLAND OF YOBE STATE, NIGERIA

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ABSTRACT

Human activities and natural events continually reshape land use patterns, underscoring the critical need for accurate land use information in various applications such as natural resource management and environmental monitoring. Land use change has become pivotal in current strategies for these purposes globally. The rapid advancements in land use mapping have spurred increased studies worldwide, aiming to assess and monitor the extent and health of forests, grasslands, and agricultural lands. Remotely sensed data, including aerial photographs and satellite imagery, are indispensable for extracting precise land use change information. This study focusing on Manga grassland (Machina, Yusufari, and Yunusari LGAs), satellite images from Landsat TM (1988), Landsat ETM (1998), Landsat ETM+ (2008), and Landsat 8 (2018) for image classification. The study employed supervised classification methods to analyse land use changes, revealing significant alterations in vegetation cover over the study period. In conclusion, it was observed that observed that vegetation cover increases from north toward the south follow the trend of rain fall, over-cutting, over grazing, and other climatic factors, which determines species distribution. Vegetation degradation is detected more in north boundary Niger republic. This may be due to southern flow of the Sahara Desert into the northern part of Nigeria around the study area. Data analysis shows that land use land cover had been changing through the study zones and this change had negative impact on natural resource development. Finally, it was recommended that the development of suitable and adequate mean of awareness for local community on the importance of species diversity and adoption of agroforestry systems, as well as the continuation of afforestation and reforestation programs. Involvement of local communities in policies, laws, decision-making, processes and participation in management of resources for sustainable use and conservation.

Keywords: Land use Change, Remotely Sensed Data, Aerial Photographs, Satellite Imageries, Landsat 8, Landsat TM, Landsat ETM, Landsat ETM+ Supervised Classification

INTRODUCTION

Land is definitely one of the most important natural resources, since life and developmental activities are based on it. Land use refers to the type of utilization to which man has put the land. It also refers to evaluation of the land with respect to various natural characteristics. However, land cover describes the vegetal attributes of land. Land use and land cover data are essential for planners, decision makers and those concerned with land resources management (Ndukwe, 1997). According to (Jaiswal, Saxena, & Mukherjee, 1999) land cover is generally used to describe physical materials of the earth surface which include grasses, asphalt, trees, bare ground, water etc. In many instances, the terms Land Use and Land Cover tend to be exchangeable. Information from (Koirala, 2010) , revealed that land use simply refers to how land is used by human or the economic use to which land is put. However, the land can be used for commercial purposes (stores, office building, apartment, etc.) or for industrial purposes (factories, assembly plants), or is the land being used for recreational or agricultural purposes. While on the other hand, land cover refers to the physical condition, structure or other features that cover the land. E.g., grass, trees, water, or large buildings.

Koirala, (2010), land use and land cover undergo changes through time due to anthropogenic factors which lead to significant impacts from the result of land management practices, economic health and sustainability, and social and political processes. Land cover and land use changes has been a great concern to every nation development. Land cover and land use are often inaccurately used interchange (Lambin, Geist, & Lepers, 2003), but each term has its specific meaning as: Land cover is commonly defined as the vegetation (natural or planted) or man-made construction (building) erected on the earth surface. For instance, water, ice, bare rock, sand and other similar surfaces, while land use is commonly referred to series of operations on land, carried out by humans with the intention to obtain products and /or benefits from land resources. Land use indicates the manner at which individuals or group of individuals utilize land whereas land cover indicates the physical land types. Land cover and land use track of a land provide wide spread picture of a particular area. This information provides fundamental components of planning and decision-making processes for many communities because it helps them to understand better where to plan for different growth and preservation, and also enhance the knowledge connectivity or fragmentation of various features in their communities(Lambin et al., 2003).

The growth and development of urbanization, population increase, scarcity of land, need for agricultural production, changes in technologies are some among the driven forces of land cover and land use in today's world (M. C. Cheruto, M. K. Kauti, P. D. Kisangau, & P. C. Kariuki, 2016). In Nigeria, (Adepoju, Millington, & Tansey, 2006) state that the transition from agricultural practices constitutes the largest land change in terms of area. Significant results from changes in land cover were observed in various settlement within the country as a result of increasing irrigation agriculture plantation, open mines, etc. accelerating from 1-2 percent per year between 1975-2000 to 2-4 percent per year in the year 2000- 2013. Within this period, pressure due to growing population and economy, forests, gallery of forests and woodlands, in addition to savannah land cover types were being diminished with loss to over 2 percent per year during

2000 -2013 periods. This total has risen to 45 percent from 1975 to 2013.

Arowolo & Deng, (2018), Nigeria has witnessed a tremendous urban expansion over the years. Evidences asserted that the share of urban population out of the total population of Nigeria was less than 7% in 1931 but has continued to escalate over the years from about 10% in 1952 to 19.2% in 1991 to 48% in 2010 and it reached 50% in 2012 (Idowu, 2013). The above increase in urbanization rate indicated that by the year 2012 and above, half of the population of Nigeria were already living in urban areas will continue to move from urban center to rural areas. This explosive increased in population has resulted in rapid human alteration or modifications of the biosphere that brought 6 changes in the land use and land cover distribution of all Nigerian land cover with Northern part of Yobe State not an exception (Adepoju et al., 2006).

Yobe is one of the states created in North- Eastern Nigeria in 1991, with the state capital located in Damaturu town. Since then, Damaturu and other selected local government has been experiencing rapid changes in the land use/land cover types due to urban expansion and economic transformation in the state. These in addition to other factors influence the land use/land cover changes within the state. Therefore, there is the need to examine the trend and pattern of these changes for proper planning and development of the city (Jajere, Isma'il, & Musa, 2015). Hence, the focus of this study is to examine the dynamics in land use/land cover change of Machina, Yusufari, and Yunusari LGAs from 1988 to 2018 using Remote Sensing and Geographic Information System techniques.

This study is aimed at analyzing the land cover changes that has taken place in the Northern part of Yobe State (covering Machina, Yusufari and Yunusari LGAs through ssampling some communities within the study areas from 1988 and 2018 using GIS and Remote Sensing technique.

MATERIALS AND METHODS

Study Area

The LGAs are Machina, Yusufari and Yunusari. These areas are located between Latitude 13° 08' 6.60" N, 13° 04' 3.60" N, 13° 06' 9.00" N and **Longitude:** 10° 02' 34.20" E, 11° 10' 19.80" E, 12° 04' 12.00" E respectively.

Adamu & Gana, (2019), the LGAs (Machina, Yusufari and Yunusari) bounded to Niger Republic to the North, Gombe State to the Southwest, Jigawa by the Northwest and Borno State by the East. The terrain consists of plains that are drained by the seasonal Komandugu-Yobe River and its tributaries in the North and by the Gongola River in the South. The vegetation of Yobe state is predominantly of the Sudan savannah type consisting of grassland with acacia and other shrubs. There is also an area of Sahel savannah and thorn scrubs towards the Northern border. The study area is located in this narrow band of Sahel savannah. The total area of the study area is 9,023.32 km^2 (Arowolo & Deng, 2018).

Adamu & Gana, (2019), indicates that the Manga grassland has extremely hot and dry weather in the North almost throughout the year, while in the South; the area is hot between the months of March to June and cooler for the rest of the months of the year. The hottest months, which are March, April, and May, the temperature ranged from 39^{o}C to 45^{o}C. Raining season in the state varies from place to place, with about 120 days in the North and 140 in the South. When estimating the annual rainfall, it ranges from 500mm to 1000mm which is feasible within the months of June to September in the North and May to October in the South. Manga grassland is part of the savannah ecosystem where the Sahel savannah vegetation zone dominates the North part of the study area. Meanwhile, Sudan savannah zone is predominant in the South. The area is severally under the threat of desert encroachment thereby resulting in arid and semi-arid condition due to excessive human activities in the region.

The study has an estimated land area of 47,153sq km with a topography that is generally flat, with exception to the southern part of Gujba and Fika local government area where the land is characterized with rocky platform, while in the north; it is completely flat with undulating sand dunes. River Yobe, from which the state is named, signify and served the most important geographical feature in the state (Adamu & Gana, 2019).

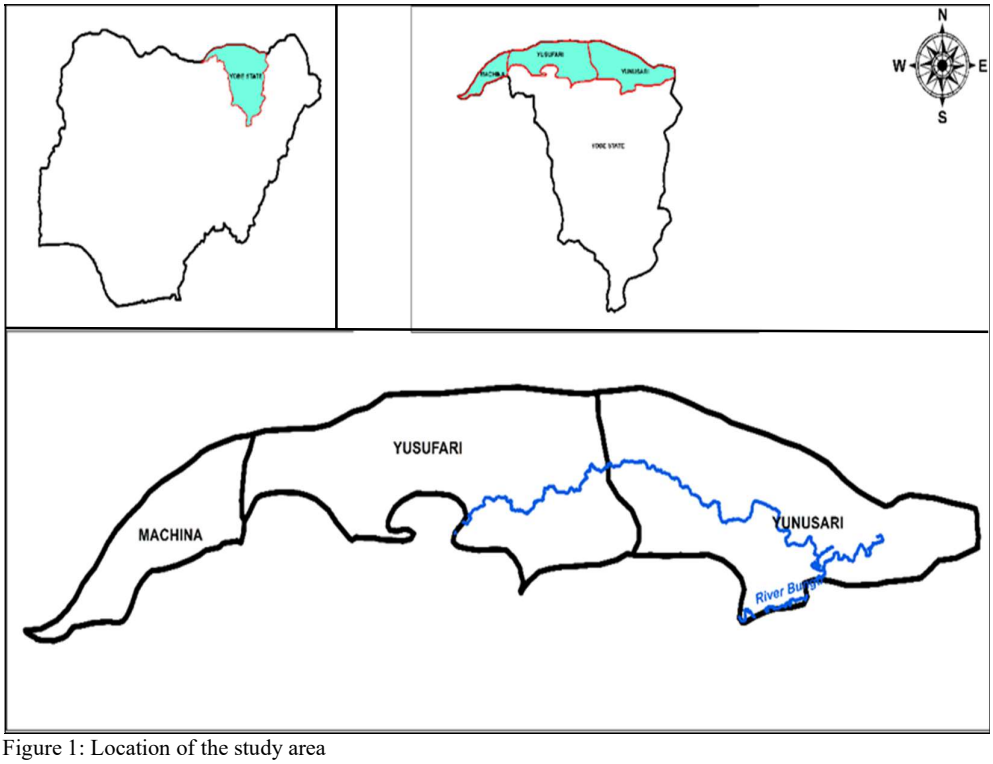

Figure 1: Location of the study area

Manga grasslands has a population of about 120,434 with the exception Yusufari and 297,673 according to the National population head count conducted in 2006 and 2016 respectively.

Materials

The study is based on both remote sensing and ancillary data. The details of different hardware and software used during analysis and field observations are given below.

Table 1: The path and row used in obtaining characteristics imageries from the land sat image

Serial Number	Image	Path and Row	Year	Source	Resolution	Type
1	Landsat TM	186/051	1988	GLCF	30	Remotely Sensed Raster Image
2	Landsat TM	187/051	1988	GLCF	30	Remotely Sensed Raster Image
3	Landsat TM	188/051	1988	GLCF	30	Remotely Sensed Raster Image
4	Landsat ETM	186/051	1998	GLCF	30	Remotely Sensed Raster Image
5	Landsat ETM	187/051	1998	GLCF	30	Remotely Sensed Raster Image
6	Landsat ETM	188/051	1998	GLCF	30	Remotely Sensed Raster Image
7	Landsat ETM+	186/051	2008	GLCF	30	Remotely Sensed Raster Image
8	Landsat ETM+	187/051	2008	GLCF	30	Remotely Sensed Raster Image
9	Landsat ETM+	188/051	2008	GLCF	30	Remotely Sensed Raster Image
10	Landsat 8	186/051	2018	GLCF	30	Remotely Sensed Raster Image
11	Landsat 8	187/051	2018	GLCF	30	Remotely Sensed Raster Image
12	Landsat 8	188/051	2018	GLCF	30	Remotely Sensed Raster Image

Ancillary Data

This research work adopted both the primary and secondary methods of data collection. Secondary data where obtained from Ministry of Land and survey, Ministry of environment, Ministry of agriculture and socioeconomic and Metrological station, while the primary data were obtained through Remote Sensing, Field survey and questionnaire. Other Hardware, Software and materials used were GPS, Garmin 12 channel, Magnetic rangers compass, Binocular, Camera.

Table 2: Hardware

Hardware	Uses
Laptop hp (4 GB RAM)	Data storage, software and internet support.
Plotter	To print hardcopy, paper maps and poster.
Scanner	To convert pictures or maps to digital form.
Printer	To produce high quality hardcopy, computer output viz. literature, thesis and report.

Table 3: Software

ArcGIS 10.3 and 10.5	Advanced software used for data input, data analysis, management, manipulation and final production of maps.
Erdas imagine 9.2 and 14	Registration and processing of topographic map and satellite data change detection Image Classification and analysis.
SURFER 32	For surface and contour maps
Microsoft office	Data entry Non-Spatial Data Analysis Thesis Compilation and Presentation
ArcGIS 10.2	Used for Geo-statistics analysis of the survey data.

Methods

The total research activities were set into pre-fieldwork, fieldwork and post fieldwork stages as shown below.

Pre-field work

Pre-field work consist initiation of project followed by downloading and preprocessing different satellite data and creation of base map. Project planning preprocessing and database creation.

This stage started by entering the coordinates of the boundaries of the study area into GPS set. These coordinates were then transferred to the appropriate geo-referenced satellite image. A rectangular grid was set at the spacing of 5 km using fishnet techniques (scale of 1:200,000) in a north to south direction and 5 km in an east to west direction as shown in Figure 2 below. Land use and Land cover were later checked, described and tentatively classified at the intersections of the grid points.

Figure 2: Sampling of Study Area

Fieldwork

The Fieldwork was conducted within the period of 4th December 2023 to 5th March, 2024 in a total area of approximately 346483.43 ha, which represents the study area. GPS (Garmin 62C) was used to navigate among check samples and to record the coordinates (X and Y values) of all each check sample. According to this study, 81 sample plots represented by 30 x 30m were designed to carry out the research work.

Pre-processing

For images to be usable, a few processes must be undertaken to enhance image quality or to merge raster data sets from different paths and rows. Raw remotely sensed data may contain radiometric or geometric flaws that may make immediate use of the data less than desirable. Therefore, some correction is needed before using the data. Land-sat 7 has a particular geometric flaw, which results in stripes appearing on images and making them difficult to work with. However, using the Land-sat toolkit, these stripes can be removed before using the image data for analysis. For images that needed line and stripe removal, the preprocessing model shown in (Figure 3 and 4) is used while the model in Figure 5 is used for those without errors.

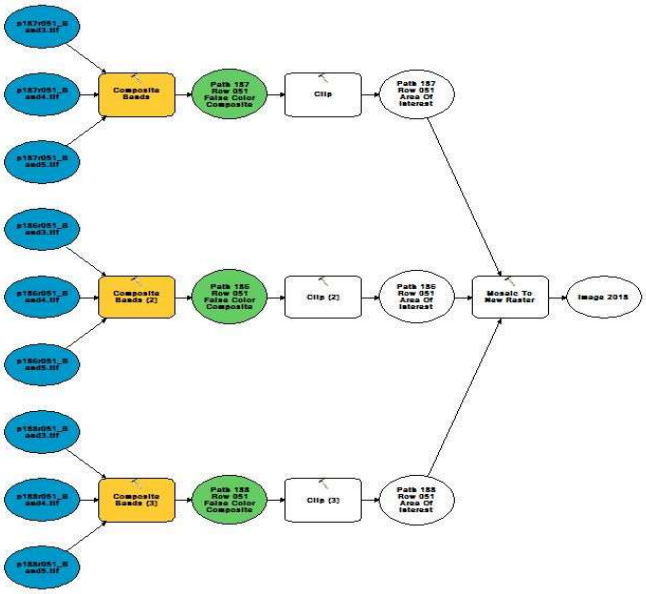

Figure 3: Image Pre-processing without lines and stripes

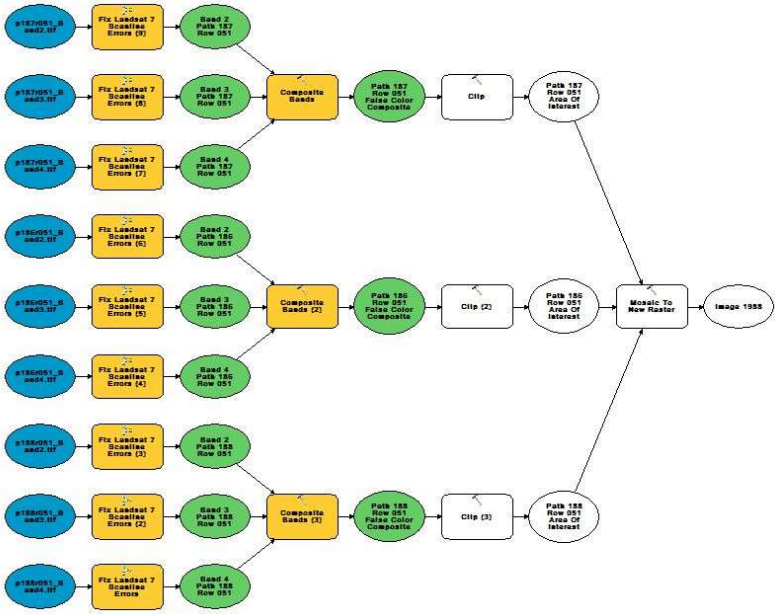

Figure 4: Image Pre-processing with lines and stripes

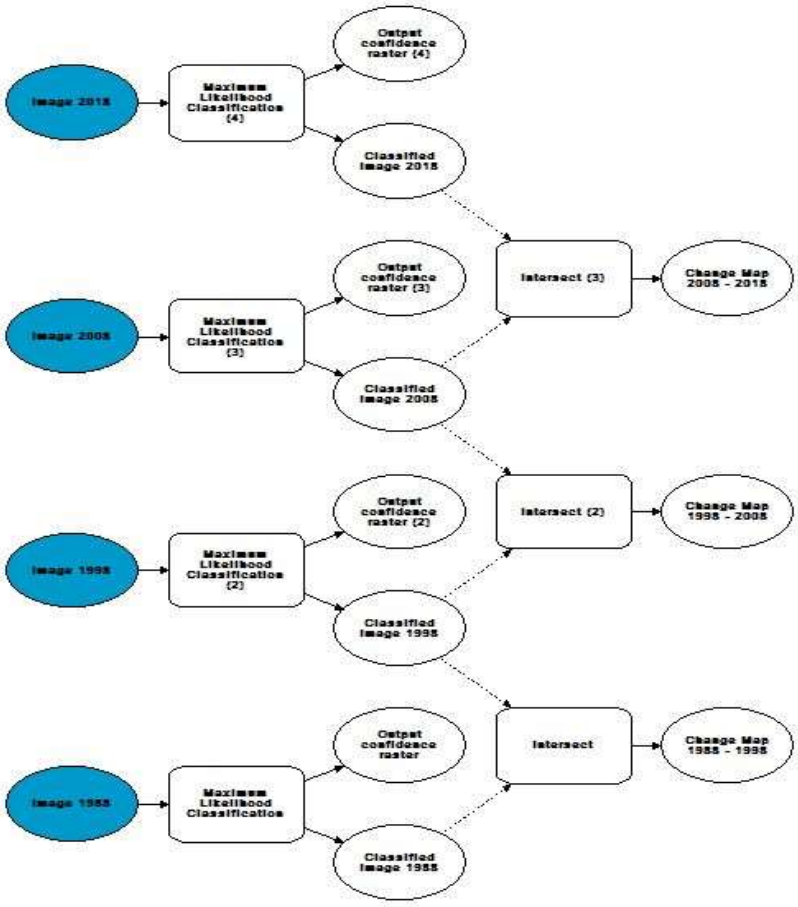

Figure 5: Analysis workflow model

Post Field work

Statistical Extraction and Questionnaire Analysis

Each of the generated images contains attribute data that are stored in adjoined tables. The extraction of statistics from the attribute tables of the images was carried out using Microsoft excel and Microsoft word. Questionnaire Analysis: Two hundred and forty three (243) were distributed within the study area. SPSS package was used to analysis all the available questionnaire returned, code the response and then do a reliability test showing the statistics result. In the case of this study, reliability test was conducted and (70% reliable) result was obtained. The researcher employed the use of descriptive statistic to expressed the result and to check correlate if any (model summary), ANOVA (regression) and finally, coefficient.

RESULTS AND DISCUSSION

A comprehensive knowledge on the rapid land use and land cover change integrating rates and spatial distribution of the changes with other land cover patterns were developed in the study area. Moreover, some investigations were performed to address the driving forces that might be associated with these dynamics. Land classification procedure using remote sensing techniques, Community surveying through distribution of questionnaires, data analysis using SPSS, and finally, soil tests to determine the profile, structure, texture, pH that determine the acidity and salinity of the soil and how it contribute to the land cover change were studied.

Land classification

First, the images below show the results obtain from satellite images from the study areas between the periods 1988-2018 (a period of 30 years) indicating the classified images of the study area land cover for the period of 1988, 1998, 2008 and 2018 together with land change detection between 1988 – 1998, 1998 – 2008 and 2008 - 2018 within the period of study.

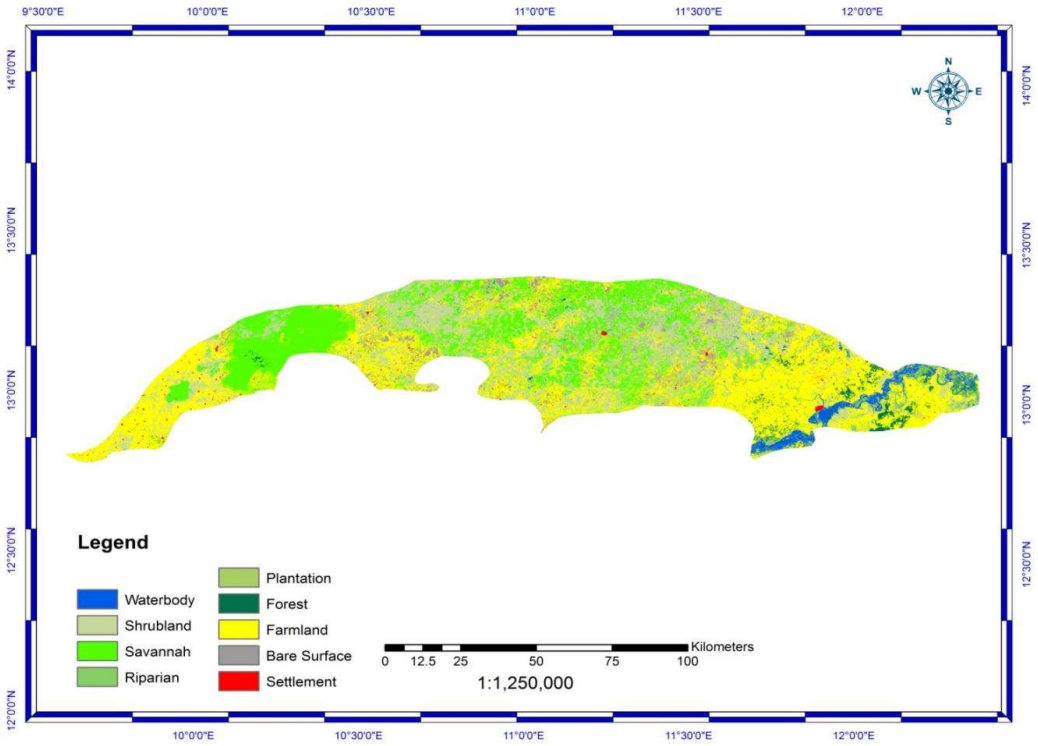

Figure 6: Classified Image for the Year 1988

Table 4: Land Use/Land Cover Areas Year 1988

S\ No.	LANDUSE/LANDCOVER	AREA (Km^2)	Percentage (%)
1	Bare Surface	435.9592	4.82
2	Farmland	3558.6302	39.33
3	Forest	148.3144	1.64
4	Plantation	49.1727	2.77
5	Riparian	245.4745	2.71
6	Savannah	2192.3194	24.22
7	Settlement	42.6163	0.37
8	Shrub land	2173.7350	24.02
9	Water body	202.7531	0.02
	Grand Total	**9048.9748**	**100**

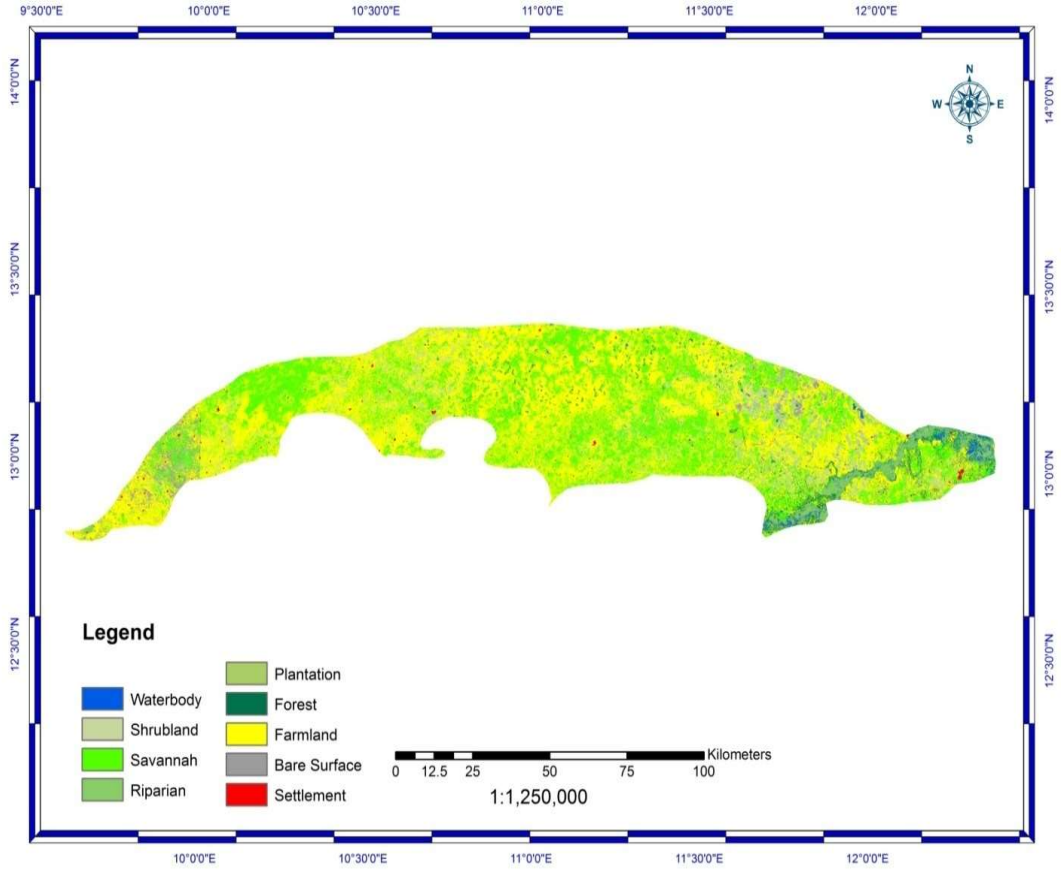

Figure 7: Classified Image for the Year 1998

Table 5: Land Use/Land Cover Areas, Year 1998

S\ No.	LANDUSE/LANDCOVER	AREA (Km^2)	PERCENTAGE (%)
1	Bare Surface	191.4603	2.11
2	Farmland	4338.6665	47.94
3	Forest	186.7727	2.1
4	Plantation	68.8850	1
5	Riparian	218.3799	2.4
6	Savannah	2997.6408	33.11
7	Settlement	33.8862	1
8	Shrubland	931.5141	10
9	Waterbody	83.8018	1
	Grand Total	**9051.0072**	**100**

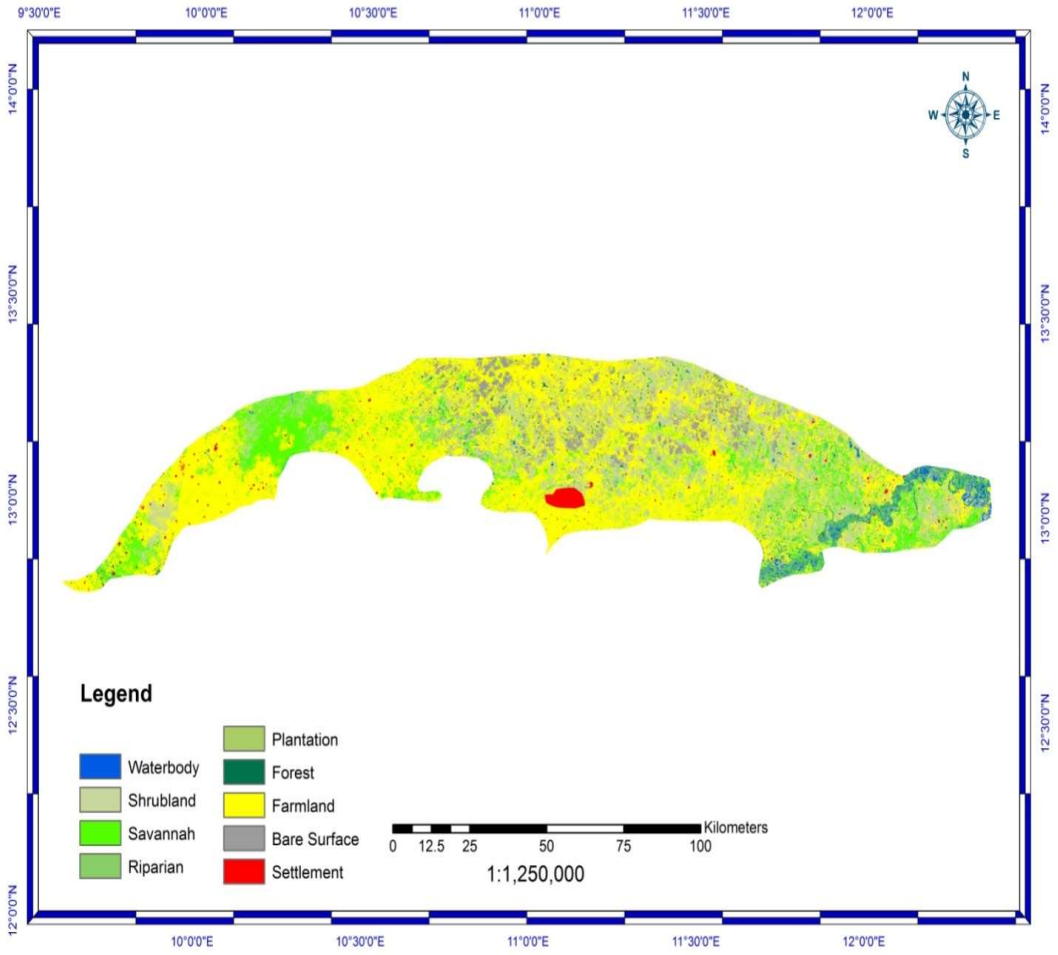

Figure 8: Classified Image for the Year 2008

Table 6: Land Use\Land Cover Areas, image for the Year 2008

S\ No.	LANDUSE\LANDCOVER	AREA (Km^2)	PERCENTAGE (%)
1	Bare Surface	431.5649	4.76
2	Farmland	4507.2061	49.79
3	Forest	51.9660	1
4	Plantation	14.2931	0.15
5	Riparian	97.6879	1.07
6	Savannah	1473.6093	16.28
7	Settlement	103.8696	1.14
8	Shrub land	2150.6388	23.76
9	Water body	220.2522	2.4
	Grand Total	**9051.0881**	**100**

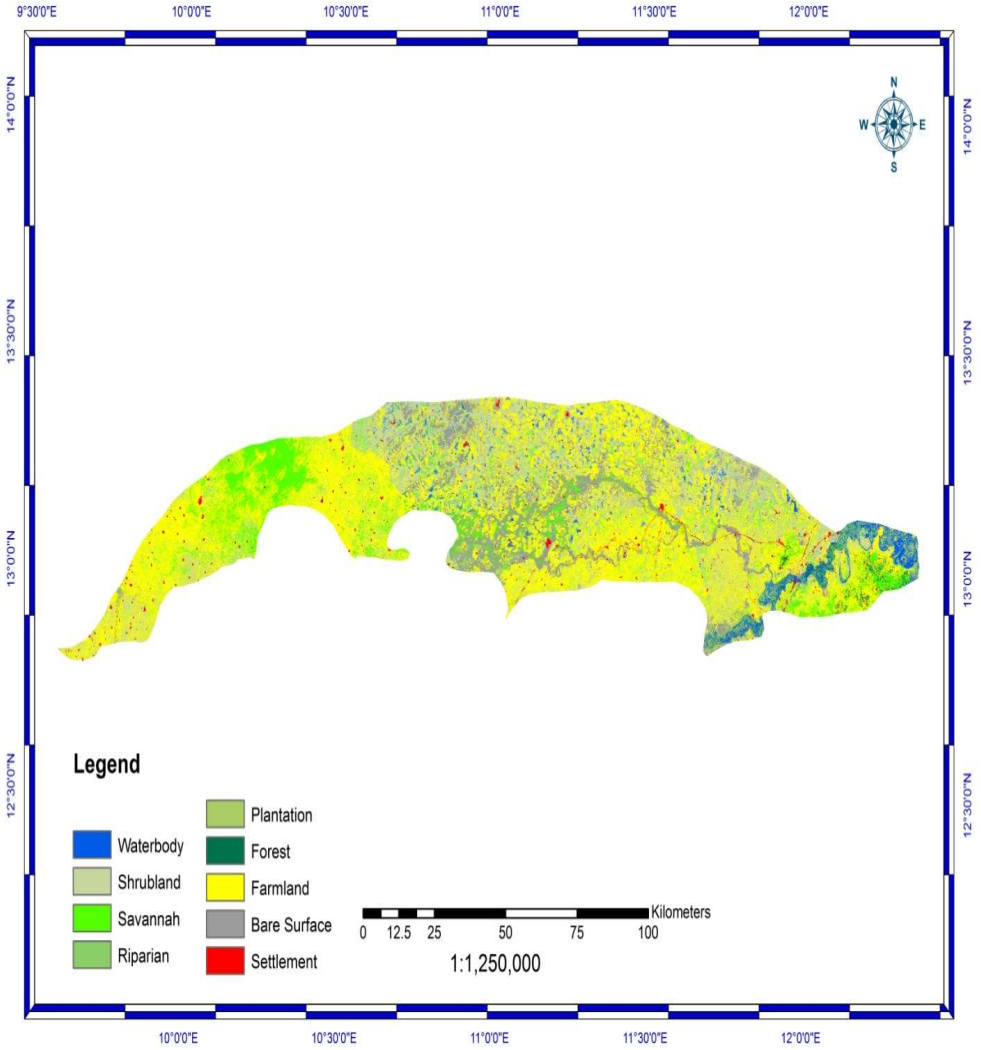

Figure 9: Classified Image for the Year 2018

Table 7: Land Use\Land Cover Areas, during the Year 2018

S\ No.	LANDUSE\LANDCOVER	AREA (Km^2)	Percentage (%)
1	Bare Surface	934.0993	10.3
2	Farmland	4079.4047	45.2
3	Forest	70.9613	0.78
4	Plantation	151.2212	1.67
5	Riparian	73.3750	0.81
6	Savannah	1105.1266	12.24
7	Settlement	90.9050	1.00
8	Shrubland	2250.9222	24.9
9	Waterbody	267.0071	2.95
	Grand Total	**9023.0223**	**100**

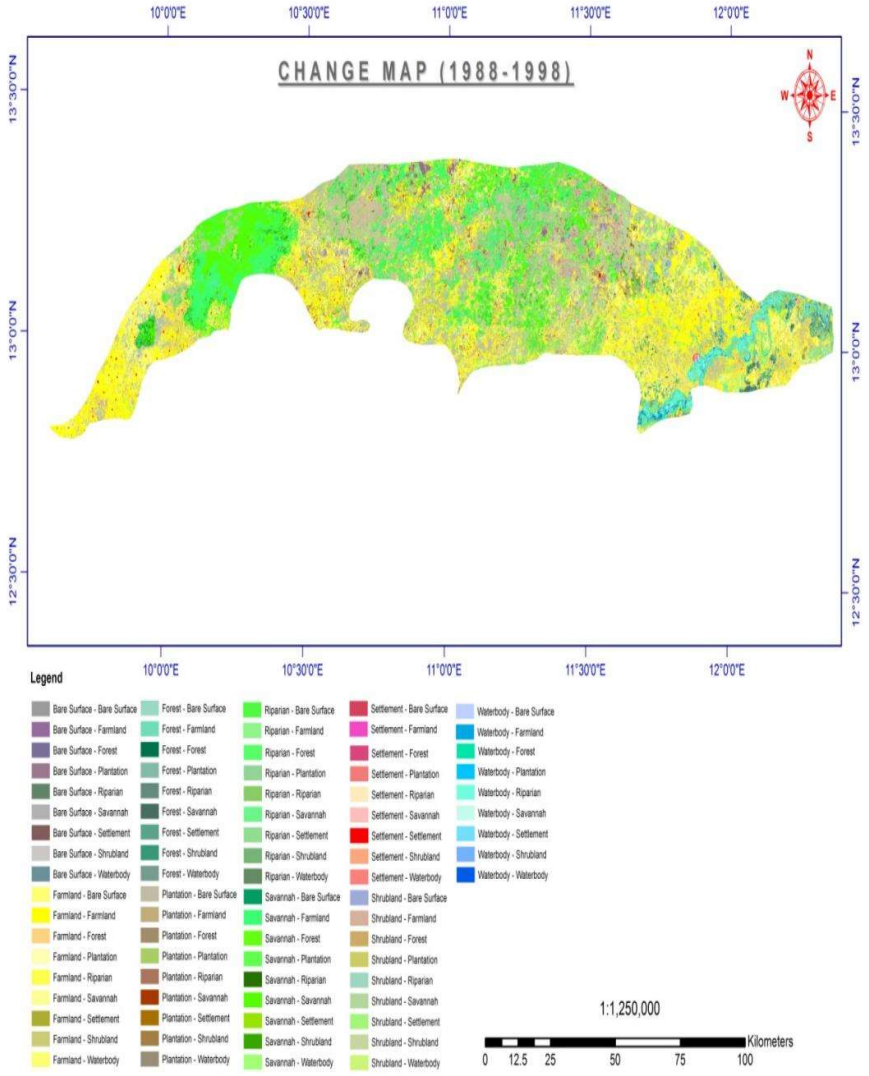

Figure 10: Change Detections Map for the Period 1988/1998

Table 8: Statistics of 1988/1998 Crossed Image

Land Use\Land Cover Classes 1988 (Km²)	Land Use\Land Cover Classes 1998 (Km²)									
	Bare Surface	**Farmland**	**Forest**	**Plantation**	**Riparian**	**Savannah**	**Settlement**	**Shrub Land**	**Water Body**	**Grand Total**
Bare Surface	4.6297	290.4613	0.0854	0.3343	0.0141	103.1125	1.4910	32.6459	3.1018	435.8760
Farmland	118.9232	1920.8432	77.1136	18.1724	10.7676	1007.9899	9.6096	384.1029	10.2091	3557.7315
Forest	0.4622	45.9860	13.4997	3.5954	13.0556	51.5220	0.5454	8.4939	11.0769	148.2373
Plantation	0.0760	17.3041	5.4500	2.2656	4.4775	17.5910	0.3812	0.6930	0.9249	49.1632
Riparian	1.9749	57.8974	37.6267	17.4289	41.9717	70.1894	2.0215	4.1335	12.1256	245.3696
Savannah	11.3123	1094.7111	3.2739	2.7185	3.8960	878.0806	2.6214	187.0574	8.3254	2191.9965
Settlement	0.7696	12.2099	1.9201	0.6948	1.3647	11.1663	11.0035	1.3303	2.1396	42.5989
Shrubland	53.1166	891.4197	31.1727	12.8406	14.2234	844.8853	6.1049	312.1085	7.5072	2173.3787
Waterbody	0.0487	5.9752	16.5624	10.8109	128.5592	11.9646	0.0979	0.6732	28.0054	202.6977
Grand Total	**191.3131**	**4336.8080**	**186.7046**	**68.8615**	**218.3299**	**2996.5016**	**33.8764**	**931.2386**	**83.4158**	**9047.0494**
Percentage (%)	**2**	**48**	**2**	**1**	**2**	**34**	**0**	**10**	**1**	**100**

Table 9: Statistics of 1998/2008 Crossed Image

Land Use/Land Cover Classes 1998 (Km²)	Land Use/Land Cover Classes 2008 (Km²)									
	Bare Surface	**Farmland**	**Forest**	**Plantation**	**Riparian**	**Savannah**	**Settlement**	**Shrub land**	**Water body**	**Grand Total**
Bare Surface	20.7614	100.9067	0.6204	0.0289	0.1312	19.3283	0.7428	47.8083	1.0671	191.3951
Farmland	383.0894	2487.3741	4.4215	0.9794	4.5009	555.1681	36.3335	826.9461	39.1568	4337.9697
Forest	0.0001	28.2223	8.3268	2.0656	15.8345	64.7703	0.8398	52.9414	13.7368	186.7377
Plantation	0.0041	8.2733	4.6560	1.4584	8.5674	22.7008	0.5663	16.0972	6.5527	68.8763
Riparian		2.1162	18.2102	2.9009	51.8445	45.6771	0.0701	27.0461	70.4840	218.3492
Savannah	2.3157	1412.4572	13.2714	6.3055	12.3029	674.0925	40.9746	793.2599	42.1628	2997.1426
Settlement	0.0955	6.5125	0.1392	0.0209	0.3157	5.2211	17.6369	3.2488	0.6936	33.8842
Shrub Land	25.0463	451.7087	0.1250	0.0168	0.5263	77.1762	6.3207	368.6133	1.8594	931.3928
Water Body	0.2228	8.6698	2.1783	0.5159	3.6489	9.2217	0.3835	14.4456	44.4552	83.7416
Grand Total	**431.5353**	**4506.2408**	**51.9488**	**14.2921**	**97.6724**	**1473.3562**	**103.8684**	**2150.4068**	**220.1684**	**9049.4890**
Percentage (%)	**5**	**50**	**1**	**0**	**1**	**16**	**1**	**24**	**2**	**100**

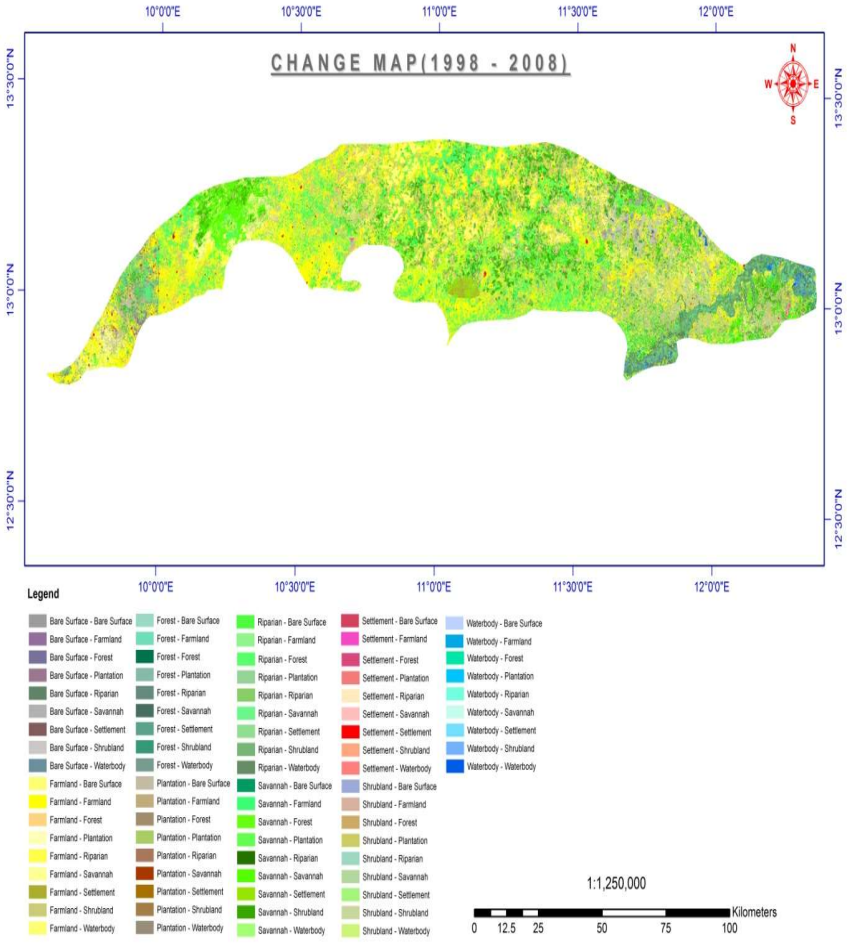

Figure 11: Change Detections Map for the Period 1998/2008

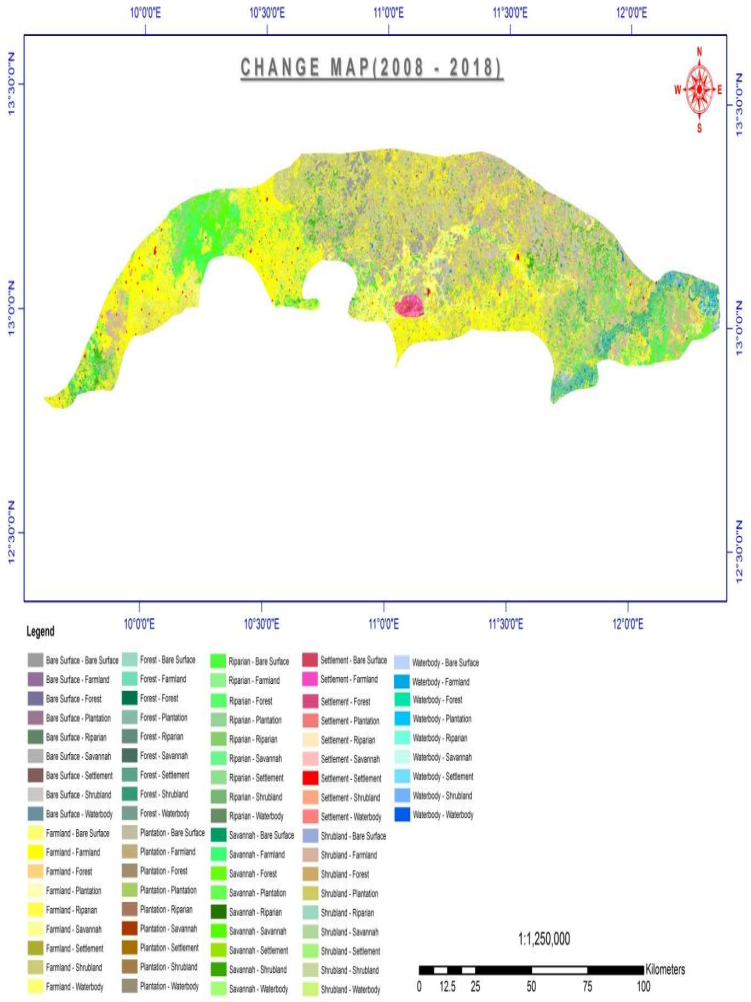

Figure 12: Change Detection Map for the Period 2008/2018

Table 10: Statistics of 2008/2018 Crossed Image

Land Use/Land Cover Classes 2008 (Km^2)	Land Use\Land Cover Classes 2018 (Km^2)									
	Bare Surface	**Farmland**	**Forest**	**Plantation**	**Riparian**	**Savannah**	**Settlement**	**Shrub land**	**Water body**	**Grand Total**
Bare Surface	287.6368	63.0719	0.0011	0.0181	0.0003	0.5999	0.8486	79.3060	0.0360	431.5187
Farmland	424.1010	2295.3629	3.9624	22.9172	0.7481	426.3271	27.9631	1260.7759	43.5920	4505.7499
Forest	1.3930	4.0281	3.0309	14.2227	6.6587	5.0599	0.3392	4.2425	12.9527	51.9276
Plantation	0.4180	0.5835	0.3904	5.3257	0.6757	2.1368	0.0862	1.5540	3.1198	14.2902
Riparian	1.6306	4.8671	7.7670	25.8557	19.0251	4.7948	0.5860	5.2624	27.8689	97.6576
Savannah	68.2674	545.9837	24.4730	35.5368	14.4366	399.4960	16.6864	320.2717	48.0311	1473.1828
Settlement	24.5772	26.6022	0.4190	0.6842	0.0027	11.3785	28.4858	11.0181	0.6962	103.8639
Shrub Land	106.6222	1137.1063	21.2432	20.2022	7.8658	239.2863	14.2920	545.5852	58.0682	2150.2714
Water Body	20.9735	15.0917	9.6228	26.6470	23.9117	20.0267	1.8622	28.8726	72.8142	219.8224
Grand Total	**935.6197**	**4092.6976**	**70.9100**	**151.4096**	**73.3248**	**1109.1059**	**91.1495**	**2256.8885**	**267.1791**	**9048.2845**
Percentage (%)	**10**	**45**	**1**	**2**	**1**	**12**	**1**	**25**	**3**	**100**

Community survey

Location A (Machina)

Table 11: Demographic features of the surveyed respondents' results

Sex	Frequency	Percent
Female	63	78
Male	18	22
Total	**81**	**100**
Age Class		
20-30 years	8	9.9
31-40 years	29	35.8
41-50 years	20	24.7
51-60 years	19	23.5
Above 60 years	5	6.2
Total	**81**	**100.0**
Marital status		
Divorce	29	35.8
Married	46	56.8
Single	6	7.4
Total	**81**	**100.0**
Residence period class		
1-10 years	19	23.5
11-22 years	19	23.5
21-30 years	18	22.2
Over 30 years	25	30.9
Total	**81**	**100.0**
Educational level		
Primary	4	4.9
Post Primary	16	19.8
Tertiary	35	43.2
Non-Formal	26	32.1
Total	**81**	**100.0**

Source: Field survey, (2023)

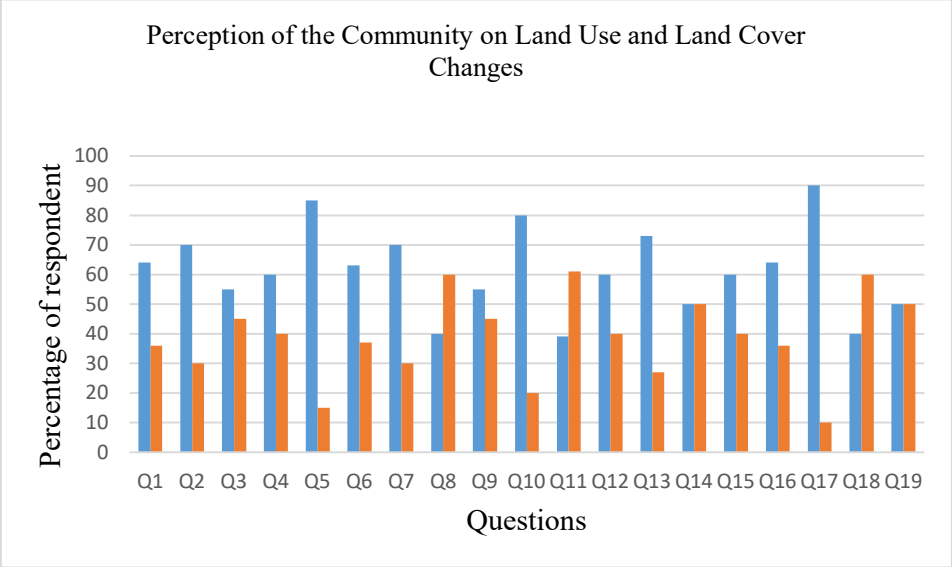

Figure 13: Perception of the Community on Land Use and Land Cover Changes

Location B (Yusufari)

Table 12: Demographic features of the surveyed respondents' results

Sex	**Frequency**	**Percent**
Female	56	69.5
Male	25	30.5
Total	**82**	**100.0**
Age Class		
20-30 years	6	7.3
31-40 years	43	52.4
41-50 years	18	23.2
51-60 years	11	13.4
Above 60 years	3	3.7
Total	**81**	**100.0**
Marital status		
Divorce	31	37.8
Married	44	54.9
Single	6	7.3
Total	**81**	**100.0**
Residence period class		
1-10 years	23	28.0
11-22 years	35	43.9
21-30 years	12	14.6
Over 30 years	11	13.4
Total	**81**	**100.0**
Educational level		
Post Primary	9	11.0
Tertiary	60	74.4
Non-Formal	12	14.6
Total	**81**	**100.0**

Source: Field survey, (2023)

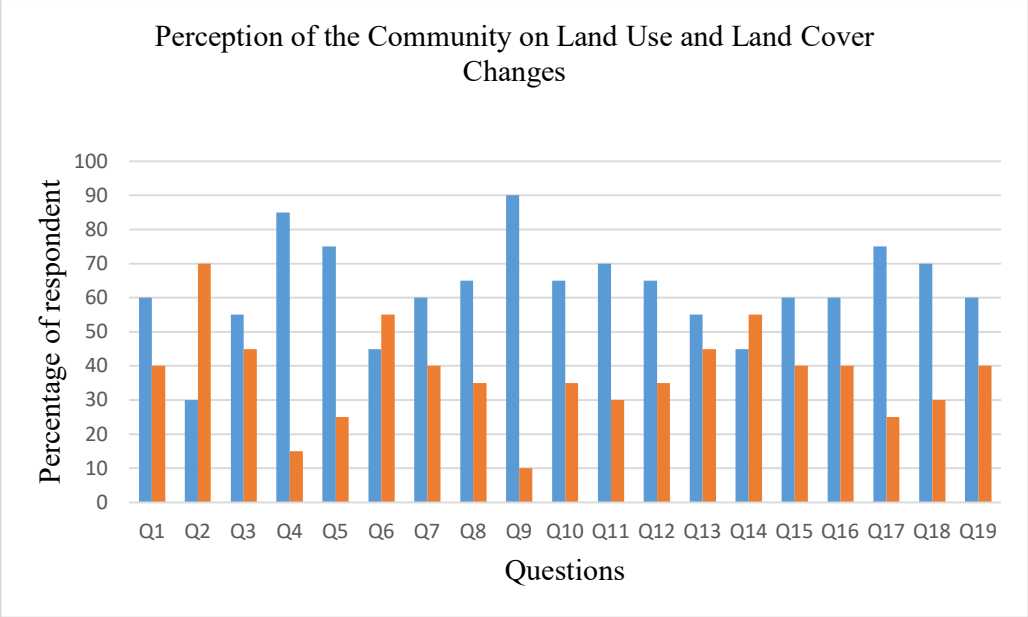

Figure 14: Perception of the Community on Land Use and Land Cover Changes

Location C (Yunusari)

Table 13: Demographic features of the surveyed respondents' results

Sex	**Frequency**	**Percent**
Female	57	70.4
Male	24	29.6
Total	**81**	**100.0**
Age Class		
20-30 years	8	9.9
31-40 years	23	28.4
41-50 years	29	35.8
51-60 years	16	19.8
Above 60 years	5	6.2
Total	**81**	**100.0**
Marital status		
Divorce	26	32.1
Married	33	40.7
Single	22	27.2
Total	**81**	**100.0**
Residence period class		
1-10 years	5	6.2
11-22 years	14	17.3
21-30 years	36	44.4
Over 30 years	26	32.1
Total	**81**	**100**
Educational level		
Primary	4	4.9
Post Primary	20	24.7
Tertiary	29	35.8
Non-Formal	28	34.6
Total	**81**	**100.0**

Source: Field survey, (2023).

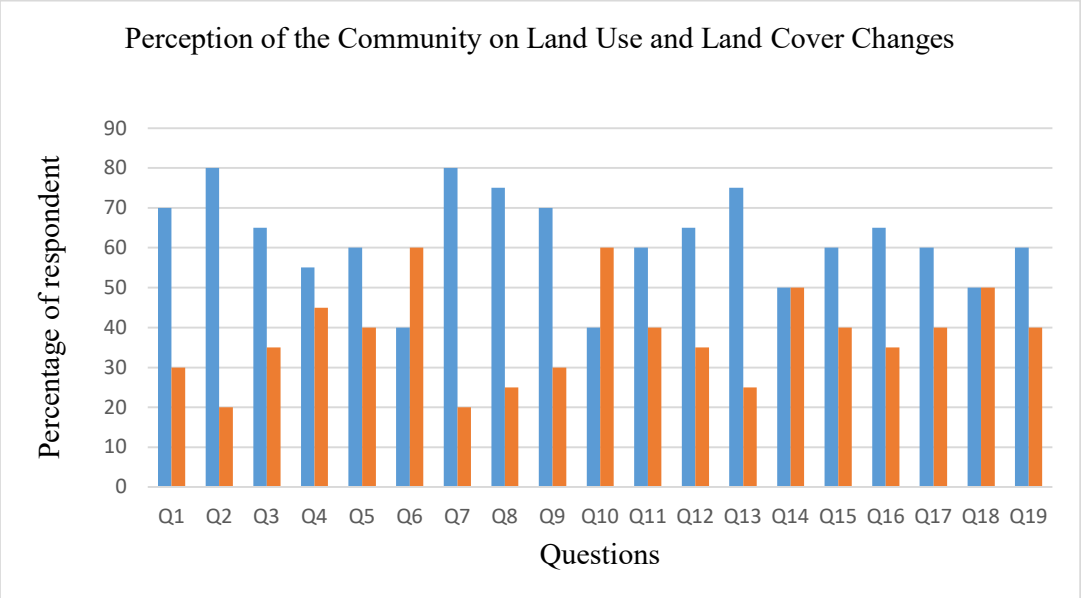

Figure 15: Perception of the Community on Land Use and Land Cover Changes

Table 14: Summary of the number of interviews per village, by period of experience

Village name	5 years' experience		10 years' experience		15 years' experience		Total	
	M	F	M	F	M	F	M	F
Site A (Machina)	18	56	4	10	3	14	25	80
Site B (Yusufari)	3	18	3	7	3	1	9	26
Site C (Yunusari)	3	10	1	8	1	2	5	20
Total	24	84	8	25	7	17	39	126

Source: Field survey, (2023).

Table 15: Summary of village demographics and main Livelihood activities

Village name	Population	Households	Ethnicity	Main livelihoods
Site A (Falmaram)	293	93	Hausa/Kanuri	Logging, shifting cultivation and livestock
Site B (Kachallari)	268	87	Kanuri	Logging, shifting cultivation
Site C (Tarmuwa)	266	49	Kanuri	Logging, shifting cultivation

Source: Field survey, (2023).

Findings

The result obtained from the satellite images clearly indicate most significant changes that occurred over the period understudy include upward trend of bare surface, decline of savannah grassland. There is also upward trend of settlements, decreased in riparian vegetation, drop in farmlands, while other classifications shows no define trend. It was also notice that the increased in bare surface were as a result of Aeolian deposits moving from the Sahara to the North and alluvial deposits by stream channel, which can be observed in the result reflecting from 1998, 2008 and 2018 which show bare surface at 191.5 Km2, 431.5 Km2 and 934.1 Km2 respectively. The damming of River Komadugu – Yobe greatly influence the drainage channels to transport water to areas within the study area that rely mostly on the source of water for livelihood, irrigation and other agricultural activities.

Other land use classes lost are expanding of the Sahara to shrub land with 106.6km^2 during the periods of 2008 – 2018. The research indicates that vegetation cover is spatially distributed with scanty forest stand showing very low variation in species composition in all the location. This implies that species distributions within the ecological zones are determined by climatic and edaphic conditions. Other changes were due to human interference because of Persistent farming, deforestation, over cultivation, over grazing and over exploitation of major resources.

Predominant species found within the study area of high percentage are the *Acacia spps, Guiera senegalensis, Acacia simie, Balanite egyptica, Baobab* etc. The research further analysed that patterns of land cover change were investigated at a 2-km2 grid. It was found that, most of the variation in the vegetation change reflected distance variables resulting from human impact, whereas tree species diversity was explained more strongly by local topographic variables and physical parameter (rainfall).

CONCLUSION

The research work concluded and clearly observed that vegetation cover increases from north toward the south follow the trend of rain fall, over-cutting, over grazing, and other climatic factors, which determines species distribution and this agree with (Cheruto, Kauti, Kisangau, & Kariuki, 2016) findings.During the process of this research findings, it was understood that predominately available species of plants growing within the study area are the Acacia spp. Vegetation degradation is detected more in north boundary Niger republic. This may be attributed to the fact that, the southern flow of the Sahara Desert into the northern part of Nigeria around the study area in addition to people interference within the area may contribute to land degradation and this confirms what (Mmom & Aifesehi, 2013) reported in their work. Land sat image classification, remote sensing, and GPS are effective tools that can be used in assessing information as regard to land use land cover change in almost all study area in respect to vegetation cover. The data analysis for this study shows that land use land cover had been changing through the study zones and this change had negative impact on natural resource development. Vegetation cover across the three locations varied according to variation in land use types and site characteristics, even thus, most of the land characteristics features are same. It will be of immersed important if special consideration in any planned intervention for substantiation of species frequency abundance within the domain will be continue practice.

Finally, it was recommended that: Remote sensing should be periodical used for assessment of land maps chemically, physically or biological vegetative areas, which will enhance adequate monitoring where degradation are taking place. Development of suitable and adequate means of awareness for local community on the importance of species diversity and adoption of agroforestry systems, as well as the continuation of afforestation and reforestation programs. Involvement of local communities in policies, laws, decision-making, processes and participation in management of resources for sustainable use and conservation. Adoption of governmental agricultural policy based on the above-recommended methods of periodical and up-to-date natural resource assessment, which can conserve the land vegetation cover. More research should be conducted to explain site characteristics effects within the study area, and establishing botanical trees garden, protected areas etc to conserve species characteristic. Encouragement of local communities in area of eco-friendly activities such as private and community forest honeybee's production, plantation of valuable trees, horticulture and animal husbandry instead of rained to boost their agriculture productivity. Continua tree planting programmes and government should suggest establishment of closed forest area over time. Coordination and partnership between NGO's, public/private etc., should relate together in solving environmental problems.

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