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PHYSICAL ASSESSMENT AND PREDICTION OF LAKE CHAD AREA, AFRICA

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ABSTRACT

The humanitarian catastrophe in the Lake Chad region is unprecedentedIn terms of scale and complexity, According to the general consensus, the uprising led by Boko Haram has caused a lot of crises. On the other hand, in recent years environmental issues have become increasingly seen as catalysts for violent conflict and humanitarian crises. This indicates that environmental concerns are becoming more polluted. Therefore, in this thesis, the Lake Chad Basin is examined for environmental reasons. In addition, future academic study has shown that environmental challenges are already being securitized and that this is not a successful strategy. Finally, the results indicate the potential risks and opportunities of a securitization strategy and represent new areas of study. Field surveys, observations and interviews are used as basic data sources as a structured questionnaire. Types of data that can assess the socio-economic characteristics of the respondents, the time spent in the area and the environmental and man-made hazards associated with pond farming practices.

In this study, data on vegetation and land use are available from 1999 to 2021. According to USGS data, images used to assess changes in vegetation and land use are selected based on their availability and quality. In fact, the selected images are without cloud cover, which allows to make suspicions about land use patterns in times of doubt. Landshut and ETM + sensors, each with a spatial resolution of 30 m, were used to accurately describe the land use boundaries of the research area during the study period.For the first time, satellite remote sensing images were corrected using ground control points from regional topographic maps with the accuracy of 2-point grids. In order to eliminate errors and provide as accurate results as possible, accurate ground control points were obtained. It is essential that the images be subjected to radiometric adjustment to eliminate the signal difference caused by the replacement of the satellite sensors. NDVI (Standard Variation Vegetation Index), one of the most advanced satellite series, was used to provide control data on the presence and size of vegetation in this study. NDVI is calculated using the following formula.

NDVI= NIR R
NIR R

Vegetation behavior of Near-Infrared (NIR) is mostly used in NDVI computation, as previously reported (R). In fact, the NIR (near infrared) reflection of vegetation is greater than the visible (visible) reflection in red. Although ice, water, and clouds are largely reflected in

the visible wavelength, bare rocks and ground reflect the near-infrared (NIR) wavelength equally. As a result, higher index values indicate better conditions for plant growth, lower values indicate worse conditions such as water and indicators around zero indicate better conditions such as bare soil.

Various methods are used to classify the images in this paper, which can be classified as moderated or moderated classification. The goal of these methods is automated land cover classification, which uses various algorithms to classify pixels in an image. Remote sensing is increasingly using a variety of unattended classification methods. The Interactive Data Self-Organization Analysis (ISODATA) approach is highly structured; Combinations of variable numbers are allowed, but the K-Mean method has a fixed number. When calculating equally distributed categories in data, the maximum probability classification determination method is used. As a result, each iteration updates the classroom and recalculates the tools. This type of action continues until the number of different pixels in each class becomes less than the predetermined amount. In other words, using this method we can gain a basic understanding of the many social classes in the area and how they are distributed. In order to make a supervised classification, field monitoring and data inclusion are required.

Introduction

There is a difference between the water surface on land and the water surface. About three-quarters of the planet's surface is covered by water. The surface of the earth is surrounded by water in various shapes and forms, called bodies of water. There are bodies of water in many shapes and sizes, from vast oceans and seas to small ponds and rivers. A large number of bodies of water can be seen on the surface of the planet. The water is all around us, and they sit on the edge of the water. "They captured our environmental waters." At 13 ° N latitude and 14 ° E longitude with a water capacity of 72 km2 at an average depth of 5 m (4 ft 11 in), Lake Chad, the sixth largest lake in the world, supplies daily water to more than 40 million people in Nigeria, Chad and Cameroon (l7cum) Sahel. Relied on for (Sarch 2001). The approximately 2,500,000 sq km area of the Lake Chad Basin is an inland basin, the largest in the world (8 percent on the African continent) with annual rainfall of more than 1,000 mm / y in the southern part of the Lake Chad Basin each year. The northern section receives less than 100 mm per year (Neil et al. 2005). The Chari / Logan River system is over 90 percent of Lake Chad. The basin covers approximately 300,000 square kilometers of floodplain, making it the eighth largest wetland in the world, despite its semi-arid western part. From about 1960 km to about 300 km2, Lake Chad's area decreased significantly (Singh et al. 2006). This disadvantage had a significant impact on the social and economic well-being of the region (Search & Birkett 2000). Studies by Coe and Foley (2001) and Birkett (2000) show that dry weather causes lakes to shrink. (Campbell 2008). The fact that the deep northern part of the lake completely dried up in the 1980s remains a mystery. The hydrographic basins of Lake Chad are described in Section 1.2. Several sub-basins form the Lake Chad Basin:

At 279 meters, Lake Chad has extraordinary physical features. There are 120 species of fish in Lake Chad. 372 species of birds; And the Kanuri tribe, unique to the Lake Chad region. Chari Logan System: Chari Logan System is the primary water source for the lake. There are two

major rivers in the area: the Chari River and the Logon River. They cover about 25,000 square kilometers of Logan floodplain, the largest of which is the Great Year, covering an area of 8,000 square kilometers. In the Logan flood plain, fishing and fish farming are crucial. (4) Job Basin: The 148,000 km drainage system is an example of aquaculture that loses most of its annual flow due to the Kaumadougou filter and evaporation. World-renowned HadejiaNgur swamps are included. It is Lake Chad, one of the major tributaries of Lake Vitrey. In drought-prone areas, it provides plenty of pasture (Carmouz&Lamoil, 1983).

Biodiversity

Over the past 30 years there have been significant changes in the distribution of precipitation in the Lake Chad Basin, resulting in a significant reduction in the lake's surface area and increased erosion. Due to fluctuations in precipitation, large numbers of people and their livestock were moved up the river, increasing pressure on resources (south). Finally, desertification takes place. Illegal mining activities without dam construction and proper planning have led to problems along the Chad Lake coast. Increasing the frequency of deforestation accelerates deforestation. By the end of 2025, Lake Chad's population is projected to grow from 25 million to 40 million. The development of dams, overfishing and drought affected the fisheries of the area, as well as the use of small nets to collect fingers. There are more than 390 species of birds in the lake basin. The population of black-crowned cranes has declined dramatically in recent years. Kangaroos, lions and other animals can be found in the lake. Crocodiles, waterfowl, waterfowl and squirrels are found in the water.

Material and Method

The type of data collection instrument used is questionnaire, which is reflecting the research objectives and questions, divided into " four " sections A, B, C, D and E. Section A deals with demographic data, Section ‘B’River basin Food Crop Production Potentials ‘C’Yield of food crop in the Lake Chad Basin, Section ‘D’Major Constrains associated with River Basin Food Crop Production and Section ‘E’ The level of environmental problem associated with lake Chad.

Data Collection Procedure

The questionnaire was distributed by the researcher to the sample of the population to fill; the questionnaire was collected over a period of a year and satellite data from united state geologic survey (USGS) for the period of 22 years

Data Required and Sources

The following information will be used in this study:

The basic data source consists of field survey, observations and interviews using a structured questionnaire, Types of data that can assess the socio-economic characteristics of the respondents, The time spent in the area and the environmental and man-made hazards associated with the farming practices of the ponds.

In this study, data on vegetation and land use cover the period from 1999 to 2021. According to USGS data, images used to assess changes in vegetation and land use are selected based on their availability and quality. In fact, the selected images are without cloud cover, which allows to make suspicions about land use patterns in times of doubt. LandshotTM and ETM + sensors, each with a spatial resolution of 30 m, were used to accurately describe the land use boundaries of the research area during the study period.For the first time, satellite remote sensing images were corrected using ground control points from regional topographic maps with the accuracy of 2-point grids. In order to eliminate errors and provide as accurate results as possible, accurate ground control points were obtained. It is essential that the images be subjected to radiometric adjustment to eliminate the signal difference caused by the replacement of the satellite sensors. NDVI (Standard Variation Vegetation Index), one of the most advanced satellite series, was used to provide control data on the presence and size of vegetation in this study.

Vegetation behavior of Near-Infrared (NIR) is mostly used in NDVI computation, as previously reported (R). In fact, the NIR (near infrared) reflection of vegetation is greater than the visible (visible) reflection in red. Although ice, water, and clouds are largely reflected in the visible wavelength, bare rocks and ground reflect the near-infrared (NIR) wavelength equally. When it comes to plant growth conditions, the index shows high values for water, while water has negative values and arid soils have an index close to zero, other values show area coverage and differences in green vegetation status.

Various methods are used to classify the images in this paper, which can be classified as non-moderated or moderated. The goal of these methods is automated land cover classification, which uses various algorithms to classify pixels in an image. Remote sensing is increasingly using a variety of unattended classification methods. The Interactive Data Self-Organization Analysis (ISODATA) approach is highly structured; Combinations of variable numbers are allowed, but the K-Mean method has a fixed number. When calculating equally distributed categories in data, the maximum probability classification determination method is used. As a result, each iteration updates the classroom and recalculates the tools. This process is repeated until the number of pixels in each category exceeds a certain amount, in other words, using this method we can gain a basic Understanding of the many social classes in the area and how they are distributed. In order to make Unsupervised classification, field monitoring and data inclusion are required.

Table 1: Data used and their sources

Type	Format	Resolution/scale	Date	Source
Landsat TM Image (2010)	Raster	30 m	20/06/2021	Web site GLCF
Landsat ETM+ Image (1999)	Raster	30 m	07/08/1999	Web site GLCF
Landsat ETM+ Image (2013)	Raster	30 m	06/04/2013	Web site GLCF

Landsat TM Image (2001)	Raster	30 m	07/05/2001	Web site GLCF
Watershed	Shapefile	-	-	ArcGIS
DEM ASTER	Raster	30 m	-	Raissouni., 2012
Topographical maps	JPEG	1/50000	-	-
Google Earth imagery	JPEG	-	06/12/2013	Google Earth

Ancillary Data and Software Packages

Regional topographic map, geological map, socio-economic map, meteorological data and all background layers are generated in the GIS environment on a scale of 1: 25,000. The software packages used in this research are ERDAS 10.0 and ARCGIS 10.7 for image processing, to analyze and display the result. The Statistical Package (SPSS 20.5) for Statistical Graphics, NCSS and Social Sciences have been used in this research.

Image Mosaicking

Because of the large extent of Lake Chad images for the separate dates had to be mosaicked together. In all, fifteen separate images were mosaicked together.

Clipping and Classification

After the images were registered, they were clipped down to a smaller size using a custom-built region of interest or ROI based on the 1975 image and applied to the other three dates. An Unsupervised K-Means post classification was then performed to identify the classes' barren land, water, vegetation, agricultural land and others

Result and Discussion

The reported the results of Land Use Land Cover changes in Lake Chad and its environs from 1991 to 2021, a 30-year period beginning in 1991 and ending in 2021. The results show a number of significant LULC changes in this area. Growth in pastures for agriculture and livestock seems to be the most important of these changes. The total area of these two LULCs was only 0.38% in 1991. By 2021, they will cover 41% of the land, while forest, savanna and grassland will decrease from 23% to about 7.40%. Wetlands, which accounted for 14% of the total land area in 1991 and less than 3% in 2021, have also declined significantly. In the following sections, we will examine in more depth the changes that have taken place in the various land uses.

Floating Planets

The lakes and rivers in the picture are classified as bodies of water. In 1991, they represented 10.98392895 per cent of the total area; In 2001, 9.450452364 per cent; In 2003, 7.619392504 per cent; In 2021, 6.51238215 per cent. Compared to the baseline, the result is a slight increase (0.18 - 0.49 percent) in water resources in the areas identified on the map. These changes may be the result of changing rainfall patterns in the region.

Agricultural Land and Grasslands

The total area under agriculture and pasture increased from 1.733244807 in 1991 to 2.100153107 in 2001 and 2.281536419 in 2013. In 2021, it will be approximately 2.737455154. During the same period, they were 0.38 per cent, 8.90 per cent and 41.05 per cent. Human activities such as agriculture, fodder and timber energy can contribute to deforestation, as evidenced by the growing proportion of farmland and grassland and the declining proportion of trees and shrubs. Growing population and livestock need more space to meet food security needs. According to FAOSTAT data analyzed in 2012, from 1980 to 2011, Chad's population increased from 4.554,000 million to 11,525,000 million. Pearson has a relatively significant correlation with agricultural land population (0.412). This suggests that population growth in Chad was a major factor in increasing the acreage of agricultural land during the research period. According to Bourne and Wyent (1994) there is a clear relationship between livestock biomass and human existence. They concluded that agriculture and rural livelihood were the most important factors in determining the location of Livestock. In the 35 years to 1996, according to Taylor et al., Agricultural coverage in Sahel increased from 5 percent to 14 percent. (2002)

Vegetation

Trees, perennial bunchgrasses and grasslands, legumes, and shrubs with a life expectancy of at least 5 years are considered permanent vegetative cover. In the lake Chad area vegetation covers about 16.44715432% in 1991 and in 2001 16.39723718 percent while in 201316.5682236% and it covers about16.63132188% in 2021 with clear changes the vegetation has increase due the number of population and animal grazing has reduced in the lake shore because of the insurgency.

Agricultural land

Lake Chad and its surroundings have been studied in the past from 1991 to 2021. There have been many significant changes in LULC in this area. The most important of these changes is expansion. In agricultural and animal pastures. In 1991, the joint area of these two LULCs was only 0.38%. It will cover 41% of the area by 2021, but forests, savannahs and grasslands will decrease from 23% to about 7.40%. Large. Later, we will explain in more detail how land use has changed over time.

Planets Floating in Space

There are many lakes and rivers that are considered water in the picture. It was 10.98392895% of the total area in 1991; 9.450452364 per cent in 2001; 7.619392504 per cent in 2003; And 6.51238215 per cent in 2021. There is a slight increase in water resources in the areas shown on the map compared to the baseline. The rainfall patterns of the area may be responsible for these changes.

Gardens and Arable Land

Agriculture and pasture increased from 1,733,244,807 acres in 1991 to 2,100,0153,107 acres in 2001, cultivating a total of 2,281,536,419 acres in 2013. It is expected to reach 2,1537450 per cent with 2,1537450 per cent. The increase of 8.90 per cent and 41.05 per cent was attributed to the increase in the area of arable agricultural lands and grasslands and the decrease in the proportion of trees to human activities such as agriculture, fodder production and use. Wood for energy Production. More land is needed to meet the growing population and livestock needs for food. According to FAOSTAT data examined in 2012, from 1980 to 2011, Chad's population increased from 4.554,000 million to 11,525,000 million. It is safe to say that there was a strong relationship between the Pearson relationship and the agricultural land population (0.412). As Chad's population increased during the study period, so did the area of agricultural land. Studies by Bourne and Wyand (1994) have shown that animal biomaterials are directly related to human well-being. They concluded that agriculture and rural life were very important variables in identifying animals. According to Taylor et al., Agricultural coverage in Sahel increased from 35% in 1996 to 14% in 1996 (2002).

Table 1.1 land use land cover change matrix

Class	Pixel Sum	Percentage %	Area [meters^2]	Area km2
Water bodies	6173972	10.98392895	5556574800	5556.5748
Grassland	974242	1.733244807	876817800	876.8178
Vegetation	9244804	16.44715432	8320323600	8320.3236
Agriculture land	707283	1.258306034	636554700	636.5547
Settlement	5136	0.009137304	4622400	4.6224

Desertification	5849128	10.4060087	5264215200	5264.2152
Fallow land	3355103	5.968963411	3019592700	3019.5927

Source satellite data

Fig. 1: Land use land cover change matrix chart

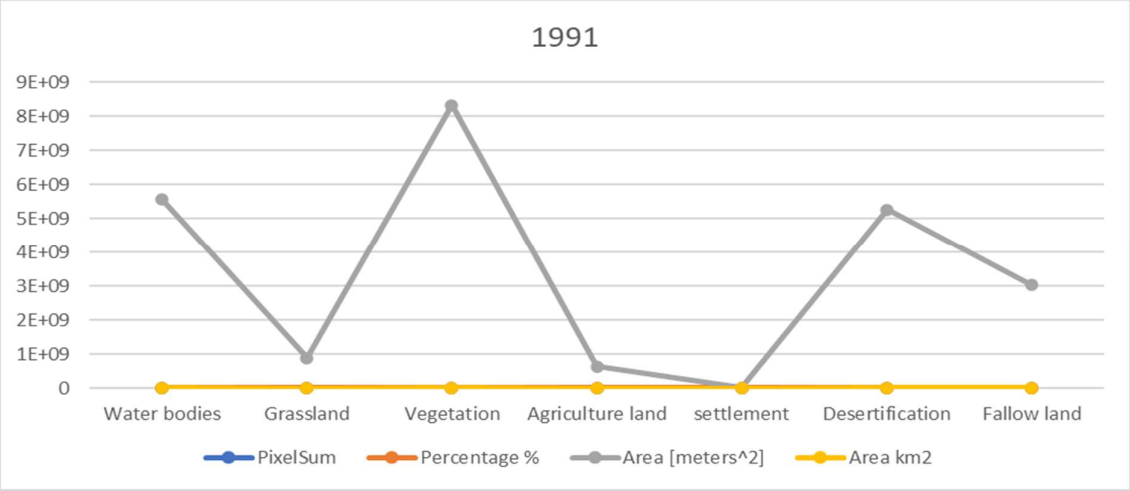


Table 1.2Land use land cover change matrix

Class	Pixel Sum	Percentage %	Area [meters^2]	area km2
Waterbodies	5312018	9.450452364	4780816200	4780.816
Grassland	1180478	2.100153107	1062430200	1062.43
Vegetation	9216746	16.39723718	8295071400	8295.071
Agriculture land	832575	1.481209284	749317500	749.3175
Settlement	12972	0.023078097	11674800	11.6748
Desertification	6157162	10.95402278	5541445800	5541.446
Fallow land	3597717	6.400590722	3237945300	3237.945

Source satellite data

Figure 3 Land use land cover change matrix chart

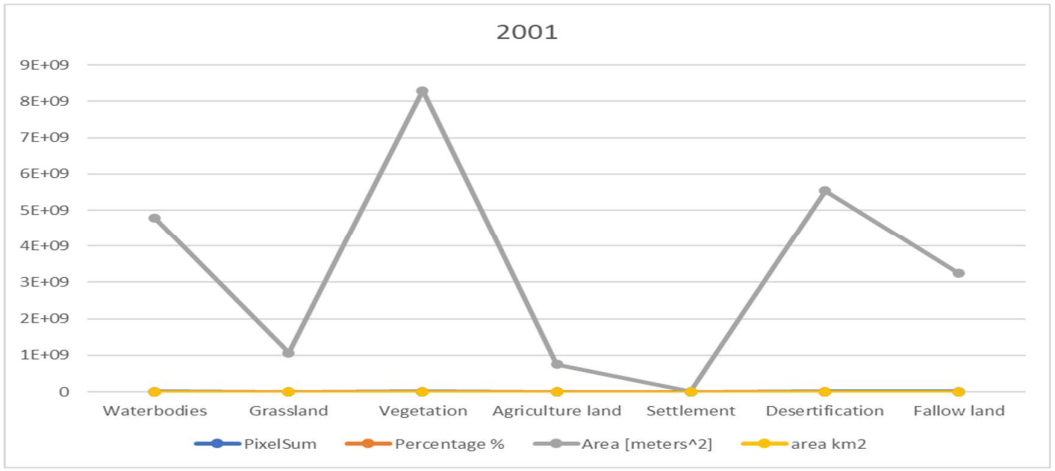


Table 1.3 land use land cover change matrix

Class	Pixel Sum	Percentage %	Area [meters^2]	Area km^2
Water bodies	4282795	7.619392504	3854515500	3854.5155
Grassland	1282432	2.281536419	1154188800	1154.1888
Vegetation	9312856	16.5682236	8381570400	8381.5704
Agriculture land	968174	1.722449409	871356600	871.3566
Settlement	35508	0.063171221	31957200	31.9572
Desertification	6299352	11.20698876	5669416800	5669.4168
Fallow land	4128551	7.344981617	3715695900	3715.6959

Source satellite data

Figure 4 Land use land cover change matrix chart

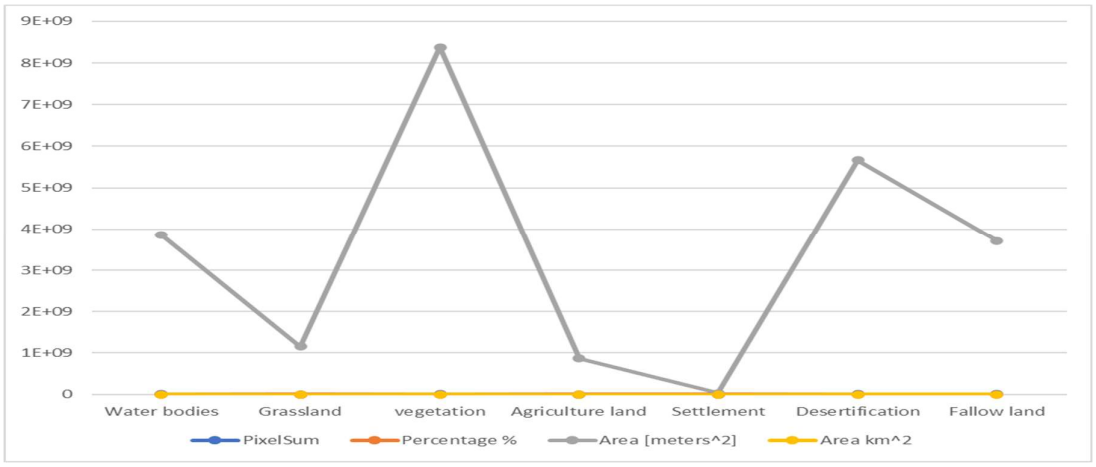


Table 1.4 land use land cover change matrix

Class	Pixel Sum	Percentage %	Area [metre^2]	Area [km^2]
Waterbodies	3660554	6.51238215	3294498600	3294.4986
Grassland	1538700	2.737455154	1384830000	1384.83
Vegetation	9348323	16.63132188	8413490700	8413.4907
Agriculture land	1063516	1.89206951	957164400	957.1644
Settlement	150191	0.267200317	135171900	135.1719
Desertification	6454585	11.48315914	5809126500	5809.1265
Fallow land	4093799	7.283155373	3684419100	3684.4191

Figure 5 Land use land cover change matrix chart

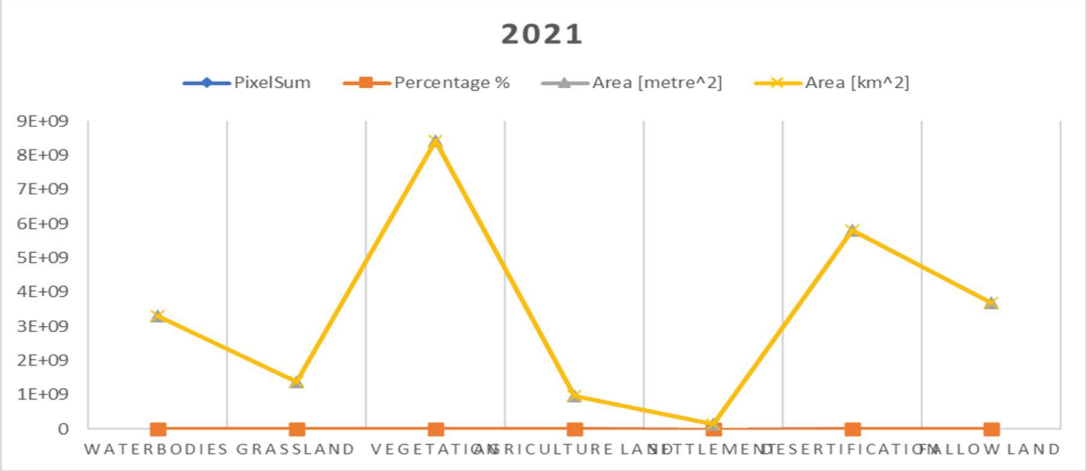


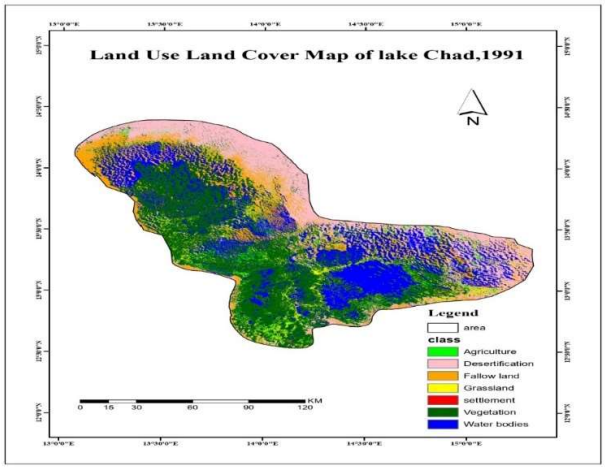
Table 1.5 land use land cover transformation

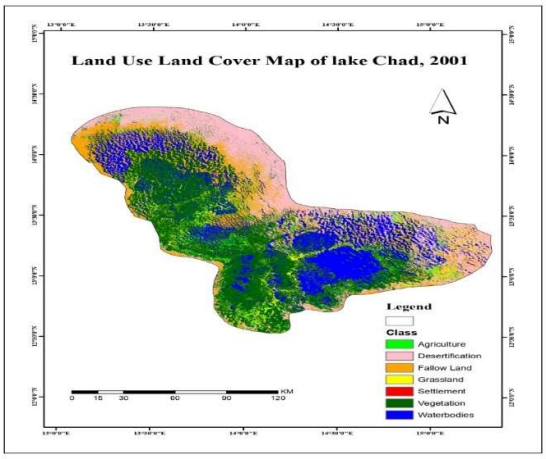
1991 Area [km^2]		2001 Area [km^2]	2011 Area [km^2]	2020 Area [km^2]
Water bodies	5556.5748	4780.816	3854.5155	3294.4986
Grass land	876.8178	1062.43	1154.1888	1384.83
Vegetation	8320.3236	8295.071	8381.5704	8413.4907
Agricultural land	636.5547	749.3175	871.3566	957.1644

Settlement	4.6224	11.6748	31.9572	135.1719
Desertification	5264.2152	5541.446	5669.4168	5809.1265
Fallow land	3019.5927	3237.945	3715.6959	3684.4191

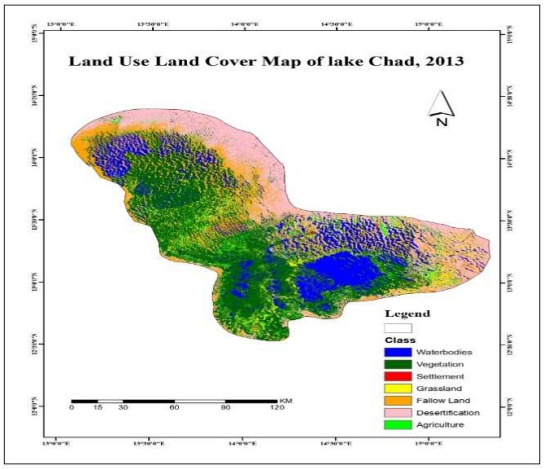
Source satellite data

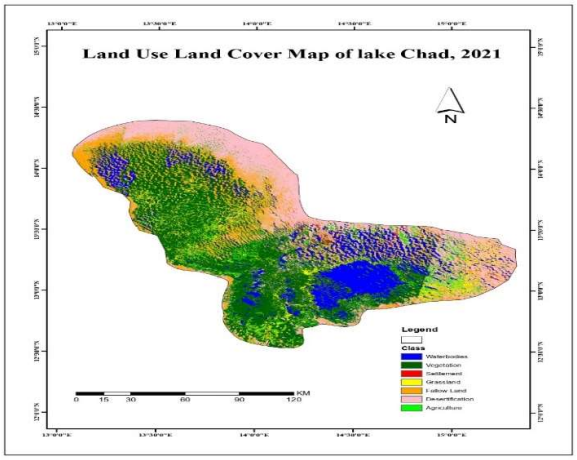
The Series of Land Use Land Cover Map of Lake Chad 1991 and 2001





The Series of Land Use Land Cover Map of Lake Chad 2013 and 2021





Future Land Use Land Cover Prediction

2030 is projected to be the transition year of Land Use Land Cover. For the years 1991-2030, future potential percentages of Land Use Land Cover changes were examined using the change probability matrix. The Markov chain and the MLP neural network provide modification and spatial distribution for Land Use Land Cover prediction in LCM, respectively. Future Land Use Land Cover images of Watershed from LCM are shown. The change percentage and rate of the covered area are also included in the table. The figure below shows the total increase or decrease of Land Use Land Cover.

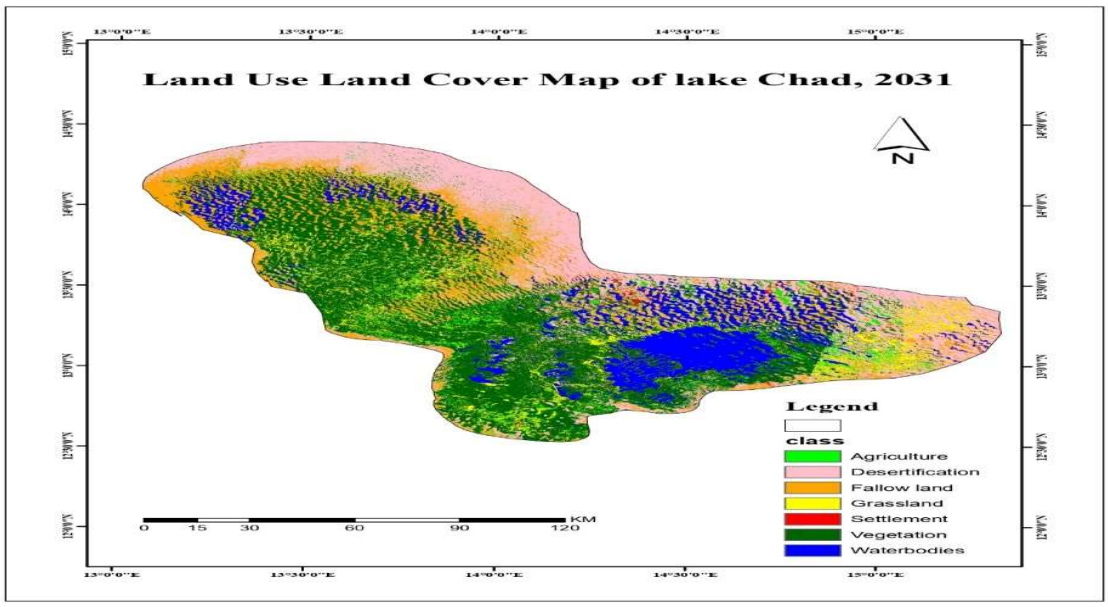
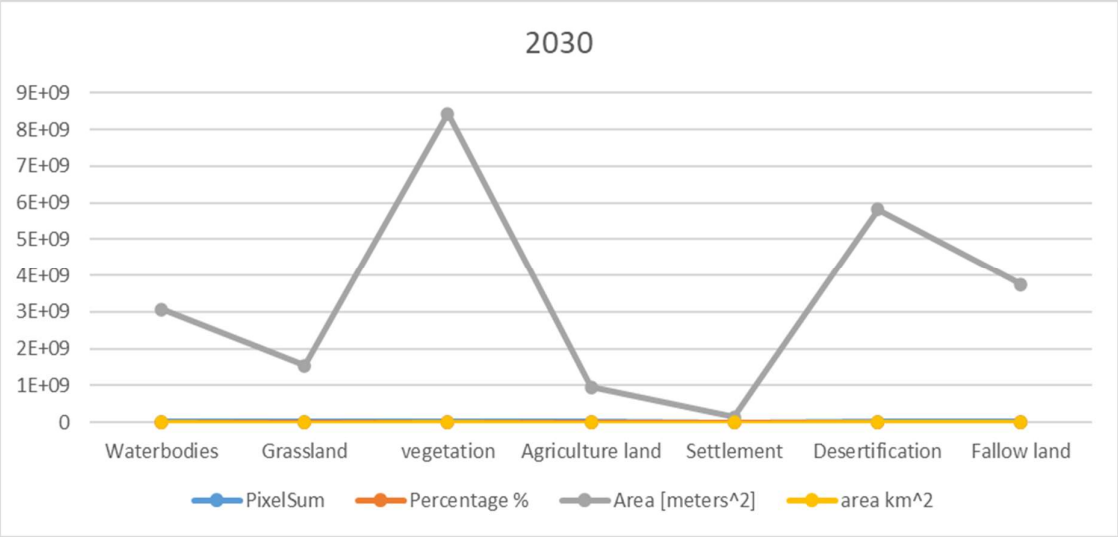


Table 1.6 land Use land cover prediction for 2030

Class	Pixel Sum	Percentage %	Area [meters^2]	area km^2
Waterbodies	3398095	6.045449192	3058285500	3058.286
Grassland	1714209	3.049697967	1542788100	1542.788
Vegetation	9362958	16.65735857	8426662200	8426.662
Agriculture land	1063516	1.89206951	957164400	957.1644
Settlement	146995	0.261514409	132295500	132.2955
Desertification	6457781	11.48884505	5812002900	5812.003
Fallow land	4166114	7.411808827	3749502600	3749.503

Figure 6 Land use land cover change matrix chart



The results of the change study show that Land Use Land Cover changed significantly between 1991 and 2030. Most Land Use Land Cover species are water dependent. The results show that the area of water resources has increased from 9.450452364 per cent in 1990 to 6.045449192 per cent by 2030. This is largely due to the conversion of grasslands, meadows and forests. Between 1990 and 2030, the area of farmland gradually increased. Elsewhere, this significant change shows that water resources continue to decline, from 5,968,963,411 per cent in 1991 to 7,411,808,827 Per cent by 2030, while the increase in water resources from 10.406,087 per cent in 1991 to 2030 and the settlement minor in 1991 to 0.009137304 per cent in 2030. Vegetation, which is now 16.44715432 per cent, will grow slightly by 16.65735857 per cent by 2021.

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