GEOSPATIAL ASSESSMENT OF CHANGES IN FISHING GROUNDS OF THE NIGERIAN PORTION OF THE LAKE CHAD

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Abstract

Geospatial assessment of changes in fishing grounds of the Nigerian portion of the Lake Chad was carried out. The aim was to investigate the fishing grounds, types of fishing gears and the species of fish caught in the site .Remotely sensed data and GIS technique were used to assess the changes in fishing grounds of the Nigerian portion of the Lake Chad. Satellite imageries of the study area were used for this research. The satellite data were processed and analyzed using GIS software packages, ground truth exercise was also conducted in order to ascertain the reality of some generated information from the remotely sensed data. Likewise information on types of gear used in the fishing grounds and the types of fish caught in the fishing grounds were obtained from fishermen through Focus Group Discussion. The result revealed that open water and swampy area were identified as the fishing grounds in the study area. While the trends show that open water have been changing over time, where in 1999 it covers about 17.20% of the Nigerian portion of the Lake Chad. And in 2013 it covers about 6% of the study area. While swampy area as a fishing ground was stable, and it covers most part of the study area than other

classes. The result also revealed that, there were some specific fishing gears (such as Malian trap, Hooks and nets) and types of fishes (such as Tilapia, Cat fish and long fish) that are caught in those fishing grounds.

Keywords: Geospatial, Landcover change, Fishing ground and Lake Chad

Introduction

Change in fishing ground denotes changes in the fishing grounds in relation to time and space as a result of the changing behavior of the Lake Chad overtime, while fishing grounds are areas in a body of water where fishes congregate and fishing is usually good (www.merrian-webster.com). Lake Chad as a water body is located within the Sahelian region of Africa has been a source of livelihood to the inhabitants of the region. The size of the lake largely depends on the availability of rain in the southern highlands bordering the basin and the high temperature in the Sahel region. The fluctuation in these parameters directly brings changes in the surface area of the Lake Chad (Lake Chad Basin Commission, 2005). The changes in the behavior of the Lake Chad affects the socio-economic activities of the inhabitants that directly rely on the lake such as farming, fishing, cattle rearing as well as water transportation (Usman, Ikusemoran, Elizabeth and Joel, 2016). Despite the fact that fishing activities is throughout the year, the seasonality in the behavior of the Lake Chad has influence on fishing activities.

One of the prime prerequisite for better understanding of landcover is information on existing landcover pattern and changes in the landcover through time (Ikusemoran 2014). For current and accurate information on landcover change, the use of remote sensing (RS) and geographic information system is very vital (Elizabeth, 2016). Remote sensing technology identifies and understands the object or the environmental condition through uniqueness of its reflection or emission (that is spectral response patterns), (Japan Association of Remote Sensing, 1996). According to Ellis (2012), sited in Elizabeth (2016) remote sensing is an essential tool of land-change science because it facilitates observation across larger extents of earth's surface than is possible by ground-based observations. While GIS is a computer assisted technique used for creating, maintaining and querying electronic data bases of information normally displayed on maps (Elizabeth, 2016). With the use of GIS technique, it has been simple to delimit and monitor the landcover changes in an area by acquiring the historical as well as the most current data from satellite images (Sambi 2010).

It has been observed that, despite the shrinkage of the Lake Chad, fishermen are seeing devising various methods and strategies in fishing around the Nigerian portion of the Lake Chad, these fishermen try to fish in the areas where vegetation on the lake is overwhelming using different fishing gears and catching various species of fish. In view of the fact that the Lake Chad is not stable and its instability has influence on fishing grounds, there

is need to identify the fishing grounds, the various types of fishing gears used, species of fish and examined the trend of changes in the fishing grounds of the Nigerian portion of the Lake Chad using satellite images from 1979 – 2013.

Study Area

Lake Chad is bounded in the north by Chad Republic, in the east by Cameroun Republic, south by Nigeria and in the north-west by Niger Republic. The Chari River and the Logone River provide over 90% of the Lake Chad's water with a small amount coming from Yobe River Nigeria (LCBC 2005). The Lake Chad portion of Nigeria is situated within latitude 12˚22′ and 13˚45′N and longitude 13˚05′ and 15˚35′E, as shown in fig.1.

According to LCBC (2005), there is a considerable shift in the rainfall pattern in the Lake Chad region as a whole in the past 35 years which resulted into a reduction of the rainfall southward. (Sambi, 2010). The annual maximum temperatures are as high as 35-40ºC particularly in the Northern parts of the region (Notter, MacMillan, Viviroli, Weingatner and Liniger, 2007). The vegetation of Lake Chad region according to Sarch (2000) in Ayuba and Dami (2011) is made up of woodland species, however northward the woodland gradually reduces to few trees and shrubs. The presence of the Lake Chad supports human population of approximately 20 million and 18million units of livestock (including cattle, goats and sheep, camel and donkeys) (Ayuba and Dami 2011).

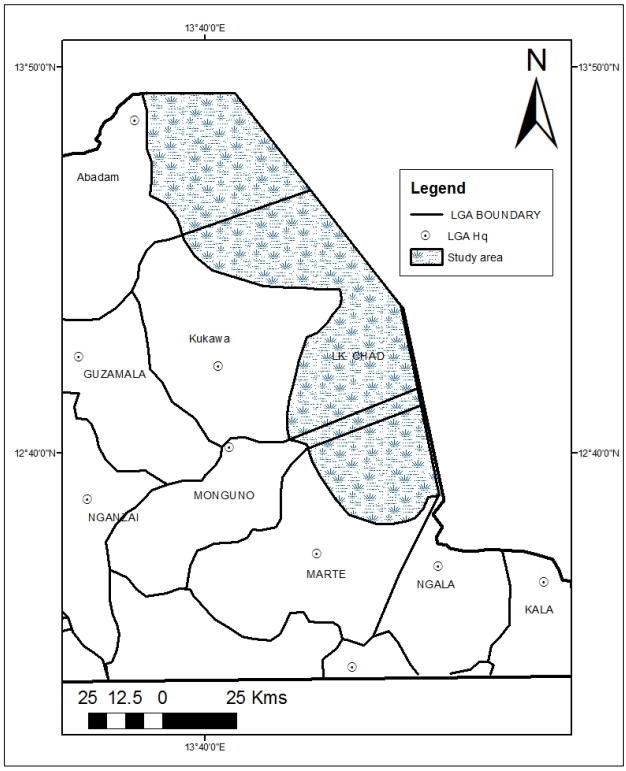


Fig 1 Map showing the Nigerian portion of the Lake Chad

Methodology

In this study four satellite images from Landsat MSS, TM, and ETM+ covering the entire Nigerian portion of the Lake Chad from 1979 to 2013 were acquired. The satellite images were captured between the months of November (when the lake water is relatively high). These satellite images were imported to Ilwis 3.3 (Integrated Land and

Water Information System) software. These images were processed (color composite), then geo-referenced, resampled and sub-mapped to the area of interest. The sub-mapped images were exported to ArcGIS 9.3 where the images were extracted (extraction by mask) using the polygon of the digitized map of the study area. The extraction was done so that it will confirm to the shape and size of the area of interest so that the image will have equal area when they are calculated. The extracted satellite images were exported to ENVI (Environmental for Visualization of Images) software and were classified (supervised classification using maximum likelihood) into different classes that corresponds to the actual phenomenon on the ground through ground truth exercise. The classes include; open water, bare surface, scattered vegetation and swampy area. The classified images were then exported to Idrisi Taiga (software) where area calculations (in kilometer) of the various classes were achieved.

Ground-thruthing exercise was conducted in the study area, ground-thruthing in remote sensing and GIS is a method of confirmation of some features on the satellite image by identifying that actual feature on the earth surface. The observed features were then compared to the features on the satellite images so as to make the necessary corrections. GPS was also used to compare the identified features on the satellite imageries and what the actual features of that same coordinate is on the earth surface.

Information on fishing grounds, types of fish caught and fishing gears used in fishing were obtained through Focus Group Discussion. Two Focus Group Discussion were conducted from the fishing settlements (Fish Dam and Fay Dondiya) that are close to the lake comprising 7-10 people that were purposively selected (Fishermen).

Results and Discussion

Trends of Changes in Fishing Grounds of the Nigerian portion of the Lake Chad

The fishing grounds on the Nigerian portion of the Lake Chad are open water fishing ground and swampy fishing ground. According to the fishermen, in the previous decades, the Nigerian portion of the Lake Chad was not covered with swamps, but rather open water, this was confirmed by Fortnam and Oguntola, (2004), who stated that, in 1963, the entire Lake Chad was covered by open water which covered approximately 23,000km^2 and each basin (the northern and the southern basin or pool) were connected by water. Now, the major part of the Nigerian portion of the Lake Chad is covered by swamps and this swamp does not discourage the fishermen from fishing as long as there is water under the swamp. The classified images as shown in fig 2-5 show the various classes of landcover of the Nigerian portion of the Lake Chad. These classes include; open water, bare surface, scattered vegetation, and swampy area. The classified images show difference or changes in the behavior of the lake, which either brings reduction

or increment in various classes of landcover in the different study periods.

The size of the fishing grounds were not stable; it fluctuates in the different study periods, fig 2 shows open water is concentrated in the northern, middle and the southern part of the study area, while swamp was distributed almost all over the study area. In 1979, open water covered about 12.90% (table 1), it drastically reduced to 6.65% in 1987, indicating reduction in the size of open water in the study period and it can be seen that the open water was restricted in the southern (fig 3) pool of the lake, this agree with the work of Fortnam and Oguntola, (2004), who stated that, in 1987, the effect of both the 1972-74 and 1982 Sahelian droughts have resulted in open water being restricted to the southern pool only. Open water, subsequently increases to 17.20% in 1999, which was the highest in the study periods, it was distributed all over the study area (fig 4) including the fringes of the study area. The increment of the Lake Chad was also reported in the findings of Taiye (2005). His findings revealed that, the size of the lake starts to increase in 1997 from about 4837 Km^2 to 7558 Km^2 in 1999. L Hote, Mahe and Triboulet (2002) and Dai, Lamb, Trenberth, Hulme, Jones and Xie (2004) also reported that, there was an increment in open water in the 90s than compared to the 70s and 80s. The findings of Fortnam and Oguntola (2004) also shows that, in 1997, there was little variation over the previous decade with open water estimated to vary inter-annually in area between 1500 to 2000km^2, plus a large surrounding area of mixed permanent and

temporary swamp land of between 2000-4000km² (entire lake). While in 2013open water was distributed in the southern portion of the study area (fig 5). Open water drops to 5.94% of the study area and which was the lowest in the entire study periods.

In 1979, swampy area as fishing ground was about 56.70% of the study area (table 1), it later increased to 60.71% in 1987. This was also observed by LCBC (2005) that there was an increase in vegetation on the entire lake in the 70s and 80s. In 1999 swampy area reduced to 51.52% which was the lowest percent in the study periods, while in 2013 it increases to 56.31% of the study area.

The changes in swampy area was not quite much compared to open water during the study periods, this indicates that swampy area as a fishing ground is more stable. This change in fishing grounds imply that the fishermen in the Nigerian portion of the Lake Chad use more of fishing gears that is meant for fishing in the swampy area.

Table 3 Landcover change of the Nigerian portion of Lake Chad

Landcover	1979 Area (Km²)	%	1987 Area (Km²)	%	1999 Area (Km²)	%	2013 Area (Km²)	%
Open water	601.69	12.90	310.30	6.65	801.88	17.20	267.84	5.94
Bare surface	494.28	10.60	543.64	11.66	391.63	8.40	441.51	7.80
Scattered Vegetation	923.05	19.80	978.20	20.98	1067.10	22.88	1327.79	28.47
Swamp	2643.99	56.70	2830.87	60.71	2402.4	51.52	2625.87	56.31
Total	4663.01	100	4663.01	100	4663.01	100	4663.01	100

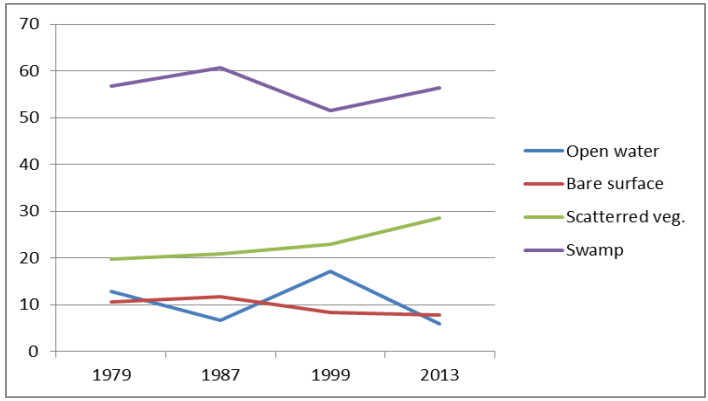


Fig.2 Trend of Landuse and Landcover Change (In Percentage)

Types of Fishing Gears use in the Fishing Grounds of the study area

Fishing activities in the Nigerian portion of the Lake Chad involved the use of simple gear, equipment and fishing methods. Fishing traps are mostly used in the lake than fishing nets; this may be due to the shallowness of the lake, though there is no scientific data supporting this claim (Agbelege, 2001). Another reason according to the fishermen is the presence of swamp (various types of floating and non-floating plants) which covers almost the entire Nigerian portion of the Lake Chad. This makes the fishermen to use fishing traps than the fishing nets. The fishing gears as identified in this research that were used for fishing in the open water fishing grounds includes; Gill net, Long line hooks, Cast net (Taru), Sein net, Homa, draw net, clap net, and Heri. While the fishing gears that were used in swampy fishing grounds includes; Malian trap (Gura), Ndurutu, Hook and line, Fishing spear, Gill net.

Types of Fish that are caught on the Fishing Grounds

The types of fish caught in the fishing grounds of the Nigerian portion of the Lake Chad is shown in tables 1and 2.

Table 1 Types of Fish caught in swampy fishing ground of the study area

Local Name	English Name	Scientific Name
Tarwada	North African Catfish	*Clarias Gariepinus*
Karfasa	Tilapia	*Tilapia spp*
Dummi	African Carps	*Labeo Senegale*
Rado	Trunk Fishes	*Mormyrops macrophthalamus*
Gartsa	Sail-fins of Bichirs	*Polypterus spp*
Gaiwa/Bunyigil	Lung Fish	*African Lung Fish*
Tufi	Snake Head	*Parachanna Africana*
Kurungu	Squeker (Cat fish)	*Synodontis Spp*

Source: Field work 2015

Table 2: Types of Fish caught in open water fishing ground of the study area

Local Name	English Name	Scientific Name
Bariya, zawai, Tsage	Tiger Fish	*Hydrocynus spp*
Musco	-	-
Tsaro	-	-
Faliya	Moon fish	*Citharinus Citharus*
Karaya	Butter fish	*Schilbe spp*
Lulu	Butter fish	*Schilbe mystus*
Talbombom	Puffer fish	*Tetraodon lineatus*
Dunkururubi	Catfish	*Auchenoglanis spp*
Youni/Dan sarki	Aba (Trunk fish)	*Gymnarchus Niloticus*
Mijiriya	Electric Fish	*Malapterurus electircus*
Romboshi	Mud Catfish	*Hetetrobrancus*
Bargi	African Bony Fish	*Heterotis niloticus*
Taga rana	*Clupeid*	*Pellonula atzeliusi*
Giwan Ruwa	Nile Perch	*Lates Niloticus*
Karfasa	Tilapia	*Tilapia Spp*
Dinko	Bayad	*Bagrus bajad*

Source: Field work 2015

Conclusion

The findings in this research identified two fishing grounds in the study area, that is open water and swampy area (Floating and non-floating plants). Trend of changes in the landcover class shows that open water have been fluctuating in the study periods, while swamp was more stable throughout the study periods. The findings also revealed that, there were specific fishing gears that are meant for catching fish in the fishing grounds, likewise there are specific fishes that are commonly caught in these fishing grounds. The use of remote sensed data and application of GIS technique for analysis have helped in further understanding of the dynamics in landcover. Therefore it can be concluded that the Nigerian portion of the Lake Chad is changing periodically. The plan to resuscitate the Lake Chad via River Oubangui should be sustained; this will make the Lake Chad to be stable

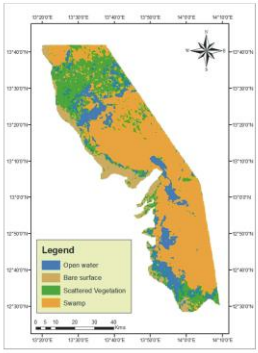
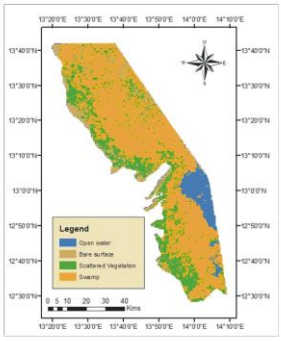


Fig. 2 1979 Landcover map of the study area



1987 Landcover map of the study

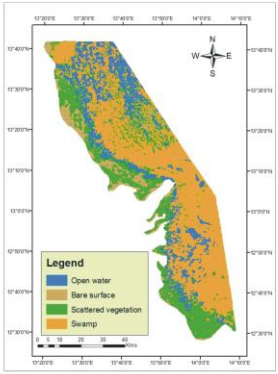


Fig. 4 1999 Landcover map of the study area

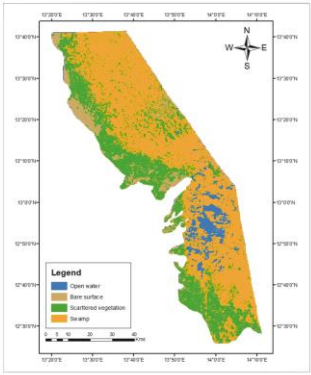


Fig. 5 2013 Landcover map of the study area

Source: Earth Science Data Interface

Classified map of the study area

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Indices