

An Assessment of the Influence of Climate Change on Morphology and vegetation of Billiri/Kaltungo Land Use Gombe State Nigeria, Remote Sensing and GIS Approach

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Abstract: *Urban growth in population has been a major factor that alters natural morphology and vegetation on an area. This paper presents research result on Influence of Climate Change on Morphology and vegetation of Billiri/Kaltungo Land Use Gombe State Nigeria, Remote Sensing and GIS Approach. The goal is to determine the consequences of various climatic changes on land form and vegetation alteration over the period from 1986 to 2005 (19 years). Data on climate (temperature and rainfall) were obtained for two decades from Nigeria meteorological Agency and State Ministry of Agricultural Development Project in order to determine climatic variation over time. Satellite images of 1986 and 2005 were acquired and classified into four categories. Data on the total farmlands, altered morphology and vegetation sizes of the classified Land sat image (ETM+) were generated from EDRISI TAIGA. Change detection analysis by area difference on the morphology revealed significant changes in the areas land use and land cover had occurred between 1986 and 2005 as shown on the table 4. Information obtained from the classified imageries of 1986 and 2005 of Billiri and Kaltungo LGA of Gombe State, indicated that there was an increase in land sizes for agricultural use by 41.858 hectares respectively. While vegetation cover had reduced by -72.125 hectares between 1986 - 2005. Based on the following findings it was recommended that; The Nigerian Government and all the stakeholders involved in the climate change issues should increase public awareness, promote research and establish a commission or an agency that will handle issues related to impacts of climate change on land forms and crop yield in the study area.*

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I. Introduction

Urban growth in population has been a major factor that alters natural morphology, through anthropogenic activities which in turn resulted to climate change. This has serious timely effects on vegetation cover. The results of these have left significant effects on local weather and climate.

Climate variability or change has a direct, often adverse effect that influences the quantity and quality of geomorphic features eventually alter agricultural production. The climate of an area is highly correlated to the morphology and vegetation cover by extension of the type of crop that can be cultivated. Temperature, rainfall, and relative humidity, were consider greatly and specifically in this research among other important climatic elements factors that affects the morphology and eventually affect the vegetation either positively or negatively.

The use of remote sensing data and Geographic information system(GIS) applications in recent times have been of immense help in monitoring changing patterns in morphology, vegetation and climate change. Change detection is the measure of the distinct data framework and geomorphic change. Digital change detection is the process that helps in determining the changes associated with land use and land cover properties with reference to geo-registered multi-temporal remote sensing data.

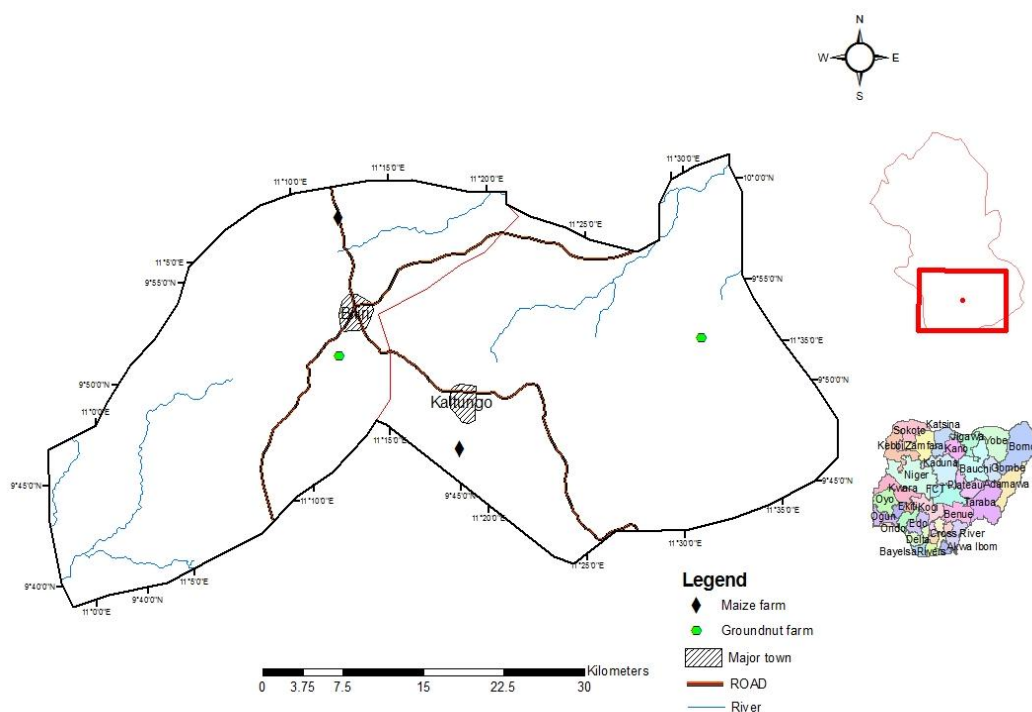
It helps in identifying change between two (or more) dates that is uncharacterized of normal variation. Change detection is useful in many applications such as land use changes, habitat Fragmentation, rate of deforestation, coastal change, urban sprawl, and other cumulative Changes through spatial and temporal analysis techniques such as GIS (Geographic Information System) and Remote Sensing along with digital image processing techniques.

GIS technology is a recent innovation that is used in the assessment of climatic change effects on morphology and vegetation in Nigeria. The IPCC, (2007), third assessment report concluded that the poorest countries (third world) countries would be hardest hit, with reduction in vegetation cover in most tropical and subtropical region due to decreased water availability and new change insect pest incidences eventually pose risk to land forms.

In a Similar study conducted in Gombe State Nigeria Anthony (2005) asserted that vulnerability to climate change has effects on land forms, vegetation and crop production. It is in this view that this study will be specifically on the effects of climate change on maize and Groundnut crop production and vegetation. The aim of this research is to examine changes in the areas land use/land cover from 1986 to 2005 in Billiri/Kaltungo of Gombe State Nigeria with the aid of GIS techniques.

Study Area

Billiri and Kaltungo are Local Government Areas in Gombe State which lies between latitudes 9°39'14"N and 10°01'42" north of the equator and longitudes 11°8' 18"E and 11°38' 00"E east of the Greenwich meridian. Billiri LGA headquarters is in the town of Billiri in the northeast of the area along the A345 highway while Kaltungo LGA headquarters is in the town of Kaltungo in the west of the area along the A345 highway. Both have an estimated area of 1618 km² and a population of 351,949 at the 2006 census(Adebayo 1999).



Methodology

Raw data that were collected on the field by means of physical observation, picking of coordinates using Global Positioning System (GPS) for groundgroundthruing. Table 4 shows the coordinate values obtained.

Table 3: The coordinates Billiri and KaltungoGombe

LOCATION	COORDINATES		L	G	A	P	C	R	O	P
LONG / LAT	11 18 36.336 East	9 46 47.908 North	K	A	L	T	U	N	G	O
LONG / LAT	11 30 59.436 East	9 52 10.702 North	K	A	L	T	U	N	G	O
LONG / LAT	11 12 31.819 East	9 58 12.628 North	B	I	L	L	I	R	I	M
LONG / LAT	11 12 30.857 East	9 51 14.536 North	B	I	L	L	I	R	I	G

Source: Researchers work (2013).

Climatic data were sourced from NIMET 2009. Enhanced Thematic Mapper (ETM+) Landsat images of Gombe state were obtained from global land cover facilities (GLCF 2013).Other literatures were sourced from text books, journals, newspapers and internet facilities.

Equipment and Materials

This involves the hardware and software component of GIS that were used in this research. Hardware; thehardware consists of: Garmin 12 channel GPS receiver (hand held) which was used to obtained the coordinates. Dell Inspiron laptop computer, printers and photocopier were used (three in one) to achieve the task.The software consists of: IDRISI TAIGA, ARC GIS 9.3 ILWIS 3.1 and Micro soft Excel 2007.

Methods of Data Collection and Analysis

Landsat ETM+ imageries of Billiri and Kaltungo LGA Gombe State for 1986 and 2005 were obtained from Global Land Cover Facility (GLCF) website. folder was created in drive C, where the two imageries were kept, from which they were imported to ILWIS 3.2 environment, in the same environment bands 3, 4, and 5 were selected for color composite to give it a clear understanding of the color for better visualization and further processing.

The Images of 1986 and 2005 were then subjected to supervised classification using ILWIS 3.2. In the Supervised classification, seven classes of land uses were defined, these include; Built-up area, bare surface, Rock out crops, Water body, vegetation cover, maiz. Digital image-processing was done using ILWIS 3.2 software packages, for the processing, manipulation, and training of pixels, analysis, and overlay in other to have the changed images over the years.

The imageries of the study areas were exported to IDRISI taiga environment in other to calculate the areas in hectares (Ha) for each class. Area change detection method was used in this research to see whether or not there are changes in sizes of the classes from 1986 to 2005.

Areas of the classified images were calculated for each of the class using the formula area of a class/Total area X 100. This was done to know the changes in the classified classes.

II. Result and Discussion

Change detection analysis by area difference on the morphology revealed significant changes in the areas land use and land cover had occurred between 1986 and 2005 as shown on the table 4. Information obtained from the classified imageries of 1986 and 2005 of Billiri and Kaltungo LGA of Gombe State, indicated that there was an increase in land sizes for agricultural use by 41.858 hectares respectively. While vegetation cover had reduced by -72.125 hectares between 1986 - 2005. The results of findings could be attributed to favorable climatic conditions in the study areas which allow alteration of land forms, which seem to favour the cultivation of crops.

Table 4: showing land use and land cover changes of Billiri and Kaltungo Areas in hectares (Ha).

S / N	Land cover/land use classes	1986 Area (Ha)	2005 Area (Ha)	Differences (Ha) 1896-2005	Remark
1	cultivation	316217	347947	41858	Increased
3	Vegetation	118567	46442	-72125	Decreased
4	Others	4316	28046	23730	Decreased

Source: field work and GIS analyst 2013.

On the contrary, reduction in vegetation cover could be as a result of increasing urbanization and population growth which altered the land forms resulted in construction activities such as roads, housing and other infrastructural activities as well as increased demand for forest products such as fuel wood, timber and so on.

Also, with the rapid growth in population in these areas we can equally deduced that there had being the negative impact of human activities which exposed the vegetation to have adverse effects of -72.125 hectares as clearly showed in table 5 in 2005 there by result in morphology dynamics.

As human population size in these areas continued to increase from 1986 to 2005, also demand for survival be, there by leading so many people engaged themselves in large scale farming operations in other to meet their daily needs, this also pose great risk on natural land forms. Other land uses mostly built-up areas, farm lands for the other crops, rivers and rock outcrops make up 4.316 hectares in 1986. This increase by 23.730 hectares owing to the population increase among other factors.

In figures (4, 5, and 6) also shows clearly that changes that took place from 1986 to 2005 most especially the vegetation cover in 2005 had changed or reduced with - 72.125 hectares due to some anthropogenic activities and the both crops.

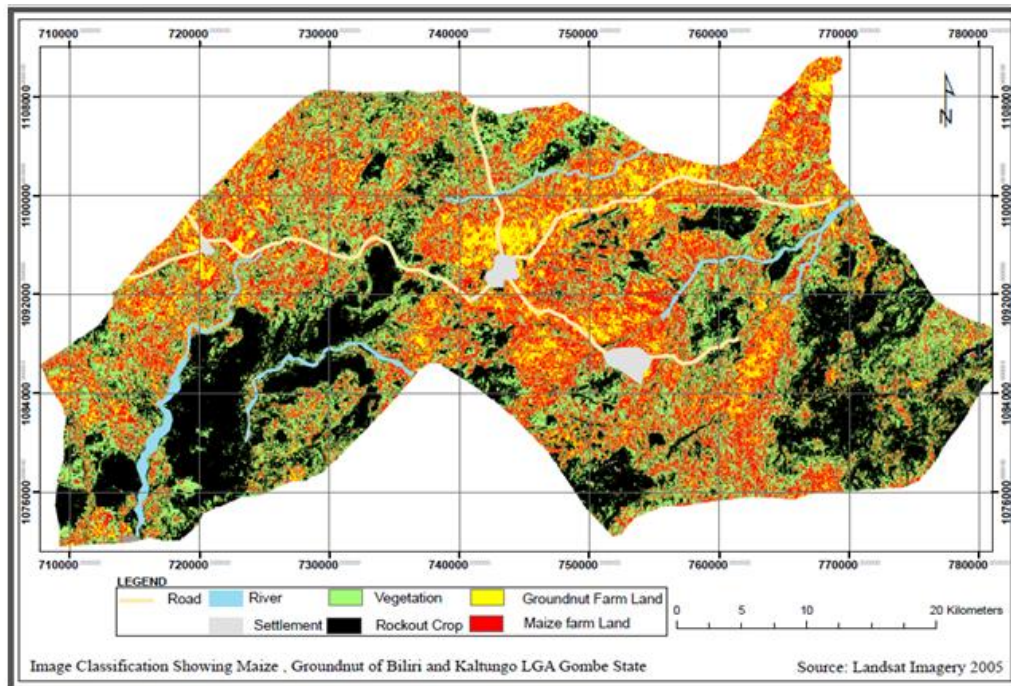


Figure 4: Showing image classification using Landsat ETM + image of Biliri and Kaltungo 2005.

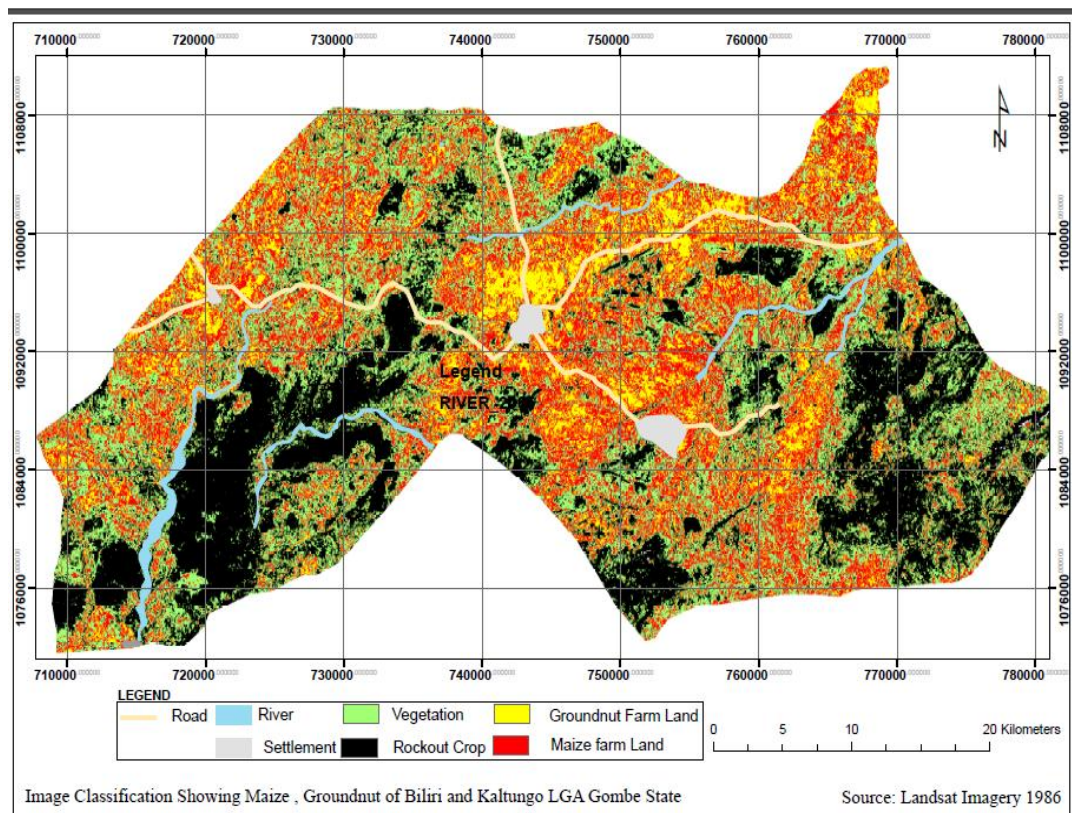


Figure 5: Showing image classification using Landsat ETM + image of 1986 of Biliri and Kaltungo LGA Gombe state.

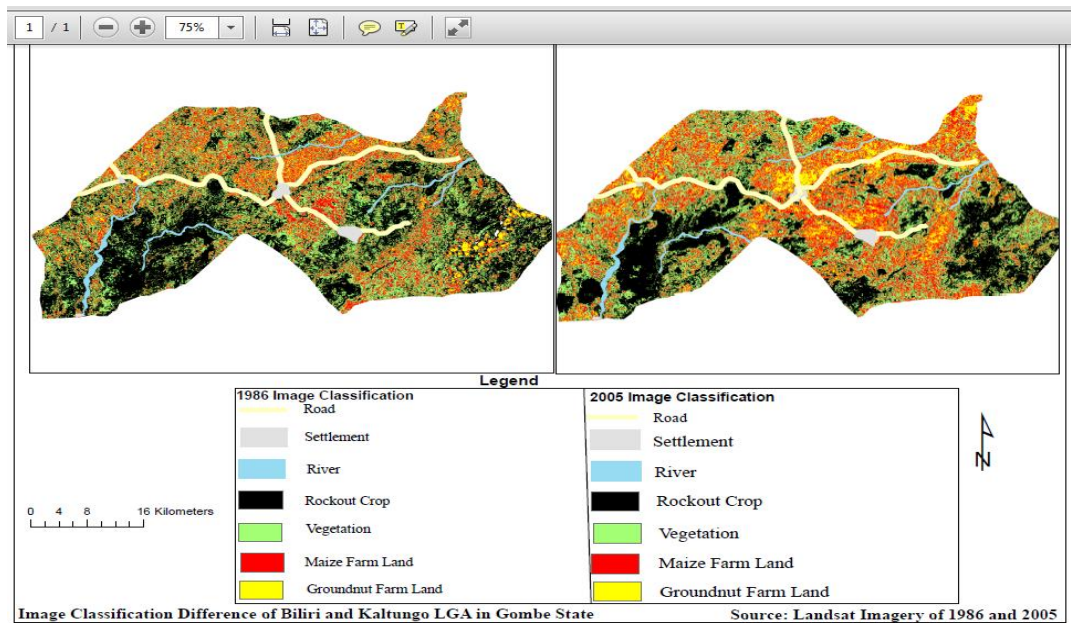


Fig 6: Showing image classification differencing of Billiri and Kaltungo LGA 1986 to 2005.

In figure 6, there is a change in vegetation of Billiri and Kaltungo from 1986 to 2005 as can be seen clearly on the image when placed side by side. The 1986 and 2005 images as it is compared in figure 3 above indicated vividly the changes in vegetation cover of the areas over the years. The image of 2005 shows clearly the reduction in vegetation cover of the area with - 72.125 hectares resulting from anthropogenic activities and other climatic factors. This means that climate change had adverse effect on the vegetation in 2005 which resulted to geomorphic changes.

III. Conclusion

The Studies and research have confirmed that the geomorphic features of the earth are undergoing severe changes as a result of climatic change. The strongest effects of global warming is on vegetation and agriculture with the rise in temperature that come with global warming, growing season become shorten, thereby reducing the strength of land forms, crop yield or production which eventually leads to erosion, food insecurity, starvation and death of human, plants and animals.

Climate change has become so problematic today all over the World and urban growth in population has been a major factor that alters natural land forms and vegetation cover, through anthropogenic activities which in turn result to climate change. The results of these have left significant effects on local weather and climate.

There is no doubt that agencies need detailed GIS technique or package as a means of Spatial Decision Support System (SDSS) to plan how to alter land forms, crops planting schemes and to monitor yield rates. The research will equally be valuable to academics, planners and those willing to make research in the area of climate change using GIS ideas. This study will also generate and upgrade the existing database of the climatic change effects on vegetation and crop production of the study area made study area made available by other researchers.

IV. Recommendations

In view of the findings, the following recommendations are made; based on the issue of global warming which alter the natural balance of land forms, climate, and the ongoing anthropogenic activities by man as follows: The Nigerian Government and all the stakeholders involved in the land form uses and climate change issues should increase public awareness, promote research and establish a commission or an agency that will handle issues related to impact of indiscriminate use of geomorphic features and climate change on land use in the study area. The International, Federal, State and Local Government agencies and other development partners are required to funds climate change projects in Nigeria for sustainable solution. Also, let there be an alternative to the usual way of using land forms to reduce too much of erosion pollution on the natural land forms. The government and other agencies should ensure proper law enforcement on deforestation and forest reserve in Kaltungo and Billiri. Research institutes should be established and well founded to device new techniques and methods of reducing climatic changes.

References

- [1]. Adebayo A.A &Tukur A.L (1999): Adamawa in maps. Department of Geography.Adefolalu DO (1986). Rainfall Trends in Nigeria.Theor. Appl. Climatol. 37: 205-219.
- [2]. Adejuwon J. O. (2006) "Food crop production in Nigeria. II: Potential effects of climatechange" Climate Research Vol 32 229-245.
- [3]. Agoumi, A., (2003) Vulnerability of North African countries to climatic changes:Cakir HI, Khorram, S., Nelson, S.A.C. 2006. Correspondence analysis for detecting landcover change. Remote Sensing of Environment 102: 306-317.
- [4]. Carnell RE, Senior CA (1998). Changes in mid-latitude variability due to increasinggreenhouse gases and sulphate aerosols, Clim. Dyn. 14: 369-383.
- [5]. Chi-Chung C., B.A. McCarl, and D. Schimmelpfennig, 2004.Yield Variability as Influencedby Climate: A Statistical Investigation. Climatic Change, 66: 239-261, 204. Res. J. Environ. Earth Sci., 2(1): 19-30, 2010 30 Climate-Nigeria, 2005.Available from: <http://www.onlinenigeria.com>.<http://nue.okstate.edu>
- [7]. Federal Government of Nigeria (FGN), 1999. Drought management in Nigeria: What canpeople do to minimize its impact? Abuja, Nigeria.hypogaeaL.cv.Makulu Red) at threaltitudes in Rhodesia. Rhodesian Journal of Agricultural Research, 13: 33-43
- [8]. Hoffer R. M (1978); 'Biological and Physical Considerations in Applying Computer- aidedanalysis techniques to Remote Sensor data. In Remote Sensing: The quantitative approach,edited by P. H. Swam and S. M Davis U. S. A; McGraw- Hil
- [9]. Hulme M, Mitchell J, Ingram W, Johns T, New M, Viner D (1999b). Climate Change Scenariosfor Global Impacts Studies. Global Environ. Change 9(4): s3-s19.
- [10]. IPCC (2007).Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to theThird Assessment Report of the Intergovernmental Panel on Climate Change [Parry,
- [11]. IPCC, 2007. Summary for Policymakers of the Synthesis Report of the IPCC Fourth AssessmentReport. DRAFT COPY 16 NOVEMBER 2007.

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