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CHANGE DETECTION IN LANDUSE / LANDCOVER MAPPING IN ASABA, NIGER DELTA B/W 1996 AND 2015. A REMOTE SENSING AND GIS APPROACH

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ABSTRACT: *Remote sensing is used in this research work for the development and acquisition of Landuse/land cover data, pattern and its attendant effects in Asaba, Delta State* Nigeria. *R*emote sensing images and digital data verified by ground trothing (field work) *satellite data are used to assess the rate of change in Landuse / Land cover between 1996 and 2015. It also examines the extent to which images and GIS softwares effectively contribute to mapping landuse/cover in the Niger Delta region. Remote sensing and geographic Information System (GIS) help integrate natural, cultural, social and economic information to create spatial information system on the available terrain resources. Sets of NARSDA images were acquired corresponding with the years, field checked to ascertain the* data *captured on the terrain.. The digital satellite data are incorporated as input data into IDRISI 32 GIS environmental to separately map out the landuse/land cover units and their magnitude determine. Five distinct units were identified in classification of landuse/landed cover pattern categories as follows: Farmland, Build up land, Waste land, Forest land and Water bodies. Land consumption rate indicate a progressive spatial expansion of the city was high in 1996/2006 and higher between 2006 and 2015. Also, land absorption coefficient being a measure of consumption of new urban land by increased urban population, was high between 1996 and 2006 and between 2006 and 2015. Ground trothing was carried out to ascertain the accuracy of data and there are major changes in the landuse/land cover. It was discovered that there is rapid inbuilt-up areas evidently explained in buildings projects that resulted in decrease in forest land, agricultural land and open space. This is attributed to the anthropogenic activities of farming, bush burning, grazing, etc. However, the area occupied by water remained unchanged over the years. This study demonstrates that remotely sensed data and GIS based approach is found to be timely and cost effective than the conventional method of analysis, classification of land use pattern effective for planning and management.*

KEY WORDS: Remote Sensing, Satellite image, Geographic information System (GIS), IDRISI 32 software, Land cover, Landuse, Mapping, Change Detection

INTRODUCTION

The demand for landuse/landcover data has grown in multiple folds over the years as an indispensable means of planning and implementation of developmental projects. Without considering the implications for planning of major developmental projects, there has been unprofessional use of agricultural land and open spaces in an unplanned situation. The data derived for landuse/land cover give insight to better understand land utilization aspects as well as play a

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vital role in the formulation of policies and programme implementation for development. It is important to note that, land is very important resource to man and it is better managed for continuous existence and its progress depends on our ability to avoid its mismanagement. Traditional field survey, remote sensing images and digital data verified by ground trothing (field work) are widely used in data collection of the environment for this study. With the traditional field survey alone, it is difficult to update and upgrade data base except for Inclusion of remote sensing and GIS method .

STATEMENT OF THE PROBLEM

Researchers have worked on Land use/Landcover mapping in ancient cities of Ibadan, Lagos, Benin City, Ilorin, etc, in Nigeria, while few have been done in new towns like Asaba town (study Area) in Oshimilli local Government Area. However, emphases were laid on aerial photographs, Landsat and spot satellites in land use / landcover mapping in cities of Nigeria for comparative analysis of sequential photographs, but none is carried out with NARSDA image f or land use / land cover mapping of Asaba town. The approach of comparison for change detection in landscape on time series analysis, is based on *land absorption and consumption coefficients of new urban land* carried out at a point in time with the image of area was taken at same time in the past and to correspond with the present. The review of literature on the related application on Landuse/ Landcover mapping shows that, there are few remarkable works on Landuse/land cover mapping and classification in the Niger Delta region of Nigeria, and this research tends to fill this gap.

AIM AND OBJECTIVES STUDY

The aim of the study is to use satellite remotely sensed satellite image to generate landuse/landcover data, make comparison using temporal consideration (1996 - 2015), with a view to ascertain the level of changes in landuse/cover based on land absorption and consumption rates. Finally to use ground truthing verify the accuracy of major changes in the landuse/land cover in the study area.

STUDY AREA

Location and Size

Asaba is the capital city of Delta State and was created in August 27th 1991 out of the former Bendel State. It also serves as the Local Government headquarter of the Oshimilli South Local Government Area. (Fig 1). It is located on the bank of the Niger River. Geographic reference indicates that, it is located on latitude 6^{o}30^{l}and longitude 6^{o}45^{i}E with estimated area of about 200 square kilometres. Asaba is made up of few villages tha are Okot include Anala, Oko-Ogbele and Okwe to mention but a few. The town has a network of good roads, standard hotels and communication facilities. The Niger Bridge connects Asaba to Onitsha in Anambra State but separated by the River Niger.

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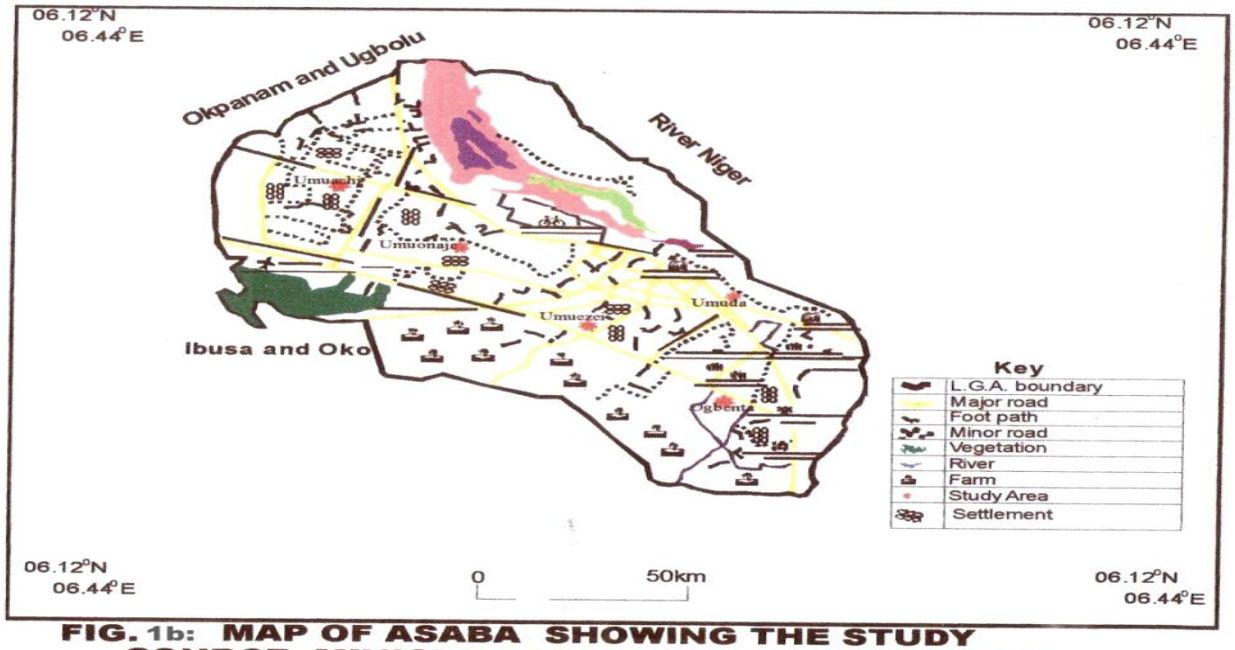

FIG. 1b: MAP OF ASABA SHOWING THE STUDY
SOURCE: MINISTRY OF LAND AND SURVEY 2006

CLIMATE

Climate and climatic variables do considerably influence water resources in the area. The climate of the area is defined by high values of evapotranspiration, humidity, temperature and rainfall that characterized humid tropical equatorial climate of the deltaic environment. The rainfall is mostly conventional and usually falls at any time of the day resulting from the effects of conventional rainfall and blown land and sea breezes .Asaba experiences a humid tropical equatorial climate with fluctuations from humid in the south due topermanent Lcalinfluence of the River Niger to the sub humid in the northeast.The two seasonal winds of NE topical continental airmass that blows from October to February and the SW tropical maritime airmassblows from March to September maintains an average tropical temperature during the dry season and an average rainfall during the rainy season. The mean annual rainfall is 1254–3032mm and temperature of 26.7^{0}C with relative humidityof about 69-80% and sunshine of 4.8 bars (Asaba Meteorological Bulletin, 2007).

GEOLOGY, RELIEF, DRAINAGE AND VEGETATION.

The vegetation is tropical evergreen rainforest with tall trees and undergrowth. This has been interfered by anthropogenic activities such as farming, bush burning, grazing and rapid development in the area. Due to these effects, the vegetation of the study area has been observed as mainly of secondary type with patches of trees in grassland.

River Niger and its tributaries drainage system is characterized by very low velocity of flow due to its low elevation together with very high capacity discharge of sediments. This results in features

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such as braided channels, lagoons, canals, bars, creeks, meanders as shown in the Nigeria Surveys topographical sheet of the area.map of that result from alternative flooding and exposure episodes of a long rainy season with short dry season accompanied with tidal movements. In the rainy season, high rainfall and poorly drained soil of low retention capacity results in wide spread flooding and erosion. Thus, 80% of the entire area is flooded with the rivers overflowing their banks at the peak of wet season as the coastline is buffeted throughout the year by tidal current (tides) of the Niger and indeed Astlantic Ocean (Ejemeyovwi ,2008).

Most of the area lies below sea level (bsl) with only few places of 20mm height above ssea level (asl) (Odemero and Ejemeyovwi, 2008). This result in marshy and waterlogged condition of the entire landscape,a poorly drained environment coupled with several tributaries and distributaries that empty waters into the River Niger,

The surface geology of the study area is made up of Ameki and Ogwashi- Asaba formations in the northeast of Delta state and the coastal plain sands (Benin formation) that astride the northern boundary with Edo State and beyond. The Ogwashi-Asaba formation is made up of coarse grained sands containing lignite and peaty clay seams. It is poor of ground water and characterized by the widespread occurrence of lost circulation (Rayment, 1965). Both the Ameki and Ogwashi-Asaba formations are richly endowed with kaolinites, while the latter formation also contains lignite seams Ejemeyovwi (2008).Three geologic formations are recognizable form the distinct attributes of depositional circles of sediments since early cretaceous (135my ± 65) in the area. They are upper Benin sands, middle Agbadaofinterbedded sands/marine shales and lower Akata made up of massive and regressive marine shales and clays deposits (Nwachukwu and Odjegba, 2001).

POPULATION OF THE AREA

The area is naturally made up mainly of the Igbo (Delta) ethnic group and as a state capital, large population of Urhobo, Itsekiri, Ijaw, Isokos are residents. The total population the area was estimated to be 49,725 in 1991,123,746 in 2006(NPC,2006)and a population of 1,723,745 due to influx of migrants especially as a state capital.

HUMAN ACTIVITIES

Asaba is mainly an administrative town with high commercial activities carried out. The banking industry has about twenty commercial banks in Asaba, located along the Nnebisi road. There is only one major market in the area, (Ogbogonogo market) which is also located along the Nnebisi road. The State government and the private investors have contributed in no small measure to the development of the place e.g. the Ogbogonogo market was reconstructed by the state government with modern facilities to enhance maximum commercial activities in the area. A small market is alsolocated along the cable point area.There are also high commercial activities in areas of transportation industry with Delta line and private ownership. There are notable companies and hotels in Asaba. These includeindustries such as textile, aluminium industry along the Agbor-Benin expressway, general steel mills (GSM) in Ibusa road and hotels like grand, sunrise, Nairese, etcLumbering activity with saw mills located in the area. The traffic light area have wood/furniture

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works, due to presence of hard wood of the humid tropical trees with various species such as Opepe, mahogany, matsonia, Iroko, etc. Agricultural activities in the form of farming, animal husbandry (poultry and rearing of animals) are carried out in the area. When the river Niger overflows its bank, it enriches the soil fertility for the cultivation of crops e.g. cassava, yam, maize in the area. A lot of fishing activities is also carried out along the river Niger and its tributaries. The river Niger beach is a tourist area that is a hospitable place for tourism

SETTLEMENT PATTERN

The settlement pattern of Asaba is a nucleated type of settlement though with some linear disposition. The major road is the Nnebisiroad and the river Niger by the town, makes for nucleated pattern of settlement and the houses are closely built but houses across the Onitsha – Asaba expressway are dispersed in a linear pattern.

LITERATURE REVIEW

The U.S Geological Survey carried out a research program in 1985 to produce 1:250,000 scale land cover maps of Alaska using landsat MSS data (Fiz Patrick et al, 1987). Also, the state of Maryland health planning commission employed landsat TM data to create a land cover data set for inclusion in Maryland geographic information (MAG) database. The seven TM bands were used to produce 21 class land cover map (EOSAT 1992). ln 1992, the Georgia Department of Natural Resources completed mapping the entire state of Georgia to identify and quantify wetlands and other land cover types using landsat thematic mapper(TM) data (ERDAS, 1992).

Onokerhoraye and Omuta (1994) attribute difference in the land use to processes of land use development in cities of Nigeria. During the pre – colonial period, land use type in the traditional cities of Nigeria comprises the residential, commercial and some open spaces. They futher explained that modern traditional cities in the country have varieties of land use types that reflect the processes and patterns of urban development in recent times. Among the dominant land use types in the urban areas of the country are residential and commercial, industrial, public and semi public, transport and communication, recreation. The comparison of some urban areas devoted to various types of landuse indicated that, residential landuse still dominates all other landuse activities in the world. This portrays the importance of residential landuse. However, in case over of 50% of the total land use devoted to residential development, residential land use with in urban area varies in terms of density, quality, racial or ethic occupancy and age. Thus, residential landuse in some urban areas are not consent rather it varies from one urban area to another in terms of density, quality, racial or ethnic grouping and even age.

Analysis of land use and cover changes using the combination of MSS landsat and land use map of Indonesia by Dimyati, (1995) revealed that, land use/land cover change were evaluated. Remote sensing was used to calculate the index of change which was carried out based on superimposition of land use/land cover images of 1972, 1984 and land use maps of 1990 was to analyze the pattern

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of change in the area, this was rather difficult with the traditional method of surveying as noted by Olorunfemi (1983) when he was using aerial photographic approach to monitor urban land use in iilorin in Nigeria.

Adeniyi and Omojola (1997) also mapped the landuse and landcover change evaluation of Sokoto-Rima Basin using landsat and archival remote sensing procedures. Adeniyi (1978, 1980,1981) did a study on residential landuse in estimating and predicting population growth of the city of Lagos. Adeniyi and Omojola (1999) in their analysis of land cover change evaluation in Sokoto – Rima Basin of North – Western Nigerian based on archival remote sensing and GIS techniques, used aerial photographs, landsat MSS, SPOT XS/Panchromatic image transparency and topographic map sheets to study change in the two dams (Sokoto and Guronyo) for time interval between 1962 and 1986. The study revealed that, land use/ cover of both areas were unchanged before the constructions and settlement mostly covered the entire area. However, during the post- Dam era, the land use/ land cover classes changed but with settlement still remaining most prominent.

Also, Ikhuoria (1999) investigated the application of spot 1 satellite data in the analysis of urban growth regimes and land characteristics of Benin City Daniel et al, (2002) in the comparison of land cover change detection methods in USA, made use of 5 methods namely traditional post – classification cross tabulation, cross correlation analysis neutral networks, knowledge – based expert systems, image segmentation and object – oriented classification. A combination of direct T1 and T2 change detection as well as post classification analysis was employed. Nine land use cover classes were selected for analysis and the merits to each of the five methods examined at the point of their research and no single approach could solve the land use change detection problem.

Arvind and Nathawat (2006) carried out study oo land use land cover mapping of Panchkula, Ambala and Yanunanger districts, Hangana state india and observed that the heterogeneous climate and physiographic conditions in these districts resulted in the development of different land use and cover pattern in these district An evaluation of digital analysis satellite data indicate that majority of the areas in these districts are used for agricultural purpose with hilly regions exhibiting fair development of reserved forest with the land cover pattern generally controlled by agro – climatic conditions, ground water potential and a host of other factors

Zubair, (2006) project examines the use of GIS and Remote Sensing in mapping land use/land cover in Ilorin between 1972 and 2001 so as to detect changes takenplace in this status between these periods. Subsequently, an attempt was made atprojecting the observed land use land cover in the next 14 years. In achieving this, land consumption rate and land absorption coefficient were introduced to aid in the quantitative assessment of the change using Arcview 3.2 GIS system. The result of the work shows a rapid growth inbuilt-up land between 1972 and 1986 while the periods between 1986 and 2001 witnessed a reduction in this class. It was also observed that change by 2015 may likely follow the trend in 1986/2001. Suggestions were therefore made at the end of the work on ways to use the information as contained therein optimally. Attempt was made to capture as accurate as possible five land use land cover classes as they change through time. Except for the inability to accurately map out water body in 1972 due to the aforementioned limitation, the five classes (farm land. waste land, built, up land, forest land and water body) were distinctly

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produced for each study year but with more emphasis on built-up land as it is a combination of anthropogenic activities hat make up this class; and indeed, it is one that affects the other classes.

Ejemeyovwi (2009) studied the land use pattern and its attendant effects in Abraka Urban, Delta State. High spatial resolution remote sensing spot satellite image of 2005 and 2008 were used for systematic mapping and classification of various land use/land cover types and their effects using Arcview 3.2 GIS system. Seven distinct units were identified in classification and land use pattern analysis as follows: commercials, communication and utilities, industrial, institution, recreation, residential and vacant land. The residential unit accounts for over 80% of all the landuse type. This study also demonstrates that remotely sensed data and GIS based approach is found to be timely, cost effective than the conventional method in classification and analysis of land use pattern and effects and for planning and management in Abraka.

CONCEPTUAL FRAMEWORK

Irrespective of the fact that the internal structure of every urban centers looks different and unique, there are common characteristics that most towns and cities posses and can be divided into three (3) distinct segments which are represented with theories of internal urban structures. These include concentric, radial and multiple nuclei cities. These various cities are usually result from different growth patterns that occurred b ut the first and the last ones apply mostly relevant to developing countries.

I. Concentric – ring theory zones

This is a hypothetical pattern of landuse within an urban area, in which activities occur at different distances from the center. This results in sequences of rings. The theory was first suggested in 1925 by an American sociologist Earnest W. Burgess on the basis of his study of city of Chicago. He identified five (5) concentric zones of land use types within the cities. These are;

1. core central business district(CBD) - the focus of the commercial, social and civic life
2. after CBD, there is the transition zone characterized by individual premises, old private houses, office and warehouses. It is usually a poor area.
3. The ring of residential properties which in the past provided accommodation for those in the CBD; but within the growth of sub-urban, become random and now house the poorest section of the community.
4. next zone comprises of more spacious and usually single family dwelling with some high class apartment which house the middle and high income earners.
5. outermost commuter zone which may be beyond the continuous built- up area of the town and it is characterized by large detached house as well as village which have taken on dormitory functions.

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KEY	Zones
1	CBD
2	TRANSITION
3	WORKERS ZONE
4	RESIDENTIAL ZONE
5	COMMUTERS ZONE

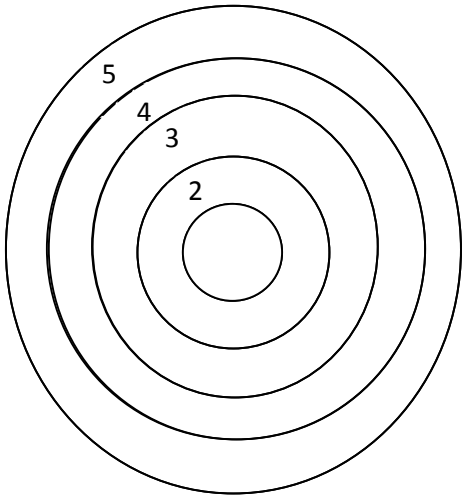

Fig 2: Concentric – ring theory zones

Multi nuclei theory:

This is model of urban landuse in which city grows from several independent points, acts as growth center for a particular kind of landscape such as industrial refuel or high quality housing. As they expand, they marge to form a single urban area. This is the most complicated of the urban use landscape models and the one that gives some insight into the growth of cities in the developing world. The multi nuclei theory was first propounded by Harris and Ullman in which they argued that the concentric and sector theories are too simple to explain the complexity of reality. This does not mean that multi nuclei theory contracedicts the existing theories because, each sub center with the city may be radial of concentric in nature. The multi nuclei cities do not have a single core but separate centers, though one may be dominant in size and importance.

Many cities of this particular type have grown as a result of several smaller towns expanding and merging together. Actually these models do not describe all urban forms. The intervention of the public sector, especially in the provision of housing, increased affluence and improved transport distorted the stereotypes. Moreover, topographical environmental influences have affected the development of various cities over time (Button, 1976; and Onokerhoraye, 1985).

MATERIALS AND METHOD

The method applied in carrying out this research is similar to that adopted by Adeniyi and Omojola (1999) system analysis, though with modification of using digital analysis within the methodology. This involve data gathering from primary sources and secondary sources (Table 1).

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Table 1. Showing data acquired

S/No	Data type and date	Source
2	Thematic mapper TM 2001	GLCF
3	Enhanced thermatic mapper 2010	GLCF
4	Map Asaba and survey Asaba.	Ministry of lands andsurveys Asaba

Asaba satellite images were acquired for different time series of 1996, 2006 and 2015 from National space research agency and development (NARSDA) Obansanjo space cente, Abuja. The plan and its environ map i.e Oshimili Local government was acquired from ministry of lands and survey to show existing drainage basin and erosion condition, transportation routes traffic intensity, etc.

The enhanced satellite data were interpreted to classify the landuse/landcover and thereafter, ground truthing (field check) and editing to produce the final data. Two major analyses were carried out on the images to accomplish the objectives of this study. These are quantitative evaluation of landuse/landcover themes extent and overlay analysis for change detection. This change detection is used for the comparison of landuse/landcover data derived from analysis based on time series data. Thus, comperism is made to highlight the trend of the landuse/landcover change using simple percentages to ascertain the degree of change in landuse/landcover. Also, specific change detection involve topologically overlay of the digitized image for classified landuse/landcovver data to generate location and magnitude of change. A landuse classification scheme is a prerequisite for proper monitoring of spatial growth of cites and landuse changes. The classification scheme in the table is a modification of Anderson (1967). The methodological framework (Fig 2:) adopted in this research work forms the basis for deriving statistics of landuse/landcover dynamics and subsequently in the overall findings involved

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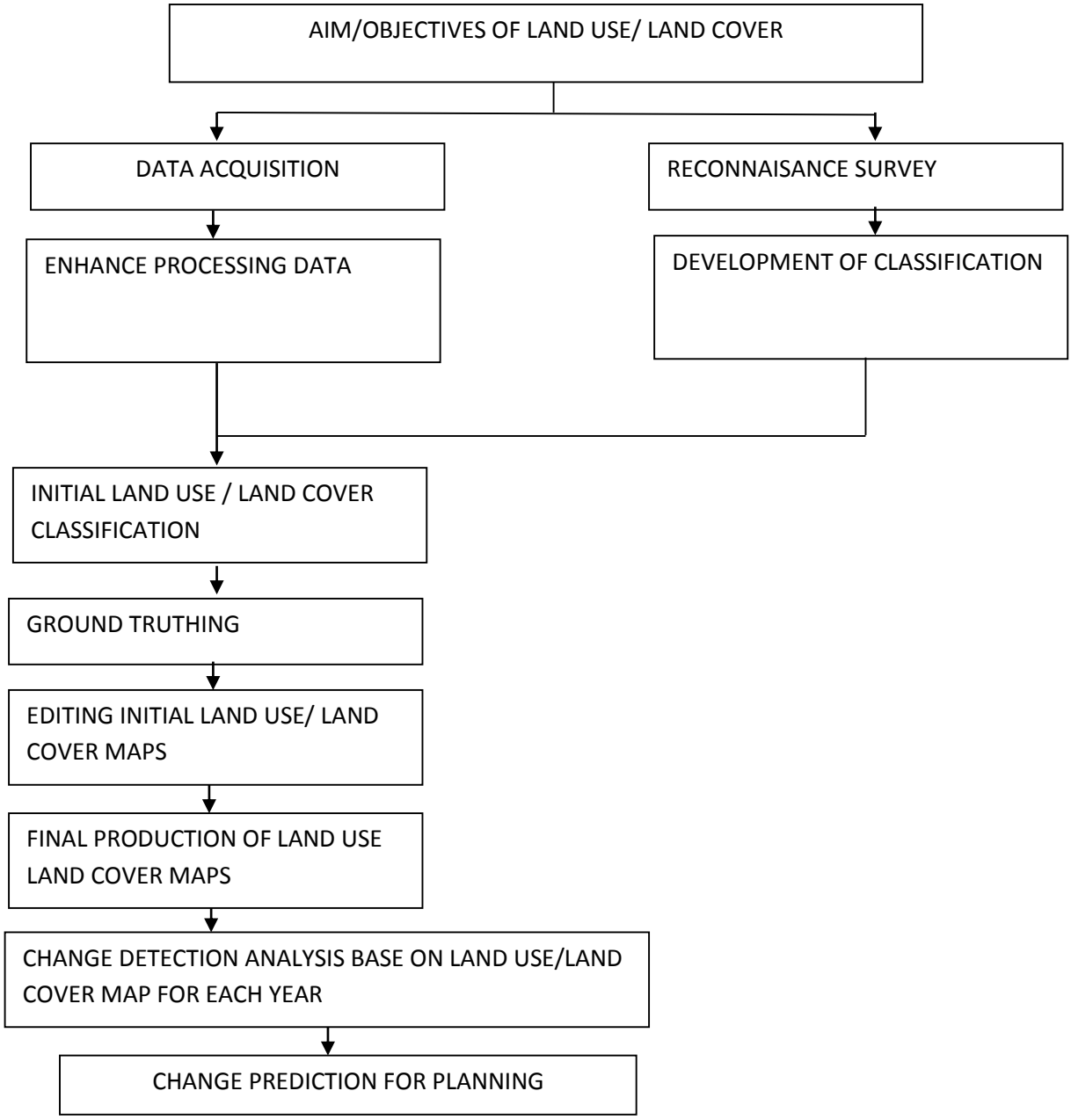

Fig 2: The methodological framework

DEVELOPMENT OF A CLASSIFICATION SCHEME

Based on reconnaissance survey in additional to the information from previous researches, a classification scheme was developed for a broad classification where the land use/landover were identified by a single digit. The classification scheme in the table 2 is a modification of

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Anderson (1967). The definition of waste land as used in this research work denotes lands without scrubs, sandy areas, dry grasses, rocky areas and other human induced barren lands.

Table 2. Landuse landcover classification scheme

Code	Landuse/landover categories
1	Farm land
2	Build up land
3	Waste land
4	Forest land
5	Water bodies

METHOD OF DATA ANALYSIS

The analyses of data involve the following five main methods adopted.

1. Calculation of the area in hectares of the resulting land use/land cover types of each study years and subsequently comparing the results.
2. Overlay operations
3. Image thinning
4. Maximum likelihood classification
5. Land consumption rate and absorption coefficient

The first two methods involvng the calculation of the area in hectare, were used combined in this study. And the comparison of the land cover statistics assisted in identifying change detection (%), trend and rate of change between 1991 and 2010. The first task was to develop a table showing the area in hectares and the percentages change for each year (1996 , 2006 and 2015) measured against each land use/ land cover type. Percentages change to determine the trend of change is evaluated by dividing the observed change with sum of changes and multiply by 100

$$\text{Trend (\%) change} = \frac{\boldsymbol{observed\ change}}{\boldsymbol{sum\ of\ change}}\ x\ 100$$

In obtaining annual rate of change, the percentages change is divided by 100 and multiplied by the number of interval years- 1996-2006 (10years) 2006 – 2015 (10 years). Overlay operations is the last methodthat identifies the actual location and magnitude of change though, this was limited to the built – up land. Boolean logic was applied to the result through the reclass module of Idrisi 3.2 which assisted in separately mapping out areas of change for which magnitude was later calculated. The land consumption rate and absorption coefficient formulae are given below:

$$\text{L.C.R} = \frac{A}{P}$$

Where A= area extent of the city in hectares , P= population.

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And L.A.C = $\frac{A2-A1}{P2-P1}$

A1 and A2 are the area extent (in hectares) for the early and later years, and P1 and P2 are population figure for the early and later years respectively (Yeates and Garner, 1976)

L.C.R =A measure of compactness which indicates a progressive spatial expansion of a city
The formula given for the population estimate was developed by the researcher in evaluating the socio-economic implications of change, the effect of observed of observed changes in the land use and land cover between 1996 and 2015 were used as major criteria.

DATA PRESENTATION AND ANALYSIS

The aim and objectives of this study form the basis of the analysis carried out. The results are presented in form of maps, histogratm charts and statistical tables..

LAND USE/ LAND COVER DISTRIBUTION

The static landuse/landcover distribution for each study year is derived from 1996, 2006, 2015 images. The figures presented represent the static area of each landuse/ landcover category for each study year

Table 3: Show landuse/ landcover distribution for 1996, 2006 & 2015 In Asaba

t-table	1996		2006		2015	
Landuse/land cover category		Area (%)	Area (Ha.)	Area (%)	Area (Ha.)	Area (%)
Farm land	110852.16	20	138565.2	15	129327.2	14
Waste land	397220.24	40	323318.8	35	230942.0	25
Built-up land	18475.36	3	120089.84	13	166278.24	18
Forest land	230942.0	19	203228.96	22	212466.64	23
Water body	166278.24	18	110852.16	15	138565.2	15
Total	923768	100	923768	100	923768	100

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Built-up in 1996 occupies the least class with just 2% of the total classes. This may not be unconnected with the fact that Asaba was made the state capital in 1991.

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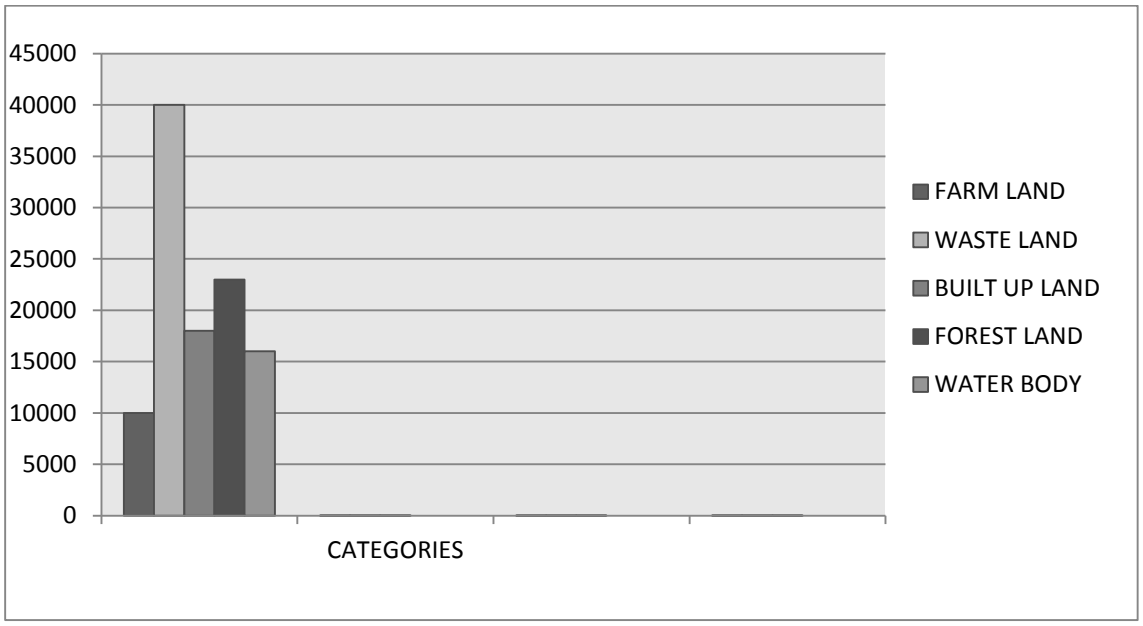

Fig 3 : Land Cover Categories Of Asaba For 1991

Fig 4: Map 2: derived from the image of Asaba in 1996 source: NARSDA.

Also, farming seems to be moderately practiced, occupying 20% of the total classes. This may be due to the fact that the city is just moving away from the rather traditional setting where farming seems to form the basis for living. Aside, the time of the year in which the area was imaged fall within the onset of hamattan and could be a major contributing factor to the observed classification. August haetus resulting unusual dry condition in the area account for the high percentage of waste land and the low percentage of forest land observed. The % for water body is also high resutling from the presence of the river Niger in Asaba for annual water supply,

In 1996 waste land still occupies the highest class with 43% of the total class, making up half of the total classes. Furthermore, the high percentage may be due to the season of the year as earlier mentioned. The built-up land takes the least percentage of the total class

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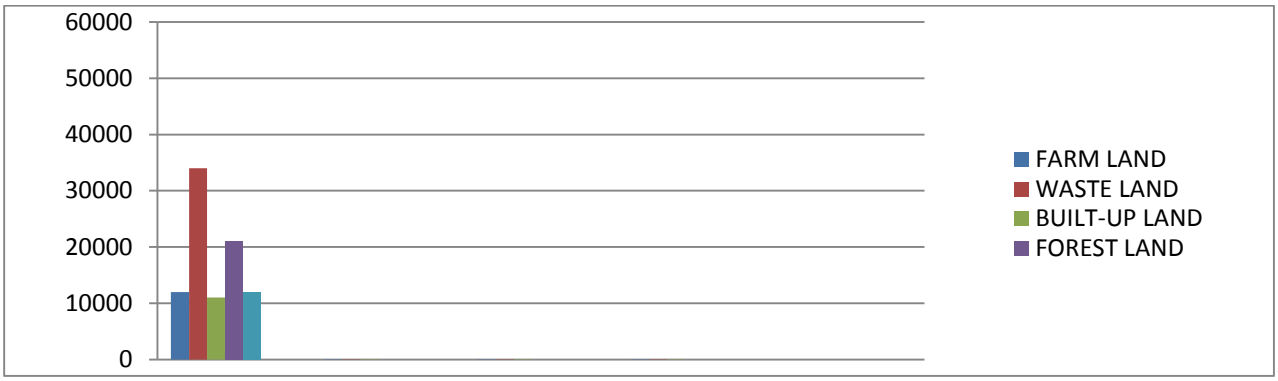
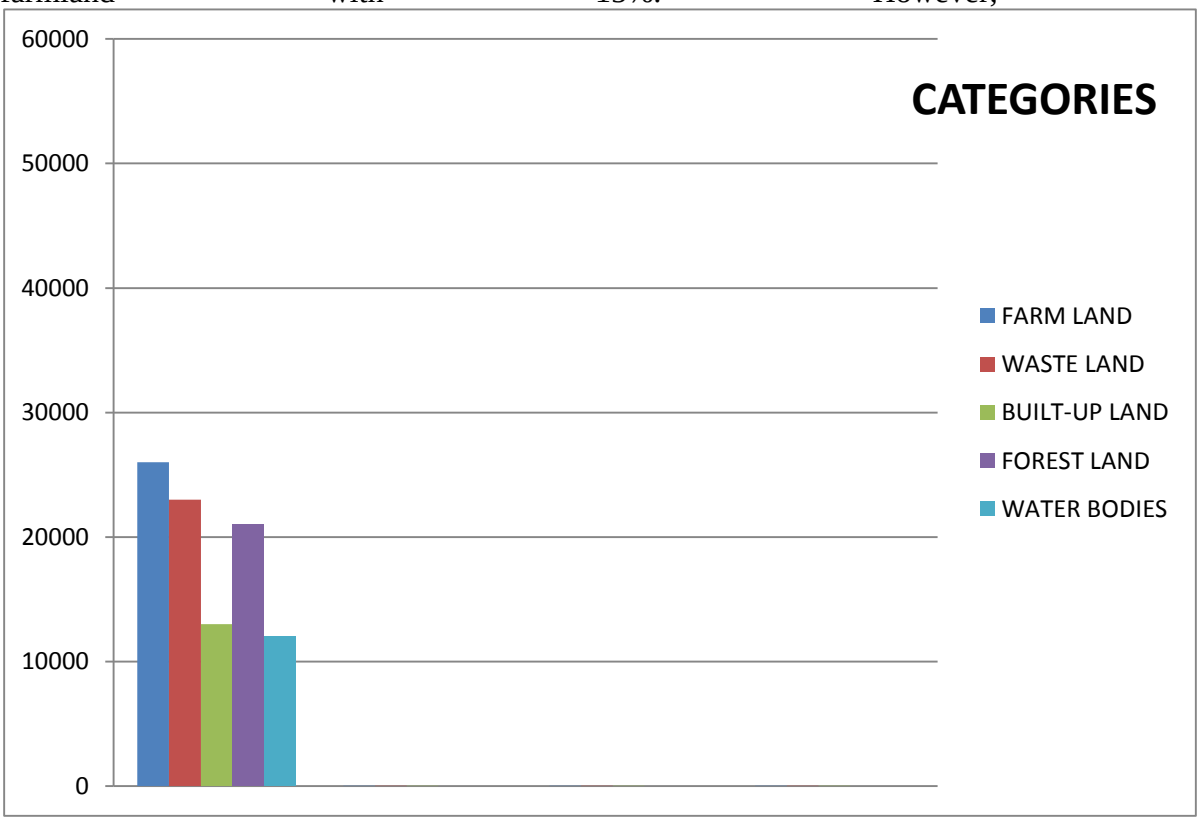


Fig 5 : Showing Landuse/land cover categories of Asaba in 2006

Fig 6 : Map 3: derived from the landsat image of Asaba 2006. Source: NARSDA

In table 4, the pattern of landuse/landcover distribution in 2006 followed the pattern in 1996 with wasteland accounting for major part of the land mass with 35% but, there is increased total farmland with 15%. However, the



built-up lands maintained the least 13% position of the classes while water body occupies 18% of the total class.

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Fig 7 : Land use/ land cover categories of Asaba in 2015

Fig 8 : Map 4: Derived from the landsat image of Asaba. Source: NARSDA

Take data in table 4. indicates 2015 is characterized with increased built up land 18% as a result of the increased ministries built and the influence of Delta State University, Asaba Campus. There is marked reduction in farmland to 14% as most people are engaged in office working in the ministries.

Table 4: LAND CONSUMPTION RATE AND ABSORPTION COEFFICIENTs

YEAR	LAND CONSUMPTION RATE	YEAR	LAND ABSORPTION CO-EFFICIENT
1996	0.005	1996/0	0.09
2006	0.02	01/2015	0.005
2015	0.01		

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Table 5: Population figure of Asaba in 1996, 2006 and, 2015.

YEAR	POPULATION FIGURE	SOURCE
1996	73381	Geonames geographical
2006	95,395	Estimate
2015	121,151	Estimate

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Notably, the closest year the population to each study year as shown above, were used in generating both the land Consumption Rates and the Land Absorption Coefficients as given in table 5.

Table 6 **LAND USE LAND COVER CHANGE: TREND, RATE AND MAGNITUDE**

LAND USE/LAND COVER CATEGORIES	AREA (HA.)	% CHANGE	AREA (HA.)	% CHANGE	1996-2006	2006-2015
Farm Land	-16410.699	-3	6102.9216	-1	14068.4949	1.05
Waste land	14124.3777	-8	-5243886	-10	50317.263	-1.05
Built-up land	7504.5402	11	1113.1074	5	10815.921	0.15
Forest land	4518.3838	3	-1432.809	1	19960.2315	-0.15
Water body	16874.6562	-3	-539.334	0	787.5576	0

Table 6 Land use land cover change of Asaba and its environs: 1996, 2006 and 2015.

From table 6, there is negative change i.e. a reduction in farmland between 1996 and 2006. This may not be unconnected with change from farming to white collar jobs as a result creation of Delta State with Asaba the capital with 13%. Subsequently, built-upland increased by 10% whiles both forestland and waterbody decreased by 8% and 16% respectively.Many projects attracted a lot of people to the area thus contributing to the physical expansion of the city as evident in the increased land consumption rate from 0.00 is 5 to 0.02 and land absorption coefficient by 0.09 between 1996 and 2006. Many of these projects include the building of the Ministries and government house, Niger Bridge, Delta State University (Asaba campus) amon others which l encouraged emigrants into the city.

The period between 2006 and 2015 witnessed a drop in the rate of farmland activities in the city as against 1996 - 2006. For instance, the farmland decreased by 1% as against the 3% increase between 1996 and 2006. This is also evident in the observed drop in the land absorption co-

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efficient from 0.09 between 1996 and 2006. Indeed the austerity measure known as (SAP) introduced in the country at this period to restore the country's economy, could be a major factor at this period. Also, there was a general increase of 2% in farmland which is evident in the 8% reduction of wasteland and 3% reduction of forest land. This may be as a result of non interest in farming and the excitement of governance which attracted many people from farming to white collar jobs.

FINDING, IMPLICATION AND RECOMMENDATION

There is anticipated crowdedness in Asaba come 2020. This situation will have negative implications in the area because of the associated problems of related crime and spread of diseases. It is therefore suggested that encouragement to build towards the outskirts through provision of incentives and reduce rforces of attraction at the city centre in these areas.Indeed, between the period of 1996 and 2015, there has been a reduction in the spatial expansion of Asaba compared witht the period between 1996 and 2006. There is a possibility of continual reduction in this area over the next 14yrs. This may suggest that the city has reduced in major functions that attracted emigrants into the area. Indeed, there have been many defunct industries within this period. It is therefore suggested here that government should encourage both local and foreign investors and more importantly revived the defunct industries.

After the initial reduction in farmland between 1996 and 2006, the city witnessed steady growth in this class and indeed continue with this trend in 2006-2015. For this projection to be realistic, a deliberate attempt should be made by the state government to achieve this since as it will lead to food security and more importantly a source of revenue to the state.Wasteland seems to be reducing between 1996 and 2006 and between 2006 and 2015 signifying a desirable change. Forest land steady reduced between 1996 and 2006 and indeed the trend in 2006-/2015. This good for the state and indeed the nation if the moderate reduction in forest land observed in between 1995 and 2006 is a projected to 2030 is upheld. Land consumption rate which is a measure of compactness indicate a progressive spatial expansion of the city was high in 1996-2006 and between 2006 - 2015 and this is the case before 2030.

Land absorption coefficient a measure of consumption of new urban land by unit increase in urban population. This was high between 1996 - 2006, and between 2006 - 2015. It suggests that the rate at which new lands are acquired for development is low. This I sthe trend in 2006-2015 as there seems to be concentration of development toward the outskirts. This may be as a result of people desiring to move away from the centre of activities to the outskirts of the city because of high crime rate

SUMMARY AND CONCLUSION

This research work demonstrates the ability of GIS and remote sensing in capturing spatial-temporal data. Attempt was made to capture as accurate as possible five land use/land cover classes as they change through time. Five classes were distinctly identified for each study year but more emphasis is placed on built-up land as it is a combination of anthropogenic activities that make up

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this class; and it is one that affects the other classes. In achieving this, land consumption and land Absorption coefficient were introduced into the research work. An attempt was also made at generating a formula for estimating population growth using the recommended national population commission of 3% growth rate.However, the result of the work shows a rapid growth in built-up land between 1996-2006 and 2006-2015.

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