

APPLICATION OF GEOINFORMATICS IN APPRAISING THE IMPLEMENTATION OF THE SOKOTO MASTER PLAN IN SOKOTO METROPOLIS

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ABSTRACT

Urbanization is creating an alarming situation in all cities of the world. This led to many problems such as extinction of agricultural land in the urban fringe areas and high land value as well as land speculation. The aim of this study is to evaluate the extent at which the Sokoto Master Plan (1983-2003) has been implemented with a view to identifying deviations and enumerating some possible ways forward. Two types of data were used which are primary and secondary types of data. The primary sets of data were collected through ground truthing conducted using Global Positioning System (GPS) hand-held receiver. This comprises the coordinates of some road intersections and track-logs of conflicting areas in the metropolis. While the secondary data used for this study were the Land use plan of 1983 covering a radius of 16 km and quick-bird satellite image of the study area for 2003. The study reveals that between 1983 and 2003, individual land use categories covered 422.234 square km. Out of which residential land use covered 163.52km square, which is the highest. Fadama covered 69.00km square. Government services and institutions covered 63.59km square. Commercial covered 2.95km square and manufacturing covered 2.75km square. Fadama land use remained relatively unchanged over other land uses as a result of its flood nature which make it intractable to other land uses more especially residential. Recommendations were equally made, some of which include the followings; New approach to planning need to be adopted in order to move away from master planning approach which should be replaced with a structure planning approach which provides the necessary framework for development and development control. Provisions of master plan should be more responsive to the needs of all businesses, hawkers and vendors. Building permits should not be excessively delayed in order to control illegal development, penalties for contravening the specific period be well enforced. Community participation should be a prerequisite in planning, for example, by carrying out public campaigns toward positive and constructive approach on all planning issues.

INTRODUCTION

The 20th century has witnessed remarkable urbanization and emergence of metropolis. The increased urbanization of the world population is inescapable and irreversible, which makes it necessary and fundamental for policy makers to adopt technologies such as Remote sensing, Global Positioning system and Geographic Information system as imperative for urban planning (Uttarwar, 2010). Urbanization as a process of urban expansion is predominantly due to enlargement of the existing towns at every level and not significantly due to addition of new towns. The forces of technological development and process of Globalization as well as population growth accelerates the dynamics of urbanization process in the developing countries. This phase of urban transition from rural to urban population in developing countries, population from migration and endogenous growth of those primate cities and industrial location on their fringes are extra ordinary expanding the urban areas (Shekhar 2010).

The Sokoto Master Plan was a result of government's desire to provide a regulatory framework to the people living in the proximity of the city, by preparing a planning tool designated to assist the Sokoto Urban and Regional Planning Board (SURPB) in discharging its task of guiding urban development within the metropolitan area. Benna (1982), indicates that the problem of traffic, ill-developed physical infrastructures and many others were becoming more obvious and more complex than expected. Therefore, it is in view of solving this problem of Master Plan that Benna (1982) was commissioned to prepare the Sokoto Master Plan to provide such a regulatory framework

to assist Sokoto Urban and Regional Planning Board (SURPB) in guiding the orderly growth of the city.

The objective of this paper is to assess the application of Geographic Information System (GIS), Remote Sensing (RS) and Global Positioning System (GPS) in appraising the implementation of Sokoto Master Plan 1983-2003. Hence to study land use changes of the city over 20 years.

Data used for the study include; Land use plan of the study area (1983) prepared by Benn Associate and satellite image of the area for 2003. Satellite Data were acquired from Quick bird image of Sokoto (2003), the map of the Master plan and ground-trothing using hand held GPS receiver. The data were geo-referenced and imported into Arc GIS software in vector format. The Quick-bird image was mosaic into single tile. Land use classes were then digitized and the resulting map reprojected to VT-M-32N. The Analog map was sub-mapped. Both maps Master Plan map (vector) and the digitized Landuse map from quick bird. The Data were later Rasterized and exported to Idrisi Andes environment for subsequent analysis. The data collected was analysed using (frequency/percentage and chi-square) contingency tables which display both descriptive and inferential statistics.

THE STUDY AREA

Sokoto urban area is circumscribed by a 16 kilometer radius centering on Shehu Kangiwa square. It is the area under the planning and development control of the former Sokoto Urban Development Authority (SUDA), now Sokoto Urban and Regional Planning Board (SURP). This

region is about 196,000 square kilometers in size (Benna 1982).

Sokoto city is situated at the north west of the confluence of the Rima and

Sokoto Rivers (Mamman, 1999). See figure 3.1. Geographically it is located between longitude 4°-6°E" and latitude 12° and 14°" N. (Udo, 1978).

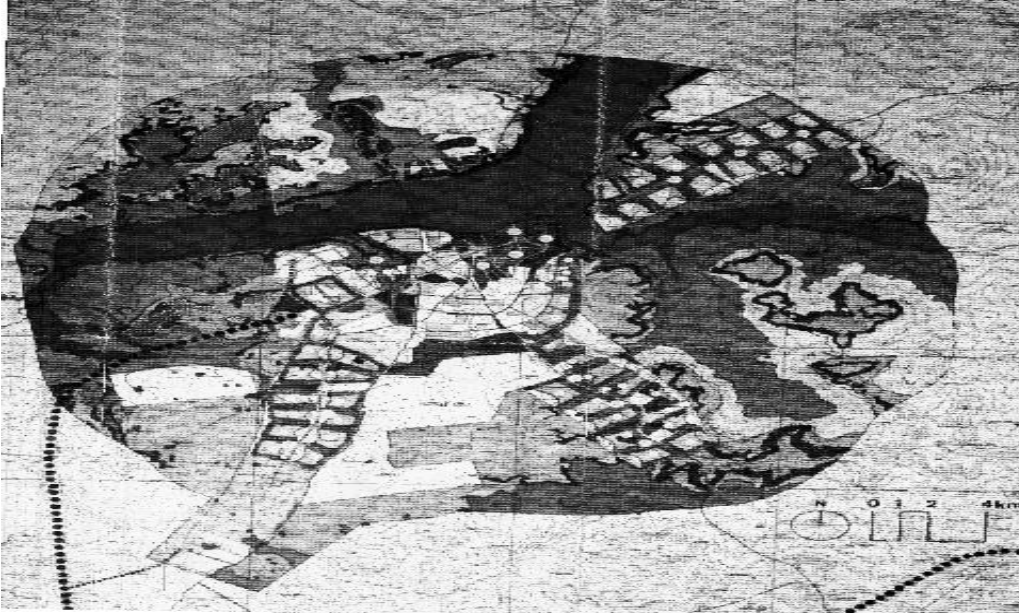


Figure 1: The master plan of the study area covering a radius of 16 km from the center Kangiwa Square. **Source:** Benna Associate 1982

i. Land use Classes in Metropolitan Sokoto

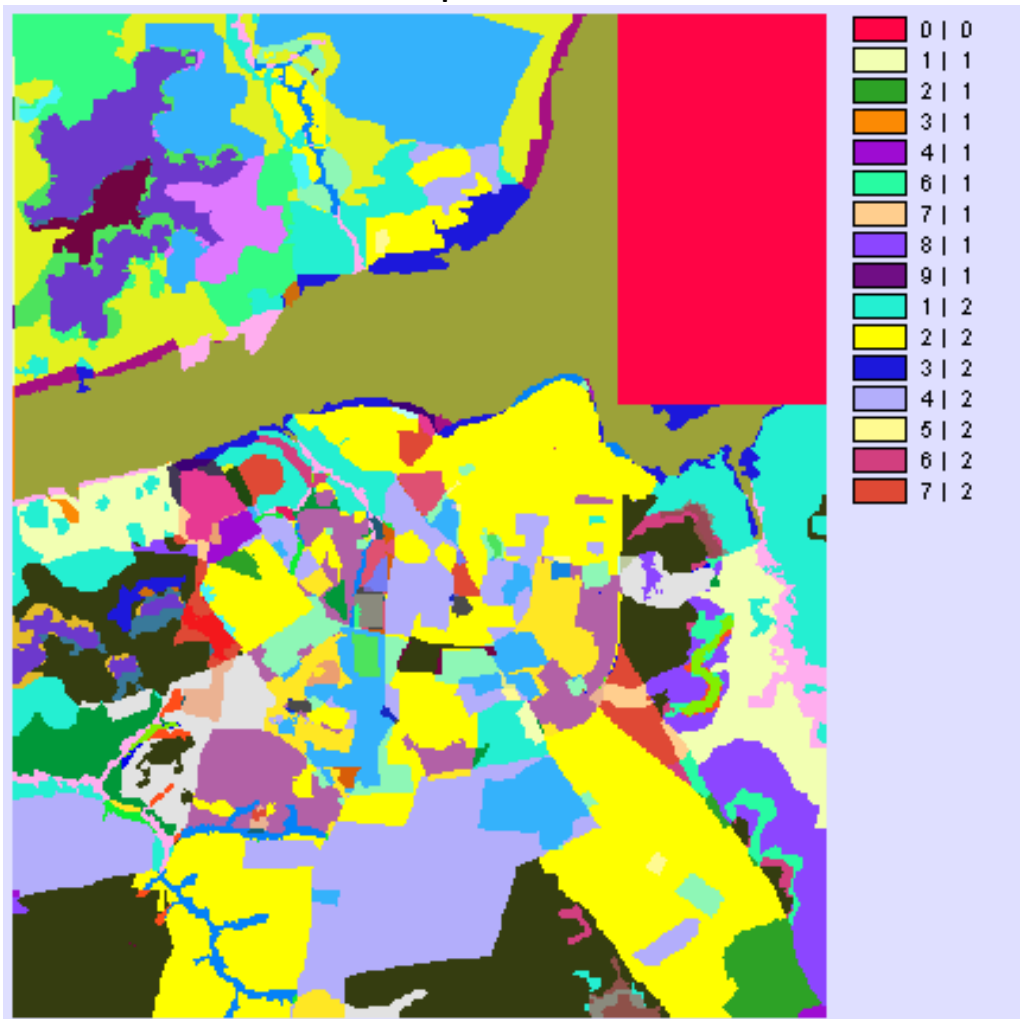


Figure 2: Cross-Classification: 1983_Landuse | 2003_Landuse
Source; Field work 2011

The legend contains 68 boxes but only 16 could be displayed at a time. Each category is partitioned into two values. For example, the category 7/2 shows areas that were formally in land use 7 in 1983 but have changed to land use 2 in 2003. If

values are the same that is 0/0, 1/1 or 2/2 etc, then the areas depicted have not changed between both dates. More interpretable is the cross tabulation matrix presented in Table 4.1.

Table 1: Cross Tabulation of 1983 and 2003 Land Use Maps

Cross-tabulation of 1983_Landuse (columns) against 2003_Landuse (rows)

	0	1	2	3	4	5	6	7	8	9	Total
0	23999	0	0	0	0	0	0	0	0	0	23999
1	0	6924	2323	160	557	0	1093	507	4973	14	16551
2	0	14487	34619	3144	18588	265	868	2266	19600	442	94279
3	0	3186	1976	29072	253	49	487	32	397	0	35452
4	0	8732	3758	1206	15433	37	2	153	1326	2022	32669
5	0	48	654	0	214	0	0	169	0	0	1085
6	0	475	228	9	54	0	226	15	415	0	1422
7	0	170	56	189	216	0	0	958	38	0	1627
8	0	2599	6380	7	3585	83	68	543	3844	0	17109
9	0	5002	400	121	2104	0	0	356	650	7174	15807
Total	23999	41623	50394	33908	41004	434	2744	4999	31243	9652	240000

Key: 0 = Outlier, 1 = Upland Agriculture, 2 = residential, 3 = Fadama, Overall Kappa 0.4154

4 = Government Services & Institutions, 5 = Commercial, 6 = Forestry 7 = Manufacturing, 8 = prime developable land, 9 = Scenic & Recreation

Source: Field work 2011

i. Assessment of land use gains and losses between both dates

Changes in land use categories between 1983 and 2003 are graphed using *Land Change Modeler* tool of Idrisi Andes. Gains and losses are expressed in square kilometers. Results indicated that residential land use has the highest gain of over 50% between 1983 and 2003. On the other hand, manufacturing and commercial sectors receive the lowest gain of less than 1% each. However, it should be noted that, the lower gain (expansion) of the commercial sector could be attributed to the fact that, most of the commercial buildings in the metropolis are attached to the residential buildings. Other sectors that recorded considerable gain include government services and institutions with close to 15% gain and prime developable land which recorded over 11%.

Similarly, agricultural sector recorded the highest loss of over 29%, which is closely followed by prime developable land with over 23% loss This could be attributed to the fact that, most of the spatial expansion occurred in these sectors with residential buildings taking over the agricultural land in the urban fringes. This can further be attributed to high rate of population increase in the area both by natural and artificial means. On the other hand, commercial sector recorded the lowest loss of less than 0.5 %. This can be explained by the fact that, urban expansion is mostly along agricultural land and that most of the newly developed residential areas have some commercial activities attached to them. Another sector that recorded considerable loss is government services and institutions with over 21% of the land initially allocated to the sector diverted to other uses.

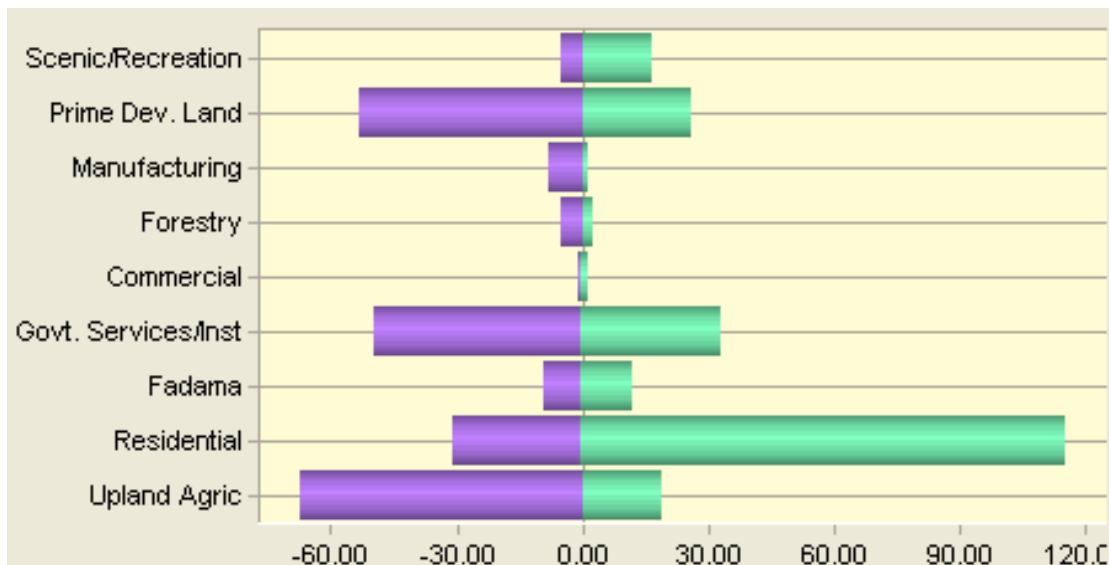


Figure 3: Gain and Losses between 1983 and 2003

Source; Field work 2011

Landuse change analysis:

Spatial assessment of gain and losses between both dates

This section of the discussion focuses on the spatial analysis of gains and losses of individual land use category between 1983 and 2003. It maps each land use in the light of the areas gained and lost (km square) between both dates. The above graph has two sides negative and positive. The negative side shows the extent of land lost by individual land use. While the positive sides portrays the quantity gained by each land use from 1983 to 2003.

It indicates that residential sector recorded the highest gain while commercial sector recorded the lowest loss from 1983 to 2003. More so, Manufacturing sector recorded the lowest gain while Upland Agriculture recorded the highest lost. Another sector with appreciable gain is Government services and Prime Developable land also recorded substantive loss of its land allocation. Fadama sector remain almost

stable without apparent lost or gain. However, a slight gain was recorded by the Fadama sector as a result of the inability of the 1983 map to recognize some Fadama features such as wetlands within the study area and these features were captured by the satellite image of 2003 of the area.

CONCLUSION

This has demonstrated the capability of Geo-informatics in providing the necessary input and monitoring tool at various phases of master plan implementation. The tool has provided the most efficient methods of assessing land use/land cover changes in the absence of required data from the local authority. It provides a good understanding of land use/ land cover changes in the study area for a period of 20 years. This impliedly assists the plan implementation Authority in carrying out their responsibility by providing the necessary input and intelligence for preparing base maps and creating planning proposals.

RECOMMENDATIONS

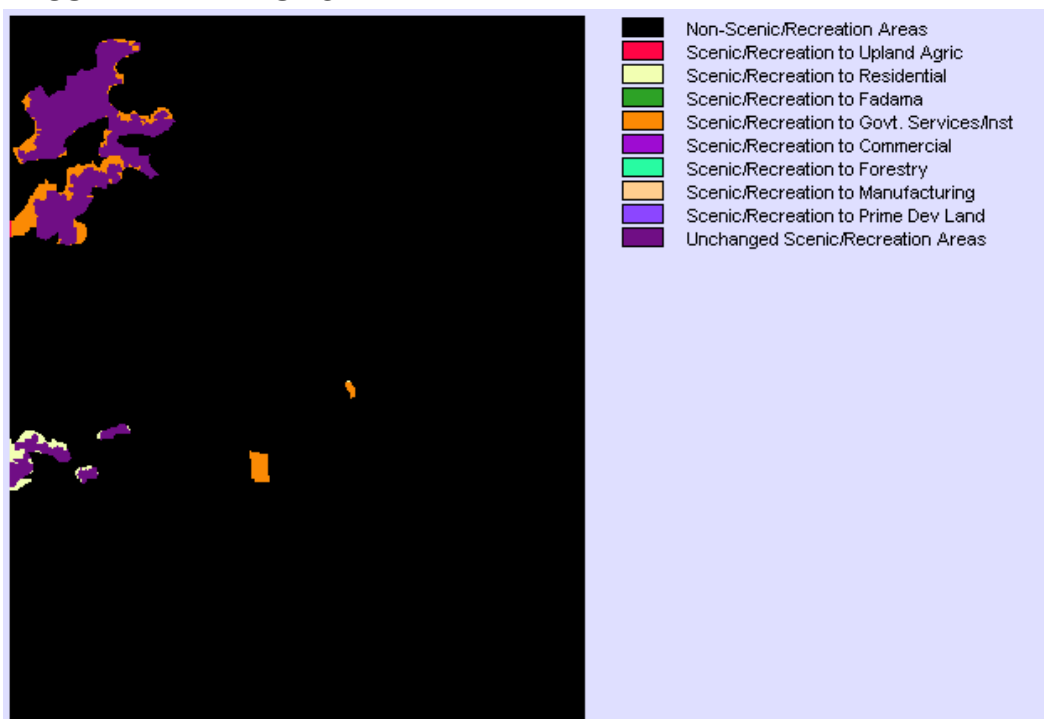


Figure 4: Class Transition from Scenic and Recreation to other Classes

Source: Field work 2011

Above is map showing the Landuse class transition which makes to adopt the followings recommendations for this study: New approach to planning need to be adopted in order to move away from master planning approach which should be replaced with a structure planning approach which provides the necessary framework for development and development control. Provisions of master plan should be more responsive to the needs of all.

Planning Authority requires an information system for monitoring and surveillance so that planning regulations will function as early warning system. Geoinformatics provides complete data about the city such as land information, demographic information etc. This helps to the large extent in providing a number of

planning procedures, effective management and application in the urban area.

Application of GIS enables the planners to study the existing land use patterns with regard to population growth. It assesses land use transformations in different parts of the city. It allows for accessibility analysis for proposed development project such as housing, transportation, water supply, health etc.

The most interesting thing about the class transition in this category is the absence of transition from the class to manufacturing, Fadama, forestry, commercial and prime developable land sectors. This is attributable to unsuitability of this sector to many land uses either as a result of its rugged nature or government restrictions. Nevertheless, the sector retained nearly 14km square of the

land budgeted for it in master plan. Government services and institution snatched roughly 4km square and housing managed to take away less than 1km square

because the landuse is unattractive to housing development. Figure 4.18 presents the detail.

REFERENCES

- Benna Associate (1982), *Sokoto Master Plan 1983-2003*. Final Report, Zaria.
- Mamman, A. B. (1999), the Evolution and Growth of Sokoto City. *Journal of Social Science and Administration*, 2; 122-125.
- Uttarwar, P. S. (2010), Application of GIS and Remote Sensing in urban planning, implementation and monitoring of urban project-A Case study of Rohini and Dwarka project, New Delhi, from <http://www.gisdevelopment.org>. 9/8 2010.
- Shekhar, S. (2010), Changing Space of Pune- A GIS perspective, Hyderabad India.
- Udo, R. K. (1978), *A Comprehensive Geography of West Africa*. Morrison and Gibb Ltd
- Zubair, A.O. (2006), *Change Detection in Land use and Land cover Using Remote Sensing Data and GIS: A Case study of Ilorin and its Environs in Kwara state*. Unpublished Master's Dissertation, University of Ibadan.