

TOWARDS SUSTAINABLE NATURAL FOREST PROTECTION AND CONSERVATION IN LAGOS STATE: THE ROLE OF CARTOGRAPHY AND GIS

Rafiu O. Olorunnimbe and Samson O. Adejobi

Abstract

This paper examines forest degradation and depletion in Lagos metropolis. It examines the rate of loss, spatial dimension and amount of loss between 1968 and 1994. The use of GIS and Cartography for spatial analysis and scientific investigation of this kind of study is imperative in order to yield the desired spatial output upon which the problem under study could better be understood and conceived. Lagos state in particular has witnessed great change in its natural forestland where almost all metropolitan forests have been cleared and reclaimed for industrial, institutional, commercial and residential purposes. Amuwo Odofin (the case study area) is one of the areas experiencing this continuous deforestation of forestland. This is as a result of the rapid urbanization been experienced in the area. Such deterioration and degradation of the environment is responsible for the incessant flooding, thermal discomfort (urban heat island), and biodiversity loss currently been experienced in Lagos State. The study then suggests, that to improve the environmental situation and the incessant flooding in Lagos State, a sustainable forest protection, conservation and management policies should be evolved.

Background

Man has proven surprisingly illiterate in learning and reading lesson of history. Perhaps this is because he is somehow blinded by the glare of immediate profit, which made him see the pages of the past as blank. This has resulted into discouraging repetition of mistakes, which is particularly true in respect of man's treatment, misuse and degradation of natural forests" [Dasmaan, 1976],

Misuse and degradation of natural forests has been a common phenomenon in both rural and urban areas of developing and developed states of the world. There is no gainsaying that degradation in form of deforestation has greatly affected the future of man where he is unable to comfortably enjoy his environment as a result of his actions. Since agriculture began about 10,000 years ago, human activities have reduced the earth's forest cover by about one quarter from about 34% to 26% of the world's land area [excluding Antarctica and Greenland] and only 12% consist of intact forest ecosystem. Slightly more than half of the world's forests are in the tropics, the rest are in temperate and boreal zones. If the rate of cutting and deforestation does not exceed the rate of re-growth and if protecting biodiversity is emphasized, forests are renewable resources.

However, forests are disappearing or are being fragmented and degraded almost everywhere, especially in tropical countries like Nigeria. Tropical forest covers about 6% of the earth land area and grows in equatorial Latin America, Africa and Asia (Tyler, 1999). Climate and biological data suggest that mature tropical forests once covered at least twice as much area as they do today with most of the destruction occurring since 1950. The lowest estimated rate of loss and degradation of remaining tropical forests is 62,000 sq. km. per year while the highest estimated rate of destruction and degradation is 308,000 sq. km. per year. Biologists consider the plight of tropical forests to be one of the world's most serious environmental problems, primarily because their forests are home to 30-90% of the earth's terrestrial species. This made Edward O. Wilson to estimate that by 2002, at least 20% of tropical forest species could be gone and as many as 50% by 2042, if current rates of tropical deforestation and degradation continue (Miller, 2000).

The above suggests that wherever people have settled in great number, forests have tended to disappear. The extent of change has been most marked in many cities and urbanized areas in Nigeria, particularly Lagos state where almost all metropolitan forest have been cleared and reclaimed for industrial, institutional, commercial and residential purposes. This shows that little or no effort is centered towards forest protection, conservation and management in most areas of Nigeria. According to Miller (2000), Nigeria is one of the tropical countries where forest loss and degradation average about 0.8% annually between 1981 and 1990 and between 1991 and 2000. Nigeria alone loses about 600,000 hectares of forestland annually according to the Food and Agricultural Organization's estimate of 1983. It is recorded that the African continent loses 1.3 billion hectares of forest annually, 55% of which come from West Africa (Osuntokun, 1997).

In recent time, Lagos is one of the fastest growing urban centers of the world. The implication of this is directly felt on the changing natural vegetation (mostly forest loss and degradation) and land use patterns within the Lagos metropolis. However since natural vegetation (especially forest) in metropolitan Lagos is being degraded and destroyed constantly, especially in Amuwo -odofin local government area of Lagos state, an area rich in swamp forest. This area is fast losing its forestlands and there is the need for scientific monitoring and assessment of natural forest loss in this area for conservation and protection purposes.

Lastly, the resultant and unimaginable negative consequences of the unrestricted destruction and degradation of natural forest in Nigeria, particularly in Lagos both at present and in future, inspires this study. Thus, a time series analysis and evaluation of natural forest degradation, clearance and loss was undertaken with the aim of

proffering sustainable forest protection, conservation and management policies for evolving environmental and ecological balance and sustainable urban growth and development.

Conceptual Consideration

Towards achieving the objectives of natural forest protection and conservation in Lagos state, the following conceptual issues are important.

❖ **Sustainable Development**

In the last decade, there have been a plethora of books and articles, not to mention videos, CD-ROM, simulation games, conferences, workshops, NGOs, and others aimed at informing anyone from the general reader to the specialist of the definition and importance of sustainable development. Beyond what is seen by many as the standard definition of sustainable development, which was defined by the Brundtland Report “as development which meets the needs of present, without compromising the ability of future generations to meet their own needs” (WCED, 1987: 43). It is important to draw attention to two distinctions in sustainable development thinking, which are relevant to the understanding of the concept.

Thus, a distinction can be drawn between “ecologically” orientated definition and “human welfare” orientated definition of sustainable development. The Brundtland definition referred to above is perhaps the archetypal welfare orientated definition, in which the starting point is “development” whether this be increasing wealth, the provision of basic needs, or even the securing of human rights. Sustainable development is then about meeting these goals and needs in the long-term without degrading natural or other resources that underpin them.

In contrast, the ecological approach is perhaps most associated with the World Conservation Strategy, in which primacy is allocated to ecological constraints and emphasis is then placed on the sustainable utilization of resources within these constraints (IUCN, 1980). Absolute protection of particular resources is necessary to ensure that they remain as they are, or at least above certain critical threshold levels in terms of quantity and quality. (Black, 1998).

❖ **Environmental Protection, Management and Conservation**

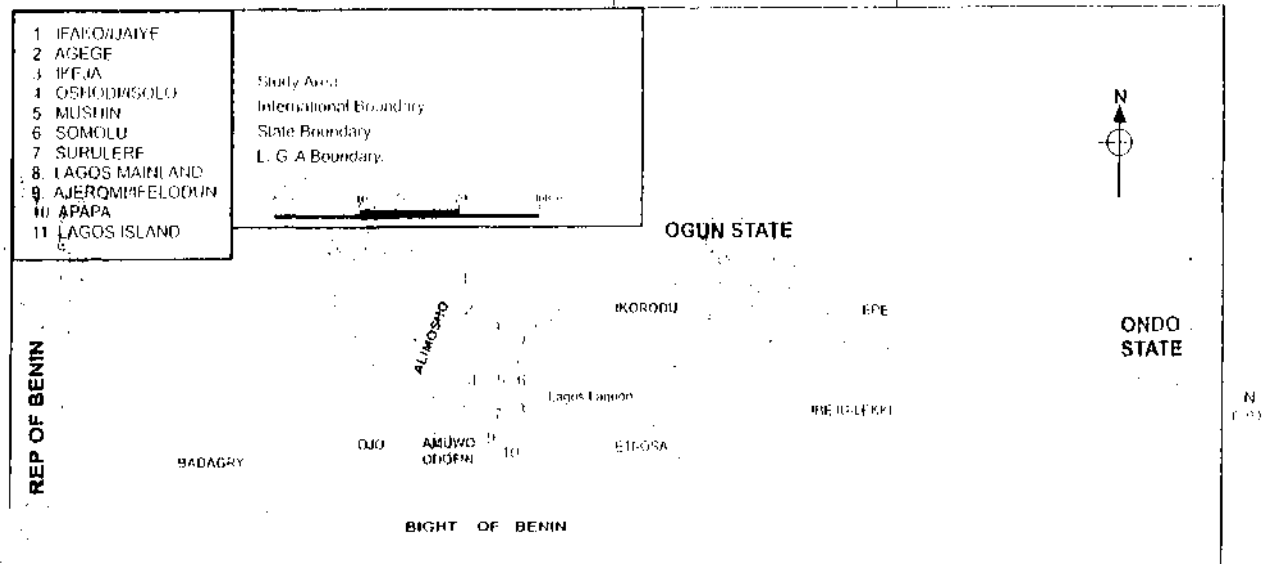
Environmental protection and management earned global attention since the United Nations Inter-Government conference on Human Environment at Stockholm (1972). The United Nations Conference on Environment and Development in Rio, Brazil (1992) consolidated the impact of the Stockholm Conference and made the environment a global agenda. Legal principles usually evolve as direct responses to human problems. Nigeria’s appreciation of the environmental problems in consonance with global agenda, led to her enactment of various legislations on the environment with the Federal Environment Protection Agency Act CAP 131 laws of the Federation 1990, as amended by Decree No. 59 of 1992, becoming the most comprehensive law. The Federal Environmental Protection Act of 1992 gave powers to each state government to legislate and enforce environmental protection laws and regulation (Anyaegbunam, 1998).

Environmental conservation is one approach towards achieving a better environmental balance. At the very least it is an approach that will minimize the risks associated with our willingness to play with our newfound physical power. At best it will lead to the understanding of the interactions between nature and humanity that will allow us to develop ways of life that can be sustained. It is most likely these ways will provide greater satisfaction and fulfillment for the people who pursue them. Thus, environmental conservation is defined as the rational use of the environment (e.g. forest) to provide the highest sustainable quality of living for humanity [Dasmaan, 1976]. Ironically, the principle of “sustainable yield” as apply to forest, is subject to criticism in its operation. Ideally viewed, the concept means forest should be managed and protected to produce a sustainable flow of forest products at some near optimum level. These forest products include clear water (found in the swamp forests) wildlife, fisheries, recreational space and livestock forage, as well as timber. In practice, the concept is applied too often to a sustained yield of timber and “no commitment is made to maintain forest in the their natural state” or in a state suited to the sustained production of their other products of value.

Study Area

The study area Amuwo-odofin local government area is located in western part of Lagos state precisely between latitude 6°.22¹N to 6°.30¹N and between longitude 3°.13¹li and 3°.20¹L. Six other local government areas bound it and its total land area is approximately 1 74square kilometer (see figure 1). The late Head of state. General Sanni Abacha, created the local government in 1996. The area consists of upland and riverine areas. The upland area include Festac town, Amuvvo - odofin estate, Onireke, Abide ado, satellite town, Ijegun, kirikiri town, Agboju, Adosoba, Fin-Niger, Navy Barracks and others. While the riverine area include areas like Irede, Iyare, Ikare, Ibaso, Imore, Igbologun, Tamoro, Okunglass, llado, Ibese, Ibafo, Porto-Novo area, Okun ibese and others.

Fig. 1: Lagos State Map Showing The Twenty Local Governments



Sayre?: *Cartography Laboratory, Peapartment of Geography and Planning, LASU*

Being a coastal area, the underlying rock of the study area is made up of sedimentary rock, which is composed of alluvial deposits. The flat nature of the surface area does not allow for easy runoff of water while quick percolation of water in order to keep the area dry is also difficult due to the high water table that is also close to the sea. The vegetation cover of the area includes: oil palms, coconut, mangrove, swamp, shrubs, marshy grasses, rooted trees with dense undergrowth and climbing tress. The area is also characterized by wet equatorial climate that is composed of high temperature, high humidity, and heavy rainfall with double maximal. The average daily temperature is 27.6 C while the maximum and minimum daily temperature are 29.6°C and 24.5°C respectively (Arowolo, 1990).

The raining season generally covers April to October with a short dry spell in August (August break) while the dry period covers between November and March. During the wet season, the southwest trade wind bringing the moisture-laden wind from the Atlantic becomes dominant, while in the dry season, the North East trade wind bringing harmattan becomes dominant.

Methodology

Panchromatic aerial photographs (23cm x 23cm), topographical maps and satellite imagery of the study area (acquired at different periods of time) were used to obtain necessary in formation about the forest area and its disappearance overtime. The study utilizes both the manual and digital image analysis techniques for determining land use change of the study area by comparing the topographic map of the area for 1964(T₁) with the aerial photographs of the area for 1983 (T₂) and with satellite imagery of the area (SPOT, HRV) for 1994 (T₃). Ground validation and text files were also used as collateral information to support the above data. The change in forest loss due to other land use invasion was detected by GIS analysis of the above data using overlay method and the extent of change in land use and natural forest loss and destruction were mapped by cartographic technique (See appendixes). However, the source and characteristics of the above data are presented in tablel below.

Table 1: Sources of data and Characteristics

Data Type	Scale	Code	Year	Spatial Resolution	SwathWidth and Bands	Source
Topographic map of Lagos showing Amuwo- Odofin LGA.	1:50,000	Sheet 279 S.E.	1964			Federal Survey Department of Lagos
Panchromatic Aerial Photographs Covering Amuwo- Odofin LGA.	1:35,000	(38-43) 83642 (15- 18)	1984			Same as Above
Topographic map of Lagos showing Amuwo-Odofin LGA.	1:25,000	Sheet 279A, N.E 279A,N.W.	1985			Same as Above
Satellite Imagery of Lagos Showing Amuwo-Odofin LGA.	1:50,000	SPOT XS (HRV)	1994	20m by 20m	60 km and 3 Spectral bands.	Remote Sensing Laboratory UNILAG, Lagos.

Source: Compiled by Researcher, 2008.

Furthermore, the study utilizes the U.S.G.S classification scheme for land use with some modification, to suite the Nigerian environment. This involves segmentation of photography / images into a mosaic of parcels with each parcels assigned to a landuse class or groping of like categories of Landuse. The aerial photographs and satellite imagery were interpreted visually by employing the strategies of image interpretation. The images were classified, enumerated, measured and delineated using direct interpretation, inferential and deterministic interpretation.

In essence, the photographs and the satellite imagery were transformed to match with the topographic map and a change map was cartographically produced by overlaying the three maps generated for each period (T₁, T₂, and T₃) *{see Appendixes}*.

Results and Discussions

The study covered a total area of 1408.16 hectares and the in-depth explanation of the results and findings therein are presented in table 2. However, most explanations were given in terms of landuse/landcover classes, which were loss or gained over the three periods being considered. More so, only the Landuse map for 1964 and the change (loss or gain) map for 1994 were presented in this work due to lack of space, while the research was limited to 1994 due to lack of fund to purchase 2008 satellite imagery. The result obtained from the analysis revealed that about 78.8% of the study area (1109.3 hectares) was covered with mixed vegetations (mosaic of palm and young secondary forest} in 1964. The remaining 21.2% was covered with creek, shrubs and grasses, and small parcel of reserves.

Interestingly, by 1984, greater percentage of the mixed forest vegetation has been converted to built-up areas, open surfaces and artificial creek (473 hectares). The remaining was changed to light and dense forests (321.67 hectares), swamps and marshy land (161.21 hectares) and grass land/ shrub [73.70 hectares] as presented in table 2 below.

Table 2: Summary of Landuse Inventory for 1964, 1984 and 1994 in A mu wo.

Landuse Category	Code	1964		1984		1994	
		Area Covered	% of Total	Area Covered	& of Total	Area Covered	% of Total
Built up Area	10	22.36 hectares	1.846	358.76b hectares	25.49	616.39 hectares	.43.07
Trade Fair	11	NIL	NIL	18.12 hectares	1.29	18.12 hectares	1.29
Plantation/Reserve	22	66.29 hectares	4.708	142.63 hectares	10.13	153.32, hectares	NIL
Dense Forest	31	NIL	NIL	42.74 hectares	3.02	NIL	NIL
Light Forest	32	NIL	NIL	278.93 hectares	19.62	222.67 hectares	15.82
Grassland/Shrub	33	8.34 hectares	0.589	82.03 hectares	5.83	36.28 hectares	2.54
Mixed Vegetation	34	1 109.3 hectares	78.58	NIL	NIL	NIL	NIL
Swamp/Mangrove	41	50.35 hectares	3.58	21 1.56 hectares	15.03	100.75 hectares	7.16
Creek/River	50	126.26 hectares	8.97	155.05 hectares	1 1.01	155.04 hectares	11.01
Sandy Beach	61	25.26 hectares	1.87	25.45 hectares	1.81	25.55 hectares	1.82
Open Surface	62	NIL	NIL	94.26 hectares	6.77	81.90 hectares	5.82
Total		1408.16 hectares	100	1409.52 hectares	100	1410.02 hectares	100

Source: GIS analysis of Topo., Map, Aerial Photographs and Satellite Imagery of the Study Area for 1964,1984 and 1994 (2008).

In the same manner, 56.26 hectare of light forest, 111 hectares of swamp forest, 37.40 hectares of dense forest and 5.16 hectares of reserves were all converted to built-up area between the ten years period of 1984 and 1994. Thus, a scientific investigation and analysis of natural forest loss in the study area revealed that between 1964 and 1984, a whole lot of 467.48 hectares of natural forest were deforested for various construction activities. While a similar tempo was discovered between 1984 and 1994 in which 188.01 hectares were also deforested. This shows that an average of 1.43 hectares of forestland is loss annually in the study area without any form of replacement. This results support the assertion of Gbadegesin and Ayileka (2000) that biological impoverishment and ecosystem loss in Sub-Saharan Africa require urgent attention so as to sustain the flow of the basic human developmental needs.

❖ **Reasons for the Natural Forest Loss in the Study Area**

Amuwo Odofin being part of metropolitan Lagos has experienced an increase in urbanization and modernization processes in recent past. The observed changes in landuse pattern and natural forest loss in the area was due largely to increasing urban expansion and land reclamation activities within the area (especially in recent times). This process has brought about population agglomeration, physical and socio-economic development of the area. More specifically, the establishment of *Festac 77*, *Amuwo housing scheme*, *Satellite town estate*, *Trade Fair complex*, *Satellite town industrial estate*, *e.t.c*, has brought about massive deforestation and reclamation of natural forest zones (land and swamp forests). In fact, most forest zones were cleared for the construction of residence, industries, institutions and roads.

❖ **Consequences of Natural Forest Loss in the Study Area**

The resultant consequences of these uncoordinated development and unrestrained deforestation are becoming alarming in recent period. The effects of massive deforestation in the area can be observed in the following areas:

- Increasing thermal warming of the area (urban heat island)
- Incessant flooding causing damages to land and properties.
- Urban congestion both in terms of population and road traffic wise.
- Increasing pollution of the air, water and soil by effluents from vehicles, homes and industries.

- Loss of some species of plants, animals and microorganisms that sustain the ecosystem.

Recommendation and Conclusion

The study has established the fact that Landuse dynamics is one of those problems that man must contend with. It also revealed that a lot of deforestation and wetland reclamation activities have taken place in Amuwo Odofin L.G.A over the four decades under study. This shows that the area, which was relatively unknown about four decades ago, now houses a considerable portion of the ever- expanding population of Lagos metropolis, judging from the greatly increased size of built up areas from 21.36 hectares in 1964 to 616.39 hectares in 1994.

It is thus recommended that:

- <◆ Government [at all levels] should enforce more realistic and sustainable laws towards coordinating physical and development activities within Lagos state.
- ❖ The public authorities should evolve harmonious and effective Landuse development policy that will promote sustainable and balance environmental development. This will ensure sustainable use of our exhaustible forest resources.
- ❖ As a matter of importance, more forestlands should be acquired and preserved by government for future generation use.
- ❖ Planning authorities should encourage intensive land utilization rather than extensive building construction in order to reduce forest clearing and degradation.
- ❖ Individual should be encouraged to plant trees and shrubs in their compound. Also, government should inculcate the policy of landscaping public recreation areas and road medians to reduce heat and thermal discomfort in Lagos metropolis. Effort of governor Raji Babatunde Fashola at afforesting Lagos State should be intensified.
- ❖ Stakeholders in the area of planning and forest management should encourage more researches in the areas of land and forest resources utilization, management and development.

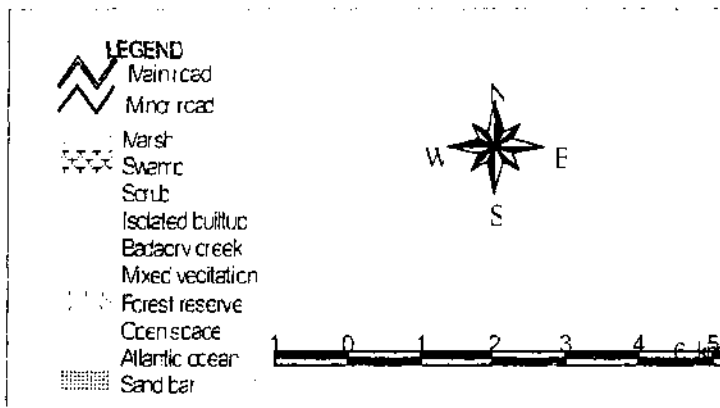
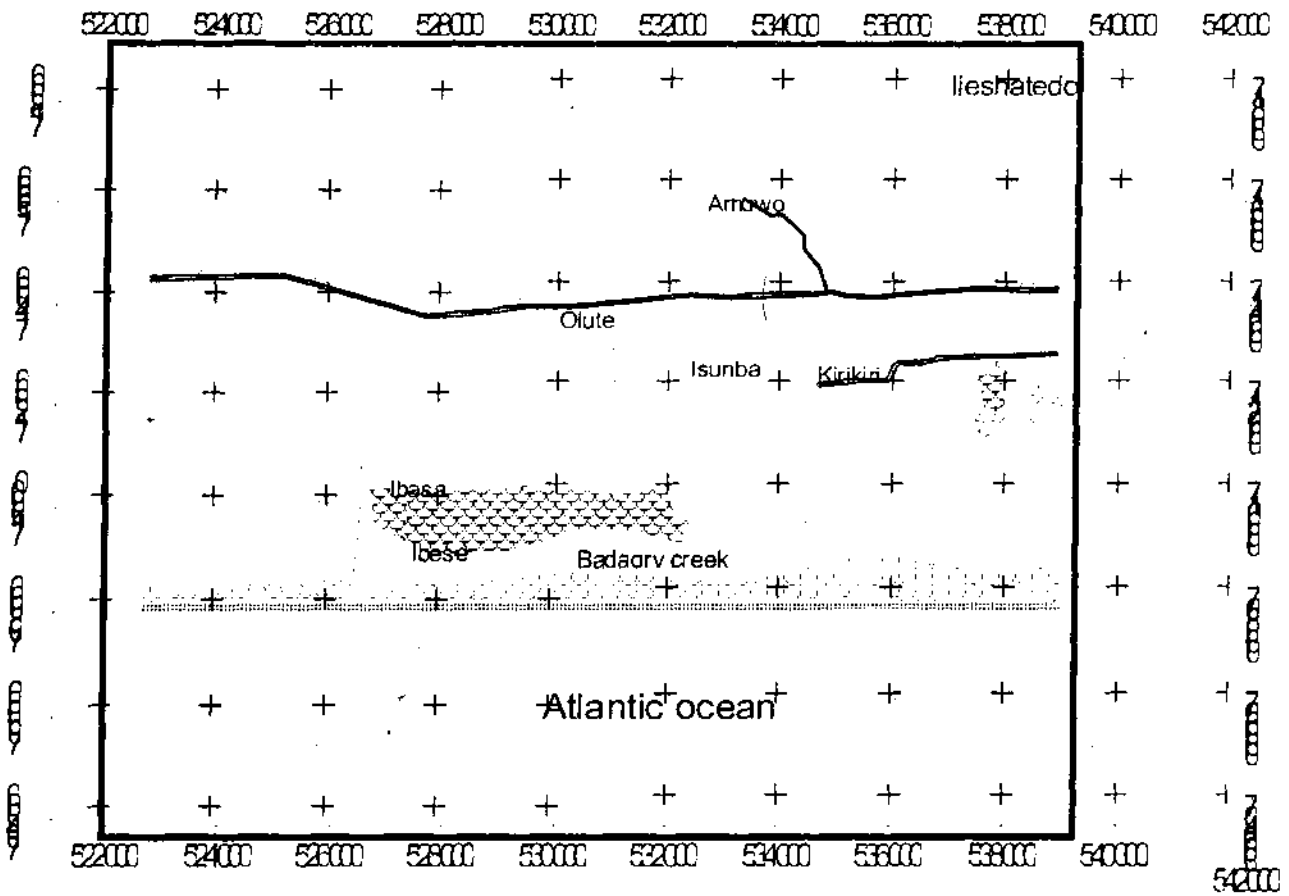
References

- Gbadegesin Adeniyi & Ayileka Olatubosun (2000): Avoiding the mistakes of the past: Towards a community oriented management strategy for the proposed National Park in Abuja-fNigeria. In *Land Use Policy* PERGAMON, 17 (2000) Pg. 89-100.
- Adeniyi, P.O. (1986): The role of remote sensing in land use planning in *Nigeria society of Remote Sensing* Publication no.2 (ed.) Nkambwe, M. Pp 19- 31.
- Anderson, J.R. *et al* (1976): Landuse classification for use with Remote sensing Data in *US. Geographical Survey Professor Paper 964*. Pp 1-25 (ed) Anderson J.R. et al.
- Areola, O.O. (1986): Introducing remote sensing techniques in routine resource surveys in Nigeria in Nkambwe, M.(ed) *Application of remote sensing techniques in Nigeria* pp.3- 7.
- Ayaegbunam E. O. (1998): Environmental protection and management laws in Nigeria: The constitutional question. *Current issues in Nigerian environment*. Edited by Akinjide Osuntokun, 1998, Davidson Press, Ibadan, Nigeria pg. 92-95
- Eitech, J.Y. (1999): A ARSE. Geo-information technology applications for resource and environmental management in Africa. *Geographical Infonation System for Land Parcel Management*. Pp.173-177.
- Environmental Assessment Source book (1993): Update on geographical information system for environmental department. The World Banks, No.3.
- European Space Agent (1996): Bulletin no.87, August 1996.
- Falade J.B. & Leke Oduwaye (1998): *Essential of land scape and planning*. Omega Hitech. Information and Planning system Ltd.
- George, C. Kehinde (2002): *Basic principles and methods of urban and regional planning*, Second Edition, Libro-Gem Limited, Yaba, Lagos, Nigeria. Pg. 62-90

- Imaging Note (2000): The world source for commercial remote sensing vol.15, no.6, December 2000.
- John Foster (1997): *Valuing nature: Ethics, economics and environment*. 1st edition, Routledge Publishing, New York U.S.A. pg. 123-128.
- Masai et al (1992): *Landuse and environmental changes in a metropolitans region And their GSP Data Base*. UAS.
- Miller, G. Tyler (1999): *Environmental science: Working with the earth*. 7th edition, Wadsworth Publishing Company, California U.S.A. pg.436-460.
- Miller, G. Tyler (2000): *Living in the environment*. 11th edition, Brook dale Publishing, California, U.S.A. Pg. 640-680.
- Miller, G. Tyler (2001): *Environmental science: Working with the earth*. 8th edition, Wadsworth Publishing Company, California U.S.A. pg.426-446.
- Nigerian Society of Remote Sensing (1996): *Application of remote sensing techniques in Nigeria*. Publication, No.2, 1996.
- Okafor, F.C. (1981): Towards a systematic approach in land use planning in Nigeria *Land use and conservation in Nigeria* (ed.) Igozurike, U.M. pp. 68 -73 University of Nigeria Press.
- Okon J. Umoh (1997): Environment, development and poverty in Nigeria. *In Nigeria Journal of Economic and Social Studies*. Volume 39,no. 3, 1997.pg 255-258
- Olorun'emi, J.F. (1993): Monitoring urban land use in developing countries - An Aerial photographic Approach. *Environmental International*, vol. 9. Pp. 27-30.
- Raymond F. Dasmaan (1976): *Environmental Conservation*. Fourth edition, John Willey and Sons, New York, U.S.A. Pg. 1-5 and 160-184.
- UNEP (2002): Regional challenges for sustainability in *Industry and Environment*. Volume 25, No. 1. January - March 2002 pg. 1-10
- Yemi Akinyeye (1997): Forest conservation as a strategy of environmental protection: The Nigerian experience, in *Dimensions of Environmental Problems in Nigeria*. Edited by AkinjideOsuntokun (1997), Davidson Press Ibadan, Nigeria. Pg. 85-100.

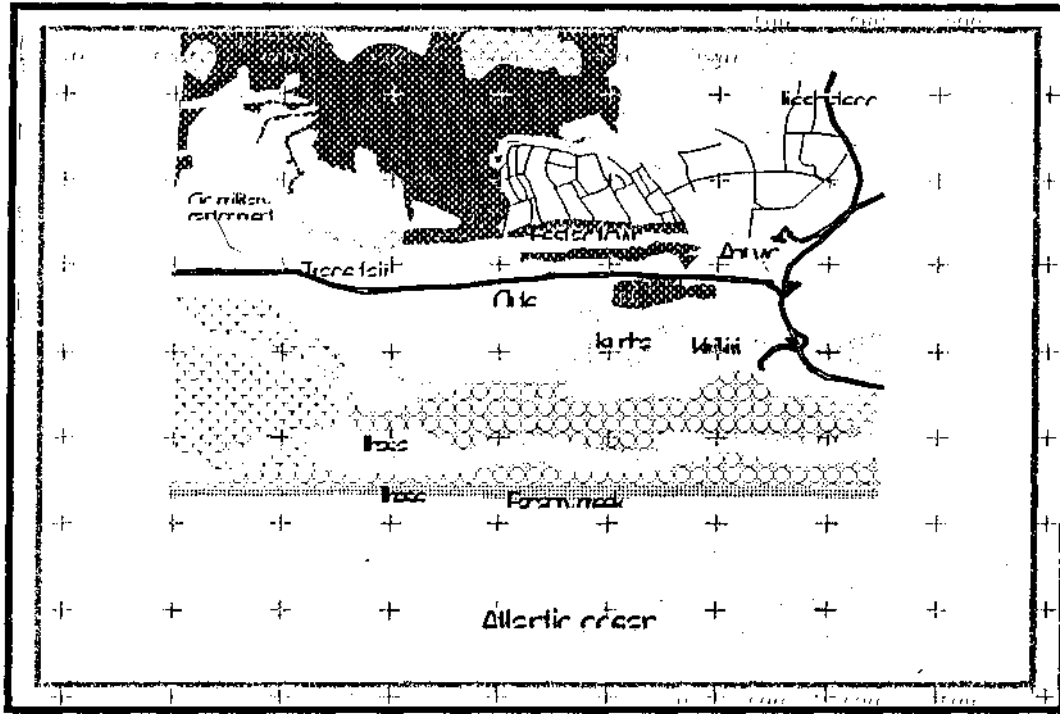
APPENDIX

Map Showing 1964 Landuse / Landcover Of Amuruw Cdofin LGA.



A BUNN

Map Showing 100% Coverage of Arable Cereals in CA



Cereals covered are shown in the following table
 CA = 100% Cereals covered (100%)

