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Application of GIS in the Protection of Natural Resources: A Case Study of Old Oyo National Park

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Abstract:

The study investigates possibility of the application of Geographic Information System (GIS) Technology in the Protection of Natural Resources. Review of global literature on GIS applications showed high potential and growing use of GIS in the Protection and Conservation of natural resources in the Park. This study is about the application of GIS in the protection of natural resources through the designing of database for Support Zone Communities (villages), Police, Law Court, and Prison location surrounding Old Oyo National Park, converting acquired data to digital soft copy format, and performing geographical analyses on the stored data based on defined criteria. This research is aimed at locating poacher's route into the Park, site for Rangers' Barrack that serves the purpose of policing Park and mapping of boundary and road networks surrounding the Park. The research shows that about 134 sq km of land was left unmapped from inception of the Park and Tede Rangers' Barrack serves virtually no purpose at its location. There is a need for the relocation of Tede Rangers' Barrack to Alakuko village and Marguba Staff at Ibuya to Kanga area while another Rangers' Barrack is needed at Banni and Tessi Apata. The Ibuya Base Camp could be used as Scout Camp by Central Squad.

Keywords: Natural resources, support zone community, geographical analyses, G.I.S, National Park

1. Introduction

Natural resources are resources that exist without actions of humankind. On earth it includes: sunlight, atmosphere, water, land (includes all minerals) along with all vegetation and animal life that naturally exists. A natural resource may exist as a separate entity such as fresh water, air, living organism such as animal, fish, bird etc or it may exist in an alternate form that must be processed to obtain the resource such as metal ores, petroleum, and most forms of energy. Protection of Natural Resources is the preservation of the natural environment essentially to maintaining community sustainability (Chape, S., Harrison, J., Spalding, M., Lysenko, I., (2005).

International Union for Conservation of Nature (IUCN, 1969) declared a National Park as a relatively large area with the following defining characteristics: (a) One or several ecosystems not materially altered by human exploitation and occupation, where plant and animal species, geomorphologic sites and habitats are of special scientific, educational, and recreational interest or which contain a natural landscape of great beauty (b) Highest competent authority of the country has taken steps to prevent or eliminate exploitation or occupation as soon as possible in the whole area and to effectively enforce the respect of ecological, geomorphological, or aesthetic features which have led to its establishment.

The first National Park was Kainji Lake, established by General Olusegun Obasanjo in 1979. The Nigeria National Park Service was established by Decree 36 of 1991 with five National Parks. These were Kainji Lake, Gashaka Gumti, Old Oyo, Chad Basin and Cross River. In 1992, Yankari Game Reserve was upgraded to the status of a National Park bringing the total to six Parks. With the promulgation of Decree 46 of 1999, now Act 46 (Cap 65 LFN 2004), two additional Parks; Kamuku and Okomu were established. However, Yankari was returned to the Bauchi State Government in June 2006, remaining seven National Parks currently in existence.

The Nigeria National Park Service (NNPS) is responsible for the coordination of the preserving, enhancing, protecting and managing vegetation and wild animals in the National Parks of Nigeria. The parks cover a total land area of approximately 22,185 km², or about 2.4% of Nigeria's 923,768 km² total land area.

The Nigeria National Parks are facing many threats particularly the continued depletion of their natural resources which needs urgent attention.

2. Statement of Problem

The natures of treats to National Parks are in varies depending on time, location, session, etc. Some of these treats are poaching, grazing, encroachment, logging, mining, gathering of non-timber forest products, climate change, air pollution, crumbling infrastructure, invasive species (foreign invaders), weeds, pest animals, untold stories, crumbling history, wildlife management, adjacent development, water issues, transportation problem, annual budget shortfalls (Pradhan B.M 2008) Lastly, the very visitors the Parks rely upon for income are also one of the threats to National Parks.

At present, mode of protecting the Park is through the use of Foot and Vehicle patrol which is inadequate in the present generation of advanced technology. The protection of Old Oyo National Park can be done in a better way if GIS technology is applied in:

- Mapping of villages close to the Park,
- Determination of sites for more Rangers Barrack based on some criteria.

3. Aim

Aim of this project is to demonstrate how GIS could be applied in the protection of natural resources of Old Oyo National Park.

4. Objectives of the Study

To achieve the above stated aim, the following objectives were highlighted:

- Use of satellite imagery to produce a digital map of Old Oyo National Park showing all facilities.
- Design of Geodatabase for Old Oyo National Park.
- Creation of Database for Old Oyo National Park.
- Preforming spatial analyses to determine the Best and Alternative Route, Buffering and Erase to know best site for propose barracks

5. Study Area

The study area is Old Oyo National Park, which is one of the Seven National Parks in Nigeria initially created by Decree No. 36 of 1991 but was later repealed and replaced with Decree No. 46 of 1999 now Act Cap. N65 L.F.N. 2004 (NPS Brochure). It is the only National Park located in the Southwest geopolitical zone of Nigeria with land cover area of about two thousand, six hundred and forty-six (2,646) Square Kilometres. It is erroneously believed to be two thousand, five hundred and twelve (2,512) Square Kilometres. It is shaped like 'Saxophone' and lies between latitudes 8°13'8.31" and 9° 0'19.02" North, and longitudes 3°34'26.94" and 4°21'6.40" East. It is surrounded by eleven (11) Local Governments.

Figure 1: Study Area Map

6. Material and Method

Google earth pro was launched and the image of Old Oyo National Park was mapped out at a resolution of 500m altitude and terraserver.com was used to ascertain the correctness of all the coordinates obtained to know whether the location was true or not. The image acquired was georeferenced using ArcGIS and shape file of area of interest was created. The entities were either polygon, line or points and each were linked to their respective tables. Primary data were coordinates of Rangers Barrack, Police Stations, Support-Zone Community, Law Courts and Prisons across the entire Park with the help of a handheld Global Positioning System (GPS), while secondary data were remotely sensed image from Google earth at 500m altitude, administrative Organogram of the Park. Also, Topographical Map of the Park was obtained and verified with the help of protection staff of the Park.

The Google Satellite Raster Image was converted from raster format to digital format through digitizing and GPS coordinates were all converted to Degree, minute, second format before entering the points in the database. The data creation was executed in the Arc GIS environment to keep the record of spatial entities. The semantic of each was entered into the table for queries and subsequent analysis was carried out accordingly. Hence, the following entities Support Zone Community (SZC), Law Court, Police Station, Prison, Rangers' Barrack, Road Network Proposed Rangers' Barrack was conceptualized and attribute tables generated.

7. Spatial Analyses and Information Presentation

The main purpose of spatial analyses is to transform and combine different data from various sources into useful information for decision making. It is the process of showing the database displaying the capability of GIS buffering, site selection, and other GIS analysis. It is the capability of GIS to carry out spatial analyses that make it different from other information systems.

Figure 2: Composite Map of the Study Area

7.1. Condition for Citing of New Rangers' Barracks

Criteria for the location of Rangers' Barrack

- Must be at least 10km distance from next Ranger Barrack
- Must not be more than 2.5 km from the Park Boundary
- Must be more 500 metres from the closest village.

7.1.1. Criterion1: (Must Be At Least 10km Distance From Next Ranger Barrack)

7.1.1.1. Buffering Operation

10km buffering was done to know the coverage area of the existing Ranger's Barracks

Figure3: Buffered Zone for the Ranger's Barrack

7.1.1.2. Erase

Erase was performed on the buffer zone of the Ranger's Barracks to know the areas that were not covered by the Ranger's Barracks

Figure 4: Erased of the Ranger's Barrack Buffer

7.1.2. Condition 2: Must Not Be More Than 2.5 Km from the Park Boundary

The boundary of the park will be buffer by 2.5km

Figure5: Park Boundary Buffer

7.1.2.1. Condition 3: Must Be More 500 Metres from the Closest Village.
Buffering of 500 meters was performed on SZC

Figure 6: SZC Buffering of 500m

7.1.3. Intersect

The results from the 3 (three) above analyses will be overlaid together, the intersect between the 3 (three) result will be areas where more Ranger's Barrack can be cited or proposed site for new Ranger's Barracks

Figure 7: Proposed Site for Ranger's Barracks

7.2. Network Analysis

Network analysis is a set of interconnected lines making up a set of features through which the resources can flow. In this work, the network analysis carried out are, best route, and alternative route in case of any barrier along the best route.

Figure 8: Best Route to the Ranger's Barracks within the Study Area

Figure 9: Alternative Route

	Best Route	Alternative Route	Difference
Distance	240 Miles	257 miles	17 Miles

Table 1

8. Summary

This study was carried out for the purpose of serving as basis for proper protection of Old Oyo National Park. The features such as roads, support zone communities, law courts, security outfits like Police station and army barrack, prison, rangers' barrack, ranges and park boundary were co-ordinated with the aid Goggle Earth Pro and GPS. Spatial attributes were implemented and spatial analyses performed through the use of ArcGIS 10.0 Version. Finding from this work is hoped to be replicated in other parks across the country and beyond.

9. Conclusion

This study has demonstrated the capabilities of geospatial techniques in the protection of natural resources. This is obvious now that the economy of the nation is in recession, moreover, the nation is diverting attention from crude oil to eco-tourism for income generation. This however, is only possible when the Park is properly managed and protected.

The test of the spatial database was successful; it can be updated from time to time without any problem. This study has been able to contribute to knowledge by demonstrating how GIS has greatly improved the rate at which spatial problem could be solved easily.

10. Recommendations

This project is recommending that a better way of combating crimes using the application of GIS in the protection of natural resources of Old Oyo National Park. Geographic Information System is a very useful tool in solving environmental problems and decision making. In the light of this, the application of GIS in the protection of natural resources cannot be overemphasized. Therefore, the following recommendations are made:

- There is an urgent need for Rangers' Barrack at Kanga, Banni, TessiApata and Alakuko environs.
- Tede and Ibuya Rangers' Barrack should be converted to other useful structure apart from Rangers' Barrack.
- The Park should be re-mapped and published for public consumption.
- The Park Management should endeavour to re-activate lost jeep tracks and open more for patrol and game viewing
- Every Park officer should be trained on how to use Goggle Earth Pro since it is free to assess.

11. References

- Chape, S., Harrison, J., Spalding, M., Lysenko, I., (2005). Measuring the Extent and Effectiveness of Protected Areas as an Indicator for Meeting Global Biodiversity Targets. Philosophical Transactions of the Royal Society of London Series B: Biological Sciences 360 (1454), 443–455.
- International Union for Conservation of Nature, IUCN (2000): Financing protected areas: Guidelines for protected Area Managers. IUCN Publications.

- iii. International Union for Conservation of Nature, IUCN (2002): Sustainable Tourism in Protected Areas. IUCN Publications.
- iv. National Park Service Cap. N65 Laws of the Federation of Nigeria (2004)
- v. National Park Service Decree No. 36 of 1991
- vi. National Parks, buffer zones and surrounding lands: Mapping ecosystem service flows in Ecosystem Services journal
- vii. Nigeria National Parks (1996): Natural Resources Conservation and Medicinal Plants (A Symposium) APNL Publication, Abuja
- viii. Pradhan, B.M., 2008. Geoinformatics for Resource Mapping and analysis, Handouts for M.Sc. in Forestry, M. Sc. In Watershed Management, and M. Sc. Natural Resource Management. & Rural Development. Institute of Forestry, Pokhara, Nepal.