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ASSESSMENT OF FOREST COVER CHANGE IN THE CROSS RIVER NATIONAL PARK IN NIGERIA BETWEEN 1986 AND 2020

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Abstract

The study assessed forest cover change in Cross River National Park in Nigeria. Land use analysis of the national park between 1986 and 2020 using landsat imageries; was employed for the study. Descriptive statistics in form of Tables, frequencies, percentages, charts and maps aided the study in data presentation and interpretation of results. Findings revealed that seven (7) land use/land cover types (degraded forest, waterbodies, thick forest, and agricultural lands, riparian/swam forest, mangrove and settlement) were identified within the Cross River National Park. Results revealed that forest cover (thick forest) reduced from 2787.82 km^2 to 2626.52 km^2 between year 1986 and 2000; and further reduced to 2333.73 km^2 in year 2020. This therefore indicated total forest cover loss of 454.09 km^2 between year 1986 and 2020. The total percentage change (loss) in forest cover between year 1986 and 2020 was -16.93%. Thus, the Cross River National park is gradually losing its forest cover through deforestation activities. Therefore, to address the rate of forest cover loss in the national park increased efforts should be directed on those activities that encourage forest conservation at all times.

Keywords: Rate of forest cover loss, Deforestation, % Change, National Park, Cross River, Land use, ArcGIS 10.5

Introduction

National Parks are so important because they are forested areas carved out for the purpose of preserving, enhancing, protecting and managing vegetation and wild animals in their natural environment. National parks are large areas of public land set aside for native plants, animals and

the places in which they live. National parks protect places of natural beauty. National park is home to many endemic species (National Parks of Turkey, 2014). They also protect places important to Aboriginal people, and places that show how people lived in the past. National parks are actually protected areas. International Union for Conservation of Nature (IUCN) (2013) definition of a protected area: "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values". Conservation of biodiversity (the variety of our native species and the ecosystems they form) is the central purpose of protected areas (National Parks). High levels of biodiversity keep ecosystems healthy and resilient, which means that they continue providing vital ecosystem services such as nutrient cycling, climate regulation, air and water purification and pollination (IPCC, 2013). Protecting biodiversity is vital to safeguard our economy; our cultural, spiritual and aesthetic values; and the intrinsic value of species and ecosystems. National parks provide a safe home for native plants and animals and also help keep the air clean.

Nigeria is highly endowed with a lot of biological resources (Olanrewaju, 2019) as the nation is one of the richest biodiversity hotspots in the world. It was reported that during the pre-independence era, massive forest reservation took place, about 96,518 square kilometres of land representing 27% of the total forest cover and 10% of the total land area was reserved as protected area. However, 66% of the forest reserves lie in the savanna region of the country, 20% falls within the humid tropical forest zones in southern Nigeria and 4% was freshwater swamps and mangroves of the coastal south of the nation. After the independence, there were 8 national parks, 445 forest reserves, 12 strict nature reserves and 28 games reserves from the colonial administrators for the protection and conservation of the forest biodiversity in the country. Regrettably, the forests reserved in the 1950s are nowhere to be found because they have been greatly destroyed as the protected areas have been deforested, degraded, encroached and converted to other land uses as a result of increased pressure from the rapidly increasing population (Odjugo, 2010; Olanrewaju, 2019).

Similarly, deforestation practices have continued to contribute to forest cover loss overtime. The Nigerian Conservation Foundation (NCF) reported that Nigeria has lost 96% of its natural forest cover and deforestation rate is at an alarming 11.1% per annum. This prevalent problem of deforestation, fragmentation and land conversion for agricultural purpose and other uses has affected adversely the forest biodiversity in the country. For instance, Nigeria is a state of forests and savannas, once, a significant part of the territory was covered with dense tropical rainforests. Constant cutting and burning out of crop plots led to a drastic reduction in the area of forests that now occupy about one-third of the territory (Makinwa, 2017). In addition, the report from the Building Nigeria Response for Climate Change (BNRCC) (2011) explains the fact that Nigeria's current population is growing tremendously with a population of about 160 million people and a population density of 138 people per km^2. Thus, increasing population density in the country is an additional pressure on natural resources (Nzegbule *et al*., 2018).

The forest cover in Nigeria has been on the decrease recently (Fashae et al., 2017). Consequently, uncontrolled deforestation has lead to environmental degradation as a result of removal of vegetal/forest cover overtime. For instance, it was stated by Badege (2008) as regards the issue of deforestation, forest loss and environmental degradation in Ethiopia that the country's forest coverage is estimated to be 40% over a century ago and to less than 3% today. Extensive forest clearing for agricultural use, exploitation of existing forests for fuel wood, construction poles and increased population are responsible factors for this reduction (Badege, 2008). The annual rate of deforestation is estimated at 88,000 ha per year while the rate at which this loss is being replaced through a forestation is estimated at 6,000 ha a year (Tamirat, 1993). Additional estimation also stated that from 1990-2000 with an estimated forest-land loss of 150,000-200,000 ha annually, environmental degradation in the area has been persistent.

Thus, the use of geospatial techniques is useful and efficient in forest cover assessment (Gashaw et al., 2014). GIS is a computer based system that deals with spatial data collection, storage, management, retrieval, conversion/changing, analysis, modeling, and display information about the features that make up the Earth's surface. It is provided the potential for mapping and monitoring the spatial extent of the built environment and the associated land use/ land cover changes (Tahir et al., 2013). It is also important for land degradation assessment, soil erosion modeling, and vegetation change detection to mention few of them. Geospatial techniques have their advantages in mapping vegetation condition and dynamics (Qi et al., 2017). Satellite sensors could collect data for large areas at a relatively low cost and in a very short time. Furthermore, there are over 40 years of satellite image collections for environmental change studies (Qi et al., 2017). This paper therefore carry out an assessment of forest cover land use changes in National park between 1986 and 2020.

Materials and Methods

i. Description of the Study Area

The study area is Cross River in the south-south region of Nigeria. The Cross River National Park is located in Cross River State, Nigeria. It is located geographically within 5^0 $0^{'}$ $00^{''}$ N and 7^0 $10^{'}$ $00^{''}$ N and longitude 8^0 $0^{'}$ $00^{''}$ E and 9^0 $35^{'}$ $00^{''}$ E (Figure 1). There are two separate sections, Okwangwo and Oban (1988) (Nigerian National Park Service (NNPS), 2010). The park has a total area of about 4,000 km^2, most of which consists of primary moist tropical rainforests in the North and Central parts, with mangrove swamps on the coastal zones (NNPS, 2010a). The study area features a tropical climate with a long wet season that stretches from March/April to October with an average temperature of around 26^0C as part of the Niger Delta region (Adejuwon, 2012; Elenwo and Ochege, 2018). The annual temperature range is small as low as 3^0C. Mean monthly temperature is 26-28^0C (Adejuwon, 2012). Rainfall is between 1800mm and 3000mm per year (Emaziye, Okoh and Ike, 2012); and it is heaviest in July. The geology of the river basin in Cross River includes the Pre-Cambrian Oban Massif, Cretaceous sediments of the Calabar flank and the recent Niger Delta sedimentary basin (Eze and Effiong, 2010). The

drainage of the study area is comprised of River Niger that drains the southern parts of the country and releases into the ocean through its few distributaries (Aweto, 2001). The vegetation varies from the mangrove swamp along the coast to the rainforest in the middle and the savanna in the north (Adejuwon, 2012; Aphunu and Nwabeze, 2012). The Okwangwo Division in Cross River national park has richly diverse flora, with about 1,545 species representing 98 plant families recorded. Some of these species are endemic to the area. Others were unknown until recently (NNPS, 2010a). The types of occupation of the people of Cross River include farming, fishing and industrial jobs.

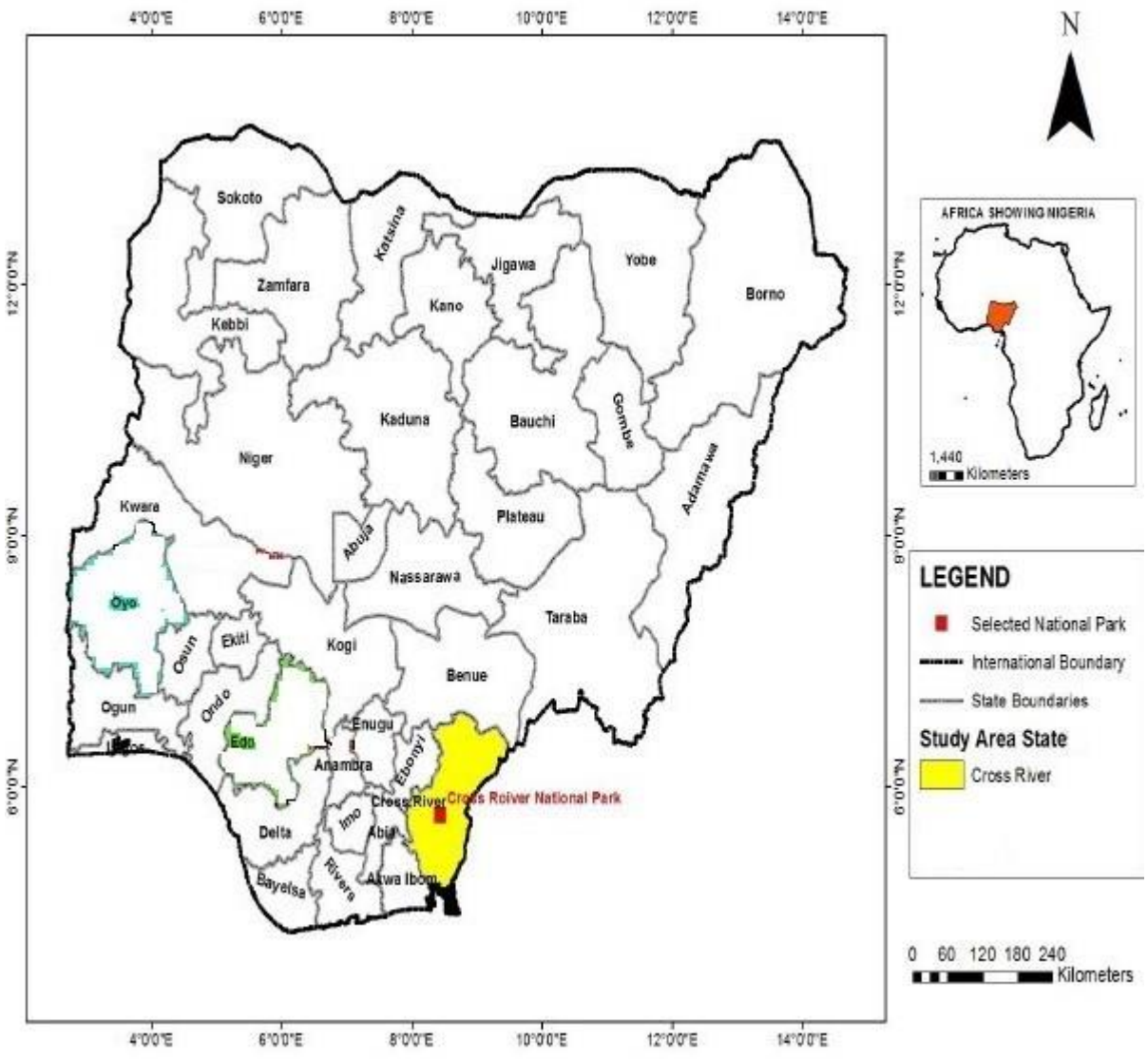


Figure 1. Nigeria locating Cross River National Park

ii. Data Acquisition and Analytical Procedure

The primary data sources were employed for this study. The primary data sources included downloading satellite imageries of the study area (national park) between 1986 and 2020 from the United States Geological Survey (USGS) (2020). The images featured Landsat TM, ETM+ and OLI and Sentinel-2 imageries in order to delineate the Cross River national park for the study. The use of Global Positioning Systems (GPS) was employed for geo-rectification of locations and points of references for the study and for ground-truthing purposes which was very important for land use analyses for the study. In other words, ssatellite imageries of Landsat TM, ETM+, and OLI and Sentinel-2 imagery of 1986, 2000, and 2020 were geo-processed to generate composite imagery in the ArcGIS 10.5 environment. This aided in the determination of the rate of deforestation/extent of forest degradation in the national park. The area of each identified land use/land cover types were computed in squared kilometres for each land use quantities in the national park.

iii. Map Overlay Analysis

The map overlay analysis was carried out for the 1986, 2000, and 2020 imageries to evaluate the spatial differences in km^2 and pattern of land use change of forest areas in the national park during the period under review in the study area. In other words, the imageries downloaded for the study were processed and super-imposed on each other. For instance, the 1986 thematic sensor landsat image model of forest areas in national parks was overlaid on year 2000 of landsat imagery and the year 2000 imagery was also super-imposed on year 2020 imagery in order to determine the spatial changes. All these processes were carried out using the overlay function of ArcGIS 10.5 environment.

Results of the Analysis

Change (Km^2) and Percentage (%) Change
Land use & Forest Cover Pattern in Cross River National Park

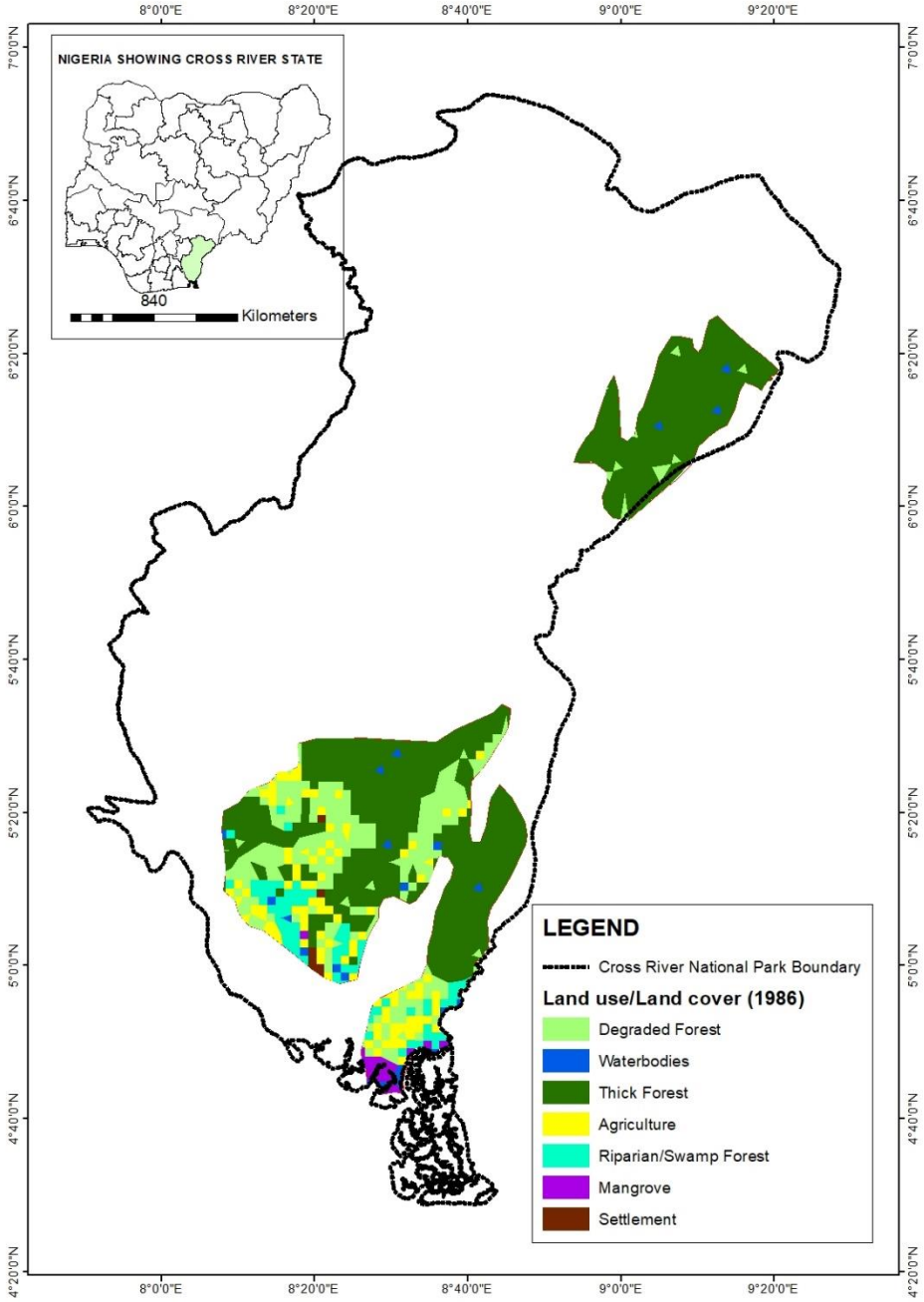
The information for the land use land cover spatial extent for Cross River National Park (between year 1986 and 2020 is displayed on Figure 2, 3, 4 and 5. The information for the change and percentage change in land use pattern for Cross River National Park is displayed on Table 1. The distribution revealed that the change (km^2) and percentage (%) change for identified land use types in Cross River National Park between 1986 and 2000 recorded 40.08 km^2 and 4.56% for degraded forests; -0.14km^2 and -0.20% for water bodies; -161.3km^2 and -5.79% for thick forest vegetation; 118.67km^2 and 30.25% for agricultural land use; 0.68km^2 and 0.25% for riparian forests; -5.18km^2 and -8.05% for mangrove forests; and 7.19km^2 and 30.60% for settlement land use in the study area. In other words, a total of 30.25% and 30.60% percentage change were recorded for the agricultural and settlement land use types in the study

area. A percentage change of -5.79% was lost by the thick forest land cover between year 1986 and year 2000.

Furthermore, the change (km^2) and percentage (%) change for identified land use/land cover types between year 2000 and year 2020 for Cross River National Park revealed thus: 159.55 km^2 and 17.36% for degraded forests; 0.17km^2 and 0.25% for water bodies; -292.79km^2 and -11.15% for thick forest vegetation; 148.52km^2 and 29.07% for agricultural land use; -23.64km^2 and -8.61% for riparian forests; -10.9km^2 and -18.43% for mangrove forests; and 19.09km^2 and 62.20% for settlement land use in the study area. In other words, a total of 29.07% and 62.20% percentage change were recorded for the agricultural and settlement land use types in the study area. A percentage change of -11.15% was lost by the thick forest land cover between year 2000 and year 2020.

Therefore, the total change (km^2) and total percentage (%) change for identified land use/land cover types between year 1986 and year 2020 revealed a total % loss and total change (km^2) of -16.93% (-454.09km^2) for thick forests; -8.36% (-22.96km^2) for riparian forest; -26.48% (-16.08km^2) for mangrove forests in the Cross River National Park. On the other hand, a total land coverage gain (+) were experienced for degraded forests which increased considerably between year 1986 and year 2020 recording a total change of 199.63km^2 and a total percentage change of 21.93%; water bodies increased slightly as values recorded were not significant (total change of 0.03km^2 and total % change of 0.04%). However, very significant changes were observed for the agricultural land use and settlement land use areas in Cross River National park. Both land use types recorded significant increase in spatial coverage between year 1986 and year 2020. A total change (increase/gain) of 267.19km and total percentage change of 59.32% was recorded for the agricultural land use area in Cross River National Park. So also, the settlement land use area also increased (gain) with a total change of 26.28km^2 and a total percentage change of 92.80% between year 1986 and year 2020. This was further depicted on Figure 6.

Based on these findings, the study concluded that activities surrounding farming and construction by man within the Cross River National park have caused more lands to be deforested and degraded thereby causing significant reductions in forests cover (thick forests, riparian and mangrove forests) overtime between year 1986 and year 2020.


NIGERIA SHOWING CROSS RIVER STATE
840
Kilometers
8°0'0"E
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5°40'0"N
5°20'0"N
5°0'0"N
4°40'0"N
4°20'0"N
LEGEND
Cross River National Park Boundary
Land use/Land cover (1986)
Degraded Forest
Waterbodies
Thick Forest
Agriculture
Riparian/Swamp Forest
Mangrove
Settlement

Figure 2: Land use/land cover for Cross River National Park (Oban & Okwango sections) (1986)

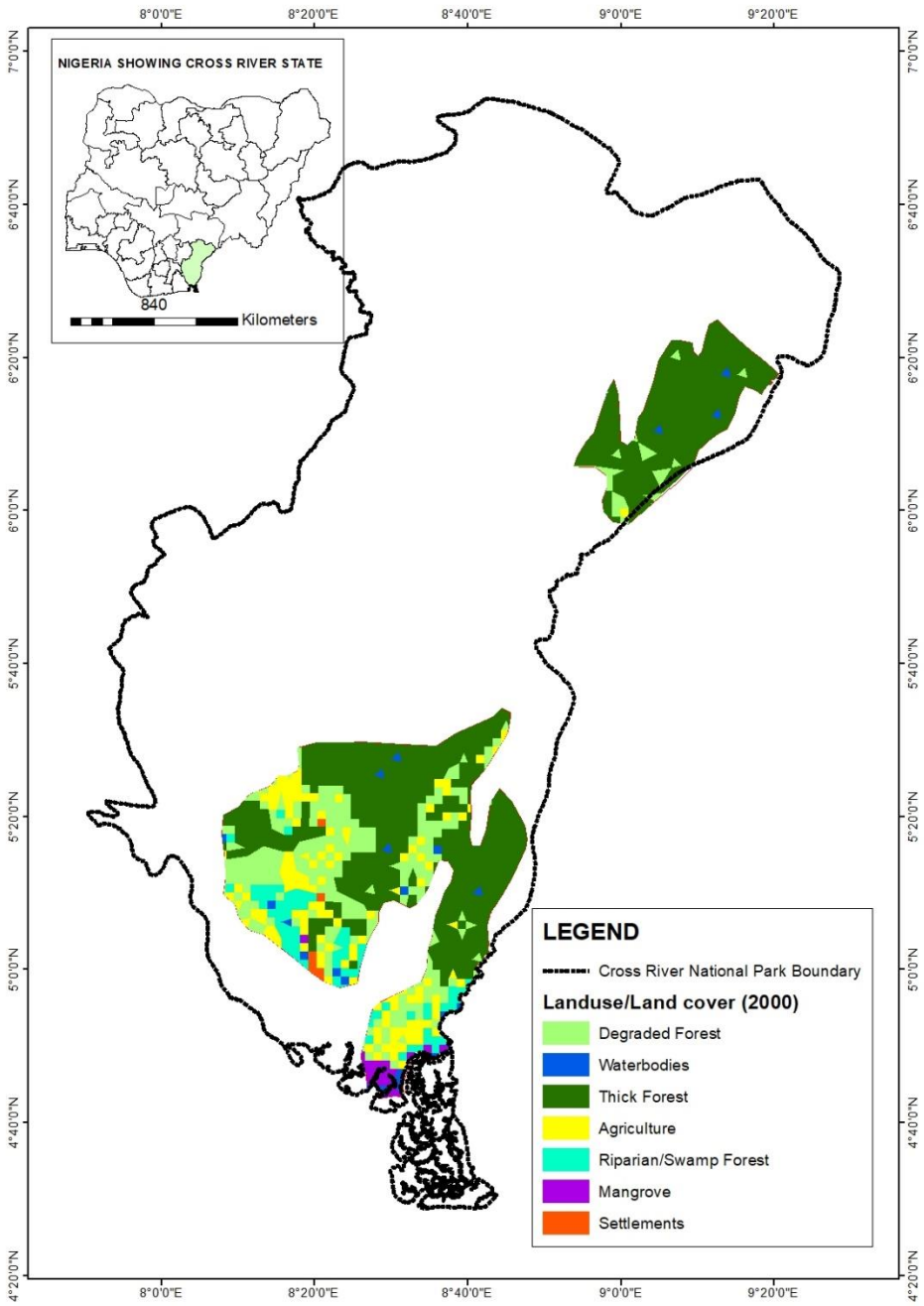

Figure 3: Land use/land cover for Cross River National Park (Oban & Okwango sections) (2000)

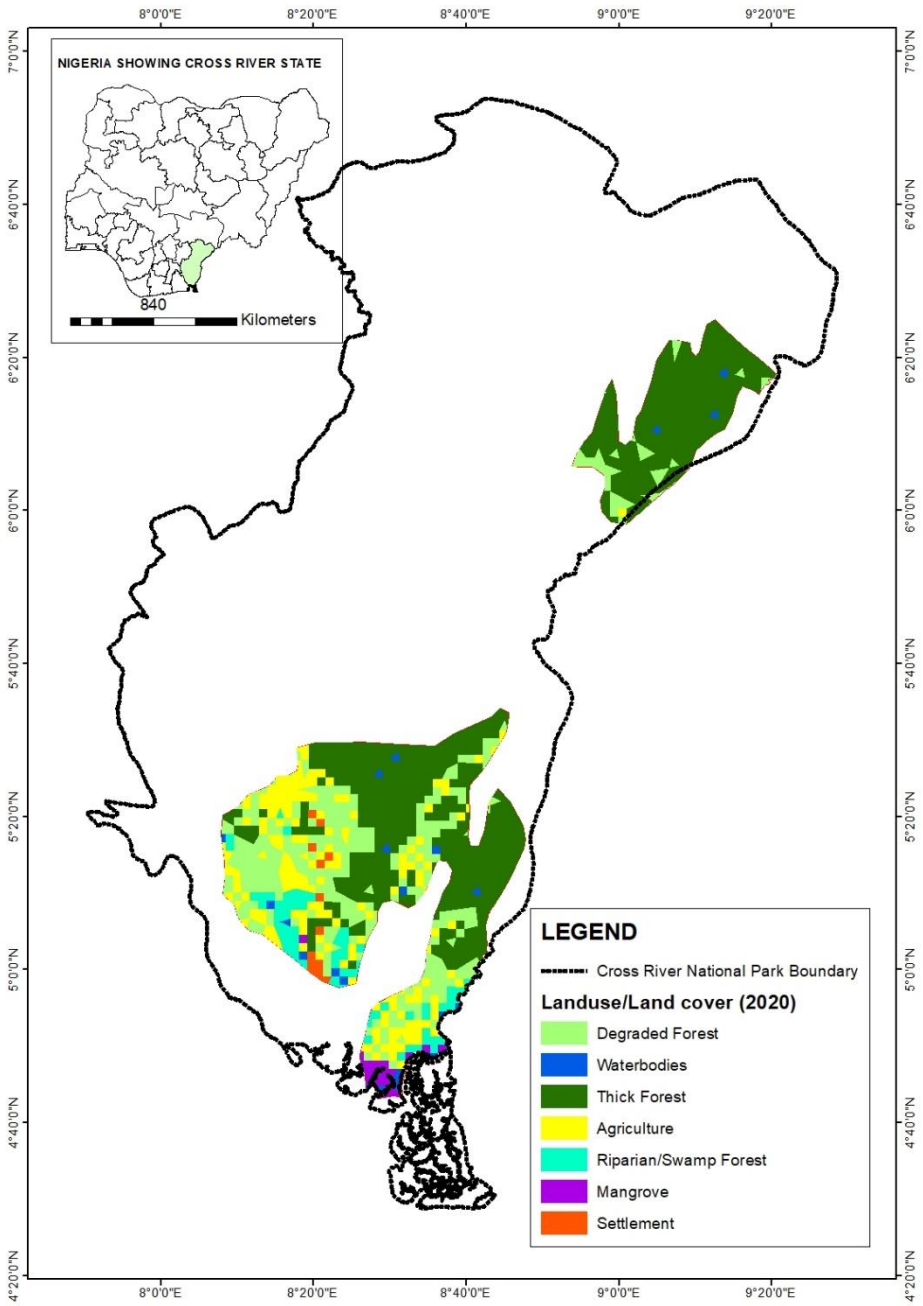

Figure 4: Land use/land cover for Cross River National Park (Oban & Okwango sections) (2020)

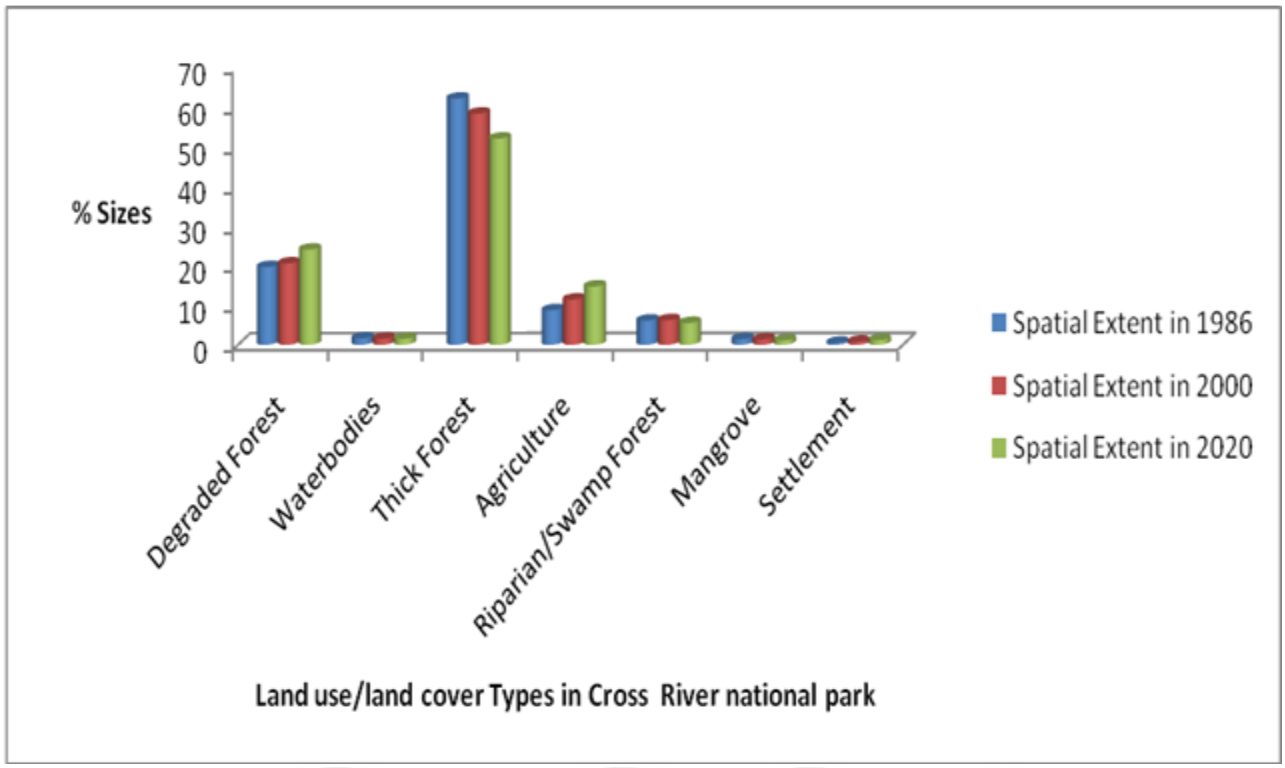

Figure 5: Land use/Land cover spatial extent in Cross River National Park between year 1986 & 2020

Table 1: Change & % Change in Land use Pattern for Cross River National Park (1986-2020)

Land use Types	1986 (km^2)	2000 (km^2)	Change (km^2)	% Change	2000 (km^2)	2020 (km^2)	Change (km^2)	% Change	Total Change (km^2)	Total % Change
Degraded Forest	878.77	918.85	40.08	4.56	918.85	1078.4	159.55	17.36	199.63	21.93
Water bodies	68.51	68.37	-0.14	-0.20	68.37	68.54	0.17	0.25	0.03	0.04
Thick Forest	**2787.82**	**2626.52**	**-161.3**	**-5.79**	**2626.52**	**2333.73**	**-292.79**	**-11.15**	**-454.09**	**-16.93**
Agriculture	392.3	510.97	118.67	30.25	510.97	659.49	148.52	29.07	267.19	59.32
Riparian Forest	274.04	274.72	0.68	0.25	274.72	251.08	-23.64	-8.61	-22.96	-8.36
Mangrove	64.32	59.14	-5.18	-8.05	59.14	48.24	-10.9	-18.43	-16.08	-26.48
Settlement	23.5	30.69	7.19	30.60	30.69	49.78	19.09	62.20	26.28	92.80

NB: - Negative sign means reduction (loss); + Positive sign mean increase (gain)

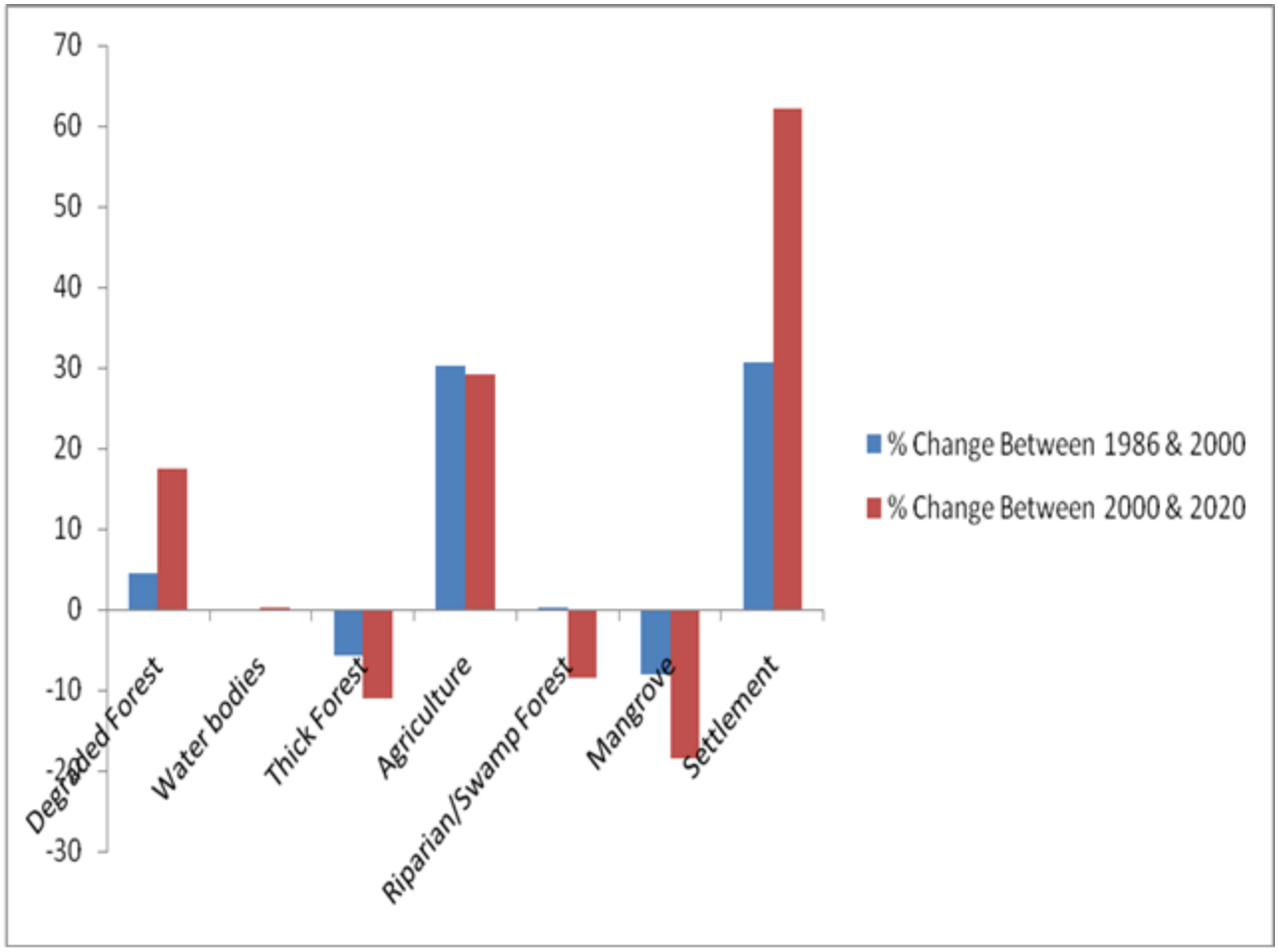

Figure 6: Trend of Land use change & forest cover change in Cross River Park between 1986 & 2020

Discussion

The study discovered that thick forest vegetation cover as well as the mangrove forested areas reduced significantly between year 1986 and year 2020 in the Cross river national park. The agricultural/farming and the settlement lad uses were gradually taking over the spatial extent of the forest cover in the study area. Findings of the study revealed that a percentage change of -16.93% of spatial coverage was lost to agriculture and settlement in the Cross River national park. Findings of the study further discovered that degraded forests increased in size between 1986 and 2020 at the Cross River national park due to several forms of encroachments by residents living in close proximity (communities within range zones) to the national park. Degraded forests are disturbed forests or can also be referred to as secondary forests. However, depending on the level of degradation, secondary forests or derived forests also have numerous benefits to the ecological systems especially as they serve as the ingredients for forests

reformations when proper conservational practices are put in place. This confirms what was earlier stated by Oke et al., (2010) concerning the importance of secondary forests to the ecological systems within protected forests areas. Their findings revealed that more of secondary forests will mean more services being rendered and forms the basis of forest regeneration processes. Thus, increasing degraded forests in Cross River national park as its advantages if they are properly conserved. Consequently, as regards the rate of deforestation in the national park, the study discovered that several human activities especially at the boundary of the national park have caused more lands to be deforested thereby causing significant reductions in forests cover overtime in the study area. Findings of the study agree with Njungbwen and Mbakwe (2013) on the rate of deforestation in Uyo between 1979 and 2004. It also agrees with the findings of Omokhua and Asimiea (2015) on the fact that increasing human activities and encroachments are affecting biodiversity in sacred forests in Emohua LGA of Rivers state. The study of Azare et al., (2020) on deforestation, agricultural activities and climate change discovered that the growth of agricultural and infrastructural developments are currently causing high rate of deforestation.

Conclusion and Recommendation

The study discovered that the size of thick vegetation cover in the national parks has reduced greatly between year 1986 and 2020 due to several forms of human encroachments from farming and settlements developments. Thus, based on these findings the study recommended that: human activities (both individuals and government) currently diminishing thick forests size should be discouraged at all cost; uncoordinated deforestation practices should be stopped while increased efforts should be directed on those activities that encourage forest conservation at all times; focus should be shifted from the immediate benefits derived from conversion of forested areas to agricultural or other developmental projects to sustainable future benefits for proper forest management practices in the national parks; lastly, adequate awareness should be created among residents within the national park on the need to be more conservative and stop their deforestation practices which does not favour forest cover protection.

References

Adejuwon J.O. (2012). Rainfall seasonality in the Niger Delta Belt, Nigeria. *Journal of Geography and Regional Planning, 5*(2), 51-60.

Aphunu A. & Nwabeze G.O. (2012). Fish Farmers' Perception of Climate change impact on fish production in Delta State, *Nigeria Journal of Agricultural Extension*, (2), 1-13.

Aweto, A.O. (2001). Impact of single species tree plantations on nutrient cycling in West Africa.International Journal of Sustainable Development & World Ecology 8, 356 – 368.

Azare, I.M., Abdullahi, M.S., Adebayo, A.A., Dantata, I.J., and Duala, T. (2020). Deforestation, Desert Encroachment, Climate Change and Agricultural Production in the Sudano-Sahelian Region of Nigeria. *J. Appl. Sci. Environ. Manage., 24*(1), 127-132

Badege, B. (2008). *Combating Deforestation and Natural Resource Development: A Call to the Ethiopian Diaspora*. Important workshop for the Ethiopian community and the African Diaspora. Ethiopian Sport Federation Silver Jubilee, Washington D.C, 1-6.

Elenwo, I.E., and Ochege, F.U., (2018). *Environment, resources and sustainability in the Niger Delta region, Nigeria*. University of Port Harcourt Press Ltd., University of Port Harcourt, Nigeria

Emaziye, P. O., Okoh R. N. & Ike P. C. (2012). "A Critical Analysis of Climate Change Factors and its Projected Future Values in Delta State, Nigeria", *Asian Journal of Agriculture and Rural Development*, 2(2), 206-212.

Eze, E.B., and Efiong, J. (2010). Morphometric Parameters of the Calabar River Basin: Implication for Hydrologic Processes. *Journal of Geography and Geology*. Vol. **2** (1).

Fashae, O., Olusola, A., and Adedeji, O. (2017). Geospatial analysis of changes in vegetation cover over Nigeria. *Bulletin of Geography, Physical Geography Series, 13*, 17-28

Gashaw, T., Fentahun, T., and Dinkayoh, T. (2014). Detection of vegetation changes using GIS techniques in Northern Ethiopia. *Merit Research Journal of Agricultural Science and Soil Sciences, 2*(6), 077-080

Intergovermental Panel on Climate Change (IPCC), (2013). Contribution to the IPCC fifth assessment report climate change WG I, 2013: The physical science basis summary for policymakers. Stockholm, Sweden: IPCC working group I.

International Union for Conservation of Nature (IUCN) (2013). Protected Areas. *https://www.iucn.org/theme/protected-areas/about* Retrieved 2019-06-25

Makinwa, E. (2017). Vegetation zones in Nigeria and their features. Available at: *https://www.legit.ng/1096264-vegetation-zones-nigeria-features.html* Retrieved 2019-06-24

National Parks of Turkey (2014). Why are National Parks so important? Available at: *www.nationalparksofturkey.com* Accessed 2019-06-14

Nigerian National Park Service (NNPS) (2010). Cross River National Park. *www.en.wikipedia.org/wiki/Old_Oyo_National_Park* Retrieved 2019-08-13

Njungbwen, E. and Mbakwe, R. (2013). A GIS and remote sensing approach to assessment of deforestation in Uyo, Akwa Ibom state, Nigeria. *Ethiopian Journal of Environmental Studies and Management, 6*(4), 348-354

Nzegbule, E.C., Nwajiuba, C., Ujor, G., Onyemeke, R., Ogallah, S.S., & Okali, D. (2018). Sustainability and the Effectiveness of BNRCC Community-Based Adaptation (CBA) to

Address Climate Change Impact in Nigeria. *Handbook of Climate Change Resilience*, 3: 1-22

Odjugo, P.A. (2010). General overview of climate change impacts in Nigeria. *Journal of Human Ecology*, 29(1), 47-55

Oke, D.O., Onyekwelu, J.C., and Yirdaw, E. (2010). Secondary forests in West Africa. *IUFRO World Series, 25*(18), 299-313

Olanrewaju R.I. (2019): The Challenge of Deforestation in Nigeria. https://prnigeria.com/2019/03/28/the-challenge-deforestation-nigeria

Omokhua, G.E., and Asimiea, A.O. (2015). Biodiversity Conservation and the Sacred Forests of Emohua, Rivers State, Niger Delta Region Nigeria – A Review. *International Journal of Science and Technology, 4*(1), 37-44

Qi, X., Wang, K., Zhang, Y., Yue, Y. (2017). The application of geospatial techniques in monitoring Karst vegetation recovery in Southwest China: A review. *Progress in Physical Geography, 41*(4), 450-477

Tahir M, Imam E and Hussain T (2013). Evaluation of land use/land cover changes in Mekelle City, Ethiopia using Remote Sensing and GIS. *Computational Ecology and Software, 3*(1), 9-16.

Tamirat L (1993). The National Population Policy of Ethiopia.