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Analysis of the Rate of Change of Mangrove Forest Ecosystem in Calabar South, Nigeria

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Abstract

The study aimed at determining the magnitude of change of the mangrove forest ecosystem in the coastal communities of Calabar. Also, this study examined the volume of mangrove trees exploited by the inhabitants of the study area. Five communities highly noted for the exploitation of mangrove in the area were used for the study – Anantigha, Efut Obufa Esuk, Cobhan-Duke Town, Henshaw town and Mbukpa Akani Esuk orok. Volume of wood exploited and which was determined by the researchers using the single tree stumpage volume with the formula,

$$\frac{\pi G^2}{4} X Ht$$

Where π= 3.143 G = Girth at breast height (^{M}) and Ht = Tree height (M). However, Tariff rate/pole and merchantable tree (logs), height, were gathered from the Monthly tree Analysis Report of Forestry Department in Calabar. In order to establish trend of mangrove forest change over years, a multi-temporal image data of the mangrove vegetation covering the area (1970 – 2011) was acquired and processed. These Include: a Toposheet (1970) derived from an aerial photo of 1970, Landsat imagery 1970, 1986, 2011 at 30m resolution. These data sets were geo- referenced into a common framework in a G.I.S environment (Arc. GIS 9.3) after which they were digitized and delineated into mangrove class, and other Non – Mangrove classes (Fresh Water Swamp, Nypa palm, Farm land and so on.) The Landsat imagery was also treated likewise. Intersection operations of the above data sets were carried out to determine the change in mangrove area coverage between the different time periods in consideration (1970, 1991 and 2011).

Indices of mangrove forest change which includes: Intensity Index, or potential trend which is given by; $T_i = U_{bi} – U_{ai}$, (1, 2…8) was computed, dynamic index whose formula is $K_i = U_{bi} – U_{ai} \times {}^1/_T \times 100\%$, (1, 2….8) was equally determined and finally the Contribution rate of change given as $A_i = U_{bi} – U_{ai}$ $\sum(U_{bi} – U_{ai})$ was analyzed.

The result of analysis revealed among other things.

i. The rate of areal change of mangrove ecosystem has been in the neighbourhood of -2.75km^2 between 1970 and 1990 and -32.12km^2 between 1991 and 2011.
ii. The areal cover of Nypa palm has been on increase from 3.04km^2 between 1970 and 1990 to 31.86 between 1991-2011.
iii. With mean value of total annual number of mangrove trees exploited was put at 6225. It was discovered that eleven years (2001-2011) recorded over exploitation.

Introduction

Mangrove forests are estuarine ecosystems in the inter-tidal and tropical sub tidal shallow zones of the world. They cover about 18 million hectares (Ukpong 2007) or 0.6 percent of all inland forests across the globe (Sanger et al 1986). Originally, mangrove dominated over two-thirds of the earth's tropical and subtropical coasts. But today, less than half of this portion is left due to human interferences. From an estimated remnant of 22 million hectares of mangrove worldwide, 17 per cent is currently located in Africa (Aksornkoae, 1998). Ukpong (2007) indicated that Nigeria has the largest mangrove forest in Africa being the third largest mangrove in the World covering a total of 999,400 hectares along the West Atlantic coast of Africa.

Once dismissed as swampy Wastelands, mangrove forests perform multiple ecological functions as the production of woody trees, provision of food and spawning grounds for fish and shellfish; provision of habitats for birds and other valuable fauna. They also protect coastlines and aid in the accretion of sediments to form new land (Hamilton et al, 1984). Some of these functions have benefits far beyond the geographical limit of the mangrove zone itself.

Quite disheartening from observation is the tendency among humans to explore, exploit and manipulate mangrove forests beyond their ecological tolerance. Pressures resulting from population growth, improved technology in resource exploitation and utilization, economic development and urban expansion have seemed to be seriously impacting on the mangrove ecosystems. The preponderance of human activities such as, poorly executed logging operation, land reclamation and conversion into slumps farms; fishponds and privatization of these marginal lands for development purpose constitute threat to the forest of the study area.

For some time now, emphasis on both global and regional scales in the study of all aspects of forestry has been on upland forest with little or no focus on mangrove as a unique ecosystem in its own right. This situation revealed itself in Calabar South of Cross River State dated back to the colonial days where several areas of its eco-zones in the tropical High forest were designated as forest reserved for conservation and protection of their biological richness, but in the case of mangrove ecosystems of the coastal communities of Cross River State it was left out. Being in this status, the mangrove forest of Calabar south was regarded as a "forgotten habitat" except for all sorts of socio economic activities and interferences by the inhabitant of the area who used it as a source of livelihood. Between 1980 and 2006 a quarter of the mangrove in West Africa was said to have disappeared and it is expected that loss rate will rise to as much as 70 per cent, if no measures are taken. The degradation of this ecosystem has a considerable impact on biological diversity and the socio-economic activities depending on it. Such impacts include: the disappearance of species of fauna and flora, poverty, employment and disputes. In view of the high tendency now regarding mangrove deforestation, the area of Nigerian mangroves (calabar south inclusive) has dropped from 9,990km^2 to 7,386km^2 between 1980 and 2006 (World Rainforest movement 2009). Nypa palm (Nypa frutican) introduced in Calabar (Eastern Niger Delta) in 1906 is taking replacement now by expanding and spreading into the degraded mangrove areas over the past few decades. A significant aspect of the distribution and spread of the palm is the near complete absence of mangrove vegetation in the places that the palm has effectively colonized. Going by the rate of spread of the palm, the displacement of native Rhizophora mangrove vegetation by the alien palm is gradually leading to habitat alteration and loss in mangrove productivity (World Rainfoest Movement, 2009). Perhaps, the massive destruction of mangrove associated with military use of herbicides in Vietnam decades ago, spurred a new zeal among Asian scientists to research into the possible implications of this unwholesome practice of man on mangroves. Although Ekeke (2003) had beamed his searchlight on measures of poverty reduction among communities in the mangrove regions of Nigeria, the approach adopted like that of others veered away from providing deeper insight into the trend of destructions and their related consequences on the environment and man.

In other words, it implies that a reasonable work has been done but not enough especially in the associated area of change rate of the mangrove ecosystem of Calabar south, Cross River State of Nigeria. Hence, the gaps this study tends to fill

Objectives of the study

The objectives of this study include:

i. To determine the rate of mangrove forest change in the area over time.
ii. To determine the number and volume of mangrove trees exploited by the inhabitants of Calabar South.
iii. To map out the change in mangrove forest ecosystem over the years.
iv. To examine annual variation in the exploitation of mangrove trees.

Study Area

Calabar South Local Government is the study area. It is located along the Nigeria-Cameroon coast between Latitude 4^0 55'N and longitude 8^0 16'E being part of the Calabar mangrove Estuary under West African mangrove sub formation (Ukpong 1995). Locally, it is bounded to the north, east and west by Calabar Municipality and Odukpani Local Government Areas respectively. It is bounded to the south east by Akpabuyo L.G.A.

The area is flanked on its eastern and western borders by two rivers, the Great Kwa and Calabar River respectively and to the south, by the Atlantic Ocean.

The climate of the area is humid tropical although rainfall occurs throughout the year. The place experiences double maxima, rainfall regime in July and September (1880 mm), the lowest rainfall values of 240 mm occur from December to February (Met; serv. 1980). The temperature is uniformly high with a maximum of 30^0C and minimum of 23^0C. The area has a high relative humidity usually between 80% and 100% and vapour pressure in the air averaged 29 millibars throughout the year. High salinity (3.8 ± 0.4%) is limited to the dry season while lower salinity (0.5 ± 0.6%) occurs in the rainy season (Ukpong1995). Tidal amplitude in the estuary ranges from 2.01m at spring tides to 1.07m at neap tides (Nigerian Navy 1986).

The present settlement starts from the mouth of the estuarine coastline and projects to the hinterland and it's growth to the south is limited by the mangrove swamps. Fallow land is available only eastwards up to the Great Kwa River and northward. The area is an interflurial settlement, typical in this part of the country built on high area between two adjacent rivers. This locational advantage permits easy access especially through waterways for intending migrants who are mostly fishermen and traders in wood and craft items to the area. However, the swamp as a whole varies by less than 1 in 500 metres in elevation except on the upland forest ecotone where abandoned levees may exceed 1in 500metres(Ukpong 1995).

The settlement pattern following the order above takes the linear shape except within and extending 20km of the mangrove forest area to the Atlantic ocean, some clustered fishing settlement pattern are identified otherwise

known as Ine (Fishing port). The presence of these fishing settlements in the area provided and facilitated easy access into the mangrove forest for rapid exploitation of its resources leading to increased depletion of the ecosystem.

Geologically, the area is composed of tertiary sandy deposits of fluvio-marine origin. These are overlain by quaternary silty and clayey alluvium eroded from massive pre-Cambrian rocks of Oban hills in the outskirts. This characteristics poorly consolidated, non cohesive and porous rock formation permits large accumulation of water through constant and occasional flooding of the ecological zone. Floodwater recession or tidal retreat permits deposition of alluvial fans and levees quite supportive of plant growth. It accounts for occupational engagement in market gardening among dwellers. The soils are sandy; light hued in some location, but clayey, muddy, dark grey in colour, water logged and boggy.

However, saline mangrove soils, developed on mud, sand or peat at the mouths of estuaries inundated by tropical tide water's (Ukpong1995).But more acid soils is identified to be associated in the zonation of *Nypa fructican, Rhizophora* species dominance (Ukpong 1995).

The predominant vegetation type is mangrove. The mangrove flora consists of trees and shrubs of few general varying species. The common genus is *Rhizophora* with three: *R racemosa, R harisonii and R. mangle.* The dominant feature of mangrove is the stilt roots of Rhizophora species. Associated with these species are *Avicennia africana and Laguncularia racemosa*. There are also palms, *Prodococcus bateri, Ancistrophyllum opacum* and the gregarious and aggressive *Nypa frutican*. Salt marshes and sea grasses interact with the mangrove forest to support the entire coastal zone. Hence, because of its status of composition and structure it is known to be part of the most complex vegetation which is the northernmost limits of the Mangrove growth in the Cross River estuary (Ukpong 1995)

This complex plant community of wetland origin formed an ecological niche for reptiles, monkeys, birds, fishes, shrimps, mollusks, and other wildlife. Thus, it is often harvested for wood, fuelwood, tannin, leaves, fibers and dyes. Mangrove environment in particular is important for inland fisheries, serving as highly productive habitat for shell and finfish. These inform the migration of fishermen from Delta, Akwa Ibom and Akpabuyo to settle and take advantage of the rich supply at this point (Nest 1991).

Its estimated population in 2007 stands at 191,515 (NPC 2006); In-migration has formed the major source of its population growth. The immigrant communities include Ibibio, Oron, Ibo, Ijaw, Anang, Urhobo, and other tribes within and outside Nigeria. Despite the ethnic intermix, a fraction of indigenous population mostly of the Efiks/Efut extraction are found in the locality. This wave of migration brought along changing perception of interaction with the environment. This scenario contributed immensely in the remaking of the greater part of the mangrove ecosystem.

The rural people engaged in artisan fishing and the cultivation of vegetables, cassava and maize at commercial and subsistence level. Fishing is done using small nets to catch even fingerlings. Shrimp farming is also in vogue. It involves clearing/cutting down the available mangrove forest or aquatic fauna for making ponds. Logging and lumbering of fuel wood for charcoal Production sales and also for timber are common practices. The fish species are Ibat/Ekpai (*Ethmalosa fimbrata*). The bonga and flat Cameroon Sardine (*S. Cammeronesis*). Commercial shrimps and prawns found here are: Pink shrimp (*Penacus duorarum*), salt water prawns (*Newmatopalaema spp*) among others.

Economic wood species harvested are; mangrove, Achi gum (*Oxystigma spp*), Owen (*Mitragyna spp*), Camwood (*Pterocarpus spp*), Mkpenek (*Uapaca spp*) and so on (Fayemi et al 2005).

Method Of Study

Data collected essentially on the quantity (volume) of Mangrove wood exploited and the areal extent of Mangrove depleted as well as the number of mangrove trees exploited annually. The principal source of data was from field work conducted by the researchers (primary source.)

Secondary sources of data to compliment primary source were from multi temporal image data (Landsat Imagery, Orthophoto maps and Topographic Maps.) Others were; tree girth, height, tariff rates and numbers of trees (merchantable and pole) from monthly tree analysis of forestry department.

Reconnaissance survey of the study area to observe the socio- economic activities and the states of the mangrove forest was carried out. Outstanding age long stakeholders of mangrove forest at different locations were contacted to assist provide information. Volume of wood were computed and determined by the researchers using the single tree stumpage volume formula,

$$\frac{\pi G^2}{4} X Ht$$

Where π= 3.143 G = Girth at breast height (^{M}) and Ht = Tree height (M). However, Tariff rate/pole and merchantable tree (logs), height, were gathered from the Monthly tree Analysis Report of Forestry Department in Calabar. In order to establish trend of mangrove forest depletion (loss) over years, a multi-temporal image data

of the mangrove vegetation covering the area (1970 – 2008) was acquired and processed. These Include: a Toposheet (1970) derived from an aerial photo of 1968, Landsat imagery 1970, 1986, and 2008 at 30m resolution.

These data sets were geo- referenced into a common framework in a G.I.S environment (Arc. GIS 9.3) after which they were digitized and delineated into mangrove class, and other Non – Mangrove classes (Fresh Water Swamp, Nypa palm, Farm land and so on.) The Landsat imagery was also treated likewise. Intersection operations of the above data sets were carried out to determine the change in mangrove area coverage between the different time periods in consideration (1970, 1986 and 2008). An area time series of mangrove forest depleted over the years was analyzed and prediction were made into the future.

Ground truthing exercise was also carried out using G. P. S. for confirmation of vegetation status based on point of coordinates.

Indices of mangrove forest change which includes: Intensity Index, Dynamics Index of land use type and Contribution rate of change were determined accordingly using the formulae: Change Intensity Index: This is defined as a percentage that an area of land-use change is divided by the total land area in the study period. It is used to compare the strength of land use change or potential trend. It is given as;

$T_i = U_{bi} – U_{ai}$, (1, 2…8)……(1)

Dynamic index of land use type: Land-use type of Dynamic Index is the rate of change for a certain type of land-use in the study area within a certain time which is given as;

$K_i = U_{bi} – U_{ai} \times {}^{1}/_{T} \times 100\%$, (1, 2….8) ……..(2)

Contribution rate of change: the contribution rate of changes is the percentage that the certain type land–use changes contributes to the total land-use change in the same period. It is given as;

$A_i = U_{bi} – U_{ai}$ …….. (3)

$\sum(U_{bi} – U_{ai})$

Where; T_i = the intensity of į'th land use type changes in study period. Uai = denotes the i'th land –use type area at the beginning

U_{bi} denotes the i'th land – use type area at the ending. B= denotes the total area of the study area at the ending.

K_i Denotes dynamic index for a certain land – use types within study period. Ai denotes the contribution rate of changes of the i'th land land-use type within study period; T denotes the study period

$\sum$=Summation. (Wang 2010). The mean value ($\bar{x}$) was used as a benchmark or theoretical framework to determine under exploitation or over exploitation of mangrove trees. Any value of mangrove trees exploited annually above the mean represent over exploitation and the value below the mean is taken for under exploitation.

Data Presentation and Discussion of Findings

The Rate of Mangrove Forest Change Over the Years

From table 1, the result reveals that the rate of mangrove change during the period (1970-1990) was 0.145km2 which represent 2.66% of the area change while in 1991-2011 there was a tremendous increase in the rate of change indicating that each year within this period 1.69 km^2 of mangrove was being depleted representing 31.12% of the entire areal change. In this case the competitive rivalry in land cover replacement was Nypa palm. Hence, any minus (negative indication) in mangrove cover is likely to be a plus (positive indication) to Nypa palm first as colonizers. Therefore judging from the result in the two time period of study 1970-2011, 1991-2011, the differences in the percentage of area change of 2.66% and 31.12% respectively as also expressed in the map (Fig 2, 3 and 4.) denotes a clearer result that the changes in the mangrove forest coverage of calabar south is very significant. In comparison with other land cover type changes also, it concludes that there is a significant difference in the rate of mangrove forest depletion over the years .This is confirmed by the indices study of mangrove forest change (change intensity index, Dynamic change index and contribution rate of change (Table 2).

Table 1: Change Rate of Mangrove Forest and Other Land Cover (1970-1991-2011)

Cover types	Cover status 1970 (Km^2)	Cover status 1991	Area change 1970-1991 (Km^2)	Rate of change per year (Km^2)	Area change (%)	Cover status 2011 (Km^2)	Area change 1991-2011 Km^2	Rate of change per year (1970-2011)	Area Change (%)
Mangroves	72.69	69.94	-2.75	0.145	2.66	37.82	-32.12	1.691	34.87
Nypa Palm	18.27	21.31	3.04	0.16	2.95	53.57	32.26	1.70	35.3
Farm Land	0.7	1.00	0.3	0.02	0.29	3.22	2.22	0.12	2.15
Raphia palm	1.0	1.01	0.01	0.001	0.01	1.04	0.03	0.002	0.03
Built up	5..59	6.10	0.51	0.027	0.49	8.77	2.67	0.14	2.59

Table 2: The indices of mangrove forest change rate in the study area

Index	1970-1990	1991-2011	1970-2011
Area change (Km^2)	-2.75	-32.12	34.87
Change intensity index (%)	2.66	35.97	38.63
Dynamic change index (%)	-0.20	-2.79	2.99
Contribution Rate of Change(%)	35.62	49.92	85.5

From the analysis, the percentage change in mangrove forest ecosystem compared to the total land area in the study site within the study period of 21 years which is denoted by the change intensity index is 38.63 percent. Also, within this period of study irrespective of other land use types, mangrove forest ecosystem alone changed as indicated by the dynamic index of change 2.99. The changes in mangrove forest ecosystem in relation to the changes in other land use types within the study period was 85.5 percent. Thus, it could summed up that the changes in mangrove forest ecosystem has been remarkable over the years.

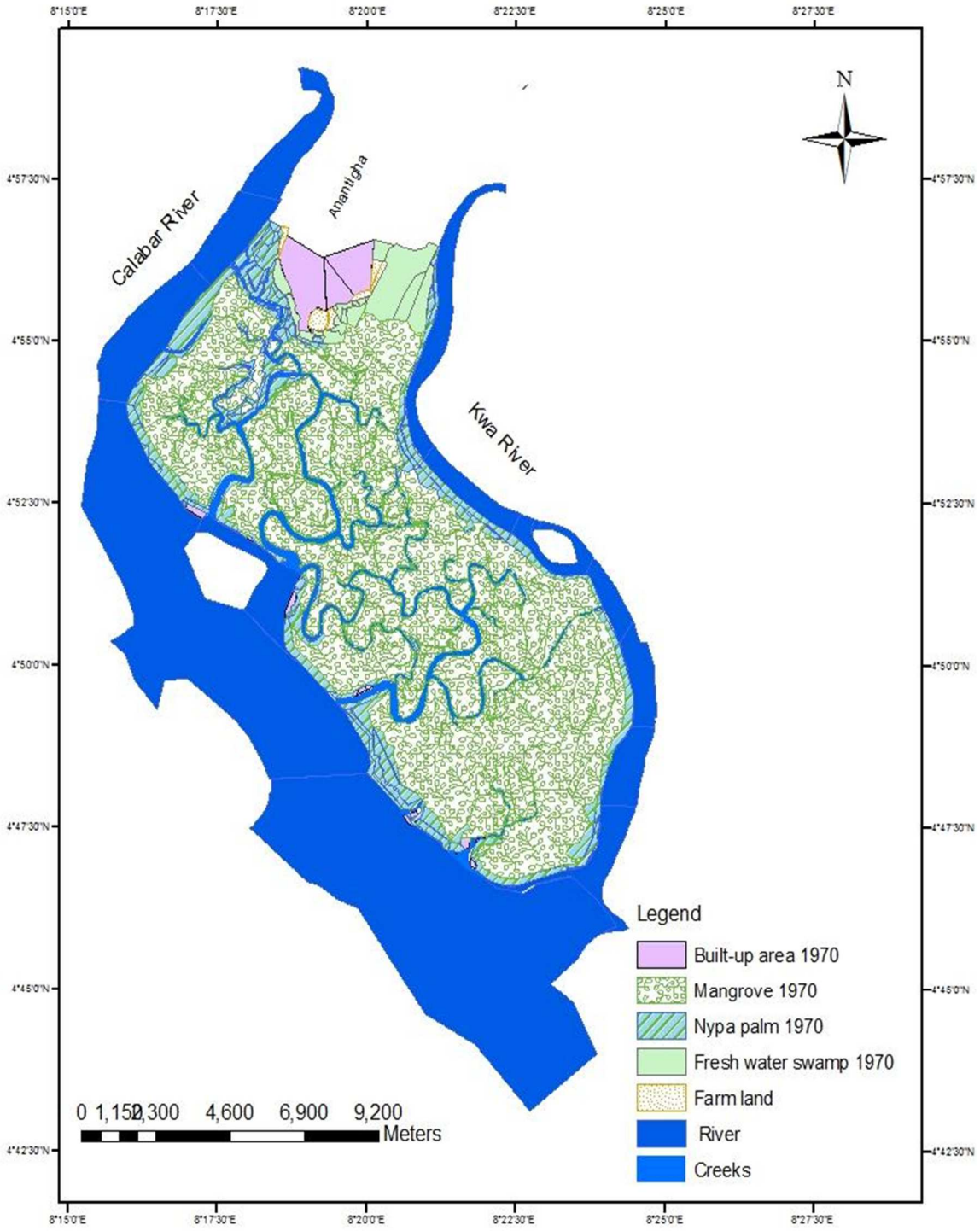

FIG 1: MANGROVE VEGETATION STATUS AND OTHER LAND COVER TYPES IN 1991

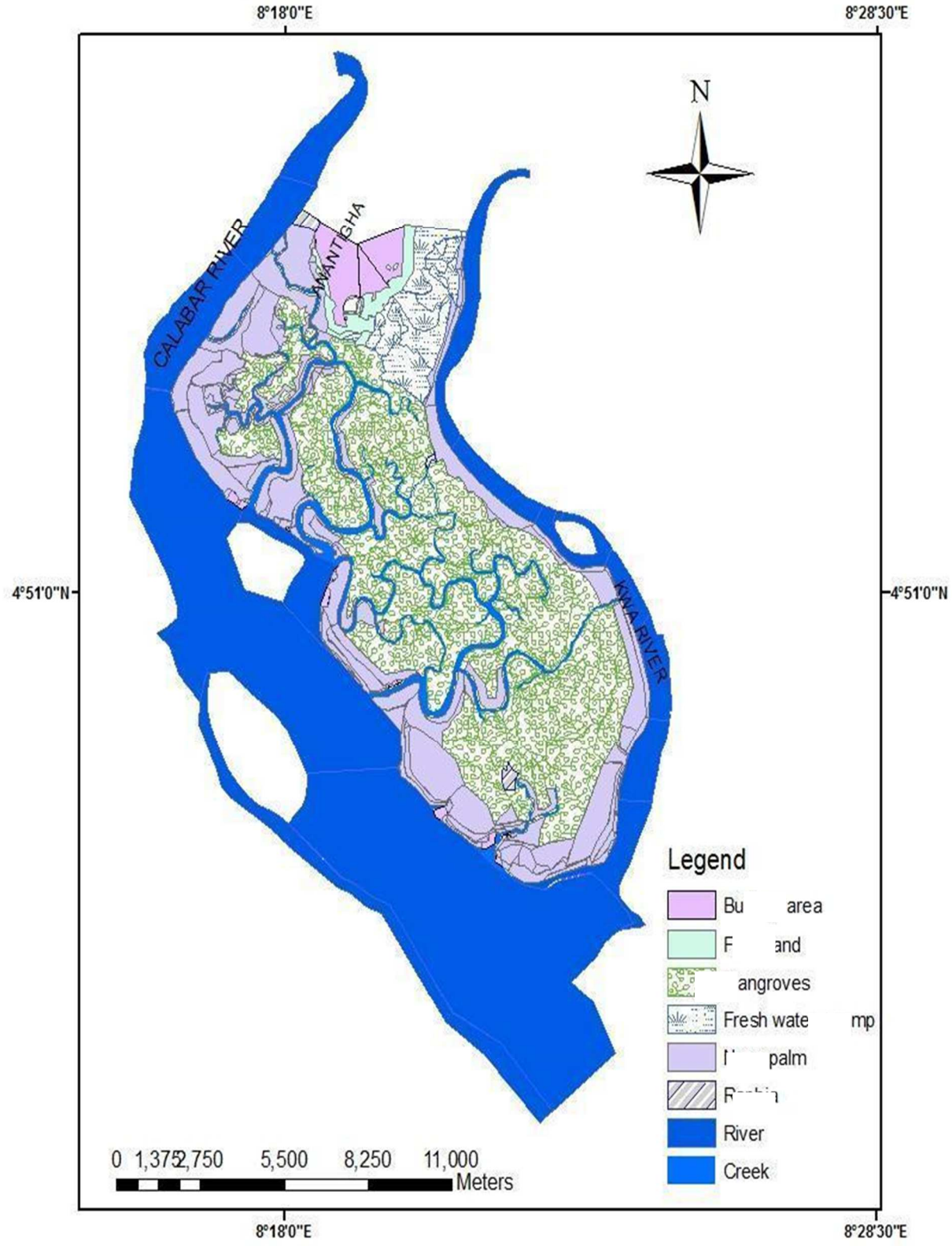

FIG 2: MANGROVE FOREST VEGETATION AND OTHER LAND COVER TYPES IN 1991

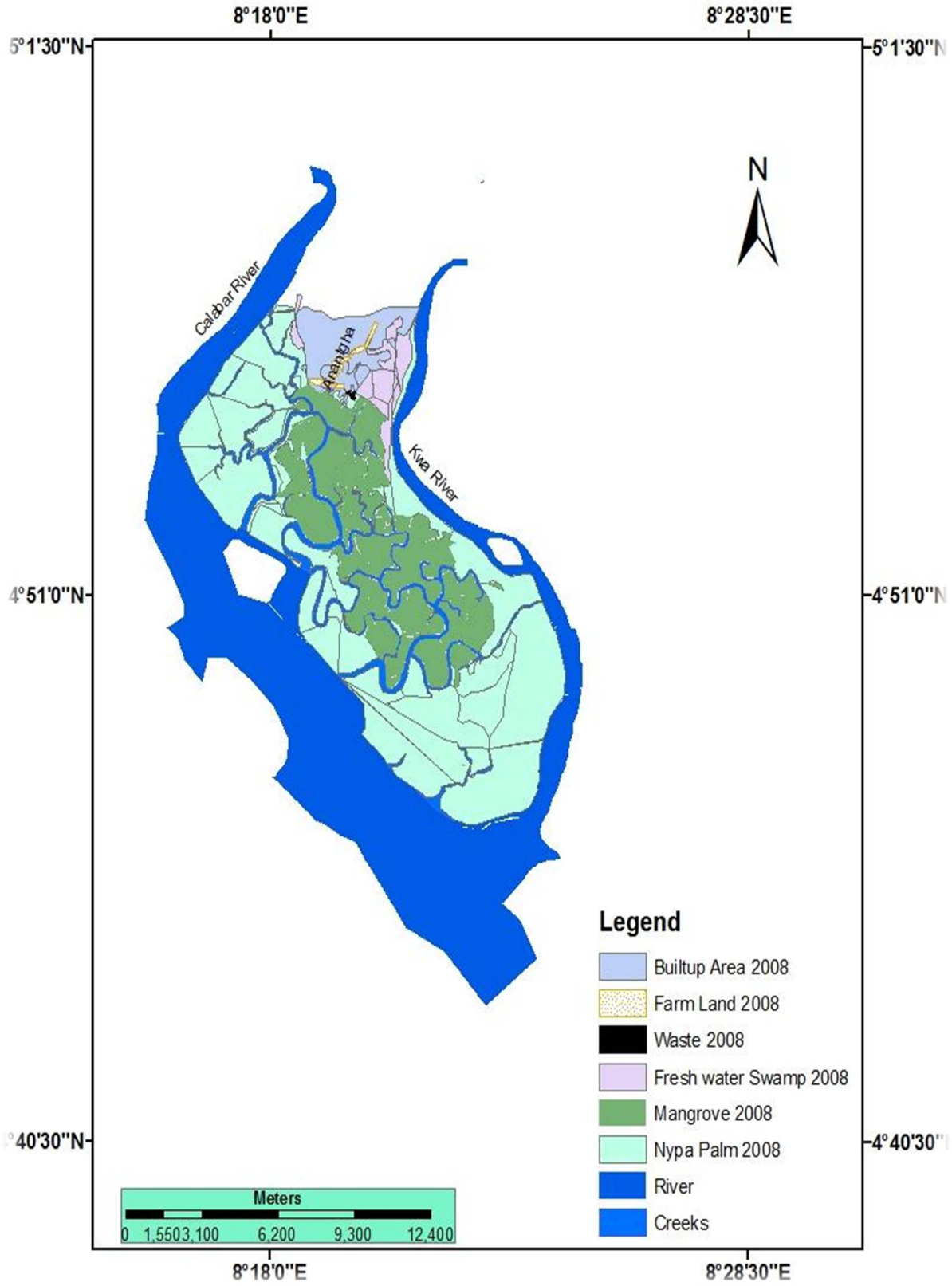

FIG 3: MANGROVE FOREST VEGETATION STATUS AND OTHER LAND COVER TYPES IN 2011

Growth of Nypa Over Mangrove During the Period of Study

Table 3: Mangrove and Nypa Growth in the study area.

LAND COVER TYPES	1970 (Km^2)	1991 (Km^2)	2011 (Km^2)
Mangrove	72.69	69.94	37.82
Nypa Palm	18.27	21.31	53.57

Source: Authors Field Report 2011.

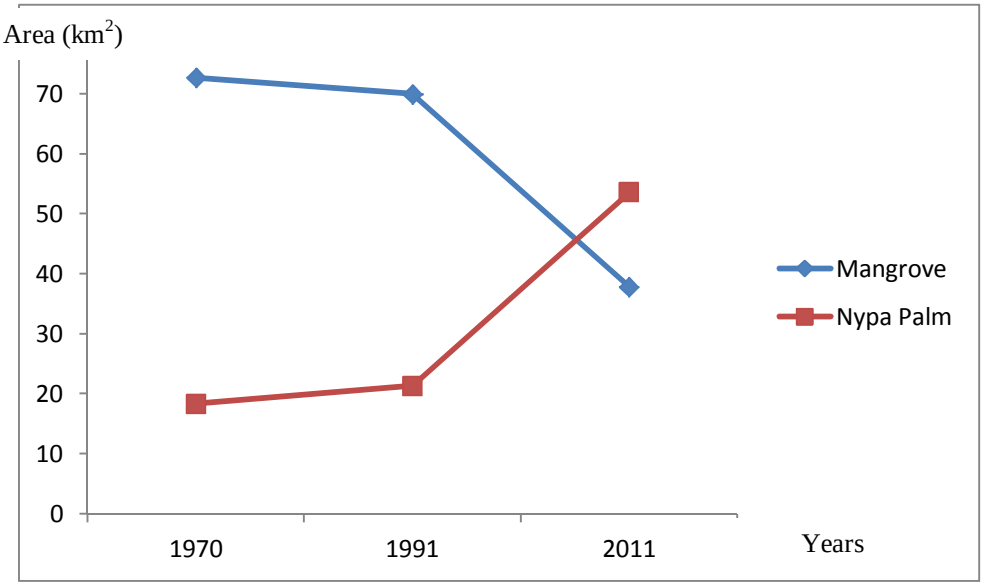

Fig 5: A graph showing Mangrove and Nypa Growth in the study area.

As table 3 and figure 5 shows, in 1970, mangrove occupied an area of 72.69km^2 as against Nypa with 18.27km^2. In 1991, mangrove had a total area of 69.94km^2 and Nypa 21.31km^2. But in 2011, the areal expanse of Nypa overshot that of mangrove with Nypa having a total area of 67.22km^2 and mangrove 42.83km^2. On the whole, this analysis indicated that Nypa has been growing profusely in the study area to occupy the place originally covered by mangrove. That is why the trend line in figure 5 which indicated the growth of mangrove and Nypa shows that of Nypa always going up and that of mangrove tending downwards.

Annual Volume and Number of Mangrove Trees Extracted

Table 4: Summary of volume & number of trees extracted over the years

S/no	Years	Total no of trees extracted	Differences between years	% difference	Annual volume extracted (M3)
1	1991	3792			11,747.74
2	1992	4708	916	19.46	8,448.54
3	1993	4733	25	0.53	6888.99
4	1994	4760	27	0.57	7,237.28
5	1995	485	-91	1.88	7911.97
6	1996	4892	41	0.84	6599.28
7	1997	4995	103	2.06	9375.18
8	1998	5188	193	3.72	8085
9	1999	5210	22	42.23	4474.94
10	2000	5944	734	12.35	9236.47
11	2001	6292	348	5.53	7227.84
12	2002	7286	994	13.64	6407.63
13	2003	7438	152	2.04	6662.34
14	2004	7480	42	0.56	6079.78
15	2005	7491	11	0.15	6453.66
16	2006	7538	47	0.62	5959.35
17	2007	7561	23	0.3	5396.65
18	2008	7608	47	0.62	5114.87
19	2009	7637	29	0.38	3923.56
20	2010	7820	183	2.34	2910.49
21	2011	7500	-320	4.27	2820.76
TOTAL		130,724			1,38,962.32

Source: Department of Forestry, Calabar South L.G.A

Table 4 indicates the number and volume of trees extracted for 21 years. The volume of mangrove trees exploited was established at 1,38,962.32m^3 while the total number of trees harvested was 130,724. It is suffice to note that the total number of trees cut annually has been progressive over the years from 1991-2011 (3,792-7500).

The highest percentage difference in the number of trees extracted within the grouping period of years (1991-2011) were recorded as follows: 1999 was 42.23 per cent, 1992 had 19.46 per cent and 2000 being 12.35 per cent. A drop in the number of trees cut was observed from (2003-20009). The least of 0.3 per cent in 2007 and 4.27 per cent in 2009 was observed. The indication here is that the forest is highly depleted in recent times. However, it should be noted that based on the computation of the single tree volume, the number of trees cut annually over a given area does not determine the volume derived, rather the higher the Girth size and height of tree in an area, the higher the volume per tree and vice versa. For instance in 1991, annual wood volume was 11,747.74M^3 from 3,792 trees exploited while 2011 – volume was 2820.76M^3 from 7500 trees exploited. The implication here is that the matured trees were no longer reached for harvest. Hence, under -girth trees were exploited due to long distances to ready matured tree destinations which is now located around Abana in Bakassi and boundary of Nigeria and Cameroon republic as observed in the field

Annual Variation in Mangrove Exploitation

From figure 5 and table 5 below, it could be seen that exploitation of mangrove has been very rapid in the area. The mean value for the number of mangrove trees exploited for the period of 21 years was 6225. Based on this value, 10 years (1991-2000) recorded exploitation of mangrove below the mean value. The reason for this low exploitation of mangrove trees from 1991-2011 was that at this time, there was still importation of timber generally in the country to complement the existing wood for construction purposes. However, from the year 2000when there was ban on importation of timber, there was therefore immense pressure on mangrove exploitation to provide wood needed for construction and other purposes. Also, observations in the field revealed that during this period, the price per litre of kerosene used for domestic heating increased so that quest for mangrove as an alternative source of energy equally increased. This led to the pressure on mangrove in the study area. The trend in mangrove exploitation increased tremendously till the close of 2010 when the Cross River State Government banned logging generally in the state that the state started witnessing a reversal in mangrove ecosystem destabilization.

Table 5:

Years	**No of Trees**	**No of Trees-Mean**	**No of Trees –Mean (Squared)**
X	X	$X-X^{-}$	$(x-x^{-})^2$
1991	3792	-4233	5919489
1992	4708	-1517	2301289
1993	4733	-492	2226064
1994	4760	-1465	2146225
1995	4850	-1375	1890625
1996	4892	-1333	1776889
1997	4995	-1230	1512900
1998	5188	-1037	1075369
1999	5210	-1015	1030225
2000	5944	-281	778961
2001	6292	67	4489
2002	7286	1061	1125721
2003	7438	1213	1471369
2004	7480	1255	1575025
2005	7491	1266	1602756
2006	7538	1313	1723969
2007	7561	1336	1784896
2008	7608	1383	1912689
2009	7637	1412	1993744
2010	7820	1595	2544025
2011	7500	1275	1625625
	$\sum$ = **130723**	X^{-}**6225**	$\sum$ = **35771344**

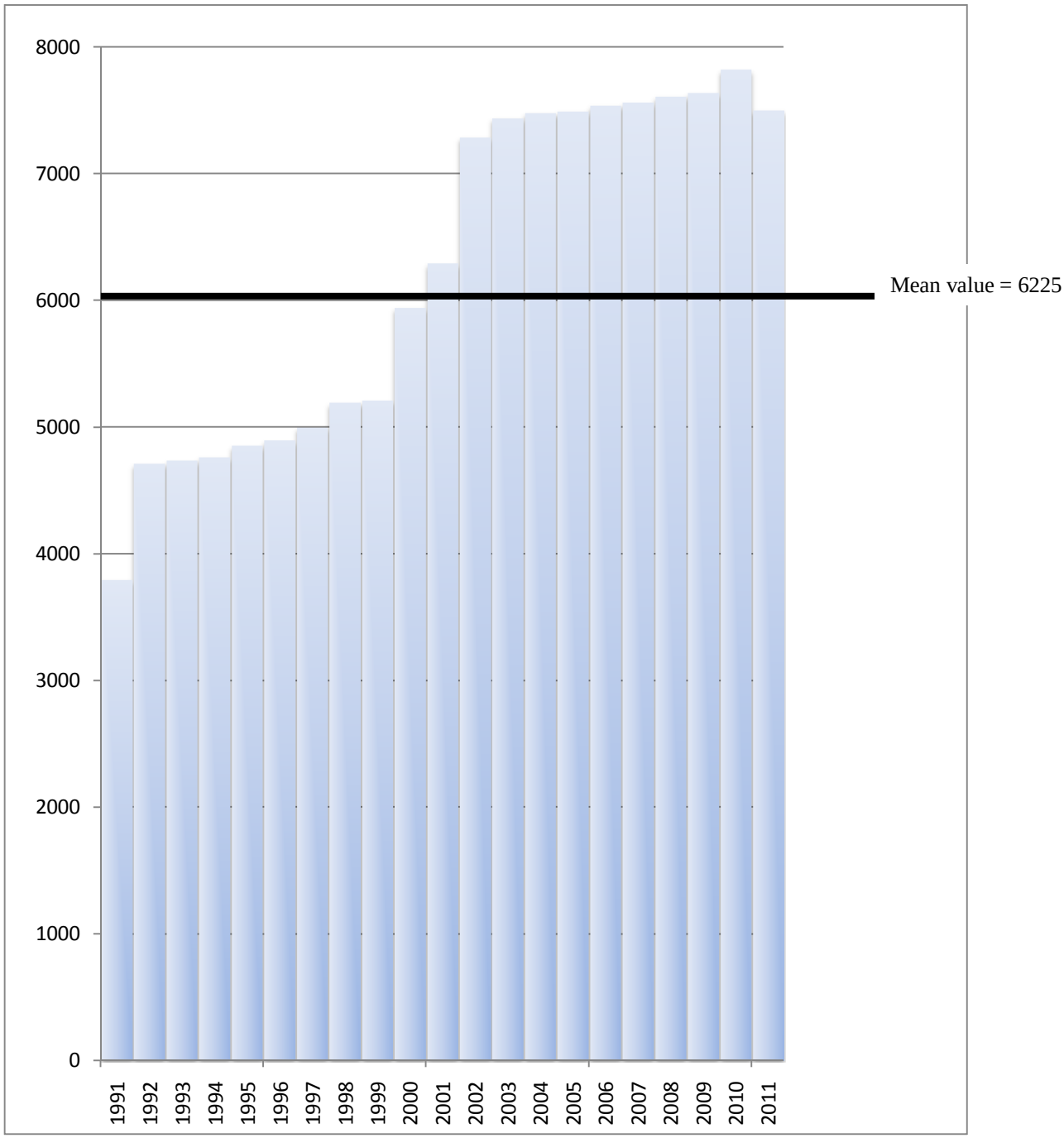

Figure 5: Annual Variation in Mangrove Exploitation showing the Mean Value as a Theoretical Benchmark for Determining Level of Exploitation.

Conclusions

It is suffice to note that mangrove forest ecosystem change in Calabar is increasing rapidly over the years. This process is bound to continue in as much as there is no forest management plan in the area. It was discovered that there is relative absence of enforced government regulatory and monitoring mechanisms which should be in collaboration with Local Communities to carry out effective mangrove reformation and biodiversity conservation programmes in the study area. This scenario has ultimately left the mangrove ecosystem in the hands of destroyers with the attendant consequences of flooding and loss of biodiversity among others. It becomes imperative therefore to suggest here that the protection of the mangrove ecosystem should be accorded priority by the government because of its role as habitat for both flora and fauna.

References

Aksornkoae, S. (1984): Mangrove Resources and the Socio-economics of Dwellers in Mangrove forest in Thailand; Humanity Development Library; document text. http://localhost/cgi-bin/gw?e=tlc10home.

Ekeke, B. A. (2003): Community Forestry and Poverty reduction in the Nigerian Mangrove Areas in Community Forestry and Stakeholders participation in sustainable Development; Proceedings of the 29th Annual Conference of the forestry Association of Nigeria held in Calabar Cross River State, Nigeria. 6th-11th October 2003 edited by S. O. Akindele and L. Popoola.

Fayemi. K, Amadi. S, Ololade B. (2005): Towards an Integrated Development of Niger Delta. Published By Centre For Democracy and Development. ISBN: 1-909296-22-2.

Hamilton, L. S., and S. C. Snedaker, eds. (1984): Handbook for mangroves area management. United Nations Environment, programmes, and Environment and Policy Institute, East-West center, Honolulu, Hawaii USA.

Meteorological service (1980) in Ukpong, I. E. (1995): Soil-vegetation interrelationships of mangrove published by Geoderma, an International journal of soil science geoderma 64 (1994) 167-181 ELSEVIER

National Population Commission (2006) Census Bulletin

Nigeria Environment Study Team (1991) Nigerian Threatened Environment. A Natural Profile, Ibadan pp 288.

Saenger, P. E. Hegerl and Davie J. D. S (1983): Global status of Mangrove ecosystems. Commission on Ecology papers, No. 3 International Union for conservation of nature and National Resources, Gland, Switzerland (The Environmentalist, Vol. 3 supplement No.3)

Ukpong, I. E. (1995): Mangrove soils of the Creek Town Creek Calabar River Swamp, South Eastern Nigeria Published by Journal of International society for Tropical ecology 36 (1): 103-115, 1995 ISSN 0564-3295

Wang,Yuanzhi (2010).A Typical Agricultural areas of China-Dezhou City's land use structure changes based on past decade data. Journal of Geography and Geology vol; 2, No.1, sept;2010.WWW.org/jgg.

World Rainforest Movement (2009). Niger Deltas Mangrove Communities Threatened by Continued Gas Flaring, Map Alert Action in Africa, in Mangroves are Disappearing and with them, the Livelihoods, WRM bulletin No 14.