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Land Resources Appraisal and Management Activities using Remote Sensing Techniques: Case Study of Akpor Town, Rivers State

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ABSTRACT
A systematic approach of understanding the land/National resources characteristics at Obio/Akpor L.G.A., Potential and limitation of remote sensing and then narrowing down to the target areas for detailed study not only improves the quality of information but also saves considerably time, cost and manpower. For such activities, satellite- based remote sensing technology has become an efficient tool due to its synoptic/multi-spectral temporal coverage. In the present study, initially, Obi/Akpor L.G.A. land and natural resources assessment was carried out using coarse scale satellite data and then based on the results, a representative site was identified for detailed studies towards resources potential evaluation and to identify the climate factors and other environmental conditions. This multi stage study was carried out for a part of Obi/Akpor L.G.A. Rivers state, Nigeria. The part set up of the study area was carried out on 1:50,000 scale using satellite map.

INTRODUCTION

The most important natural resource, upon which all human activity is based since time immemorial, is land. Land, better referred to as "a tract of land" is defined as an area to the earth's surface, the characteristics of which embrace all reasonably stable or predictably cyclic attributes of the biosphere (vertically) above and below this area, including those of the atmosphere, soil, geology , hydrology, plant and animal populations, and the result of past and present human activity (FAO, 1976).

Land resources refer to delineable area of the earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface, including those of the near-surface hydrology (including shallow lakes, rivers, marshes and swamp), the near-surface sedimentary layers and associated ground water and geohydrological reserve, the plant and animal populations, the human settlement pattern and physical results of past and present human activity (terracing, water, etc) or drainage structures, roads, buildings (FAO, 1993b). Land resources in the other hand can be taken to mean the resources available from the land. Examples: Water, Land/soil, Vegetation, Natural gas, Coal and Petroleum.Land resource is our basic resource. Throughout history, we have drawn most of our sustenance and much of our fuel, clothing and shelter from the land. It is useful to us a source of food, as a place to live, work and play. It has different roles. It is a productive economic factor in agriculture, forestry, g

STUDY AREA.

Obio/Akpor Local Government Area, with its Head quarters at Rumuodumaya, Popularly known as the gate-way Local Government Area, because of it location.It has a land mass of approximately 311.71 square kilometers and shares boundaries with Emohua, Ikwerre, Etche, Oyigbo, Eleme, Okirika, port Harcourt local Governement Areas of Rivers State and accessible by road, sea, and air transportation.

Obio/Akpor is constituted mainly by the people of Ikwerre ethnic nationality. Specifically there are four (4) prominent Ikwerre Kingdoms that constitute the local Government Areas, which are: Akpor, Apara, Evo and Rumueme Kingdoms.It also has an average of 2.82% growth rate which puts the population of the Local Government Area as at 2004 to be over 500,000 people (National Bureau of Statistics, 2004).

The local government Area is rich with land and natural resources, such as land, soil, vegetation, water, coal, petroleum, gas, animals, wildlife, air, wind and atmosphere, clay, sand, gravel.

Location and Delineation

The area belongs to the south-south regions of Nigeria or otherwise known as Niger delta region. It is located between latitudes $4^0$45'E and $4^0$60'E and longitude $6^0$50'E and $8^0$00'E

Climate and Other Environmental Conditions

The study area enjoys tropical hot monsoon climate due to its latitudinal position. The tropical monsoon climate is characterized by heavy rainfall from April to October ranging from 2000 to 2500 mm with high temperature all the year round and relatively constant humidity. The relief is generally lowland which has an average of elevation between 20 and 30m above sea level. The geology of the area comprises basically of alluvia sedimentary basin and basement complex.(Eludoyin,2010) The vegetation found in this area includes raffia palms, thick mangrove forest and high rain forest. The soil is usually sandy or sandy loam underlain by a layer impervious pan and is always leached due to the heavy rainfall experienced in this area. The study area is well drained with both fresh and salt water. The salt water is caused by the intrusion of sea water inland, thereby making the water Slightly salty. Due to continuous heavy rainfall and river flow, the study area experiences severe flooding almost every year (Ayolagha,2010).

Materials and Methods

The dataset used for this study are as follows:

1. Satellite map of Obio/Akpor L.G.A on 1:50,000 and 1:25,00 scale acquired on December 17th 2000
2. Survey of Port Harcourt topographical sheets on 1:50,000 and 1:25,000 scale for the corresponding area.
3. Cutlass, shovel, measuring tape, trowel and polythene bag (nylon).
4. limited field observation collected during field observations collected during field checks.

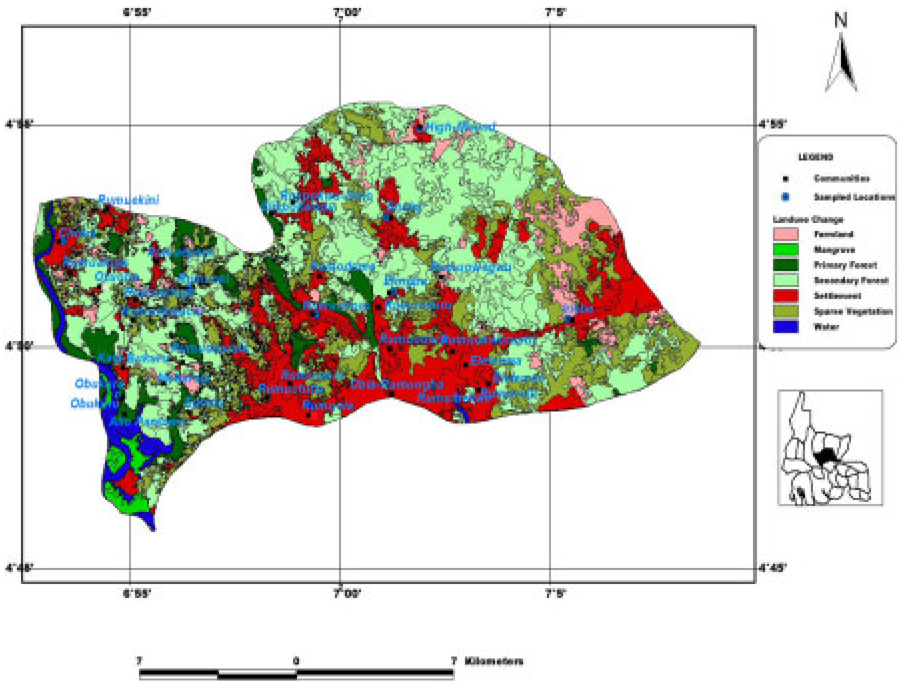
Methodology

Satellite map of entire Obio/Akpor L.G.A was prepared on 1:50,000 scale for assessing the land resources of the study area, visual interpretation methods for soil mapping, topography/relief, vegetation types, and climate for the study areas were assessed. It was observed that the study area enjoys tropical hot monsoon climate due to its latitudinal position. The tropical monsoon climate is characterized by heavy rainfall from April to October ranging from 2000 to 2500 mm with high temperature all the year round and relatively constant high humidity (Eludoyin, 2012). The relief is generally low land, the vegetation found in this area includes raffia palms, thick mangrove forest and light rain forest. The soil is usually sandy or sandy loamy, silt loamy, clay loamy and sandy clay (Ayolagha, 2010).

After understanding the land resources set-up of the area and its problems (as discussed above), a representative test site, that is the area of interest was selected for detailed study at 1:50,000 scale. Considering that large-scale satellite data could provide detailed information of the land resources found in the area.

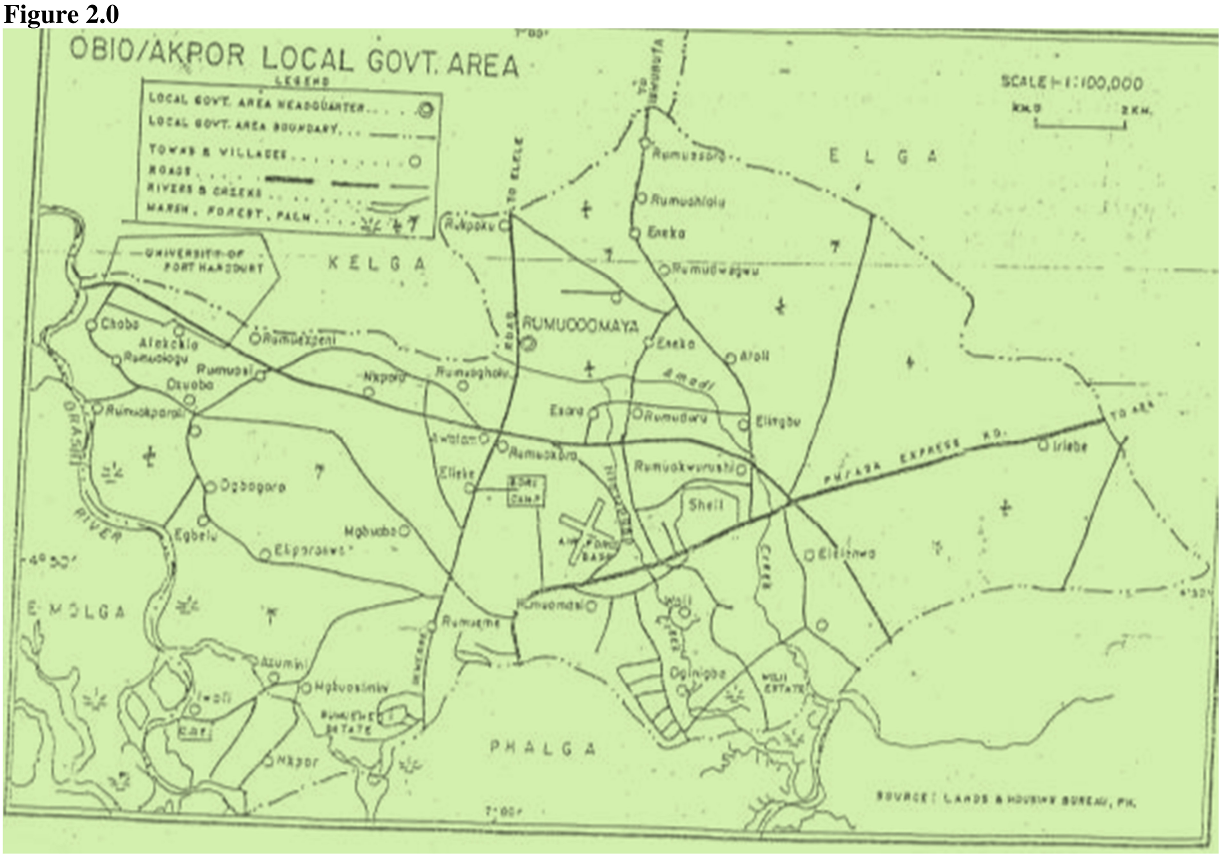
After the target areas were selected from the satellite map prepared on 1;50,000 scale for detailed study, the corresponding point was cleared with cutlass and profile pits were dug using shovel followed by soil sample collection with the use of trowel which I started from the bottom of the soil pit to the top surface of the profile pit to avoid contamination of other soil at the sub horizon with soil sample collected from another horizon mainly from the top surface.

Figure 1.0



Obi/Apkor L.G.A Satellite map on 1:50,000 and 1:25,000 Scale

Figure 2.0



Obio/Akpor LGA Topo Map on 1:50,000 and 1:25,000 Scale

Laboratory Analysis of the Soil Sample

The following were carried out on the soil samples:

a. PH determine in water (a soil/water ratio 1:1), using a pH meter with glass electrodes;
b. Total Nitrogen (TN) determined using the macro-kjeldahl procedure described by Jackson (1958).
c. Organic carbon (OC) determined using the method by Walkley and black (1934).
d. Organic matter (OM) content was determined by multiplying the organic C content by 1.724.
e. Exchangeable K^+, Ca^{2+}, Mg^{2+} and N^{a+} was determined by extraction with 1N ammonium acetate; amount of K, Ca and Na in the filtrate determined using a corning flame photometer with appropriate filter and Mg was determine using perkin-Elmer atomic absorption spectrophotometer.
f. Total exchangeable base (TEB) was determined by summation of all the exchangeable Cation (K.Na,Ca, and Mg).
g. Total exchangeable acidity (TEA) was determined by titration method (IITA, 1979).
h. Cation exchange capacity (CEC) was determined by summation
i. Percentage base saturation was determined by summation of all the total exchangeable base over CEC multiply by 100.

RESULTS

Table 1.0 Morphological Characteristics of the Soils Collected

Profile	Horizon depth (cm)	Munsel colour (moist)	Texture	Structure	Consistency	Roots	Mottling	Boundary
1. A_p	0-15	10yr4/2	SL	2,m-ab	Non-sticky	Abundant	Absence	W
A_2	15-30	10yr5/6	SL	3,m-ab	Non-sticky	Abundant	Absence	W
Bt_1	30-45	7.5yr5/8	SL	3,m-ab	Non-sticky	Few	Presence	S
Bt_2	45-60	5yr4/4	CL	3,m-ab	plastic	Absent	Absence	S
B_h	60-75	5yr4/4	CL	3,m-ab	plastic	Absent	Absence	S
2. A_p	0-15	10yr4/4	SL	2,m-ab	Non-sticky	Abundant	Absence	W
A_2	15-30	10yr4/2	SL	2,m-ab	Non-sticky	Abundant	Absence	W
Bt_1	30-45	7.5yr4/4	SL	2,m-ab	plastic	Few	Absence	S
Bt_2	45-60	5yr4/4	SL	2,m-ab	Sticky	Absent	Absence	S
B_h	60-75	5yr4/4	SL	2,m-ab	sticky	Absent	Absence	S
3. A_p	0-15	10yr3/3	SL	2,m-ab	Non-sticky	Abundant	Absence	W
A_2	15-30	10yr3/3	SL	3,m-ab	Non-sticky	Few	Absence	W
Bt_1	30-45	10yr4/4	SL	3,m-ab	Non-sticky	Absent	Presence	S
Bt_2	45-60	10yr4/4	CL	3,m-ab	Sticky	Absent	Absence	S
B_h	60-75	10yr4/4	CL	3,m-ab	plastic	Absent	Absence	S
4. A_p	0-15	10yr5/4	SL	3,m-ab	Non-sticky	Abundant	Absence	W
A_2	15-30	10yr4/2	SL	3,m-ab	Non-sticky	Abundant	Presence	W
Bt_1	30-45	10yr4/4	SL	3,m-ab	plastic	Few	Presence	S
Bt_2	45-60	10yr4/4	CL	3,m-ab	Sticky	Absent	Presence	S
B_h	60-75	10yr4/4	CL	3,m-ab	Plastic	Absent	Presence	S
5. A_p	0-15	10yr4/2	LS	2,m-ab	Non-sticky	Abundant	Absence	W
A_2	15-30	10yr4/3	SL	3,m-ab	Non-sticky	Few	Absence	W
Bt_1	30-45	10yr4/4	SL	3,m-ab	Non-sticky	Absent	Presence	S
Bt_2	45-60	10yr4/4	CL	3,m-ab	plastic	Absent	Absence	S
B_h	60-75	10yr4/4	CL	3,m-ab	plastic	Absent	Absence	S
6. A_p	0-15	10yr6/6	LS	2m-ab	Non-sticky	Abundant	Absence	W
A_2	15-30	10yr3/4	SL	1m-ab	Non-sticky	Few	Presence	W
Bt_1	30-45	7.5yr4/4	SL	1m-sab	Sticky	Absent	Presence	S
Bt_2	45-60	7.5yr4/4	CL	1m-sab	Plastic	Absent	Presence	S
B_h	60-75	7.5yr3/4	CL	1m-sab	Sticky	Absent	Presence	S

Table 2: Mean of the Physical Properties of The Soil

Profile	g/kg sand	g/kg silt	g/kg clay
1	848	6.12	9.08
2	884	4.84	6.94
3	850	6.5	8.5
4	798	8.54	11.46
5	840	7.16	8.84
6	828	6.68	10.52

Table 3: mean values of chemical properties of soil samples of study area

Profile	Soil pH H_2O 1:1	OC	OM %	TN %	C:N %	TEB cmol/kg	TEA cmol/kg	ECEC cmol/kg	PBS %
1	5.37	0.16	0.26	0.02	5.25	5.80	0.46	5.05	91.24
2	6.03	0.20	0.30	0.09	4.00	4.16	0.34	4.50	92.47
3	6.14	0.59	0.96	0.09	26.50	17.74	1.99	19.73	89.7
4	6.11	0.28	0.38	0.02	11.15	0.07	0.43	4.50	89.08
5	6.11	0.13	0.17	0.01	5.32	4.80	0.47	5.27	89.92
6	6.11	0.13	0.17	1.60	1.60	3.96	0.34	4.30	91.99

Tables 4

PLANT SPCIES

S/N	BOTANICAL NAME	COMMON NAME
1	*Elaeis guineensis*	Oil palm
2	*Magnifera indica*	Mango
3	*Gmelina arborea*	Gmelina
4	*Dacroydes edulis*	Africana pear
5	*Psidium guajava*	Guava tree
6	*Azadiractha indica*	Neem tree
7	*Khaya spp*	Mahogany
8	*Triplochton seleroxylon*	Obeche tree
9	*Butyosppermum paradoxum*	Shea-butter tree
10	*Hevea braziliensis*	Rubber

Morphological characteristics of the Soil.

The results for the morphological characteristics for this soil in table 4.1 shows that the texture of the soil ranged from sandy loam to clay loam.

Structures of the soils in the A_p horizon was moderate angular blocky to strong angular blocky. In the lower horizons, this trend was followed in the soil consistence, where the soils were non-sticky in the first three horizons and slight plastic in the lower horizons.

Good drainage conditions existed in the A_2 horizons and mottles in the Bt1 were abundant but very low in intensity. Root/roolets decreased in occurrence at the lower horizons. Soil boundaries were wavy and then smooth as the depth increased.

The results shown above indicated that the topography of the soil is flat. The top horizon had a wavy boundary and this trend changed to smooth as the horizon depth increased. There was no evidence of erosion, either sheet or gully. The top soil colour was dark grayish brown, (10yr4/4) (moist). The soil is imperfectly drained at lower depths and has an udic moisture regime. The top soil texture was sandy loam. The top soil (A_P), structure was moderate to angular blocky. Roots/rootlet occurred in the first three horizons of the profile.

From the table shown above, it was observed that the soil has a slight undulating nature. The soil was poorly drained. Little evidence of flooding was observed, but no evidence of erosion was noted. Root occurrence and distribution reduced with depth. The surface horizon is predominantly sandy loam and this was trend in the

A4 horizons until it became clayed loam. All the horizons in this profile occurred as strong medium angular blocky, this shows evidence of high occurrence of clay fractions in them.

The results shown on the morphological characteristics or properties of the soil indicated that the drainage in the area was very poor. Evidence of flooding and erosion were seen ground water depth was very high, thus showing an aquic moisture regime.

Root distribution reduced with depth and biological activity was high. The soil were stone free.

In this profile pit cited there was an indication sandy loam texture all through the profile, followed by structure, where the soils were weak, moderate and angular block in the lower horizons. Consistency was non-sticky, in the first three horizons to non-plastic in the lowest two horizon.

From the result shown above on the morphorlogical properties of the soil particularly on profile 6 above was an indication of poor drainage with high moisture throughout the profile resulting to an aquic moisture regime. The top soils were characterized with sandy loam textures, while the sub soils were predominantly sandy clay loam. Apart from the A_p horizon, all the horizons were of weak, medium, sub angular blocky.

Physical Properties of The Soils.

The results in Table 2 shows the mean value of the physical properties of soils such as silt, sand and clay in the profile pit dug in the study areas.

Sand: From the mean value of sand recorded in table 4.1 above it was observed that the value increases in depth and sometime decreases but it was noted that the profile No: 2 recorded the highest mean value of 884, while profile No: 4 had the least mean value of sand of about 798. Although the values range from 798-884.

Silt: On this other aspect of physical properties of soil called silt, I found out that the mean values recorded were unstable such that it increases and in some case decrease in increase in depth of the profile but the highest men value of silt was found in profile No: 4 with total mean value of 8.54, and the range is between 4.66 and 8.54.

Clay: The soil separate consisting of particles < 0.002mm in equivalent diameter, or a soil textural class containing >40% clay, <45% sand, and <40% silt called clay was also found having such inconsistency character of increasing and decreasing properties in all the various profile pit cited. The mean value of clay observe range from 6.94 to 11.46 and the profile No:4 recorded the highest value.

Chemical Properties of the Soil

pH from the results shown in Table 3,it was noted that all the soils studied are either slightly acidic or moderately acidic with pH mean values ranging from 5.37 to 6.1 and the soils vary generally between and within horizons in terms of pH values.OC, on this other aspect of chemical properties called organic carbon the mean value recorded on the table above shows a value of 0.13 to 0.59.O.M, mean values of organic matter in the study area showed an increased and a decreased down the profile, though occasionally breaks in trend were observed in most of the profile and the lower horizons. TN, the mean value of total nitrogen content of the soil revealed values ranging from low to high in each horizons of the profile cited.

Generally, the values range from 0.01 to 1.60.C:N, in carbon/nitrogen ratio, a close relationship existed between the total nitrogen and carbon/nitrogen content of the soil in profile six (PR6) in terms of mean value of 1.60., but the mean value range from 1.60 to 26.50.

TEB: Mean values of total exchangeable bases in the study area ranges from medium to high. Generally, the value is from 3.96 to 17.74. But the profile 4 (PR4) had the highest value while the profile6 (pr6) recorded the least.

TEA: The mean value of total exchangeable acid on the table above could be said to be medium to high from 0.34 to 1.99. The higher value of TEA was recorded in the profile with high pH value.ECEC: The Effective Cation Exchange Capacity (ECEC) of the collided fraction of soil exhibits a wide range because humans and several minerals may be present in varying amounts. (Brady, 1974).The ECEC mean values ranges from 4.30 to 19.73cmol/kg.

PBS: From the mean results table on the chemical properties of the soil studied it shows that Percentage Base Saturation was very high throughout all the horizons and in each of the profile.

Assessment of Palatable Vegetation Species

Table 4 shows the palatable plant species found in the study area during the field work. These palatable plant species were found in the light rain forest and thick mangrove forest hence their occurrence in sparse herbaceous and non-sparse herbaceous areas. Remote sensing was used to map species inventory result from field observations were associated with the satellite map.Settlement areas were identifiable from the satellite map generated using remote sensing. However, remote sensing could not directly be used to indentify the palatable plant species. This confirms the finding by Joshi (2006) that remote sensing cannot be used directly to map plant species unless dominate the ecosystem.

Results and Discussion

Land resources representing largely the soil and water phases contribute significantly to the development and sustenance of various living components in terms of flora and fauna. It is our basic resource alongside air and water. It is one of the marvelous products of nature without which there would be no life. It is a productive economic factor in agriculture, forestry, grazing, fishing, mining and various other industrial and social activities.

Our land resources perform various functions like providing base for vegetation, water bodies, habitat for human, animals, birds and other organism, producing food and fibre; maintaining or enhancing water quality; partitioning water flow and sequestering carbon. Majority of these functions of land are, however, determined by the quality of soil. Maintaining and improving the quality of the Nation's soils can increase farm productivity, minimize use of nutrients and pesticides, improve water and air quality and help store greenhouse gases.

Potentials and Limitations of Using Remote Sensing Techniques and Products in Assessing Palatable Plant Species

Remote sensing remained limiting in mapping the palatable plants species in this study. In the study areas the palatable vegetation species did not dominate any settlement identified in the satellite base map this remained difficult to detect and assessed by remote sensing in a direct and straight forward manner. The palatable plant species were however, commonly found both in light rain forest and mangrove forest, while some were found around settlement areas and therefore, could only be detected and assesses through indirect means of associating them with settlements. A combination of remote sensing techniques and ground base method can however, be instrumental in assessing such vegetation.

Recommendations

There are several interacting process occurring among the components of soil as with atmosphere. Soil is the storehouse of major, secondary micronutrients required for plant growth and also for growth of soil micro-flora and fauna. Through different physical, chemical, biological, and microbial processes, these nutrient elements are released slowly as per the requirement of plant and other organisms.

Soils of the land area perform filtering action for water and therefore, its capacity to filter determines the quality of surface and ground water bodies. Concentration of carbon dioxide has been constantly increasing due to its emission from burning of fossil fuel, deforestation and large scale disturbance for urbanization.

Thus the land care and soil quality management assume great significant for ensuring agricultural sustainability which is inevitable to feed the burgeoning population not only in Obio/Akpor L.G.A but across the country.

Vegetation

Remote sensing cannot be solely relied upon in mapping the palatable plant species. This is more in the conditions of the study areas where closed canopy cover of vegetation is somehow rare. Vegetation in the study areas were also heterogeneous, and this makes it even more difficult to map species by remote sensing techniques. Intensive research is, therefore, recommended in methodologies that may be combined with remote sensing in assessing plant species in general. There is need to develop models that may be applied in identifying plant species.

Generally, the following recommendations should be adopted for policy makers for better decision-making.

(1) The continual increase of the aerial coverage of built up area needs to be checked by promulgating a law of unlawful expansion hence, this would protects the biodiversity in the study area.

(2) Adequate continuous monitoring by making use of satellite remote sensing should be encouraged.

(3) Forest guards should be employed if they should be employed and they should be exposed to more training on protecting the forest.

(4) The people in the study area should, be enlightened or educated on how to manage and protect the environment.

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