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ENVIRONMENTAL IMPACT OF PROPOSED BUILT-UP AREA ON SOIL RESOURCE BASE OF AKAMKPA SOUTHERN NIGERIA

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Abstract

Soil Resource Study and Environmental Impact of a built-up area on sustainable farming in Ekong Oban Community was conducted with the view to looking at the soil resource base of the surveyed area to ascertain the impact of the proposed built-up area on crop production since most locals in the area depend mostly on farming for their livelihood. Two soil mapping units (SUnit I and SUnit II) were delineated and characterized in terms of morphological, physical and chemical properties and classified using USDA Soil Taxonomy and World Reference Base (WRB). Soil Mapping Unit I comprise moderately deep to deep mature soils (≥ 80 cm depth), on a nearly level plain that is imperfectly drained. The soils are non-gravelly and lack surface rock-out crops. Soil Mapping Unit II represents young, shallow (≤ 50 cm depth), gravelly to rocky soils, occurring on a higher elevation than the former. The soils are well drained with about < 10 – 15 % of the surface covered by rock-outcrop. The soils are derived from Basement Complex Rocks. It is classified as Typic Kandi. Similarly, Mapping Unit SUnit II were classified as Lithic Udorthents (USDA) and correlated with Eutric Cambisols (Loamic) WRB). The study revealed that sustainable soil management technologies to mitigate any adverse effect on the soil resource base and the environment should be carried out. It further recommended that housing estate project, wildlife habitat, hunting areas, fish ponds, and other recreational facilities should be executed only when adverse effect on the environment is minimal.

1.0 Introduction

Environment comprises the physical, biological and societal components and processes that define our surroundings. Environmental Impact Assessment (EIA) is a process with an ultimate objective of providing decision makers with an indication of the likely environmental consequences of a proposed estate development. It could be defined as a systematic, comprehensive, logical process of analysis of a project and its effects (positive and negative) on the environment based on prevailing baseline conditions and a description of the mitigation actions. According to the Nigerian Environmental Impact Assessment Act of 1992 Mandates Federal, State and Local Governments and private companies must carry out a detailed environmental impact assessment on environmentally threatening projects, with mandatory public consultations and opportunity for comment (in line with Section 7 of EIA Act 1992). Similarly, the Nigerian law – the same EIA Act – requires that anyone clearing more than 50 hectares of forest obtain a federal permit and is mandated to carry out an EIA study assessment. For the study, there was need to look at the soil resource base of the surveyed area in order to ascertain the impact of the proposed built-up area, since most locals in the area depend mostly on farming as their means of livelihood. Consequently, without doubt, land suitable for estate development, wildlife habitat, hunting areas, fish ponds, and other recreational facilities should be subjected to soil surveys studies with the view to knowing the prevailing baseline conditions for sustainable environmental development.

2.0 Description of the study area

The project is located at Ekong Oban, Akamkpa, Cross River State, Nigeria. The extent is 3,983.4 ha, expected to carry 18, 400 housing units. Akamkpa Local Government Area is located about longitudes 8° 12' to 9° 00' E and longitudes 5° 00' N to 5° 48' N in the humid typical rainforest zone of Cross River State, Nigeria. The climate is a tropical humid, while annual rainfall ranges between 2, 500 mm and 3,000 mm (Bisong and Mfon, 2006)

3.0 Sampling designs / Areas

3.1 Soil mapping units 1

Soil Mapping Unit I comprise moderately deep to deep mature soils (≥ 80 cm depth), on a nearly level plain that is imperfectly drained. The soils are non-gravelly and lack surface rock-outcrops. Soil Mapping Unit II represents young, shallow (≤ 50 cm depth), gravelly to rocky soils, occurring on a higher elevation than the former. The soils are well drained with about < 10 – 15 % of the surface covered by rock-outcrop. The soils are derived from Basement Complex Rocks. It is classified as Typic Kandi

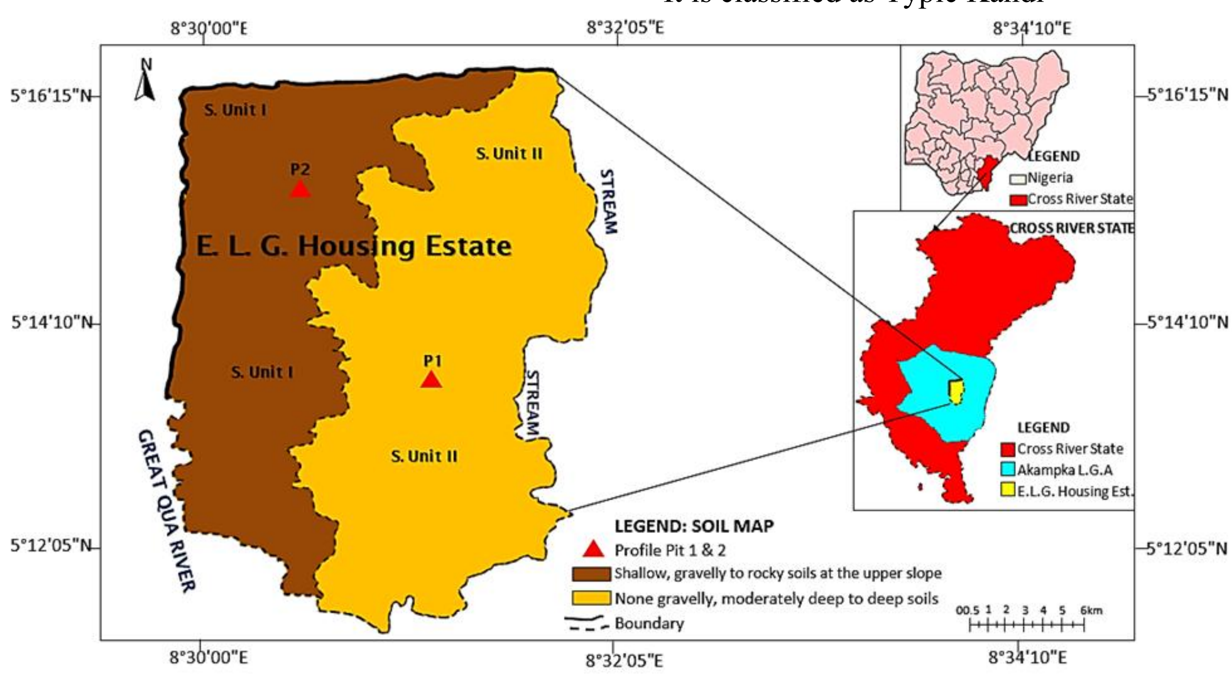

Figure 4.2. Soil Mapping Units (I and II)

Table 3.1.2 Physical and morphological properties of mapping unit I

Mapping Unit SUnit I										
Horizon										
Designation	**Depth (cm)**	**Colour (moist)**	Particle size distribution (%)			**Textural class ***	**Structure ****	**Consistence *****	**Boundary**	**Gravel/ Stones ###**
			Sand	Silt	**clay**					
	Pedon 1. Ekon Village, Akamkpa									
Ap	0 – 10	Dark brown (7.5 YR 3/2)	**78.6**	**6**	**15**	SL	W, f, sbk	Ss, sp, f	Gradual	None
AB	10 - 20	Gray (5Y 5/1)	**77**	**6**	**16**	SL	W, f, cr	Ss, sp, f	Diffuse	None
Btg	20 – 50	Pale yellow (5Y 7/3)	**68**	**7**	**25**	SCL	W, c, cr	Ns, Np	Diffuse	None
BC	50 – 80	Reddish yellow (7.5 YR 6/8)	75	5	**20**	SCL	**S,c, sbk**	**S, p**	**-**	None

Surface soil

1.	0 – 15	80	4	16	SL
	15 –30	76	6	18	SL
2.	0 - 15	79	5	16	SL
	15 –30	74	5	21	SCL
3.	0 -15	84	6	10	LS
	15 -30	77	8	15	SL
4.	0 – 15	78	6	14	SL
	15 -30	73	6	21	SCL
5	0 - 15	85	5	11	LS
	15 - 30	69	7	24	SCL

Where: sl =sandy loam, scl = sandy clay loam, ls = Loamy sand
w = weak, M = moderate, c = coarse, m = medium, f = fine,
sbk = sub-angular blocky, cr = crumby, gr = granular
Ss = slightly sticky, Ns = non sticky, Np = non plastic, S = sticky, p = plastic
f = firm, vf = very friable, l = loose
G = gravel, Co = concretions, s = stones

Table 3.2. Physical and morphological properties of mapping unit II

	Pedon 2 Obibid Eko, Ekong Oban									
Horizon										
Designation	**Depth (cm)**	**Colour (moist)**	Particle size distribution (%)			**Textural class ***	**Structure ****	**Consistence *****	**Boundary**	**Gravel/ Stones ###**
			Sand	Silt	**Clay**					
Ap	0 – 5	Pinkish gray (5 YR 6/2)	**76.8**	**8**	**16**	SL	W, f, gr	Ss, sp, vf gradual		G
AB	5 – 10	Reddish yellow (5YR 6/6)	**80**	**6**	**14**	SL	M, c, gr	Ss, sp, vf	Diffuse	G,s,
Bt1	10 – 25	Reddish yellow (5 YR 6/8).	**80**	**5**	**15**	SL	M, c, gr	S, p, f	Diffuse	G,s, Co

Surface soil					
1.	0 – 15	75	6	19	SL
	15–30	70	8	22	SCL
2.	0 – 15	77	6	17	SL
	15-30	79	6	15	SL
3.	0 –15	79	6	18	SL
	15-30	76	7	21	SCL
4.	0 - 15	69	8	22	SCL
	15 –30	67	9	24	SCL
5.	0 - 15	78	5	15	SL
	15 -30	76	8	16	SL

Where: sl =sandy loam, scl = sandy clay loam
w = weak, Mo = moderate, c = coarse, m = medium, f = fine,
sbk = sub-angular blocky, cr = crumby, gr = granular
Ss = slightly sticky, Ns = non sticky, Np = non plastic, s = sticky, p = plastic
f = firm, vf = very friable, l = loose
G = gravel, Co = concretions, s = stones

3.2.2: Soil chemical properties

The soil chemical properties of Mapping Unit I (Table 4.1) and Mapping Unit II (Table 4.2) are shown. The soils ranges from 4.80 to 6.00 (Table 4.1) indicating strongly acidic to slightly acidic (Table 4.2) while it is slightly acidic (.5.3 – 6.3). The organic matter ranges generally from medium to high at the topsoil but low in the sub-soil. Total N is generally low to medium (<0.15 to >) 0.20 % at the topsoil. Similarly, available P is generally medium to high 15 ≥ 25 mg/kg. Exchangeable cations are high as reflected in the high base saturation (>50 %) (Tables 4.1 and 4.2). The soils of Mapping Unit SUnit I are classified as Typic Kandi aqualfs (USDA) and correlated with Gleyic Luvisols (Loamic) (WRB). Similarly, Mapping Unit SUnit II are classified as Lithic Udorthents (USDA) and correlated with Eutric Cambisols (Loamic)WRB).

3.3 Environmental impact

Effect of land use changes can assume two dimensions: effects on the land on which the changes (estate development) is being implemented and on effects on other areas of land (off-site effects). The most likely significant localized effect is soil degradation which is multi-faceted, as highlighted below.

3.3.1 Decrease in organic matter content

Bush clearing and the use of heavy equipment to excavate the soil during construction works will lead to scraping and removal of top soil which contains medium to very high organic matter (1.84 –7.42 %). Related to organic matter depletion is general reduction in soil fertility because most of the soil nutrients are concentrated in the top soil as shown in Tables 3 and 4). Similar report was documented by (Chukwu, 2013) when he noted that the nature and amount of organic carbon produced after decomposition of litter depends on the dominating tree species present and the site characteristics of that area which regulate the physical and chemical properties of soil.

3.3.2 Soil sealing

Estate development means that some part of the soil will be sealed permanently and be lost for agricultural use. The change in land use means a reduction of agricultural land. These has a serious consequence for food production. However, social services/ infrastructural development is preferred for land use over food production.

3.3.3: Loss of soil biodiversity

Another consequence of soil sealing is the loss of soil life. Millions of micro-organisms in the soil are buried and as houses and macadamized roads are constructed.

1. *Soil erosion.*

Removal of the vegetative cover of the soil followed by pedoturbation (scraping of the soil) will destroy the soil structure, compact the soil and increase the erodibility potential of the soil particles. The consequence is accelerated soil erosion.

2. *Increased run off*

Because of the construction work and differential is soil slope, the rate of run off is likely to increase. This may aggravate soil erosion and flooding at the leeward (down slope), destruction of farm crops, etc.

3. *Siltation of streams.*

Some of the eroded soil particles could be uploaded in downstream leading to turbidity of the stream. At the extreme, small streams could be silted so much that aquatic life like fishes could be lost.

3.4: Mitigating measures to reduce adverse effects on the environment

This section outlines the broad measures that may be implemented to mitigate against soil erosion, nutrient decline, structural decline, acidity and salinity in the surveyed area

3.4.1: Nutrient decline

This problem could be partly overcome by implementing the following measures: retain vegetative cover through landscaping of parts of the building, planting some forestry trees as part of arboriculture to beautify the avenues/street layout. Establishment of home gardens, composting using household refuse that can serve as organic manure. Nutrient decline can also be prevented by adding fertilizers to replenish nutrients, particularly nitrogen, phosphorus and potassium. Establishment of plant species that have lower nutrient requirements; such as some indigenous plant species have lower nutrient requirements than exotic species can correct the challenge of declining soil fertility (Ikwa *et al*., 2013)

3.4.5: Structural decline and soil erosion

This may be mitigated through control of the movement of heavy vehicles and equipment over the soil, including restricting movement over non-essential areas; use of broad or multiple tyres or bulldozer type tracks which spread weight over a larger surface area. Minimize the degree of soil cultivation, e.g., minimum or zero tillage cultivation techniques should be applied where possible. Efforts should be made to stockpile topsoil into low, broad mounds and replacing as soon as possible to prevent excessive compaction and help with the retention of soil fauna; Application of organic matter such as leaf litter and manure and compost will improve the soil structure, biological activity, water-holding capacity and soil fertility

4.0: Summary and conclusion

A reconnaissance soil survey of the project site was undertaken using free survey method to provide a baseline soil data of the project site and environmental impact of developing the site for housing on the soil resource base. Two soil mapping units (SUnit I and SUnit II) were delineated and characterized in terms of morphological, physical and chemical properties and classified using USDA Soil Taxonomy and World Reference Base (WRB).

The environmental impact of the proposed project on soil was assessed. Sustainable soil management technologies to mitigate any adverse effect on the soil resource base and the environment were suggested. It is concluded that housing estate project, wildlife habitat, hunting areas, fish ponds, and other recreational facilities should be executed only when adverse effect on the environment is minimal.

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