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An Edaphological Approach to Biodiversity Conservation in Ikwuano Local Government Area (LGA) of Abia State: Implication for Agro-Technology Transfer

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Abstract

A soil survey of Ikwuano Local Government Area in Abia State, Nigeria was conducted using a combination of Participatory Rural Appraisal (PRA) and Free Survey Techniques (FST) with a view to understanding the physical environment as a basis for biodiversity conservation. Four soil mapping units, namely, *Ibe, Ibeobo*, *obolo* and *Ariolo* were delineated based on toposequence and lithosequence. Mapping unit *Ibe* was found to be hydromorphic, clayey and derived from alluvium and shale. Mapping unit I*beobo* occupies dissected plains threatened by morpho erosion, while mapping unit *Obolo* occupies gently undulating plains. *Ibeobo* and *Obolo* are coarse loamy soils derived from coastal plains sands. Mapping unit *Ariolo* is a nearly level plain with sandy or coarse loamy soils derived from coastal plain sands and alluvium. Good land husbandry practices, fishery, rice-fish culture and sloping agricultural land technology are recommended on appropriate soil mapping units. The paper recommends dissemination of these technologies through effective extension services and on-farm research in order to increase biodiversity and enhance biodiversity conservation in Ikwuano Local Government Area.

Keywords: Edaphology, Biodiversity, Conservation, Agro-technology Transfer.

Introduction

Soil is a natural resource and a habitat for plants, animals and micro-organisms. Consequently, misuse of the soil will reduce its productivity and engender genetic erosion. This necessitates the need for soil survey to understand the potentialities and limitations of any piece of land and to enhance its judicious management.

Previous soil studies in South-eastern Nigeria delineated Ikwuano LGA within broad soil groups: the Acid Sands (Doyne *et al.,* 1938). Ferralitic soils (Jungerius, 1964) and soil mapping unit 431 (FDALR, 1985). Information about soils of Ikwuano LGA is usually extrapolated from

the results of these macro soil studies. Edaphologial biodiversity conservation strategies based on results of such extrapolations are likely to engender loss of species.

This paper discusses the result of a soil survey executed in Ikwuano LGA to understand the physical environment for judicious management and dissemination of improved agro-technologies, to achieve higher genetic variability and save biodiversity in the area.

The Study Area

Ikwuano LGA is located about latitudes $5^0$24`-$5^0$30`N and Longitudes $7^0$32`-$7^0$37`E in the rainforest area of south-east agricultural zone of Nigeria. The L.G.A. covers about 310km^2 (Spotlight in Ikwuano Local Government, 1992), and comprises of Ariam, Ibere, Oboro and Oloko autonomous communities. The area is characterized by heavy precipitation of over 2,000mm per annum, mean minimum and maximum air temperatures of 22.3 and 31.0^{0}c, mean annual soil temperature of 28.8^{0}c and relative humidity ranging from 66-79%.

The vegetation of Ikwuano LGA is typical of the rainforest. Relatively thick natural forests and forest plantations of *Gmelina arborea* exist in Ibere. Some important cash crops in the area include cocoa (Theobroma *cacao*), oil palm (*Elaeis guineensis*), banana and plantain (*Musa spp*). Cassava (*Manihot esculenta*) and maize (*Zea mais*) are popular arable crops.

Methods of Soil Survey

During the reconnaissance survey of the area, the Participatory Rural Appraisal (PRA) approach, (Nebasa *et al,* 1995), was adopted to produce a base map used for the soil survey. Free survey method of soil survey was used at a sampling density of 1:64ha land at least 50m away from roads and foot paths to depth of 120cm whenever possible and described. Eight pedons were described and sampled following the procedures of soil conservation services (1984) and FAO-UNESCO (1988).

Soil samples were air-dried and analyzed for particle size distribution, pH, organic carbon, total N, available P and exchangeable cations as outlined in the Soil Survey Laboratory Methods Manual (Soil Survey Staff, 1992). Soil classification was based on the USDA Soil Taxonomy (Soil Survey Staff, 1990) and the FAO-UNESCO (1988).

Results and Discussion

Soil Mapping Units

Four soil mapping units were delineated based on toposequences and lithosequences (Table 1). They are *Ibe, Ibeobo, Obolo,* and *Ariolo*. The mapping unit names are coined to reflect dominant soils in the autonomous communities. For instance, mapping unit Ibe indicates soils that are dominant in Ibere autonomous community. Similarly, mapping unit *Obolo* shows that the soils are extensively found in Oboro and Oloko autonomous communities.

Table 1:
Soil Physiochemical Properties of Ikwuano Soil Mapping Units

Parameters	**Pedons**	***Ibe***		***Ibeobo***		***Obolo***		***Ariolo***	
		1	2	3	4	5	6	7	8
Sand(%)		48	42	74	75	77	72	86	85
Silt(%)		22	27	4	2	4	5	2	2
Clay (%)		30	31	22	23	19	23	12	13
pH(H_2O)		5.5	5.0	4.8	4.9	4.9	5.0	4.8	4.9
Total N(%)		0.17	0.15	0.13	0.12	0.12	0.12	0.08	0.7
Organic carbon (%)		1.88	1.70	1.38	0.85	1.37	1.38	0.84	0.80
Available P (Bray-2) (mg/kg)		7.75	6.88	25.8	19.3	25.5	32.5	20.0	14.0
Exchangeable cations (me/100g)									
Ca		2.0	1.79	1.00	0.90	1.00	0.99	0.75	0.72
Mg		0.53	0.59	0.51	0.49	0.47	0.61	0.37	0.31
K		0.32	0.21	0.07	0.07	0.08	0.12	0.06	0.6
Na		0.14	0.14	0.09	0.09	0.08	0.09	0.07	0.8
Exchangeable acidity		3.12	3.85	3.15	3.65	3.78	3.45	4.46	4.26
ECEC		6.44	6.58	4.82	5.18	5.20	5.25	5.70	5.70
Base Saturation(%)		46.1	41.5	34.5	30.5	30.1	34.2	20.5	23.4

*Mean values of 0-40cm depth.
ECEC = Effective Cation Exchange Capacity.

Mapping unit *Ibe* is about 42km^2, blouse-shaped and occupies a physiographic surface 30-61m above sea level. The soils are hydromorphic with clay loam to clay epipedon. Apart from available P which is low (<15mg/kg), total N, and exchangeable k and medium is high on the epipedon (Pedons 1 and 2) (Table 1). The parents materials are essentially Shale and Alluvium and are classified as Typic Paleudalfs (USDA): Gleyic Aerisol and Haplic Nitisol (FAO-UNSCO). This unit appears to be the richest in biodiversity because of long fallow periods of 3-7 years and the existence of relatively thick natural forests and forestry plantation.

Mapping unit *Ibeobo* is hat-shaped and occupies about 40km^2 on dissected undulating plains 61-91m above sea level. It is characterized by landlocked depression that suffer morpho-erosion (Nurdin, 1992), and fed by perennial springs. Morpho-erosion is a collective term for water-induced erosion characterized by landslides, gulley's, stream bank and road side erosion. The epipedons are sandy loam underlain by whitish mottled clay at about 120-180m depth. The soils are strongly acidic, different in N and K but medium to high in P (Pedons 3 and 4) (Table 1). The soils are derived from coastal plain sands. Soils at the crest and mid slope are classified as Typic kandiudults/Typic Palendults, while valley bottom soils are typic kandiaquults (USDA); Hoplic Acrisols and Gleyie Acrisols (FAO-UNESCO). Although mapping unit *Ibeobo* is the least disturbed in terms of farming activity, this units, has most likely suffered genetic erosion as soil and plants are washed away by morpho erosion.

Mapping unit *Obolo* is a staff-shaped gentle undulating plain about 100km^2 rising from 91-152m above sea level. The soils are low in N and K, but medium to high in P (Pedons 5 and 6)

(Table 1). The soils are derived from coastal plain sands and are classified as typic kandiudults and Typic paleudults (USDA); Hoplic Aerisol (FAO-UNESCO). Fallow period ranges from zero, in home-stead farms, to 3 years in distant farms. Ethnohistory suggests genetic erosion in indigenous crop species such as yam bean (*Sphenostylis stenocarpa*) and oil bean (*Pentaclethra macrophylla)* in these units.

Mapping units *Ariolo* is horse-shoe shaped with 0-2% slope. The soils are sandy and suffer multinutrient deficiencies as regards. N, P and K (pedons 7 and 8) (Table 1). They are derived from Alluvial sand and are classified as Arenic kandiudult and Arenic Paleudult (USDA); Hoplic Aerisol (FAO-UNESO). Fallow period in *Ariolo* is 3-5 years.

Biodiversity Conservation

Edaphological biodiversity conservation strategies suggested for the areas include integration of suitable crops and animal species into farming systems of the areas in relation to delineated soil mapping units. For instance, mapping unit *Ibe* is suitable for rice, sugarcane, aquaculture, and bio-Nfertilization of rice, and fish ponds with azolla. Mapping unit *Ibeobo* favours forestry, sloping agricultural and technology (SALT) and ethno-engineering structure to minimize loss of soil and plants through morpoho erosion. Similarly, mapping unit *Ariolo* is suitable for cashew plantation. Conservation tillage, incorporation of organic residues, judicious use of mineral fertilizers and plating of alley crops such as *Acio bateri* to improve and sustain soil fertility and productivity are recommended to increase genetic diversity and biodiversity conservation in the area.

Implications for Agro-technology Transfer

Adaptable plant and animals species should be introduced in the areas through on-farm research. Indiscriminate logging which is common in mapping unit *Ibe* should be discouraged. Extension agents should liaise with the local government authorities, to educate the villagers on the adverse effect of uncontrolled logging on the environment and influence them through village heads, age grades, women groups and town unions to formulate and implement graduated sanctions against defaulters. The villagers should be motivated and mobilized to participate effectively on soil conservation measures such as tree plantings, adopting of SALT etc., to check land sliding, gullying and roadside erosion on mapping unit *Ibeobo*. While improved varieties of crops should be introduced to increase genetic diversity in the area, local species should be included in the germsplasm of the National Root Crops Research Institute and the Michael Okpara university of Agriculture, both at Umudike.

In conclusion, effective extension services, good land husbandry practices, introducing plant species to discourage indiscriminate logging and uncontrolled bush burning are recommended to boost genetic diversity and check genetic erosion in Ikwuano LGA.

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