

## THE WETLANDS OF AKWA IBOM STATE: UTILIZATION AND PRESENT LAND USE PRACTICES

S. O. EDEM,<sup>1</sup> G. S. EFFIONG<sup>1</sup> AND G. S. UMOH<sup>2</sup>

1. DEPARTMENT OF AGRONOMY, FACULTY OF AGRICULTURE, UNIVERSITY OF UYO 2. DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION, FACULTY OF AGRICULTURE, UNIVERSITY OF UYO, UYO

### ABSTRACT

*Studies on the utilization and present land use of wetlands in Akwa Ibom State were conducted on three representative wetland soil types - Inland Valley, Flood Plain and Mangrove. All the Wetland types but one (Mangrove) are used for crop production. More than 80 percent of the farmers had farm sizes between 0.4 and 1.6 hectares. The wetlands are grossly under-utilized. Mixed cropping was the main cropping system. The present land use include dry-season vegetable and food crop production, rainfed lowland rice and raffia palm production, fishing, hunting and gathering. The soils have great potentials for agriculture with favourable characteristics of low bulk densities, coarse to medium texture, high effective cation exchanges capacity and high organic matter content.*

### INTRODUCTION

Akwa Ibom State is known to have one of the highest population density with a very limited land mass which is seriously threatened is a made up of upland and wetland and 70 percent of the labour force are engaged in peasant agriculture

Wetland is a sizable land area which is in a large part permanently or seasonally flooded for a considerable part of the year and which normally supports hydrophilic plants and animals (Ojanuga and Lekwa, 1984). According to Eshiett (1994), in these days of declining productivity from upland agriculture, there is a compelling need to expand arable cropping into the country's vast and hitherto little exploited wetland resources. Wetland soils are known to have great potentials for agriculture under appropriate management including flood control, drainage and fertilization (Ojanuga and Lekwa, 1984). Wetland soils could be used for dry season crop production (Ojanuga and Lekwa, 1984; Opuwaribo and Isirimah, 1984; Ibanga and Armon, 1992; Eshiett, 1994).

In spite of the various uses to which wetlands can be put, it has been observed that in Nigeria wetland soils are grossly under-utilized (Ojanuga and Lekwa, 1984). Similar observations have been made by Obi (1984); Moormann and Juo (1986) and Eshiett (1994). Soils wetness or flooding has been identified as a key feature that tends to limit or hinders all year round utilization of wetland soils for agricultural production (Ojanuga and Lekwa, 1984; Obi, 1984)

The objectives of this study are:

1. To assess current utilization of the wetlands so as to determine the present land use practices in the study area.
2. To assess the cropping system practices in the study areas.
3. To study some physical and chemical properties of the soils so as to determine their potentials for agriculture

### MATERIALS AND METHODS

Six sites, in three wetland types of Akwa Ibom State - Inland Valley, Flood Plain, and Mangrove Swamps were used for the study. The area lies between latitude 4°30' and 5°30' north and longitude 7°30' and 8°30' east. It has a tropical climate and is situated

within the humid coastal plains and the subhumid hinterland (SLUD - AK, 1989). The annual rainfall ranges from 2000 to 3000mm while annual temperature varies between 26 and 28°C.

Soils of Inland Valley and Mangrove are classified as Typic Tropaquept while those of Flood Plain are Aeric Tropaquept for Ikot Offiong and Typic Tropaquept for Nwaniba. The study sites were located in Ikpa and Nung Obong in Inland Valley; Ikot Offiong and Nwaniba in Flood Plain; and Ebughu and Ete in Mangrove.

In order to determine the utilization and present land use practices in the study areas, data were collected from wetland farmers. Fifty (50) respondents were randomly selected from each of the three wetland types considered. This gave a sample size of 150. The instrument of data collection was structured questionnaire. The data collected were supplemented with information obtained from AKADEP staff and local leaders. Descriptive statistics of percentage and frequency counts were employed in analyzing the data.

Particle size distribution was by pipette method (Black, 1965). Bulk density was by core method (Vomocil, 1965) using a core 10mm long and 8cm internal diameter. Exchangeable cations ( $Cs^{2+}$ ,  $Mg^{2+}$ ,  $K^+$  and  $Na^{2+}$ ) by extraction with INB KCl (unbuffered solution (Longanathan, 1984) - K and Na by flame photometer and Mg and Ca by EDTA titration. Exchangeable acidity by titration method (Juo, 1979). Organic matter by wet oxidation method (Walkley - Black, 1934) as described by Nelson and Sommers (1982).

## RESULTS AND DISCUSSION

### Utilization And Present Land Use of the Wetlands

In order to determine the utilization and present land use of the wetlands, field survey was conducted in the study areas using questionnaire and discussion with AKADEP staff, local leaders and farmers. Of the 150 questionnaire distributed, 118 were received. Based on the survey and analysis of the questionnaire, the following were revealed.

### Farmers knowledge of Wetland and their use for Agricultural Production.

The response of farmers to knowledge of the three wetland types - inland valley, Flood Plain and Mangrove is shown on Table 1. The respondents admitted knowing the three different types of wetlands of which Inland Valley and Flood Plain soils are used for agricultural production.

Table 1: Farmers Knowledge of Wetland Soils in Akwa Ibom State

Responses	Frequency	Percentage
Yes	118	100
No	-	
Total	118	

Source: Field survey, 1995

### Farm Size

The farmers fall under the small holders farm (Table 2). More than 80 percent of the farmers have farm sizes between 0.4 and 1.6 hectares. All the farmers practise subsistent farming. No large scale farming was identified in the study areas. In spite of the extensive land area in all the study areas only a small proportion has been put into effective use. This is in agreement with the observation of Ojanuga and Lekwa (1984).

Moomiani and Juo (1986) and Eshiett (1994) that in Nigeria Wetlands are grossly under-utilized.

**Table 2: Farm size**

Farm size	Number of Farmers	Percentage
0.4-0.8	23	19.49
1.2-1.6	76	64.41
2.0-2.4	17	14.41
Above 2.4	2	1.69
Total	118	

Source: Field Survey, 1995.

### Cropping System

All the farmers practiced mixed cropping (Table 3). This is in consonant with the practice of subsistent farming. Table 4 shows the crop combination per wetland type. This reveals that the areas are put large to arable crop production. As indicated earlier, the mangrove soils are yet to be used for agricultural production in the study areas.

**Table 3: Cropping System**

System	Frequency	Percentage
Mono cropping	-	-
Mixed cropping	118	100
Others	-	-
Total	118	

Source: Field Survey, 1995

### Present Land Use

In the study areas swampland farming began in Ikpa and Nwaniba sites in the late 1950s (DHV consul, 1994). Prior to this they were not used for crop production, but as a source of raphia palm and oil palm which were not cultivated

The swamps are made up of permanently flooded areas which are not suitable for crop production and shallower swamps. The shallower swamps are seasonally flooded and are used for production of agricultural crops. There are two cropping seasons in the swamp areas. The dry season from late November to early June and wet season from Late June to early November.

The existing land use patterns are the same in the two wetland types - Inland Valley and Flood Plain. Cultivation of arable and permanent crops are being practiced on these two wetlands. The Mangrove Swamps have not been put into crop production. The present land use include:

#### (a) Dry-Season Vegetable and Food Crop Production

The crops produced in the wetlands are shown on Tables 4 and. The crops were planted on flats after clearing the land when the floods have receded in November. The debris were burnt or used in making bunds especially where rice was cultivated. Two crops are possible within the season using local varieties, for example, cassava ("Eko Iwa") which matures within 4-5 months (DHV consult, 1994), cocoyam ("Osobo") which is planted in March and harvested in August

**Table 4: Crop combination per wetland Type.**

Wetland Type	Crop Combination
Inland Valley	Telfairia, cassava, Maize, Melon Cassava, Okra, pepper Telfairia, Cocoyam, Maize, Telfairia, cassava, Raphia Palm., cocoyam, rice, Okra, Pepper.
Flood Plain	Cassava, Okra, Pepper, Telfairia, Telfairia, cassava, Melon, Maize Maize, Cocoyam, Telfairia, cassava Raphia palm. Cocoyam, vegetable Rice, peper, Okra.

Source: Field Survey, 1995.

While immature plants are not dug up but are left in the ground to be harvested in the following December or January.

Vegetable such as Telfairia, pepper, okra, cucumber and other food crops such as maize, cassava, melon, beans are cultivated on the Flood Plains of the Cross River during the dry season. Of all the study sites, Ikot Offiong in Itu Local Government Area produces the highest number of vegetable namely Telfairia, Okra and pepper that are used in Akwa Ibom State and beyond.

(b) Rainfed Lowland Rice and Raphia Palm Production

Rice cultivation is not very popular among the farmers in the study areas. As a result only very few farmers are involved in the cultivation of swamp rice (Table 4 and 5).

**Table 5: Crop Yield/Revenue per Hectare**

Wetland type	DRY SEASON			WET SEASON		
	Type of crop	Yield per ha (ton)	Revenue per ha (=N=)	Type of Crop	Yield per ha (tone)	Revenue per ha (=N=)
Inland Valley	Telfairia	7.63	93550.75	Cassava	12.27	30981.6
	cassava	10.04	62740.37	Rice	1.44	21666.6
	Pepper	2.15	63584.91	Cocoyam	15.26	86117.6
	Cocoyam	15.87	67180.62	Cucumber	12.5	85000.0
	Cucumber	9.04	124960.0	Raphia	3323.4	241428
	Beans	3.6	27692.31	Palm	(litre)	
	Raphia	1500	9000.0	Okra	12.1	14135
	Palm	(litre)		Yam	11	132000.0
	Okra	8.98	120370.50	Maize	9.73	
	Melon	2.55	28333.33			
	Maize	7.27	45445.86			
Flood Plain	Telfairia	6.88	86404.15	Rice	1.85	
	Cassava	11.57	32514.29	Cocoyam	9.11	
	Pepper	2	6000.0	Raphia	1571.43	
	Cocoyam	9.16	73684.21	Palm	(litre)	
	Raphia	3200	24800.0			
	Okra	5.64	78181.82			
	Maize	7.14	7142.86			

During the field survey, it was gathered that some farmers in Ikpa experimented on swamp rice cultivation. Some of them were successful while others failed. Those that were successfully hired experienced rice growers from Ini as labour (DHV Consult, 1994). When these labourers left coupled with the expensive nature of the project, it was

abandoned. Most of these pieces of land have been put to the cultivation of raphia palm and vegetable crops.

Raphia palm is extensively cultivated in Ikpa and Nwaniba sites. This raphia palm plays an important role in the economy of the community because it provides building and fencing materials in the form of bamboos and mats as well as strong fibre for typing. It also provides palm wine which is often distilled into "Kaikai" (illicit gin) and these serve as traditional drinks that generate revenue for the people.

(c) Fishing

Fishing is an important economic activity in the study areas. It is carried out using diverse equipment such as fishing nets, hooks and conical valved basket traps ("Nsim"). The dug-out canoe is the main fishing craft. In swamps with raphia palm, fishermen string their nets in between the trees to catch fish during the wet season.

In some areas particular at Ikpa and Nwaniba holes of 20-30mm depth with width of varying dimensions are dug during the dry season. These serve as breeding area for fishes during the wet season when the areas is flooded. When the flood recedes during the dry season, the water in the holes is bailed out and fishes that were bred in these holes are harvested. Fish farmers are known to earn between ₦1,500 and expedition (DIIV Consult, 1994).

(d) Hunting

Wild animals are some to the resources of the swamp land and these are hunted all year round using single-barrel guns or den guns. Assorted animals such as antelope, grass cutter, including birds are hunted. A hunter can realize as much as ₦800 a night from the sales when an expedition is fruitful. Hunting, particularly in the night is carried out mostly in Ikpa and Nwaniba swamps. Interaction with the farmers during the field survey revealed that hunting does not yield as much income as fishing.

(e) Gathering

A lot of useful materials are gathered from the swampland. These include medicinal plants such as guava (used against diarrhoea), papaya (against constipation and to tenderize meat), the neem tree (against skin diseases and malaria) and garcinia kola (against coughing). Food, firewoods, building materials, oil palm and raphia palm are also obtained from the swampland. Swampland also provides different types of trees such as *Tectona Grandis* (Teak) that are sawn for timber. Sea foods such as periwinkle, auster, crabs and snails are particularly gathered from the Mangrove Swamp.

### Income Realized From The Use of the Wetlands

The cost of putting the wetlands into production and the revenue generated thereof are resented on Table 6 and 7 respectively. From Table 7 it could be seen that the farmers made reasonable returns. The yield per hectare of the cultivated crops, for example, cassava,

**TABLE 6: PER HECTARE COW OF PRODUCTION ON WETLAND**

Wetland type	Item	DRY SEASON		WET SEASON	
		Total Cost (=N=)	& Total Cost (%)	Total cost (=N=)	% Total cost (%)
Inland Valley planting	Land Preparation	9754.55	38.58	11689.72	40.56
	Planting	9754.55	38.58	3957.95	13.73
	Fertilizer Application	3559.09	14.08	6415.63	22.26
	Weeding	5926.56	23.44	3359.77	11.66
	Harvesting	2816.09	11.14	3398.30	11.79
	Total	3228.41	12.77	28821.37	
Total		25284.7		17107.39	
Flood plain	Land Preparation	4677.67	32.96	7176.67	41.95
	Planting	3033.33	21.37	3160.0	18.47
	Fertilizer Application	1800.0	12.68	1880.95	10.99
	Weeding	2466.67	17.38	2896.67	16.93
	Harvesting	2213.79	15.60	1993.10	11.65
	Total	14191.46		17107.39	

ranged from 10.04 to 11.57/ha for dry season in both Inland Valley and Flood Plain (Table 5) as against 8-28/ha given by AKADEP (Table 8). The yield was moderated

**TABLE 7: TOTAL COST AND REVENUE PER HECTARE OF WETLAND CULTIVATED.**

Wetland type	DRY SEASON			WET SEASON		
	Total cost per ha (=N=)	Total Revenue per ha (=N=)	Gross Margin (=N=)	Total Cost per ha (=N=)	Total Revenue per ha (=N=)	Gross Margin (=N=)
Inland valley	25284.7	65627.23	40342.52	28821.37	760580.40	472376
Flood Plain	14191.46	62069.48	47878.02	17107.39	33412.36	16304.97

**Physical And Chemical Properties of the Soils**

The soils have favourable characteristics for agricultural production. Soil bulk density, texture and chemical properties are among the soil characteristics that influence its productivity. These parameters are in a favourable state in the study areas (Appendix 2 and 3). Generally the soils have low bulk densities. The bulk density ranged from 0.40 to 0.60gcm<sup>-3</sup> with a mean of 0.27gcm<sup>-3</sup> with a mean of 0.47gcm<sup>-3</sup> in the flood plain soils while in the mangrove soils it range from 0.60 to 1.39gcm<sup>-3</sup> with a mean of 1.02gcm<sup>-3</sup>. This implies that soil compaction will be minimal, aeration will be enhanced and there will be easy root penetration for water and nutrients.

In accordance with FAO (1974) the soils are coarse textured (Nnig, Obong, and Ee Pedons), Medium textured (Ikpa, Nwaniba and Ebughu pedons) and fine textured (Ike Offiong pedon). Soils of these textures especially the medium texture are known to have reasonable proportion of water holding pores which are necessary for the supply of available water for plant use (Kandil et al., 1976; Eden, 1995). The texture is chemically

active. This will promote high exchange capacity of the soils, which will influence the fertility of the soils. With moderate exchange capacity as expressed by the effective cation exchange capacity (ECEC), the soils have great potentials for agricultural production. The mean ECC values for wetland types were 11.48, 16.0 and 12.54 meq/100g for Inland Valley, Flood Plain and Mangrove soils respectively. Though the ECEC is dominated by exchangeable acidity giving rise to the low pH of the soils, the high organic matter content of the soils will offset this. This is in line with the report of Davies et al. (1993) that in wetland soils with high organic matter content crops still do well at low pH relative to mineral soils. Also humic substances produced during the decomposition of organic materials are known to adsorb toxic cations resulting in their immobilization and detoxification (Woomer et al., 1994). Furthermore, organic acids from decomposing residues complex with aluminium (Al) in solution resulting in less toxic forms of Al in the soil solution without changing the soil pH (Bell and Besho, 1993; Woomer and Muchena, 1995). Organic matter content of the soils ranged from 4.31 to 21.05 percent with a mean of 12.59 percent in the Inland Valley soils while in the Flood Plain soils it range from 0.55 to 13.31 percent with a mean of 6.03 percent. In Mangrove soils it ranged from 0.46 to 8.81 percent with a mean of 3.20 percent.

Using silt/clay ratio (Appendix 2) the soils are made up of "Young" parent materials with low degree of weathering because they have silt/clay ratio above 0.15 indicative of the young age of parent materials (Van Wambeke, 1962) and above 0.25 indicative of the low degree of weathering (Asomoa, 1973). Therefore, the soils are likely to have weatherable minerals that will supply nutrients needed for plant nutrition and hence their high potentials for agricultural production.

## APPENDIX 1: YIELD OF SOME MAJOR CROPS IN AKWA IBOM STATE

	Crop	Yield (t/ha)	Remarks
1	Yam	8.5-12.5	Depending on management.
2	Cassava	8-28	Depending of management and variety.
3	Cocoyam	5-15	Depending on sett. Size and management.
4	Raffia palm	800-1200l/ha or 60 litre/day or 2145 litre/ha 300-80 litre/ha	Improved palm under swamp condition Under upland conditions
5	Planting bananas	5-5-12	Under improved practice 2.5 x 2.5 spacing
6	-do-	25 - 30	Under improved practice of 2.5x2.5m spacing
7	Cowpea	0.5-1 .5-2	Under farmer's condition Under improved practice
8	Rice	0.8-1.5 (paddy) 1.2-2.5 (paddy)	For upland Under swamp conditions
9	Maize	0.5-1.8 (Dry Grain) 1.9-3.7	For openly pollinated For hybrid maize, depending on agronomic practices
10	Tomatoes	(a) 6 (Fresh) (b) 15 (Fresh)	Under farmer's condition Improved management under rainfed condition
11	Onions	25	Under dry season crop
12	Okra -do	6-12 (Fresh Pods) 15-20	Farmers condition Improved condition
13	Pepper	0.45-1.0 (Fresh pepper) 1.45	Farmer's condition Improved practice
14	Carrot	6-10 (Fresh Carrot)	Improve management
15	Telfairia	1.7-2.5 (Fresh leaves)	Under mixed cropping.

Source: AKADEP, 1995



Appendix II: Particle Size Distribution, Textural Classes and Bulk Density of the Soils

Location	Wetland Type	Soil Sand cm	PARTICLE SIZE DISTRIBUTION %								Silt/Clay Ratio	Bulk Density G/cm <sup>3</sup>
			Course Sand	Medium	Fine Sand	Total Sand	Silt	Clay	Textural Class			
Lapa	Inland valley	0-20	0.6	0.9	45.5	47.0	41.0	12.0	L	3.42	0.40	
		20-40	0.4	0.8	66.8	68.0	29.0	3.0	SL	9.67	0.20	
		40-60	0.2	0.9	60.9	62.0	28.0	10.0	SL	2.80	0.10	
		60-80	0.6	0.4	58.0	59.0	30.0	11.0	SL	2.73	0.10	
		80-100	0.8	0.5	54.7	56.0	31.0	13.0	SL	2.38	0.10	
	Profile Mean		0.52	0.7	57.18	58.4	31.88	9.8				
Pang Obong	Inland valley	0-20	3.0	8.6	80.4	92.2	6.0	2.0	S	3.0	0.50	
		20-40	2.6	4.2	67.2	74.2	20.0	6.0	SL	3.33	0.35	
		40-60	1.1	1.3	78.6	81.0	15.0	4.0	LS	3.75	0.20	
		60-80	2.5	4.2	72.3	79.0	17.0	4.0	LS	4.23	0.10	
		80-100	3.1	2.4	80.5	86.0	11.0	3.0		3.67	0.60	
	Profile Mean Inland valley		1.49	2.42	66.49q	70.4	22.8	6.8			0.35	
Pang Obong	Flood Plain	0-20	1.0	1.8	19.2	22.0	39.0	39.0	CL	1.0	0.50	
		20-40	0.2	0.6	3.2	4.0	49.0	47.0	Silty	1.04	0.60	
		40-60	0.9	1.6	8.5	11.0	43.0	46.0	CL	0.93	0.90	
		60-80	0.8	0.5	1.6	12.0	47.0	41.0	Silty	0.15	0.90	
		80-100	1.1	0.9	9.0	11.0	44.0	45.0	CL	0.98	0.70	
		Profile Mean		0.82	1.08	10.1	12.0	44.4	43.6	Silty CI Silty CL		
Panda	Flood Plain	0-20	0.8	1.0	63.2	65.0	26.0	9.0	SI	2.89	0.15	
		20-40	0.5	0.7	51.8	53.0	37.0	10.0	SI	3.70	0.25	
		40-60	0.3	1.0	46.7	47.0	52.0	1.0	Silty L	52.0	0.25	
		60-80	0.9	0.8	60.3	62.0	33.0	53.0	SL	6.60	0.25	
		80-100	0.8	0.6	52.6	54.72	30.0	16.0	SL	2.54	0.20	
		Profile Mean		0.6	0.82	54.72	56.2	36.2	7.6			0.22
Purby	Mangrove	0-20	9.8	4.4	64.8	79.0	4.0	17.0	L	0.24	1.00	
		20-40	7.6	5.0	60.4	73.0	9.0	18.0	SL	0.50	1.01	
		40-60	3.6	3.2	58.2	65.0	17.0	18.0	SL	0.94	1.14	
		60-80	4.2	3.1	61.7	69.0	6.0	25.0	SL	0.24	1.29	
		80-100	5.0	1.2	68.8	75.0	5.0	20.0	SL	0.25	1.39	
		Profile Mean		6.04	3.38	62.78	72.2	8.2	19.6			1.17
Purby	Inland Valley	0-20	5.2	3.5	65.3	74.0	24.0	2.0	S	12.0	0.60	
		20-40	4.9	3.3	66.8	75.8	20.0	5.0	SL	4.0	0.70	
		40-60	4.2	5.9	68.9	79.0	18.0	3.0	LS	6.0	0.80	
		60-80	5.0	5.6	70.4	81.0	16.0	3.0	LS	5.33	0.90	
		80-100	3.6	4.9	78.5	87.0	11.0	2.0		5.50	1.39	
		Profile Mean Inland valley		4.58	4.64	69.98	79.2	17.8	3.0			0.88
		5.31	4.01	66.38	75.7	13.0	11.3			1.02		

Appendix 1.1: Some Chemical Properties of the Soils Studies

Location	Wetland Type	Soil Depth cm	EXCHANGEABLE CATIONS						EC/EC	pH (2.5)	
			Ca <sup>2+</sup>	Mg <sup>2+</sup>	K <sup>+</sup>	Na <sup>+</sup>	Al <sup>3+</sup>	H <sup>+</sup>		Water Wet	Dry
Ikpa	Inland valley	0-20	2.56	1.60	0.06	0.10	4.2	0.9	9.429	6.4	3.1
		20-40	2.88	1.28	0.02	0.08	16.35	1.4	22.01	6.5	1.7
		40-60	1.60	0.96	0.03	0.08	5.6	0.9	9.17	6.3	1.6
		60-80	1.92	0.96	0.03	0.08	14.10	1.4	19.19	6.4	1.5
		80-100	4.48	1.28	0.07	0.09	2.910	2.50	32.52	6.3	1.6
		Profile mean		2.26	1.22	0.04	0.09	13.01	1.42	18.46	6.4
Nung Ohong	Inland valley	0-20	0.96	0.32	0.02	0.09	1.30	1.30	2.99	6.4	4.1
		20-40	0.64	0.32	0.02	0.08	1.80	0.05	3.36	6.3	4.4
		40-60	0.64	0.32	0.04	0.08	1.60	0.55	3.23	6.5	3.5
		60-80	0.64	0.34	0.04	0.08	4.15	0.95	6.20	6.4	3.3
		80-100	0.76	0.52	0.03	0.08	4.44	0.71	6.73	6.4	3.4
		Profile Mean Inland valley mean		0.77	0.36	0.03	0.08	2.66	0.60	4.50	6.4
Ikot Offiong	Flood Plain	0-20	2.88	0.96	0.07	0.07	8.75	1.85	14.58	6.5	4.2
		20-40	2.24	1.28	0.05	0.10	9.45	1.90	15.02	6.6	4.8
		40-60	1.92	0.62	0.04	0.10	9.25	1.05	12.98	6.5	5.0
		60-80	2.88	0.96	0.05	0.10	5.15	0.80	9.94	6.6	5.3
		80-100	3.52	1.28	0.06	0.11	3.70	0.50	9.17	6.6	5.3
		Profile Mean		2.69	1.02	0.05	0.10	7.26	1.22	12.34	6.6
Nwaniba	Flood Plain	0-20	3.52	1.28	0.03	0.09	3.15	1.25	9.32	6.2	3.8
		20-40	1.92	0.64	0.03	0.08	19.80	1.20	23.67	6.5	2.3
		40-60	2.24	0.96	0.03	0.08	24.80	1.40	29.51	6.5	2.3
		60-80	2.56	1.28	0.02	0.09	13.20	1.20	18.35	6.4	1.8
		80-100	2.24	0.96	0.07	0.08	12.87	1.27	17.49	6.5	1.8
		Profile Mean Flood Plain Mean		2.50	1.02	0.04	0.08	14.76	1.26	13.67	6.4
		2.59	1.02	0.05	0.09	11.01	1.24	16.00	6.5	3.7	

Sample	0-20	0.96	0.56	0.02	0.07	1.90	0.65	4.16	6.2	2.4	1.97
	20-40	2.56	1.22	0.02	0.40	10.01	1.35	15.55	6.3	2.3	1.50
	40-60	1.60	0.61	0.02	0.30	5.40	1.30	19.26	6.4	2.4	0.49
	60-80	1.28	0.60	0.02	0.47	1.10	0.50	1.87	6.4	3.4	1.08
	80-100	1.60	0.62	0.02	0.28	1.80	0.15	6.77	6.5	2.9	0.46
Profile Mean	1.60	0.73	0.02	0.28	6.44	0.85	9.92	6.4	2.9	1.10	
Sample	0-20	2.24	1.20	0.03	0.26	0.08	0.02	1.81	6.4	4.6	8.81
	20-40	2.24	1.10	0.03	1.65	16.90	1.20	21.12	6.5	2.3	7.99
	40-60	2.56	1.10	0.02	0.43	12.50	1.40	18.01	6.2	2.4	6.20
	60-80	3.20	1.96	0.03	0.40	13.0	1.30	19.89	6.4	2.4	2.06
	80-100	1.92	0.90	0.03	0.32	6.60	1.15	10.92	6.5	2.5	1.46
Profile Mean	2.43	1.25	0.03	0.61	9.82	1.01	15.15	6.4	2.8	5.30	
Sample	2.02	0.99	0.02	0.49	8.13	0.9	12.54	6.4	2.9	3.20	

## REFERENCES

Asomon, G. K. 1973. Particle Size and free iron oxide distribution in some latosols and ground water laterites of Ghana. *Geoderma* 10: 285-297.

Bell, L. C. and T. Besho 1993. Assessment of aluminium detoxification by organic materials in an ultisol using soil solution characterization and plant response. In: *Dynamics of organic matter in relation to sustainability of agricultural system*. J Wiley and Sons, UK.

Black, C. A. 1965. *Method of Soil Analysis*. Part 1. Am. Soc. Agron., Monograph No. 9.

Davies, D. B., D. J. Eagle and J. B. Finney, 1993. *Soil Management*. Farming Press Books and Videos, Wharfedale Road, UK.

DIV Consult 1994. Enyong Creek Swamp Rice Study. Stage 1 Report. Vol.1 Min Report, AKDEP.

Edem, S. O. 1995. The effect of soil texture and structure on water retention properties of alluvial soils of the Niger Delta area of Nigeria: Implication for food production. *Ibom J. Social Issues* 2: 94-109.

Eshiet, E. T. 1994. The Wetlands of Nigeria: Distribution, characterization and Traditional Land Use practices. 21<sup>st</sup> Anni. Conf. Soil Soc./ Nigeria, Uyo.

Ibanga, I. J. and M. N. Armon 1992. Report on the wetland Soils of Cross River State, Nigeria. Cross River Agricultural Development Project, Calabar.

Juo, A. S. R. 1979. *Selected Methods for Soil and Plant Analysis*. IITA Manual Series No. 1.

Kandil, M. F., M. E. Shawky, J. Abdel-Hodi and A. Fathi, 1996. Effect of Soil texture on the available water of some soils from Egypt. *Egypt j. Soil Sci.* 16: 153-161.

Loganathan, P. 1984. *A Laboratory Manual on Soil and Plant Analysis*. Rivers State University of Science and Technology, Port Harcourt, Nigeria.

Moormann, F. R. and A. S. R. Juo 1986. Present Land Use and Cropping Systems in Africa. In: A. S. R. Juo and J. A. Lowe (ed.), *The Wetlands and Rice in Sub-Saharan Africa*, IITA, Ibadan.

Obi, M. E. 1984. Physical properties of wetland soils. 21th Ann. Conf. Soil Sci. Soc. Nig., Port Harcourt.

Ojanuga, A. G. and G. Lekwa, 1984. Distribution, classification and use of wetland soils in Nigeria. 12<sup>th</sup> Ann. Conf. Soil Sci. Soc. Nig., Port Harcourt.

Opuwaribo, E. E. and N. O. Isirimah, 1984. Fertility and Management of wetland soils in Nigeria. 12<sup>th</sup> Ann. Conf. Soil Sci. Soc. Nig., Port Harcourt.

SLUS - AK 1989. Technical Report of the Task Force on Soils and Land Use Survey, Akwa Ibom State.

Van Wambeka, A. R. 1962. Criteria for classifying tropical soils by age. J. Soil Sci. 124-132.

Woomer, P. L., A. Martin, A. Albrecht, C. V. S. Resck and H. W. Scharpenzel, 1990. The importance and management of soil organic matter in tropics. In: P. Woomer and W. J. Swift (ed.) Biological Management of Tropical Soil Fertility. J. Wiley and Sons, U. K.

Woomer, P. O. and F. N. Muchena 1995. Overcoming soil constraints in crop production in tropical Africa. In: Y. Ahenkorah, E. Owusu-Bannoah and G. N. N. Doyinona (ed.) Sustaining Soil productivity in Intensive African Agriculture. Technical Centre for Agricultural and Rural Cooperation, ACP-EU (CTA), The Netherlands.