Effects of the Volta dam on the properties of two soil series in the Lower Volta floodplain in Ghana

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SUMMARY

Since the completion of the Volta dam, seasonal floodings of the Lower Volta floodplain have ceased, resulting in a drastic change in the soil environment. Post-dam modal profiles of Amo and Tefle series, in the floodplain, were analyzed and compared with the available pre-dam data. The objectives were to identify changes in the soil properties, and to classify the soils according to the USDA and FAO systems. The data showed that the *p*H of Amo series decreased from about 6.0 to 4.9 within the 0 - 100 cm depth; its exchangeable acidity, however, increased by 1.0 to 5.0 cmol (+)/kg. Organic matter content in the surface horizons of Tefle series decreased from 60 to 31 g/kg, and its structure improved from massive to blocky. These changes were caused mainly by the change in the moisture regimens of the soils. By the USDA Taxonomy, the Amo and Tefle series are Vertic Dystropept and Alic Dystraquert, respectively.

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RÉSUMÉ

AMATEKPOR, J. K.: *Les effets du barrage de Volta sur les propriétés des deux séries du sol dans la plaine inondable de la Basse Volta au Ghana.* Dès l'achèvement du barrage de Volta, les inondations saisonnières de la plaine inondable de la Basse Volta se sont terminées, aboutissant en un changement radical dans l'environnement du sol. Les profils modals d'après barrage des séries Amo et Tefle, dans la plaine inondable étaient analysés et comparés avec les données disponibles d'avant barrage. Les buts étaïent d'identifier les changements dans les propriétés du sol et de classifier les sols selon les systémes d' USDA et FAO. Les données révélaient que le *p*H des séries Amo diminuait d' environ 6.0 à 4.9 dans les limites de 0-100 cm en profondeur; toutefois ses acidités échangeables augmentaient par 1.0 à 5.0 cmol (+)/kg. Le contenu de la matière organique dans les horizons de surface de séries Tefle diminuait de 60 à 31 g/kg et ses structures amélioraient de massive en bloc. Ces changements étaient provoqués principalement par le changement dans les régimes d'humidité des sols. D' après la Taxonomie d' USDA les séries Amo et Tefle sont Vertic Dystropept et Alic Dystraquert, respectivement.

Introduction

Soils are a product of continual natural change. Their horizons are usually changed slowly such that for decades few or no changes may be identifiable. However, soils may change rapidly in response to drastic changes in their environment (Nikiforoff, 1953; Cline, 1961). In soil environments where there is alternation of strong reducing and oxidizing conditions, pedochemical weathering and transformation of silicate clays, especially smectites, may take place (Brinkman, 1970; Coleman, 1962). Well-drained upland loamy sand and sandy loam soils in the drawdown area of the Volta lake, which flooded seasonally, lasting from 5 to 20 weeks each year had practically all the smectite clay species in their profiles weathered within a pedologically short period of 5 years (Amatekpor, 1989).

Before the Volta dam was built, soils in the Lower Volta floodplain were liable to seasonal floodings by the Volta river during the peak of the rainy season (September - November) in the northern catchment area. Since the completion of the dam in 1965 for the generation of hydroelectric power, and the consequent regulation of the Lower Volta river flow, the seasonal floodings of the floodplain have ceased. This has caused a drastic change in the environment of soils in the Lower Volta floodplain.

The Amo and Tefle series are the most extensive soils in the floodplain. The total area of the Lower Volta floodplain is about 58 520 ha, 84 per cent of which is occupied by the Amo-Tefle soil association. The Amo and Tefle series were first studied during a reconnaissance soil survey of the Accra plains in the 1950s (Brammer, 1967). A detailed soil survey of the Kpong Pilot Irrigation Area, a small area in the northern part of the Lower Volta Floodplain, had earlier been carried out (Brammer, 1955). The findings of these surveys are the main sources of information on the spatial distribution, morphological, and physico-chemical properties of the Amo and Tefle series in the Lower Volta floodplain during the pre-dam period. Other soil surveys such as FAO (1963) and Kaiser Engineers (1964) also provided some information on the pre-dam properties of the two soil series. However, these useful pieces of information lack adequate analytical data to support modern classification of the soils.

After the Volta dam was built, several soil surveys, such as FAO (1971), Tate & Lyle (1978), Agyili & Tei (1980), Asiamah (1984), and Acres International (1985), were carried out in different parts of the Lower Volta floodplain to provide information on the irrigability of soils in the area. In spite of these surveys, adequate analytical data on the Amo and Tefle series are still lacking.

The construction of the Volta dam and the consequent cessation of seasonal flooding of the soils in the floodplain for over three decades has caused a drastic change in the pre-dam soil environment. This change probably caused some modifications in the pre-dam properties of the soils because soils change in response to changes in their environment. These modifications, if any, in the soil properties have to be investigated to provide the basic data on the present (post-dam) characteristics of the soils. This will facilitate the formulation of the appropriate soil management measures for sustainable crop production and other types of land use.

The main objectives of this study, therefore, were as follows:

i. To assess changes that might have occurred in the pre-dam properties of the Amo and Tefle series as a result of cessation of the seasonal flooding of these soils.
ii. To provide adequate analytical data for the classification of the soils according to the guidelines provided by the USDA Soil Taxonomy (Soil Survey Staff, 1994) and the FAO Legend (FAO, 1990).

Materials and methods

Location and characteristics of the study area

The study area is within the Lower Volta floodplain stretching from Kpong, south of the main Volta dam, to Ada on the Atlantic coast, and covers a distance of about 100 km (Fig. 1). The soils used in the study are the Amo and Tefle series which are developed from recent Volta alluvium. The alluvial materials have been transported from the whole Volta River catchment area which is composed mainly of Voltaian sandstones and shales. The floodplain falls within the coastal savanna ecological zone of Ghana where the annual rainfall ranges from about 1100 mm at Kpong to about 885 mm at Ada. The annual mean temperature is about 27 °C. Potential evapotranspiration is about 1600 mm per annum and the vegetation is savanna grassland with scattered trees and shrubs.

Field investigations

Three modal profiles each of the post-dam Amo and Tefle series were excavated. Four of the six profiles were excavated in the locations where Brammer (1955, 1967) and FAO (1963) described the pre-dam modal profiles of the two soil series, while the remaining two profiles were excavated in other parts of the floodplain where other workers described them (Fig. 1). This approach was to minimize, as much as possible, variability in soil properties which could affect comparison of the pre-dam and the post-dam characteristics of the soils. The soils were sampled and described according to the FAO guidelines for soil profile descriptions (FAO, 1977).

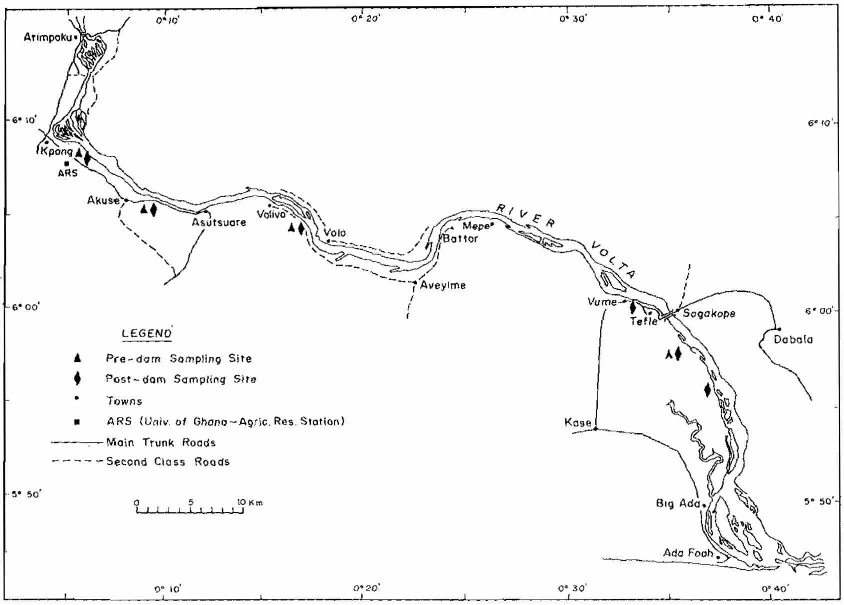

Fig. 1. Location map of the study area and the sampling sites.

Laboratory analyses

The post-dam soil samples were analyzed for as many properties as would make modern classification of the soils easy and also provide some basic data for soil management. Particle size distribution was determined by the pipette method (Klimer & Alexander, 1949). Soil *p*H was measured in water and in 0.01 M $CaCl_2$ solution at soil-water ratio of 1:1 and soil - 0.01 *M* $CaCl_2$ ratio of 1:2. Cation exchange capacity and exchangeable bases were determined by the NH_4OAc - *p*H 7 method (Soil Survey Staff, 1984). Exchangeable acidity (Al + H) was determined by neutral 1 *M* KCl method (Barnhisel & Bertsch, 1982). Organic carbon was determined using Walkley - Black wet oxidation method. Soil available phosphorus was extracted with a mixture of 0.1 *M* HCl and 0.03 *M* NH_4F solution, and total phosphorus extracted with a mixture of nitric acid and perchloric acid (Soil Survey Staff, 1984). The element was determined colorimetrically with spectrophotometer.

Results and discussion

General profile descriptions

Amo series. The post-dam Amo Series is a deep (>200 cm) soil ranging in texture from silty clay in the surface horizons to clay in the subsoil. This soil generally consists of 15 to 40 cm of dark brown (10YR 4/3) to dark yellowish brown (10YR 4/4) clay that has moderate, medium subangular blocky structure, and is sticky when wet and also has common vertical cracks when dry. Beneath this lies a 100 to 150 cm of light yellowish brown (10YR 6/4) clay, with yellow, white, and grey mottles. At 150-200 cm depth, the soil is underlain by structureless yellowish red (5YR 5/8) sand with prominent white and pinkish white mottles. The soil is strongly acid (*p*H 4.9-4.5) through the 0-100 cm depth. It, however, becomes slightly acid (*p*H 6.1 - 6.5) in the sandy horizon which underlies the solum in some areas.

Tefle series. The post-dam Tefle series is also a deep (>200 cm) soil ranging in texture from silty clay in the surface horizons to heavy clay in the subhorizons. This soil generally consists of 20-30 cm of dark brown (10YR 3/3) to dark greyish brown (10YR 4/2) silty clay or clay that has well-developed subangular to angular blocky structure and is very sticky when wet and has many vertical cracks when dry. Beneath this lies 150-200 cm of greyish brown (10 YR 5/2) to grey (2.5Y 5/0) clay with distinct yellowish brown, yellow, and black mottles. At about 200-220 cm depth, the soil is underlain by greyish brown (2.5Y 5/2) structureless sand. The Tefle series is extremely acid (*p*H 4.5 - 4.7) up to about 100 cm depth and then the *p*H rises to 6.9 in the sandy horizon which underlies the solum in some areas close to the Volta river channel.

Comparison of pre-dam and post-dam soil properties

According to Brammer (1967), Amo and Tefle series are geomorphologically different. The Amo series occupies almost level land between the sandy levee soil (Chichiwere series) on the high river bank , and the Tefle series on the bottom lands or the depressions of the floodplain. The Amo series thus occupies the transitional sites between Chichiwere and Tefle series, but sometimes it occurs extensively on broad low ridges in the wider sections of the floodplain.

The Tefle series, developed in the depressions, were flooded during the pre-dam times for long periods and remained moist for a greater part of the year. The seasonal flooding and waterlogging that prevailed before the Volta dam was built contributed much to the differences that existed between Amo and Tefle series.

Table 1 indicates the morphological data on modal pedons of post-dam (1996) Amo and Tefle series. Tables 2 and 3 show the post-dam physico-chemical data on Amo and Tefle series, respectively. Table 4 compares some pre-dam with post-dam properties of the two soils, compiled from different sources including the present study. Lack of adequate pre-dam data on these soils makes assessment of changes in some of the soil properties very difficult. Changes in some of the important properties of the soils were, therefore,

TABLE 1

Morphological Properties of Present (1996) and Post-dam Amo and Tefle Series

Soil series (classification)	*Horizon*	*Depth (cm)*	*Matrix colour (moist)*	*Texture*	*Structure #*	*Consistency† moist/wet*
a. Amo	Au1	0-5	10YR 4/3 (Dark brown)	Clay	1f gr	fr, sticky
(Vertic Dystropept)	Au2	5-15	10YR 4/4 (Dark yellowish brown)	Clay	2m sbk	fi, sticky
	Bw1	15-45	10YR 4/4 (Dark yellowish brown)	Clay	2m sbk	fi, sticky
	Bw2	45-70	10YR 5/4 (Yellowish brown)	Clay	2m abk	fi, sticky
	Bw3	70-110	10YR 6/4 (Light yellowish brown)	Clay	2m abk	fi, sticky
	Cg	110-152	10YR 4/2 (Dark grayish brown)	Sandy clay loam	2m abk	fi, sticky
	2Cg	152-200+	5YR 5/8 (Yellowish red)	Sand	sg	l, non-sticky
b. Tefle	Au1	0-5	10YR 3/3 (Dark brown)	Clay	2f gr	fi, v s
(Alic Dystraquert)	Au2	5-18	10YR 4/2 (Dark grayish brown)	Clay	2m sbk	fi, v s
	Au3	18-36	10YR 5/4 (Yellowish brown)	Clay	2m sbk	fi, v s
	Bw1	36-80	10YR 5/2 (Grayish brown)	Clay	2m sbk	fi, v s
	Bw2	80-135	10YR 5/1 (Gray)	Clay	2m abk	fi, v s
	Bw3	135-196	2.5Y 5/0 (Gray)	Sandy clay	2m abk	fi, v s
	Cg	196-225	2.5Y 3/0 (Very dark gray)	Clay loam	2m abk	fi, v s
	2Cg	225-236+	2.5Y 5/2 (Grayish brown)	Sand	sg	l, non-sticky

\# 1= weak, 2 = moderate, fgr= fine granular, fsbk = fine subangular blocky, msbk = medium subangular blocky, sg = single grain, m = massive.

†- vfr = very friable, fr = friable, l = loose, fi = firm, vs = very sticky.

TABLE 2

Analytical Data on Post-dam (1996) Amo Series (Vertic Dystropept)

Depth (cm)	% particle size distribution Sand 2.0-0.05	Silt .05-0.002	Clay <0.002 mm	pH 1:1 H_2O	1:2 0.01M $CaCl_2$	Organic carbon g/kg	Organic matter g/kg	Available P mg/kg	Total P mg/kg	N g/kg
0-5	26.9	32.1	41.0	4.9	4.3	17.8	31.0	7.50	69.04	1.1
5-15	18.7	33.5	47.8	4.8	3.7	11.5	19.8	3.50	61.92	1.1
15-45	10.0	31.0	59.0	4.9	3.8	6.4	11.0	1.20	42.72	0.7
45-70	14.9	27.5	57.6	4.8	3.9	4.9	8.4	0.70	46.32	0.6
70-110	46.3	14.5	39.2	4.7	4.3	0.7	1.3	7.13	20.96	0.6
110-152	57.0	10.8	32.2	4.8	4.2	2.2	3.7	1.20	27.68	0.4
152-200+	91.1	3.4	5.4	6.5	5.8	1.2	2.1	7.46	40.92	0.3

Depth (cm)	Exchangeable bases (cmol(+)/kg) Ca	Mg	K	Na	Sum bases	KCl extr. Al &H Al cmol(+)/kg	Al+H	CEC cmol(+)/kg	CEC NH_4OAc cmol(+)/kg	PBS	PBS NH_4OAc
0-5	8.2	0.1	0.43	0.25	8.98	0.95	1.30	10.28	24.0	87	37
5-5	6.4	1.6	0.24	0.24	8.48	3.55	4.15	12.63	22.0	67	38
12-45	6.7	1.8	0.14	0.37	9.01	4.75	5.45	14.40	29.2	62	31
45-70	7.1	3.8	0.14	0.59	11.63	3.90	5.25	16.88	18.4	69	63
70-110	4.9	2.1	0.09	0.72	7.68	1.30	1.70	9.38	19.2	82	40
110-152	3.8	3.2	0.08	0.72	7.80	0.60	0.70	8.50	18.8	92	41
152-200+	1.8	0.8	0.03	0.24	2.87	0.10	0.10	2.97	6.8	97	40

PBS = Percent base saturation (sum of cations)

TABLE 3

Analytical Data on Post-dam (1996) Tefle Series (Alic Dystraquert)

Depth (cm)	% particle size distribution Sand 2.0-0.05	Silt .05-0.002	Clay <0.002 mm	pH 1:1 H_2O	1:2 0.01M $CaCl_2$	Organic carbon g/kg	Organic matter g/kg	Available P mg/kg	Total P mg/kg	N g/kg
0-5	8.6	32.8	58.6	4.6	4.2	12.9	22.2	8.4	105.6	1.7
5-18	3.9	32.0	64.1	4.6	4.0	9.9	27.1	3.5	86.5	1.3
18-36	6.1	28.4	65.5	4.5	4.1	8.7	14.9	1.1	76.5	1.1
36-80	7.3	23.8	68.9	4.4	4.1	3.2	5.5	1.5	83.6	0.3
80-135	17.7	23.3	59.0	4.3	4.1	4.9	8.4	1.2	90.7	0.7
135-196	20.3	23.2	56.5	6.1	5.6	3.4	5.8	3.3	69.3	0.6
196-225	39.0	21.6	39.4	6.5	6.1	2.6	4.6	7.1	43.32	0.3
225-236	92.0	0.1	6.2	6.5	6.1	0.2	0.3	1.1	9.64	0.2

Depth (cm)	Exchangeable bases (cmol (+)/kg) Ca	Mg	K	Na	Sum bases	KCl extr. Al & H Al	Al+H cmol(+)/kg	CEC cmol(+)/kg	CEC NH_4OAc cmol(+)/kg	PBS	PBS NH_4OAc
0-5	10.0	5.4	0.32	0.48	16.20	1.7	2.25	18.45	32.4	88	50
5-18	10.6	2.6	0.16	0.45	13.81	3.5	4.45	18.26	32.4	76	43
18-36	8.8	3.4	0.21	0.52	12.93	4.2	5.05	17.98	30.0	72	43
36-80	11.6	2.4	0.13	0.88	15.01	2.7	3.05	18.06	20.8	83	72
80-135	7.6	7.8	0.11	1.28	16.79	0.1	0.1	16.89	28.4	99	59
135-196	10.6	7.4	0.11	1.09	19.20	0.1	0.1	19.30	29.2	99	66
196-225	8.4	3.6	0.09	0.63	12.72	0.1	0.1	12.82	21.2	99	60
225-236	1.0	0.8	0.03	0.17	2.00	0.2	0.2	2.20	2.6	91	76

PBS = Percent base saturation (sum of cations)

TABLE 4a

Comparison of Some Pre-dam and Post-dam Properties of Amo Series

Depth (cm)	Pre-dam Brammer (1955)	Pre-dam FAO (1963)	Post-dam FAO (1963)	Post-dam Asiamah (1984)	Post-dam Dorgbetor (1994)	Post-dam (1993)	Post-dam Amatekpor (1996)
Amo series: pH (H_2O)							
0-8	5.6	6.5	5.1	4.5	5.0	4.5	4.9
8-33	5.9	5.1	5.0	4.3	4.8	4.9	4.8
33-58	6.3	5.2	6.5	4.4	4.8	4.8	4.9
58-91	5.7	5.5	5.5	4.2	4.8	4.6	4.8
91-124	5.1	6.5	5.5	4.0	4.9	4.6	4.7
124-157	6.4	6.5	6.0	4.0	4.8	4.5	4.8
157-200	6.5	6.5	6.0	3.9	6.1	4.6	6.5
200+	-	-	-	-	-	5.6	6.5
Amo series: KCl Exch. Al + H (cmol(+)/kg)							
0-8	-	-	0.9	3.3	1.1	1.5	1.3
8-33	-	-	1.1	5.1	4.3	5.1	4.2
33-58	-	-	0.9	5.0	5.2	4.5	5.5
58-91	-	-	0.8	4.1	5.1	1.1	5.3
91-124	-	-	0.8	2.8	1.8	0.9	1.7
124-157	-	-	0.9	2.6	0.7	0.8	1.7
157-200	-	-	0.8	2.4	0.2	0.2	0.1
200+	-	-	-	0.1	-	-	-
Amo series: Organic matter (g/kg)							
0-8	31	27	32	30	31	32	31
8-33	17	10	11	11	18	15	20
33-58	10	05	09	7	1	6	11

assessed from the available data.

Table 4 shows that pre-dam Amo series was medium acid to slightly acid (*p*H 5.6 - 6.5), but the post-dam Amo series has become very strongly acid (*p*H 4.5 - 4.9). On the other hand, Tefle series which was very strongly acid (*p*H 4.5 - 5.0) during the pre-dam era has not shown any marked change in *p*H since the dam was built. Exchangeable acidity (Al + H) of the Amo series shows a drastic change in the upper 0-100 cm depth of the solum with values ranging from 1.0 to 5.0 cmol(+)/kg soil.

Morphologically, the post-dam Tefle series has shown a remarkable improvement in soil structure. Brammer (1967) described the pre-dam Tefle series as "grey, mottled, cloddy clays," or "massive clays" but the post-dam Tefle series has developed moderate to strong subangular and angular blocky structure throughout the solum, just like the Amo series (Table 1).

Regarding organic matter content of the pre-dam Tefle series, Brammer (1967) stated that most organic matter (OM) accumulated in the soil due to the prolonged sooding of this soil. Table 4 shows that the A1 (0-10 cm) and A2 (10 - 40 cm) horizons of the pre-dam Tefle series had 60 and 37 g/kg OM,

TABLE 4b

Comparison of Some Pre-dam and Post-dam Properties of Tefle Series

Tefle series	*pH (H_2O)*						
	Pre-dam			*Post-dam*			
Depth (cm)	*Brammer (1967)*	*FAO (1963)*	*FAO (1963)*	*Asiamah (1984)*	*Dorgbetor (1994)*	*(1993)*	*Amatekpor (1996)*
0-10	4.6	-	-	4.9	4.7	4.3	4.6
10-41	4.8	-	-	4.3	4.7	4.5	4.5
41-81	4.8	-	-	4.3	4.5	4.5	4.4
81-152	4.9	-	-	4.3	4.5	4.4	4.3
152-220	5.4	-	-	4.5	6.9	4.4	6.1
220+	-	-	-	4.3	6.9	6.9	6.5
	-	-	-	4.3	-	5.6	6.5
Tefle series	*KCl Exch. Al + H (cmol(+)/kg)*						
0-5	-	-	-	0.4	1.4	1.3	2.3
5-18	-	-	-	1.6	4.3	3.5	4.5
18-36	-	-	-	1.3	5.2	4.5	5.1
36-80	-	-	-	2.4	4.1	3.1	3.1
80-131	-	-	-	3.3	1.8	0.2	0.1
131-194	-	-	-	7.2	0.1	0.2	0.1
194-212	-	-	-	2.5	0.2	0.1	0.1
212+	-	-	-	-	0.1	0.2	0.2
Tefle series	*Organic matter (g/kg)*						
0-10	60	-	-	43	32	30	22
10-41	37	-	-	2	17	11	17
41-81	14	-	-	5	17	6	15

respectively; but all the available post-dam data showed considerable decrease in OM content of the Tefle series. The Al and A2 horizons of the post-dam Tefle series now have only about 31 and 11 g/kg OM, respectively. On the other hand, the pre-dam and post-dam OM contents of the Amo series do not indicate any significant change; both the pre-dam and post-dam Amo series have in their Al and A2 horizons (0 - 8 and 8 - 30 cm) about 31 and 12 g/kg OM, respectively.

The reasons for the changes noted in the characteristics of the two soil series could be many, but they are obviously due mainly to the drastic change in the moisture regimen of the soils. This was caused by the cessation of the seasonal flooding of the soils since the Volta dam was built some three decades ago. The strong acidity of the pre-dam Tefle series, which occupies the depressions in the floodplain and so remained waterlogged for long periods every year, could be due largely to the organic acids produced during the slow but certain mineralization of the accumulated OM, and to the oxidation of the mineralized nitrogen and sulphur to nitric and sulphuric acid, respectively.

The present (post-dam) extremely acid characteristic of the Tefle series could be due partly to the increased rate of oxidation of the sulphuric materials and the jarosite mottles in the profile, and partly to the pedochemical weathering or ferrolysis of the smectite clay species, resulting in the release of aluminium and other ions from the octahedral lattice edges of the clay minerals which upon hydrolysis would give equivalent diffusion of hydrogen ions. This is evident from the high concentration of KCl exchangeable acidity in the post-dam Tefle series. The increase in the acidity of the post-dam Amo series could also be due largely to the pedochemical weathering of the smectite clay species.

The drastic decrease in the OM content of the Tefle series is obviously due to the increased rate of oxidation of the OM which under the post-dam environmental conditions, has reached a dynamic equilibrium of about 30 g/kg characteristic of the surface horizons of most clayey soils in the coastal savanna ecological zone. The stable fraction of the mineralized OM has contributed to the improvement in the structure of the Tefle series from massive to blocky. Thus, by their present characteristics, the post-dam Amo and Tefle series have become quite similar in several properties, especially in soil reaction (*p*H), exchangeable acidity, organic matter content, and soil structure. Other soil properties, such as cation exchange capacity and percentage base saturation, however, do not indicate any marked changes and these need further investigations.

Classification of the soils

By its present morphological and physico-chemical properties, the post-dam Amo series can be classified as a Vertic Dystropept according to the USDA Soil Taxonomy (Soil Survey Staff, 1994), and as a Vertic Cambisol according to the FAO Legend (FAO, 1990). Although the Amo series has ceased to be seasonally flooded since the completion of the Volta dam in 1965, evidence of the pre-dam floodings still persists in the soil profile because of the prominent mottles in the lower horizons. However, chromas are now strong and the placement of the soil in an aquic suborder could be misleading for soil management.

The post-dam Tefle series, by its geomorphic position in depressions of the floodplain, still becomes waterlogged during the major rainy season but for relatively shorter periods compared to the pre-dam era. The grey colours especially in the lower horizons justify its placement in an aquic suborder. Judging from the post-dam characteristics, the Tefle series can be classified as an Alic Dystraquert according to the USDA Soil Taxonomy (Soil Survey Staff, 1994), and as a Glei-Dystric Vertisol according to the FAO Legend (FAO, 1990).

Conclusion

Since the Volta dam was completed in 1965, soils in the Lower Volta floodplain have ceased to be seasonally flooded as they used to be in the pre-dam era. This drastic change in the environment of the soils has caused some changes in the properties of Amo and Tefle series, the most extensive soil association in the Lower Volta floodplain. The Amo and Tefle series are geomorphologically different and so have differences in their pre-dam characteristics. Comparison of the pre-dam with the post-dam data showed that the post-dam Amo series, during the over three decades of no flooding, changed from slightly acid (*p*H 5.6 - 6.5) to strongly acid (*p*H 4.5 - 4.9), and exchangeable acidity (Al + H) increased by as much as from 1.0 to 5.0 cmol(+)/kg soil. The organic matter content of the surface soil of the Amo series, did not indicate any significant change.

The Tefle series, on the other hand, showed a drastic change in its surface soil organic matter content from about 60 to 31 g/kg. Structure of the Tefle series improved considerably, changing from massive to moderate/strong fine to medium angular and subangular blocky structure throughout the solum. Exchangeable acidity of Tefle series also increased, from about 1.4 to 7.2 cmol(+)/kg, but soil *p*H did not indicate any significant change in the 0-150 cm depth.

Thus, the post-dam Amo and Tefle series have become very similar in several characteristics, especially in soil reaction (*p*H), exchangeable aluminium, organic matter content, and soil structure. The reasons for these changes in the properties of the soils could be varied, but they are mainly due to the change in the moisture regimen of the soils, resulting in increased oxidation of soil organic matter and pedochemical weathering of the smectite clay species. By their present characteristics, the Amo and the Tefle series are classified as Vertic Dystropept and Alic Dystraquert, respectively, according to the USDA Soil Taxonomy. They are Vertic Cambisol and Glei-Dystric Vertisol, respectively, according to the FAO Legend. The overall changes noted in the characteristics of the two soil series call for innovative soil management practices that would enhance sustainable crop production.

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