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RICE YEILD AND CHANGES IN SOME SOIL PROPERTIES FOLLOWING SAWAH RICE MANAGEMENT SYSYTEMS IN AN INLAND VALLEY IN SOUTHEASTERN NIGERIA.

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INTRODUCTION

- Failures of Green Revolution in West Africa despite its success in Asia, are the inability to develop the abundant lowland valleys for Agriculture.
- The environmentally creative technology, or ecological engineering Technology, such as Sawah farming is not traditionally practiced in sub-saharan Africa.

- Sawah refers to a leveled rice field surrounded by bunds with inlet and outlet connected to irrigation and drainage canals.
- Irrigation and drainage without sawah farming technologies have proved inefficient, or even dangerous because of accelerating erosion.

OBJECTIVE OF THE STUDY

- Compare the influence of sawah and nonsawah water managements on the physico-chemical characteristics of the soil.
- Compare the influence of water management systems on rice grain yeild.

MATERIALS AND METHODS

- Treatments arranged in split plot in a Randomized Complete Block Design (R.C.B.D).
- Treatments include:
- F- NPK (20:10:10) fertilizer. Locally recommended rate for rice.
- PD-Poultry droppings
- RD-Rice husk dust

- RD + PD
- PD + F
- RD + F
- F + PD + RD
- CT-Control (No soil amendment)

FIELD LAYOUT



Spaces between plots and replications are bunds to maintain water levels in sawah plot while they are mere demarcations in non-sawah plots

Table 1: Some properties of the top soil (0-20 cm) before ploughing and amendment

Soil Property	Value
Clay %	10
Silt %	21
Total sand %	69

Textural class	SL
Gravimetric moisture content (%) at	
- 0.1 MPa (Field capacity) FC	27
 1.5 MPa (Permanent wilting point) PWP 	9.2
Saturated hydraulic conductivity <i>Ks</i> (cm h-1)	7.0
Bulk density Mg m-3	1.29
Total porosity %	51.2
Potassium (K)	0.11
Calcium (Ca)	3.0
Magnesium (Mg)	1.6

Cation exchange capacity CEC	5.06
Exchangeable acidity (EA)	1.8

Table 2: Nutrient concentrations (%) in the amendments

Property	Amendment			
	Poultry Dropping (PD)	Rice Husk Dust (RD)		
Р	2.55	0.49		
Ca	14.4	0.36		
Mg	1.2	0.38		
Na	0.34	0.22		
К	0.48	0.11		
С	16.52	33.72		
Ν	2.1	0.7		
C:N	7.9	48.2		
C:P	6.5	68.8		

Table 3: Effect of sawah system and amendments on soil organic carbon, Nitrogen and pH on 0-20 cm top soil

	1 st Year						
Amendment		Non-Sawah	l				
	OC %	N %	рН	OC %	N %	рН	
F	0.67	0.074	4.8	0.45	0.071	5.2	
PD	0.49	0.069	4.9	0.43	0.076	5.1	
RD	0.83	0.047	5.0	0.62	0.070	5.1	
RD+PD	0.55	0.062	5.1	0.63	0.061	4.8	
PD+F	0.49	0.49 0.070 5.2		0.48	0.051	5.2	
RD+F	0.76	0.76 0.062 4.8		0.62	0.082	5.1	
F+PD+RD	0.76	0.065	4.9	0.46	0.070	5.2	
СТ	0.76	0.055	4.9	0.47	0.057	5.1	
Mean	0.66	0.063	5.0	0.52	0.067	5.2	
LSD (0.05)	0.18	0.012	0.22	0.18	0.012	0.22	
LSD (0.05) Non-Sawah x Sawah OC			NS				
Non-Sawah x Sawah N			NS				
Non-Sawah x Sawah pH			0.13				

	2 nd Year							
F	0.68	0.056	4.5	0.54	0.065	4.8		
PD	0.72	0.061	4.4	0.92	0.056	4.6		
RD	0.72	0.065	4.4	0.91	0.056	4.8		
RD+PD	0.72	0.051	4.4	0.87	0.047	4.9		
PD+F	0.66	0.045	4.5	0.76	0.065	4.7		
RD+F	1.01	0.056	4.5	0.86	0.056	5.0		
F+PD+RD	0.69	0.061	4.4	0.65	0.057	4.7		
СТ	0.67	0.051	4.7	1.07	0.043	4.8		
Mean	0.73	0.056	4.4	0.82	0.056	4.8		
LSD (0.05)	0.22	0.006	0.20	0.22	0.006	0.20		
	LSD	(0.05)		NS				
Non-Sawah x Sawah OC								
Non-Sawah x Sawah N				NS				
No	on-Sawah	x Sawah p	H	0.07				

NS= non-significant

Table 4; Effect of sawah system and amendments on cation exchange capacity,percent base saturation and exchangeable acidity on 0-20 cm top soil

	1 st Year					
Amendment		Non-Sawa	ah		Sawah	
	CEC cmol/ kg	BSAT %	EA cmol/kg	CEC cmol/kg	BSAT %	EA cmol/kg
F	3.60	44.3	1.87	3.39	49.9	1.67
PD	3.79	49.2	1.93	4.82	66.9	1.53
RD	3.49	44.7	1.40	3.42	55.2	1.87
RD+PD	3.49	45.9	1.67	4.06	50.1	1.93
PD+F	3.09	56.8	2.00	3.37	49.1	1.93
RD+F	3.38	57.8	2.27	3.79	58.8	2.27
F+PD+RD	3.36	49.0	2.13	3.64	47.2	1.87
СТ	3.41	39.8	2.20	2.84	41.9	2.27
Mean	3.45	48.4	1.93	3.73	52.4	1.92
LSD (0.05)	0.56	14.2	0.44	0.56	14.2	0.44
LSD (0.05) Non-Sawah x Sawah CEC			0.03			
Non-Sawah x Sawah BSAT			NS			
Non-Sawah x Sawah EA				NS		

	1 st Year						
Amendment		Non-Sawa	h		Sawah		
	CEC cmol/kg	BSAT %	EA cmol/kg	CEC cmol/kg	BSAT %	EA cmol/kg	
F	3.60	44.3	1.87	3.39	49.9	1.67	
PD	3.79	49.2	1.93	4.82	66.9	1.53	
RD	3.49	44.7	1.40	3.42	55.2	1.87	
RD+PD	3.49	45.9	1.67	4.06	50.1	1.93	
PD+F	3.09	56.8	2.00	3.37	49.1	1.93	
RD+F	3.38	57.8	2.27	3.79	58.8	2.27	
F+PD+RD	3.36	49.0	2.13	3.64	47.2	1.87	
СТ	3.41	39.8	2.20	2.84	41.9	2.27	
Mean	3.45	48.4	1.93	3.73	52.4	1.92	
LSD (0.05)	0.56	14.2	0.44	0.56	14.2	0.44	
LSD (0.05) Non-Sawah x Sawah CEC			0.03				
Non-Sawah x Sawah BSAT			NS				
	Non-Sawah x	Sawah EA		NS			

Table 5: Effect of sawah system and amendments on bulk densityand total porosity of 0-20 cm top soil

	1 st Year				
Amendments	Non S	awah	Sav	vah	
	Bulk Density Mg m ⁻³	Total Porosity %	Bulk Density Mg m ⁻³	Total Porosity %	
F	1.29	51.4	1.46	44.9	
PD	1.45	45.8	1.15	56.7	
RD	1.12	57.9	1.20	54.4	
RD+PD	1.34	49.4	1.20	54.9	
PD+F	1.31	50.2	1.29	51.4	
RD+F	1.46	44.8	1.19	55.4	
F+PD+RD	1.25	52.7	1.32	50.4	
СТ	1.29	51.2	1.33	49.7	
Mean	1.31	50.4	1.27	52.2	
LSD (0.05)	0.14	5.9	0.14	5.9	
Non Sawah x Sav	wah Bulk density	0.03			
Non Sawah x Sav	Non Sawah x Sawah Total porosity				

	2 nd Year					
F	1.25	52.8	1.35	48.9		
PD	1.31	50.8	1.13	57.5		
RD	1.13	57.1	1.23	53.5		
RD+PD	1.27	51.9	1.18	55.7		
PD+F	1.30	50.6	1.23	53.5		
RD+F	1.45	45.3	1.13	57.0		
F+PD+RD	1.26	52.7	1.28	51.6		
СТ	1.27	52.1	1.28	51.7		
Mean	1.28	51.7	1.23	53.7		
LSD (0.05)	0.10	3.9	0.10	3.9		
Non Sawah x Sawah Bulk		0.026				
density						
Non Sawah x Sawah Total		1.12				
pore	osity					

Table 6: Effect of sawah system and amendments on moisture content at field capacity (FC) and wilting point (WP) of 0-20 cm top soil

	1 st Year				2nd Year	
Amendments		Non Sawah		Sawah		
	FC %	WP %	Ks (cm/h)	FC %	WP %	Ks (cm/h)
F	37.9	14.0	5.07	30.4	9.2	7.61
PD	24.8	7.2	5.34	40.4	15.5	12.9
RD	44.9	18.0	15.1	38.5	16.2	21.5
RD+PD	36.6	12.8	3.43	39.7	14.4	12.7
PD+F	40.5	15.3	21.3	36.9	14.2	4.80
RD+F	26.9	7.5	14.9	41.7	16.6	11.6
F+PD+RD	41.1	15.8	20.8	30.4	11.6	11.7
СТ	27.0	9.2	6.6	34.6	12.1	10.9
Mean	35.0	12.5	11.6	36.6	13.7	11.7
LSD (0.05)	NS	3.9	9.4	NS	3.9	9.4
Non Sawah x Sawah FC		NS				
Non Sawah x Sawah WP		NS				
Non Sawah x Sawah Ks		NS				

	2 nd Year					
F	41.9	16.3	6.16	35.6	14.1	10.8
PD	24.6	6.8	8.18	43.2	17.9	14.6
RD	45.4	18.7	19.0	38.5	14.7	25.7
RD+PD	35.7	13.4	6.36	38.7	14.5	14.4
PD+F	38.9	13.9	22.8	40.2	17.6	9.89
RD+F	29.9	10.1	15.6	39.5	16.8	13.5
F+PD+RD	37.2	12.9	24.14	31.2	11.1	19.3
СТ	27.0	7.7	7.29	35.3	13.9	12.6
Mean	35.1	12.5	13.7	37.8	15.1	15.1
LSD (0.05)	NS	4.38	9.6	NS	4.38	9.6
Non Sawah x Sawah FC		NS				
Non Sawah x Sawah WP		2.04				
Non Sawah x Sawah Ks		NS				

Table 7: Effect of sawah system and amendments on rice grain yield (t/ha)

Amendment	1 st Year		2 nd Year		
	Non-Sawah	Sawah	Non-Sawah	Sawah	
F	6.18	7.11	5.30	6.28	
PD	6.37	6.56	5.41	6.52	
RD	5.26	6.56	6.07	6.00	
RD+PD	5.45	5.96	4.81	7.96	
PD+F	6.44	6.65	5.55	7.30	
RD+F	5.31	6.11	6.15	6.45	
F+PD+RD	5.37	5.78	5.02	7.06	
СТ	4.59	5.23	4.26	4.68	
Mean	5.62	6.25	5.32	6.53	
LSD (0.050)	0.32	0.32	0.80	0.80	
Non-Sawah x Sawah		0.14		0.50	



Fig. 2: Relationships between organic carbon and rice grain yield in the first year

Fig. 3: Relationships between organic carbon and rice grain yield in the second year







Fig. 5: Relationships between CEC and rice grain yield in the second year

CONCLUSION

- The soils are loose, low in pH and poor in plant nutrient elements.
- Essential plant nutrients and CEC were improved upon in Sawah management within the period.
- Sawah managed soils reduced significantly the soil bulk density and increased the soil total porosity.
- Rice grain yield increased significantly with sawah system.

THANK YOU FOR LISTENING