

**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

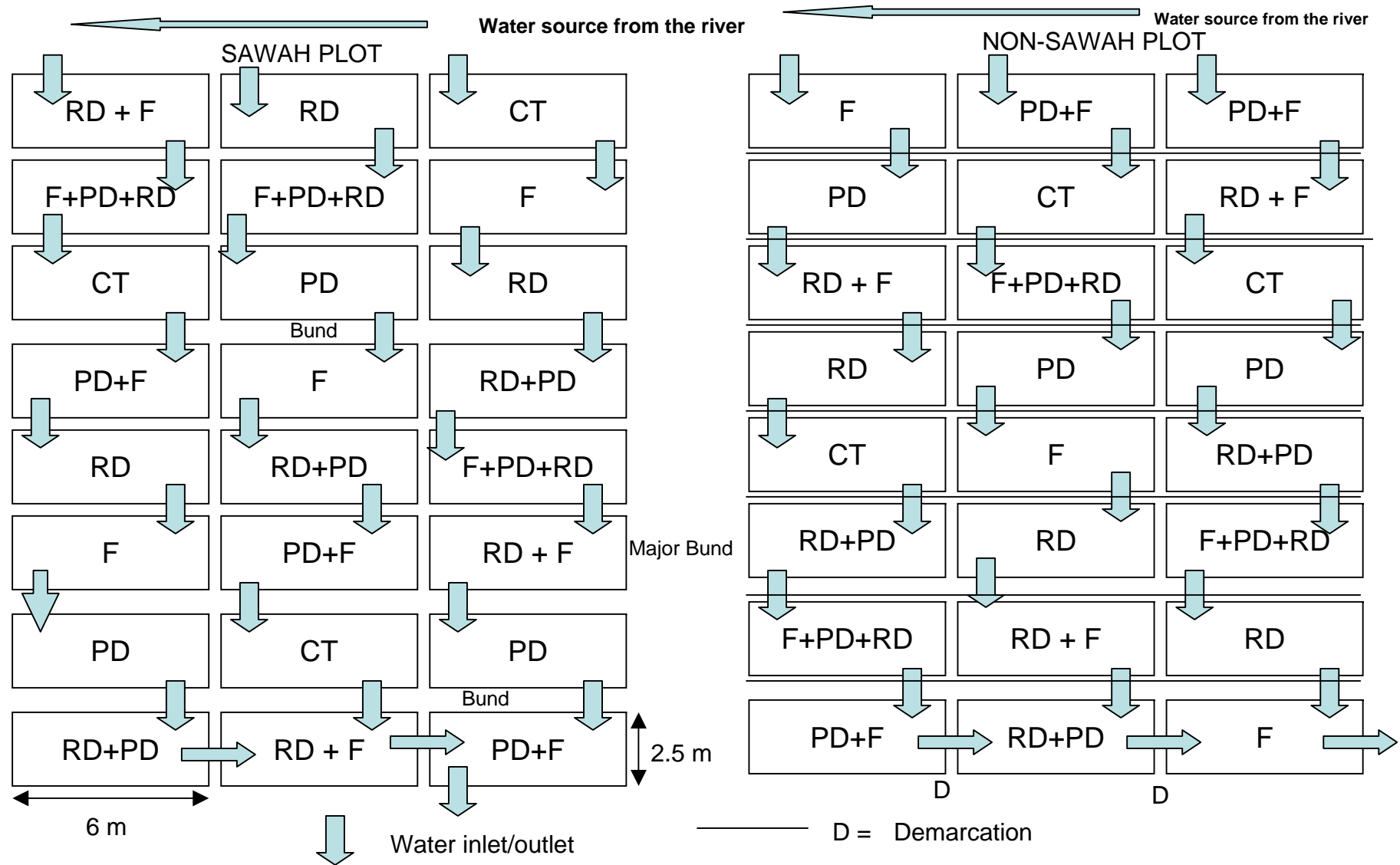
- Compare the influence of sawah and non-sawah water managements on the physico-chemical characteristics of the soil.
- Compare the influence of water management systems on rice grain yeild.

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>K_s</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)
P	2.55	0.49
Ca	14.4	0.36
Mg	1.2	0.38
Na	0.34	0.22
K	0.48	0.11
C	16.52	33.72
N	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			Sawah		
	OC %	N %	pH	OC %	N %	pH
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	0.070	5.2	0.48	0.051	5.2
RD+F	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
CT	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
CT	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) Non-Sawah x Sawah OC				NS		
Non-Sawah x Sawah N				NS		
Non-Sawah x Sawah pH				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

Amendment	1 st Year					
	Non-Sawah			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
CT	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-Sawah			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
CT	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 density and total porosity of 0-20 cm top soil

	1 st Year			
Amendments	Non Sawah		Sawah	
	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
CT	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 Sawah Bulk density		0.03		
Non Sawah x Sawah Total porosity		1.12		

	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
CT	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 density		0.026		
Non Sawah x Sawah Total porosity		1.12		

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			2 nd Year		
Amendments	Non Sawah			Sawah		
	FC %	WP %	<i>K_s</i> (cm/h)	FC %	WP %	<i>K_s</i> (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
CT	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 <i>K_s</i>		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
CT	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 K _s		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
CT	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

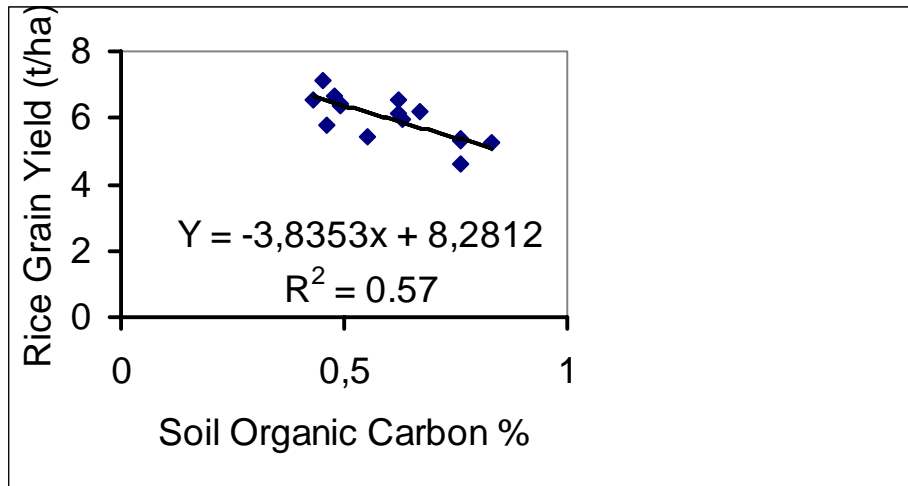


Fig. 2: Relationships between organic carbon and rice grain yield in the first year

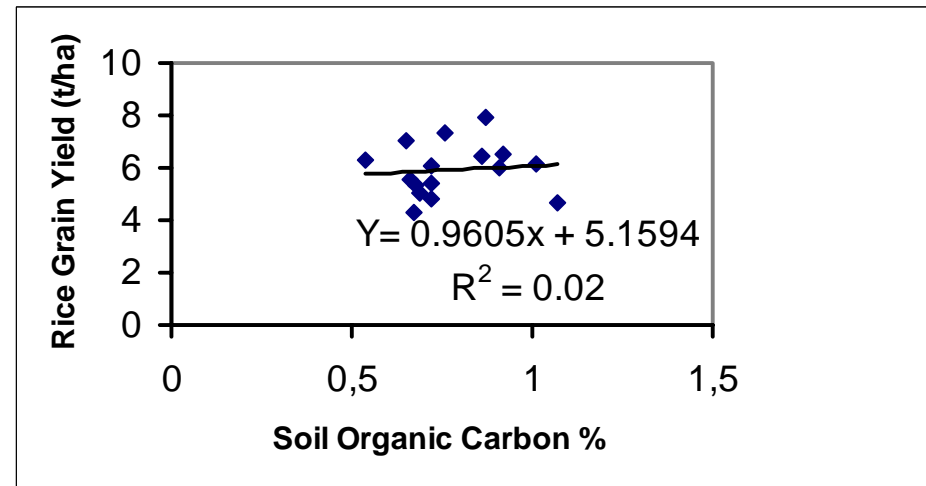


Fig. 3: Relationships between organic carbon and rice grain yield in the second year

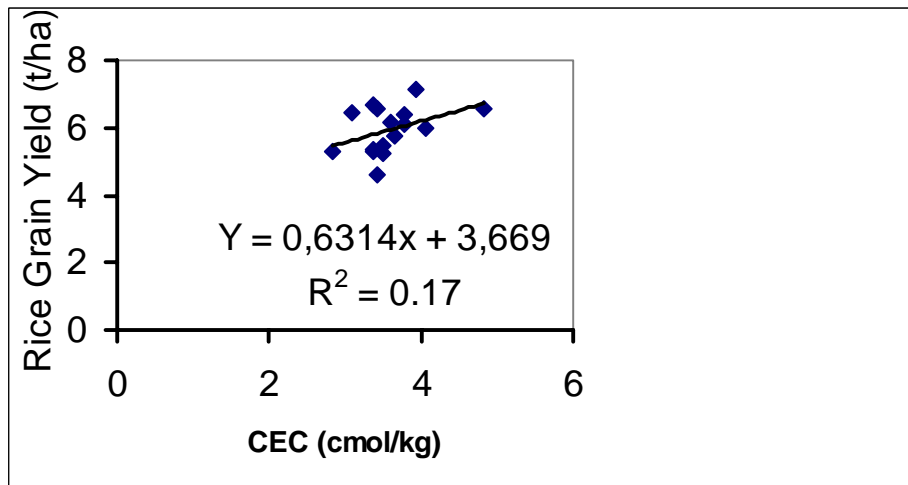


Fig. 4: Relationships between CEC and rice grain yield in the first year

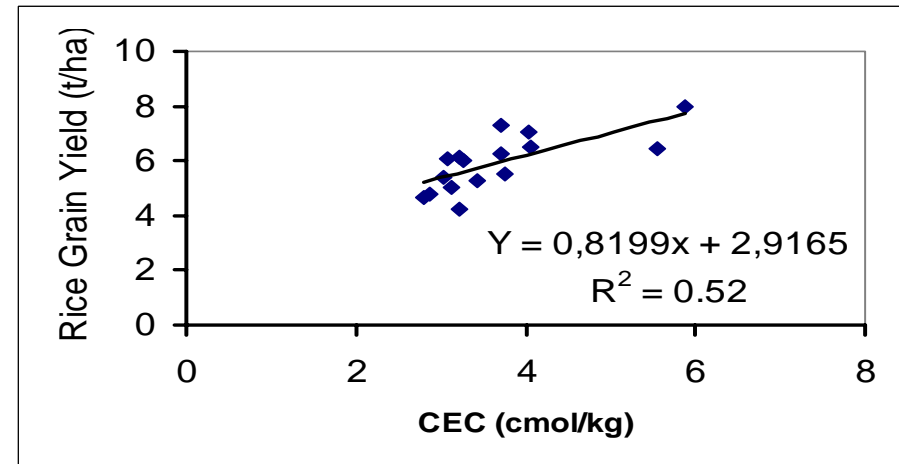


Fig. 5: Relationships between CEC and rice grain yield in the second year

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