Significance of microtopography in a Gleysol

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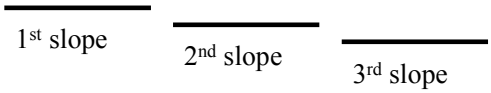
Abstract
A field-based study was conducted to assess the potential of a Eutric Gleysol (WRB 2006) in sustaining the cultivation of rice. The FAO (1983) frame work of land evaluation was used to assess the actual and potential suitability of the soils. Two varieties of rice, Tox 3108-56-4-2-2-2 and Thai Jasmine rice were cultivated. Tox 3108-56-4-2-2-2 had the highest number of spikelets but the least number of panicles, while Jasmine rice had the highest number of panicles, but the least number of spikelets. Slope 3 was best suited for the cultivation of rice by virtue of moisture content. The actual suitability of the soil was rated as marginally suitable (S3fct) with fertility (f), climate (c) mainly rainfall and topography (t) as the main limiting factors. The potential suitability was suggested to be highly suitable (S1) if fertility and moisture limitations were ratified.

Key Words
Gleysol, landuse, catenary sequence, rice.

Introduction
A catenary sequence represents a sequence of soils of about the same age, derived from similar parent material and occurring under similar climatic condition, but having different characteristics because of variation in relief and drainage (Brady and Weil 2002). A typical sequence of soils formed on slopes of between 0 and 10^0 underlain by sandstones, shales and conglomerates was studied. The soils at the toe slopes and the valley bottom may have a potential for rice cultivation due to the fact that they normally have heavy textures, slower organic matter decomposition and enjoy an influx of ions from the surrounding higher lands. Physically, these soils have good water holding capacity and reduced rate of infiltration and percolation of water.

Methods
Two varieties of rice Thai Jasmine rice and Tox 3108-56-4-2-2-2 were cultivated as mono crop at the School of Agriculture Teaching and Research farm at the University of Cape Coast, Cape Coast, Ghana. The ethno-pedological soils (Udu series) occur on slopes < 2%. The soils are poorly to very poorly drained, fine-textured. An area of 15 m by 6 m was demarcated and prepared for cultivation. Four experimental plots measuring 1.5 m by 15 m were laid out in a completely randomized design (CRD). Each plot was divided into three segments according to the gradient which has a drop of about 1 cm to 1.5 cm. Each plot was randomly seeded with the test crops in four rows at 30 cm between rows (Thai Jasmine rice on two of the plots and Tox 3108-56-4-2-2-2 on the remaining two plots). Below is the schematic representation of the contour of the surface soil.



Two of the rows on each slope segment were fertilized with 90 – 40 – 40 kg N, P_2O_5 and K_2O per hectare as urea (46%), single supper phosphate (20%, P_2O_5) and muriate of potash (60% K_2O) respectively at 42 days after planting. Weed control was done manually at 14 days interval. Rainfall was depended upon mainly as a source of water supply. Measurement started twenty eight days after crop emergence and continued every 7 days till harvesting. Growth parameters such as plant height, number of tillers, number of leaves per plant, days to 50% flowering and average height at maturity were monitored and measured. The yield parameters taken were, number of panicles per plant, number of spikelets per panicle per plant and number of tillers per plant. An area of 1 m^2 was harvested at each slope for biomass yield determination. Total above ground biomass were dried at a temperature of 60 – 80 ^{0}C for three days to obtain the dry weight. Evaluation for actual and potential suitability of the soil series was done using the Simple Limitation Method.

Table 1 gives the assessment of the soil and landscape characteristics. The major land characteristics used to classify the soils were: drainage, effective depth, slope, texture, sum of basic cations (0 – 25 cm), pH, organic carbon and apparent CEC.

Conclusion

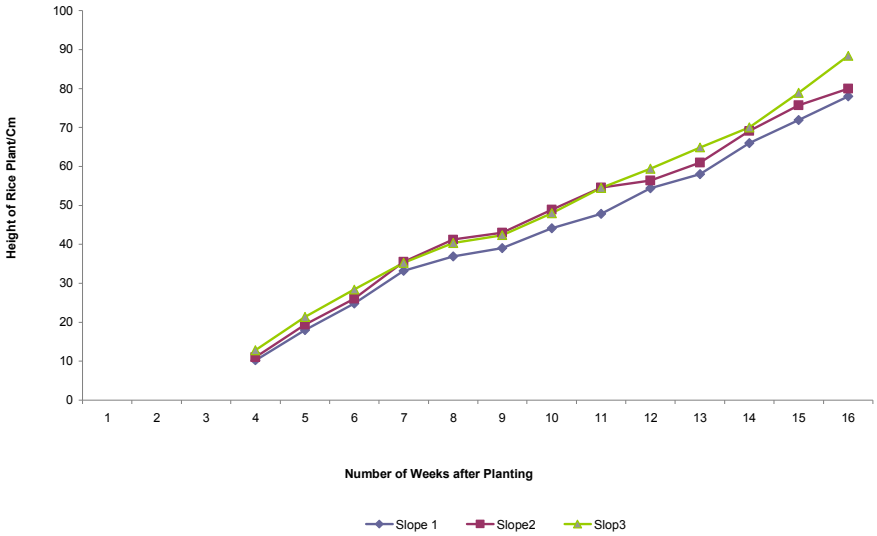


Figure 1. Effect of slope on the growth of Thai Jasmine rice.

The evaluation process was achieved by comparing land characteristics with the crop requirements. The suitability classes were determined according to the less favorable characteristics.

Table 1. Evaluation of landscape and soil characteristics.

Characteristics	Data	Suitability Classes
Topography (t)		
Slope %	0 - 2%	S1/S2
Wetness (w)		
Flooding	Seasonal	S1
Drainage	Imperfectly drained	S1
Physical soil characteristics		
Texture/Structure		
Coarse Fragment	Clay loam	S1
Depth	1%	S1
	100+	S1
Fertility characteristics		
ECEC ($cmol_c$/kg clay) (30 cm)	57.85	S1
Sum of basic cations (cmolc/kg soil)	6.86	S1
pH	5.23	S1
Organic carbon (%)	1.30%	S2/S3
Salinity and alkalinity		
EC ds/m		
ESP	0 ds/m	S1
Total landscape and	>10	S1
soil suitability rating for rice		
		S2/S3

The potential suitability of the ethno-pedological soil (Udu series) will be highly to moderately suitable for rice cultivation if fertility limitation is rectified by the provision of organic and inorganic fertilizers. However, in application, the type of fertilizer and time of application would need to be considered since these can have consequences for soil acidity, leachability and fertilizer solubility among others. Moisture and topography limitation could be ratified by the construction of bunds to collect water for irrigation or probably levelling the configuration of the land.

References

Brady NC and Weil RR (2002) 'The Nature and Properties of Soils'. 13th edtion. (Prentice-Hall: Upper Saddle River, NJ).

FAO (1983) 'Guidelines for land evaluation for rain-fed agriculture'. Soils Bulletin 52. (FAO: Rome).

World Reference Base for Soil Resources (2006) 'A framework for International classification, correlation and communication'. (FAO: Rome).