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GEODATABASE FOR SUSTAINABLE RICE PRODUCTION IN KWARA STATE, NIGERIA

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ABSTRACT
The challenge of increasing food production (including rice) has been the concern of the three tiers of government in Nigeria. This paper creates a geo-database to determine soil suitability for rice production at Duku-Lade rice production scheme in Kwara state Nigeria. Global Positioning System was used to reference soil sample points. Forty composite soil samples were systematically collected at two depths, 0-15cm and 15-30cm as top and sub soils respectively. Soil properties that are essential for rice yield were identified and tested for, using standard routine Laboratory procedures. The GPS data were stored in a relational database and the results of the Laboratory tests were linked to the map in GIS environment. Spatial analysis, queries and geographical search were conducted on the created database. The query and geographical search revealed that 9 soil properties were dominant in the area, they include sand, silt, organic carbon, organic matter and calcium others are magnesium, potassium, exchange acidity and base saturation. The soil characteristics also revealed that sand content was high, while total nitrogen and sodium content low. Twenty five percent of the soil properties were found to be inadequate for rice growth and development. It implies that 30 of the 40 soil sampled points were found to be suitable for rice cultivation based on the 3.0tons/ha bench mark of the Project co-coordinating Unit report. The study has showcased geo-database as an integral and essential tool for identifying and monitoring point to point information necessary for decision on rice cultivation. It therefore, recommends creation and regular updating of geo-database for farm managers in guiding rice farmers in their farming activity.

KEY WORDS: Rice, Production, Geo-database, Soil properties

INTRODUCTION
Producing enough rice to meet the local demand has been a great challenge and concern of the three tiers of government in Nigeria. For example, the nation, for a long time has been formulating policies and designing strategies for ensuring optimum quantity and quality of rice production. Government has been encouraging Nigerians to patronize locally grown rice and getting all stakeholders to work towards attaining the production target of self-sufficiency. But for the nation to be self-sufficient in rice production as contained in the Rice Farmers Association's 10-year rolling plan; "Target 2012 Grains Revolution", she should increase her production and compete with other rice producing countries. In the light of these, sustainable rice production should be the target, through identification of areas viable to foster yield increase. Rice, the seed of the monocot plants, requires adequate supply of nutrients to achieve the high yields necessary to feed growing populations. These nutrients come from soil. According to IRRI (2011), soils support life, and without soils, many of the world's living organisms cannot survive and thrive; including grasslands biome that harbour economically important plants such as rice that feeds more than half of the world's population. FAO (2010) reported that yield increases are the major source of food production growth, contributing about 80 percent of increased cereal production (including rice) in the developing countries as a whole. Therefore, timely and accurate detailed information on soil resources is required to achieve a sustainable rice production; this determines the capability of soil for current and future uses. Sustainability of rice production cannot be understood without some understanding of the chemistry of 'rice soils'. The fact is that inadequacy in soil fertility results in crop damages, retarded growth, and low yield. In addition, the composition of a particular soil is crucial to plant health. That is, how well the soil drains, its ability to retain organic materials, and accommodate plant's capability. As put forward by Olabode (2011), adequate information about these component parts of agriculture is a pathway to the scientific research based for sustainable agricultural development. Thus, the objective of the study is to adopt geo-database technique in Geographic Information System (GIS) to analyze soil for sustainable rice production to meet the demand in the country and for the country to be self sufficient.

CONCEPTUAL FRAMEWORK
Agriculture is a spatial activity with growing interest in placing site-specific information in a spatial and long-term perspective. According to National Research Council (NRC, 1997), precision agriculture requires models that calculate spatial variation in crop growth at a scale of meters and with a time scale appropriate for management decisions, often hours or days. This is a stage where Geographic Information System (GIS) is relevant and important. According to Burrough (1986), GISs have been in existence for almost three decades, but only in the last

10 years its applications have been widely used in agriculture and natural resource management. In the 1980s, the number of applications grew as a result of vendor-driven efforts to show the capabilities of GIS and vendors' perceptions which resulted into the development of these applications (Dangermond, 1991). Geographical Information Systems (GIS) facilitates the storage, manipulation, analysis, and visualization of spatial data. Most process-based agronomic models have examined temporal variation using point data from specific sites, which generated model outputs for site-specific management.

STUDY ENVIRONMENT

For the purpose of this study, Duku-Lade Rice Irrigation Scheme in Patigi Local Government Area of Kwara State was selected as the study area. This location is chosen because rice has been a major crop and larger proportion of the entire state production comes from the area.

Extent and Location

The study area is geographically located within the Latitude $5^0 80^1$ and $7^0 60^1$ North of equator and Longitude $4^0 60^1$ and $5^0 21^1$ East of Greenwich (Figure 1).

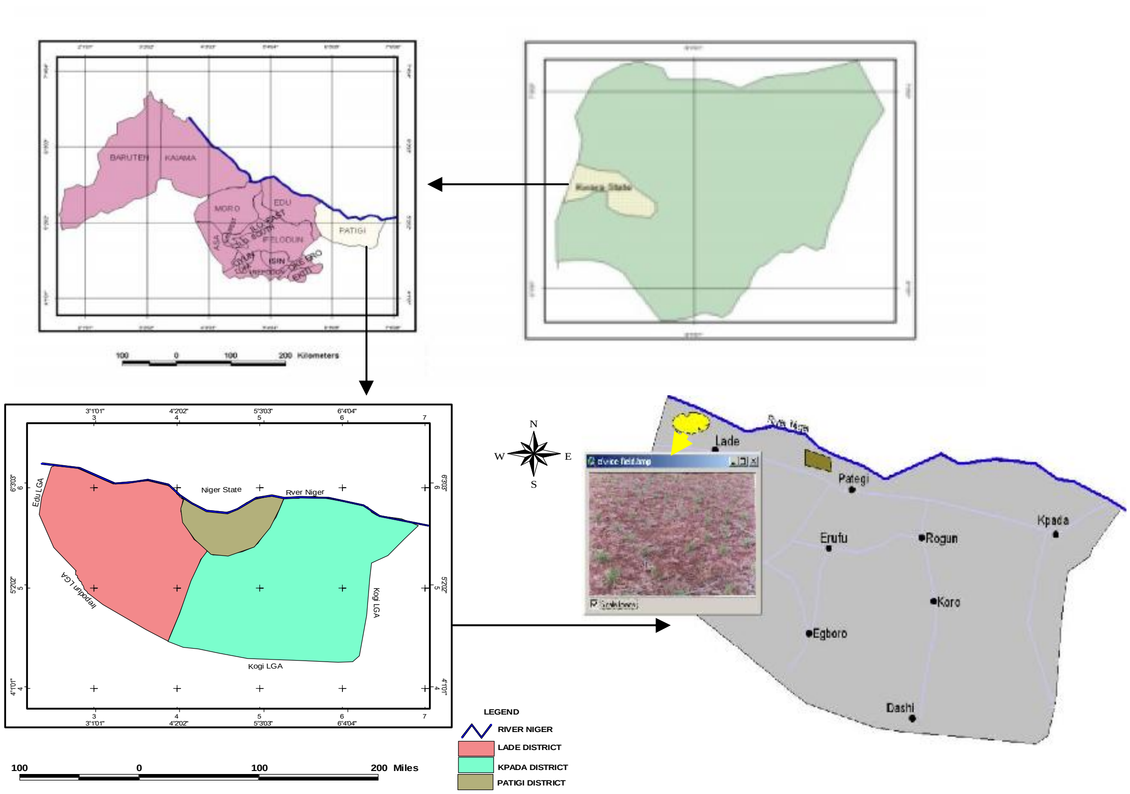

FIGURE 1: Study Area
Source: Ministry of Lands and Housing, Ilorin (2010)

The Local Government Area shares common boundaries with Niger State, Kogi State as well as Edu and Irepodun Local Government areas (figure 1). It has a total land area of about 2924.62km^2, which is about 5% of the total land area of Kwara State (www.kwarastate.gov.ng). According to Kwara State Agricultural Development Project (KWADP, 2007), approximately 25% of the land area of the Local Government is being used for farming activities.

Based on genetic soil classification system of Food and Agriculture Organization (FAO), there are three distinct soil types in Kwara State where the study area falls. These are ferruginous tropical soils, Ferrasols and Hydromorphic soils. Among the three soil types, Ferrasols and Hydromorphic tropical soils are the common soil identified within the study area. Patigi Local Government Area of the state is dominated by Ferrasols. They are deeply weathered red and yellowish brown soils with abundant free iron oxides but generally without a lateritic iron pan layer. The soils belong to the order of OXISOLS in American system taxonomy soil classification. The Hydromorphic soils are seasonally waterlogged soils. They are whitish or grayish in colour, an evidence of poor drainage, which reduces oxides in the soil. They are found in the valleys of most rivers and streams in the study area but widespread along the Niger River. Alluvial deposits were also found along the bank of river Niger. The climax vegetation was tropical deciduous forest but the influence of man, especially farming activities has turned it into dry woodland savanna, which is characterized by scattered trees and tall grasses. Because of topographic changes, rainfall differences and edaphic factors, some pockets of other distinct vegetation types were found within the study area. Various vegetation species contained here were; Raphia Palm (*Raphia Sardomical*), *eiba Pentandra*, and *Lannea Acida* among others (KWADP, 2007).

MATERIALS & METHODS

The study employed both primary and secondary data. Primary data involved field survey through which composite soil samples were collected from two depth; 0-15cm and 15-30cm, representing top-soil and sub-soil respectively. From each of the two soil layers, 40 composite soil samples were taken from the demarcated quadrats each measuring 100m x 100m on the Irrigated Rice Field. The Forty quadrats were selected systematically (at every other quadrant). In each of these quadrats, five soil samples were selected and composite sample was prepared for subsequent routine laboratory analysis. Coordinates of rice fields at Duku-Lade were identified using Global Positioning System (GPS), which were recorded in degrees, minutes, and seconds and later converted into Universal Traverse Mercator (UTM) for easy manipulations using Geographic Calculator (Blue Marble Geographic, 1994). The soil physical and chemical content were taken as the attribute data for the database creation and subsequent analysis. The database was subjected to spatial query and geographical search. These soil identifier charts contain values of each soil elements in a specific sample point. The soil status was categorized into three parts such that each level represents "low, medium and high". The database was queried for the level of soil properties

Database Creation

The GPS data generated were stored in a relational database; they which consist of core dataset (soil sample points and unique ID) to which the associated spatial data (X, Y, Z coordinates) stored in tables were linked. The attribute table created was linked to the map in GIS environment with the Universal Traverse Mercator Projection Coordinate System. The point coordinates of soil samples for the rice farms were imported into Arc view GIS through the Add Event Theme in the Theme Menu from the coordinates table generated in Notepad (as delimited text file). This imported GIS data were converted to dBase (dbf) for further editing.

RESULTS & DISCUSSION

The attribute data of each soil samples within the study location is presented in table 1. The table containes the coordinate points of all the soil properties with their respective rice yield and farm-size of the studied rice field. Generally, Geo-database is essential part of sustainable rice cropping because it is adequate for monitoring and managing soil nutrient for rice growth and development especially on location basis. This database, when properly updated, helps in identifying areas that is subject to excess or insufficient soil nutrients within the rice farm. This also helps in identifying soil nutrients requirement from point to point on a farm area with understanding of the soil's ability to supply needed nutrients to profitable crop production.

Point Locations of Soil Samples in the Irrigation Farm

Point map of the observed 40 soil sample locations was superimposed on the digital contour map of the irrigation site with their spatial reference positions within the study area (figure 2). The result show that is essentially indicates that the selection of the soil sample was spatially represented. The described spatial pattern suggests that soil properties in this area are mostly homogenous with exception of some minor heterogeneous distribution, which is generally significant to rice cropping; especially the nutrient distribution.

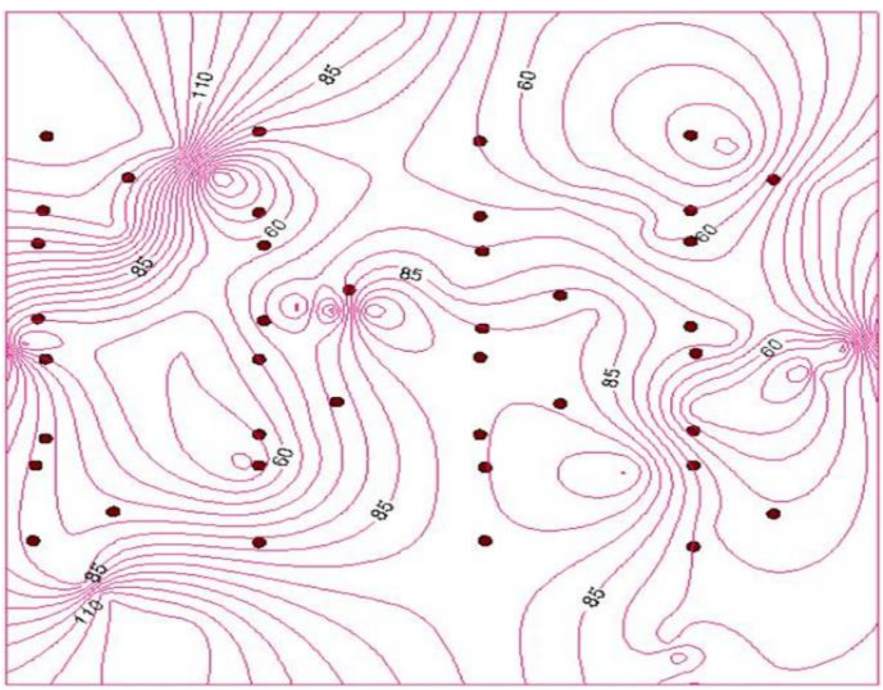

FIGURE 2: Contour Map of Irrigated Rice Field and Soil Sample Points
Source: Author's Survey, 2013

TABLE 1: GIS Database Showing Rice Field, Species and Some Soil Parameters

Shape	Id0	Rice Field	Species	pH (1:1)	Nitrogen (%)	OC (%)	OM(%)	Sand (%)	Silt	Clay (%)	Ca++
Polygon	Area3	Irrigated	Faro 52	5.60	1.40	0.86	1.48	83.52	8.00	8.48	5.00
Polygon	Area4	Irrigated	Faro 52	6.00	2.38	0.72	1.24	87.52	6.00	6.48	4.00
Polygon	Area5	Irrigated	Faro 52	6.10	2.10	0.54	0.93	85.52	8.00	6.48	5.60
Polygon	Area6	Irrigated	Faro 52	6.50	1.75	0.82	1.41	85.52	8.00	8.48	5.20
Polygon	Area7	Irrigated	Faro 52	5.60	2.03	0.54	0.75	83.52	8.00	8.48	4.00
Polygon	Area8	Irrigated	Faro 52	5.40	1.61	0.56	1.48	81.52	8.00	10.48	5.40
Polygon	Area9	Irrigated	Faro 52	5.60	1.54	0.55	0.70	83.52	10.00	6.48	6.00
Polygon	Area10	Irrigated	Faro 52	5.80	1.61	0.59	1.03	88.52	8.00	8.48	6.20
Polygon	Area11	Irrigated	Faro 52	6.00	1.40	0.69	1.20	79.52	10.00	10.48	6.00
Polygon	Area12	Irrigated	Faro 52	6.00	2.26	0.86	1.48	83.52	8.00	8.48	5.60
Polygon	Area13	Irrigated	Faro 52	5.80	1.57	0.88	1.50	81.52	8.00	10.48	5.20
Polygon	Area14	Irrigated	Faro 52	5.50	1.40	0.67	1.17	81.52	12.00	6.48	4.20
Polygon	Area15	Irrigated	Faro 52	5.50	1.68	0.45	0.79	81.52	10.00	8.48	4.00
Polygon	Area16	Irrigated	Faro 52	6.20	1.40	0.65	1.14	81.52	6.00	12.48	6.40
Polygon	Area17	Irrigated	Faro 52	5.00	1.75	0.75	1.30	81.52	6.00	12.48	4.80
Polygon	Area18	Irrigated	Faro 52	5.20	1.70	0.86	1.48	65.52	18.00	14.48	4.20
Polygon	Area19	Irrigated	Faro 52	5.10	1.45	0.62	1.06	79.52	6.00	14.48	3.60
Polygon	Area20	Irrigated	Faro 52	5.80	1.40	0.48	0.83	87.52	4.00	8.48	3.40
Polygon	Area21	Irrigated	Faro 52	5.60	1.26	0.85	1.48	81.52	4.00	14.48	3.20
Polygon	Area22	Irrigated	Faro 52	5.80	1.05	0.89	1.55	81.52	6.00	12.48	6.00
Polygon	Area23	Irrigated	Faro 52	5.80	1.19	0.72	1.24	71.52	16.00	12.48	5.60
Polygon	Area24	Irrigated	Faro 52	5.60	1.40	0.77	1.15	75.52	14.00	10.48	3.60
Polygon	Area25	Irrigated	Faro 52	5.50	1.75	0.67	1.11	71.52	20.00	8.48	4.00
Polygon	Area26	Irrigated	Faro 52	5.60	1.68	0.54	0.93	77.52	12.00	10.48	6.20
Polygon	Area27	Irrigated	Faro 52	6.00	1.26	0.61	1.40	81.52	10.00	8.48	4.00
Polygon	Area28	Irrigated	Faro 52	6.10	1.26	0.76	1.31	73.52	14.00	12.48	5.60
Polygon	Area29	Irrigated	Faro 52	6.50	0.98	0.34	0.58	77.52	10.00	12.48	6.40
Polygon	Area30	Irrigated	Faro 52	5.60	1.05	0.53	0.93	81.52	10.00	8.48	6.00
Polygon	Area31	Irrigated	Faro 52	5.40	1.33	0.67	1.17	81.52	6.00	10.48	6.80
Polygon	Area32	Irrigated	Faro 52	5.60	1.33	0.62	1.07	83.52	10.00	6.48	5.60
Polygon	Area33	Irrigated	Faro 52	5.80	1.26	0.69	1.20	79.52	8.00	12.48	4.40
Polygon	Area34	Irrigated	Faro 52	6.00	1.05	0.83	1.45	87.52	8.00	10.48	5.80
Polygon	Area35	Irrigated	Faro 52	6.00	1.40	0.73	1.27	77.52	10.00	12.48	6.20
Polygon	Area36	Irrigated	Faro 52	5.80	1.12	0.65	1.38	75.52	12.00	12.48	4.00
Polygon	Area37	Irrigated	Faro 52	5.50	1.26	0.67	1.40	73.52	12.00	14.48	4.80
Polygon	Area38	Irrigated	Faro 52	5.50	0.91	0.39	0.68	75.52	12.00	12.48	4.20
Polygon	Area39	Irrigated	Faro 52	6.00	1.40	0.83	1.45	81.52	6.00	10.48	4.00
Polygon	Area40	Irrigated	Faro 52	6.00	1.54	0.76	1.31	63.52	4.00	12.48	3.80

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TABLE 2: GIS Database showing other Soil Parameters, Yield and Field Coordinate

Mg++	Na++	K++	Acidity	AP (mg/kg)	CEC	BS (%)	BD g/cm3	WHC	Yield (tons)/GP	X	Y	Z
2.40	1.60	1.71	0.06	5.60	10.12	99.40	1.94	10.00	300	571.280	867.924	67
2.80	1.47	1.18	0.12	8.40	8.97	98.66	2.13	10.00	180	540.880	855.045	110
2.80	1.13	1.25	0.60	6.30	19.37	98.85	1.65	9.67	84	570.223	831.709	106
1.80	0.90	1.35	0.10	4.20	9.91	98.99	2.00	7.40	150	591.078	845.661	62
2.00	1.61	1.41	0.08	5.60	8.43	99.05	1.90	9.67	435	523.791	874.608	33
3.00	1.30	1.21	0.05	9.10	11.31	99.55	2.00	6.25	348	577.620	840.611	51
3.00	1.21	1.02	0.08	11.12	11.31	99.29	1.96	11.66	464	520.655	860.775	65
2.40	1.21	1.64	0.10	8.40	11.55	99.21	1.98	8.00	600	551.177	859.334	77
2.00	1.61	1.33	0.16	5.60	11.10	98.70	1.65	8.00	336	534.511	837.877	70
2.80	1.08	1.30	0.80	5.60	10.86	99.15	1.70	9.80	280	501.933	849.880	53
1.40	1.21	1.23	0.08	7.00	9.32	99.40	1.67	3.84	280	566.220	854.633	91
1.80	1.52	1.23	0.12	11.12	8.87	98.40	1.70	6.25	240	575.606	843.109	89
2.60	1.30	1.18	0.80	7.70	9.16	99.45	1.74	6.25	300	557.600	898.503	63
1.60	1.30	1.03	0.80	5.60	10.41	99.60	2.03	10.00	390	576.821	800.645	74
3.00	1.39	1.08	0.10	3.50	10.37	99.75	2.09	6.35	450	533.211	855.430	88
2.80	1.17	1.35	0.10	3.50	9.62	99.58	1.65	5.76	336	591.710	851.756	69
2.40	1.08	1.41	0.60	8.40	8.55	99.16	2.06	11.66	392	573.221	866.421	58
4.60	0.95	1.08	0.12	11.12	9.15	99.96	1.67	6.15	378	591.701	871.979	86
5.20	1.21	1.28	0.10	6.30	10.99	99.45	1.14	10.00	348	530.721	802.300	111
1.00	1.04	1.41	0.08	4.90	9.53	98.75	2.13	7.81	290	562.660	869.505	71
2.20	1.30	1.53	0.80	4.20	10.91	99.34	1.96	4.76	609	583.441	856.960	66
2.80	1.39	1.23	0.12	8.40	9.14	99.54	2.09	13.46	390	563.650	874.345	57
4.20	1.17	1.15	0.10	6.30	10.63	99.65	2.09	8.45	522	581.244	850.886	79
1.80	1.26	1.23	0.10	4.90	10.59	99.67	1.71	13.33	464	594.391	849.755	46
3.60	1.13	1.28	0.10	4.90	11.25	98.32	2.32	9.09	512	580.071	823.411	69
0.80	1.17	1.17	0.60	7.00	9.34	99.85	1.96	8.00	560	520.590	808.577	123
0.60	1.04	1.30	0.40	7.00	9.14	98.99	1.81	9.43	540	500.211	847.933	104
1.00	0.86	1.04	0.30	9.80	9.20	99.87	1.65	5.88	372	536.677	854.988	56
1.20	1.39	0.86	0.30	7.00	10.53	99.69	1.74	12.12	248	533.442	874.900	66
3.00	1.13	1.39	20.00	11.20	11.32	99.78	1.67	10.00	364	508.755	815.550	75
2.80	0.95	1.21	20.00	7.00	9.56	98.72	2.15	6.66	336	519.404	878.660	125
2.60	1.13	1.13	50.00	7.00	10.03	99.65	1.96	8.62	377	590.006	845.781	39
1.80	1.00	1.00	50.00	9.10	10.50	99.42	1.96	6.94	377	544.900	896.727	85
2.40	1.21	1.21	60.00	7.00	9.53	98.76	1.90	6.84	544	598.067	851.707	117
1.60	1.21	1.26	0.40	7.00	9.27	99.22	2.32	8.00	240	512.954	866.507	120
2.60	1.60	1.00	0.40	9.80	9.88	99.80	2.38	8.00	320	527.200	832.444	48
3.20	0.86	0.86	1.00	7.00	9.92	98.40	1.54	8.33	336	574.612	806.767	73
2.20	1.02	1.02	1.00	7.20	9.28	99.10	1.54	5.71	560	581.732	878.433	38

Soil Nutrient Status of the Irrigated Rice Farm

Figures 3, 4 and 5 are the result of the soil nutrients analyzed in Arcview software.

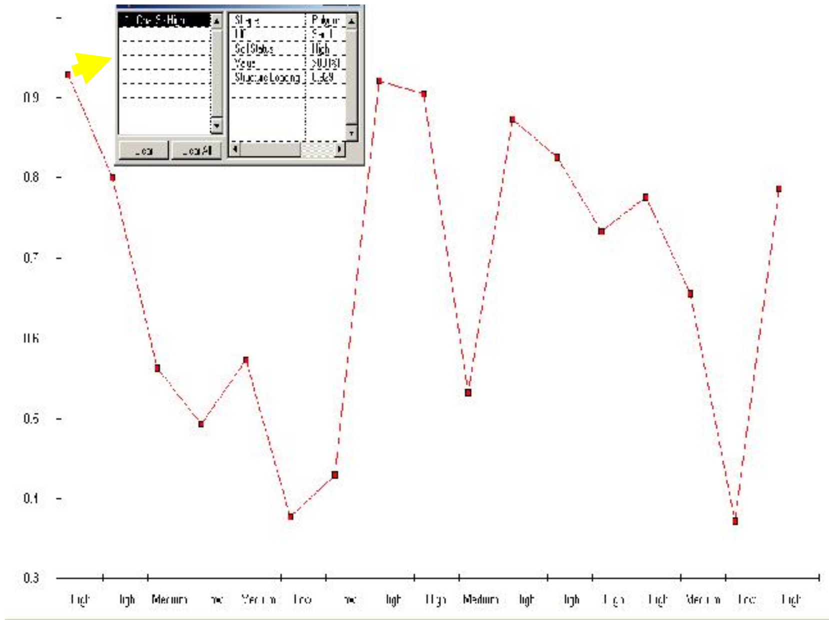


FIGURE 3: Sand Content of the selected Soil Sample

The level of sand, among other soil properties and within the selected point was high in the entire study area. This is indicated by the GIS 'identify result' located at the upper part of figure 3. Whereas, the Sodium content in the soil of this area was low (figure 4).

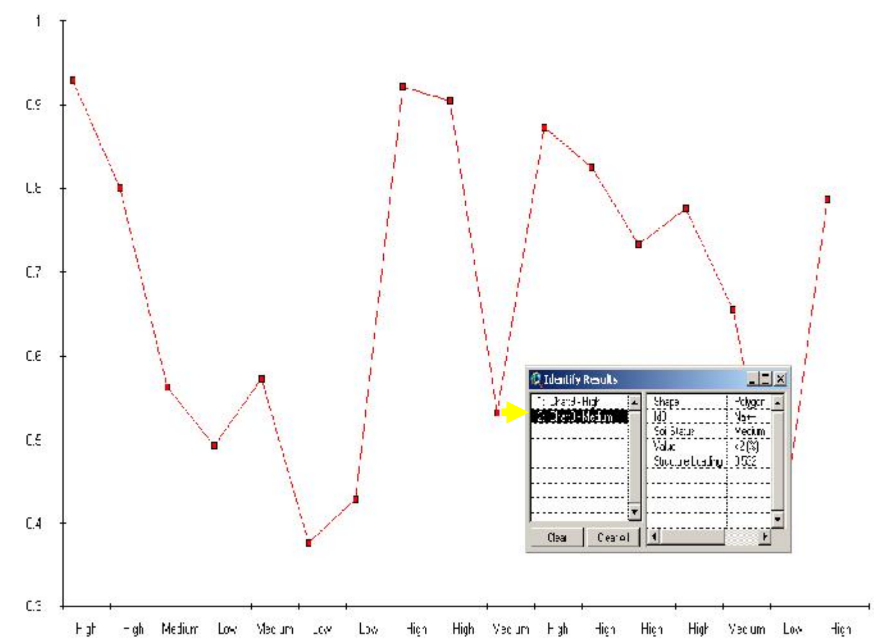


FIGURE 4: Content of Sodium for the Selected Soil Sample Point

Total Nitrogen in the soil of this area was equally found to be of low content. This is identified in figure 5, where less than 25 percent of the soil property was found inadequate for proper growth and development of rice.

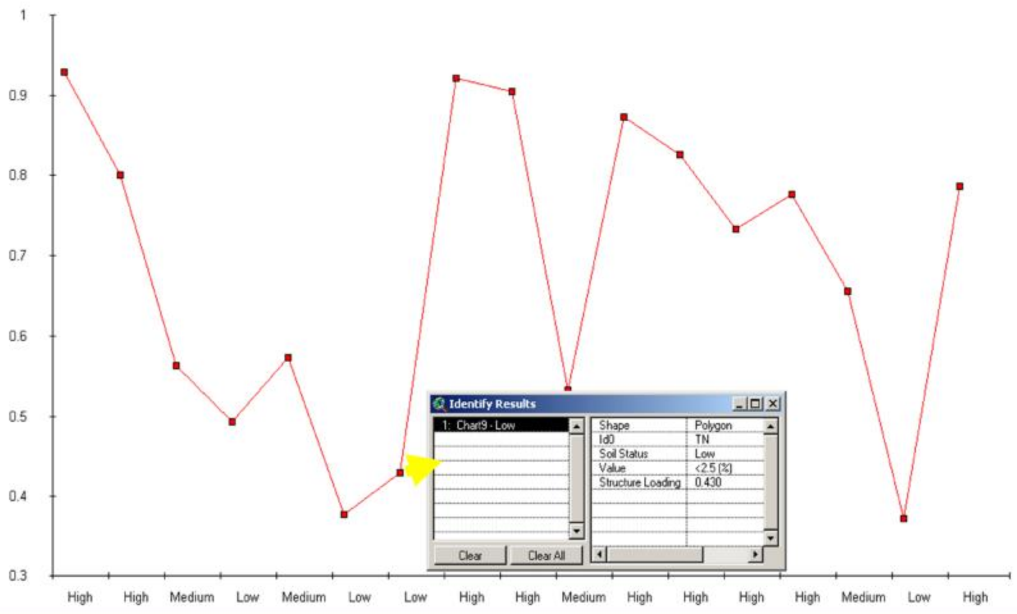


FIGURE 5: Content of Total Nitrogen of the Selected Soil Sample

Spatial Queries and Geographic Searches

The result of the queried database in table 3 shows that nine soil properties have high content, they include sand, silt, organic carbon, organic matter, calcium, magnesium, potassium, acidity, and base saturation. These are the dominant soil properties in this area (table 3).

TABLE 3: Nine Soil Properties with "High" content level

Shape	Id0	Soil Status	Value
Polygon	Sand	High	>80 (%)
Polygon	Silt	High	<30 (%)
Polygon	Clay	Medium	<15 (%)
Polygon	Bulk Density	Low	<3 (g/cm)
Polygon	Water Holding Capacity	Medium	<14(%)
Polygon	pH	Low	<= 6.5
Polygon	Total Nitrogen	Low	<2.5 (%)
Polygon	Organic Carbon	High	<1 (%)
Polygon	Organic Matter	High	<2
Polygon	Sodium	Medium	<2 (%)
Polygon	Calcium	High	<7 (cmol/k
Polygon	Magnesium	High	<5.0(cmol/
Polygon	Potassium	High	<2 (cmol/k
Polygon	Exchange Acidity	High	1 (%)
Polygon	Available Phosphorus	Medium	<12(cmol/k
Polygon	CEC	Low	<12
Polygon	Base Saturation	High	>90(%)

Attributes of Soilpoint analysispoly.shp

Fields: [Shape], [Id0], [Soil Status], [Value]

Values: "High", "Low", "Medium"

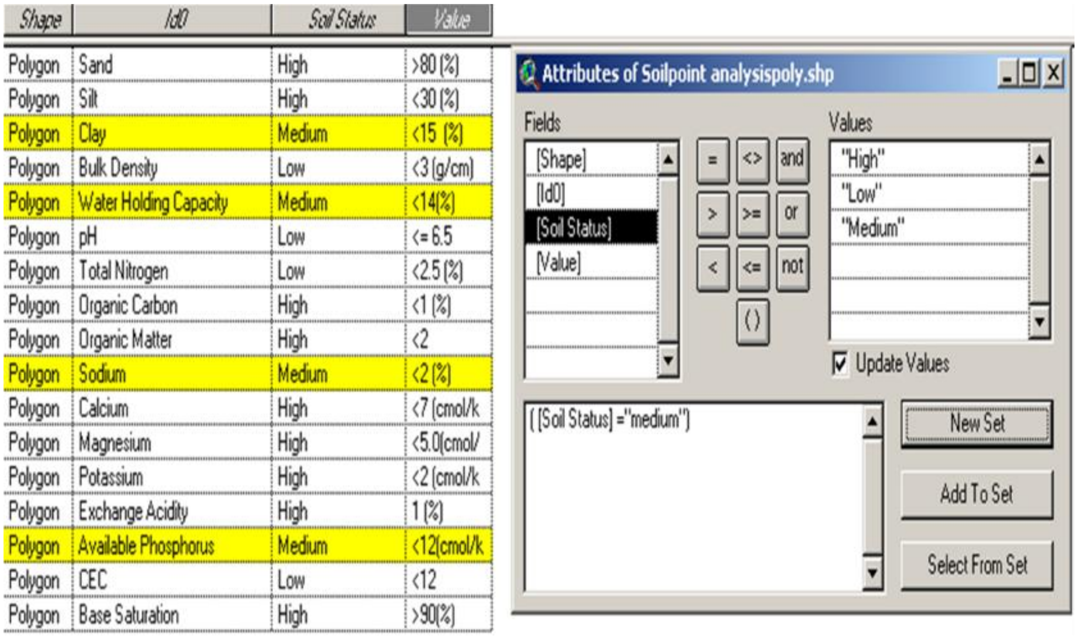
Update Values

([Soil Status] ="high")

New Set | Add To Set | Select From Set

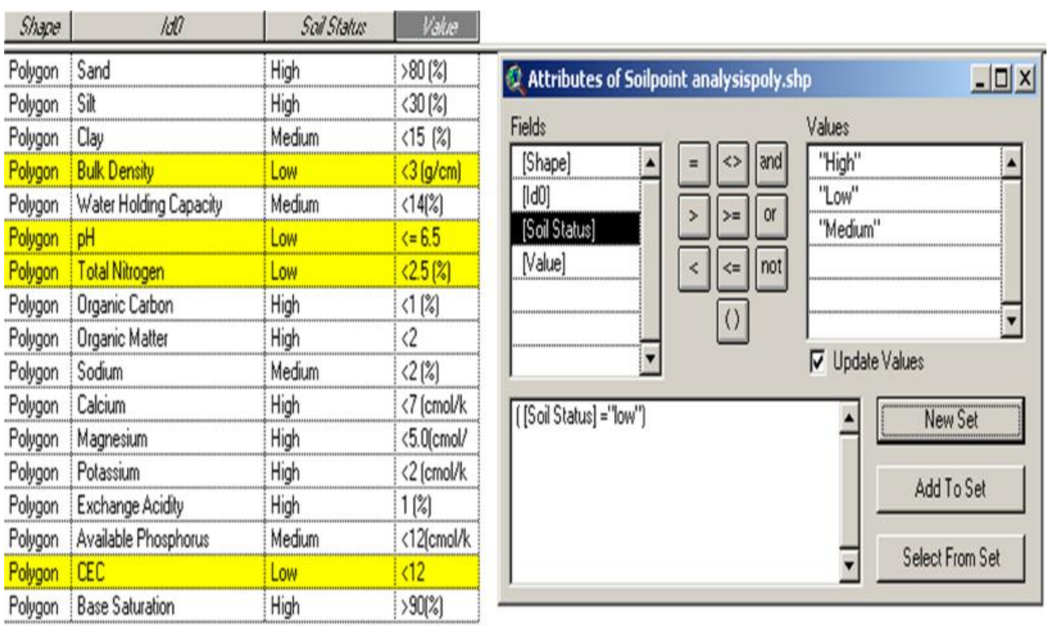
Those in the Medium group are identified in table 4. They are Clay, water holding capacity, sodium, and available phosphorus.

TABLE 4: Soil Properties with "Medium" Status



Shape	Id0	Soil Status	Value
Polygon	Sand	High	>80 (%)
Polygon	Silt	High	<30 (%)
Polygon	Clay	Medium	<15 (%)
Polygon	Bulk Density	Low	<3 (g/cm)
Polygon	Water Holding Capacity	Medium	<14(%)
Polygon	pH	Low	<= 6.5
Polygon	Total Nitrogen	Low	<2.5 (%)
Polygon	Organic Carbon	High	<1 (%)
Polygon	Organic Matter	High	<2
Polygon	Sodium	Medium	<2 (%)
Polygon	Calcium	High	<7 (cmol/k
Polygon	Magnesium	High	<5.0(cmol/
Polygon	Potassium	High	<2 (cmol/k
Polygon	Exchange Acidity	High	1 (%)
Polygon	Available Phosphorus	Medium	<12(cmol/k
Polygon	CEC	Low	<12
Polygon	Base Saturation	High	>90(%)

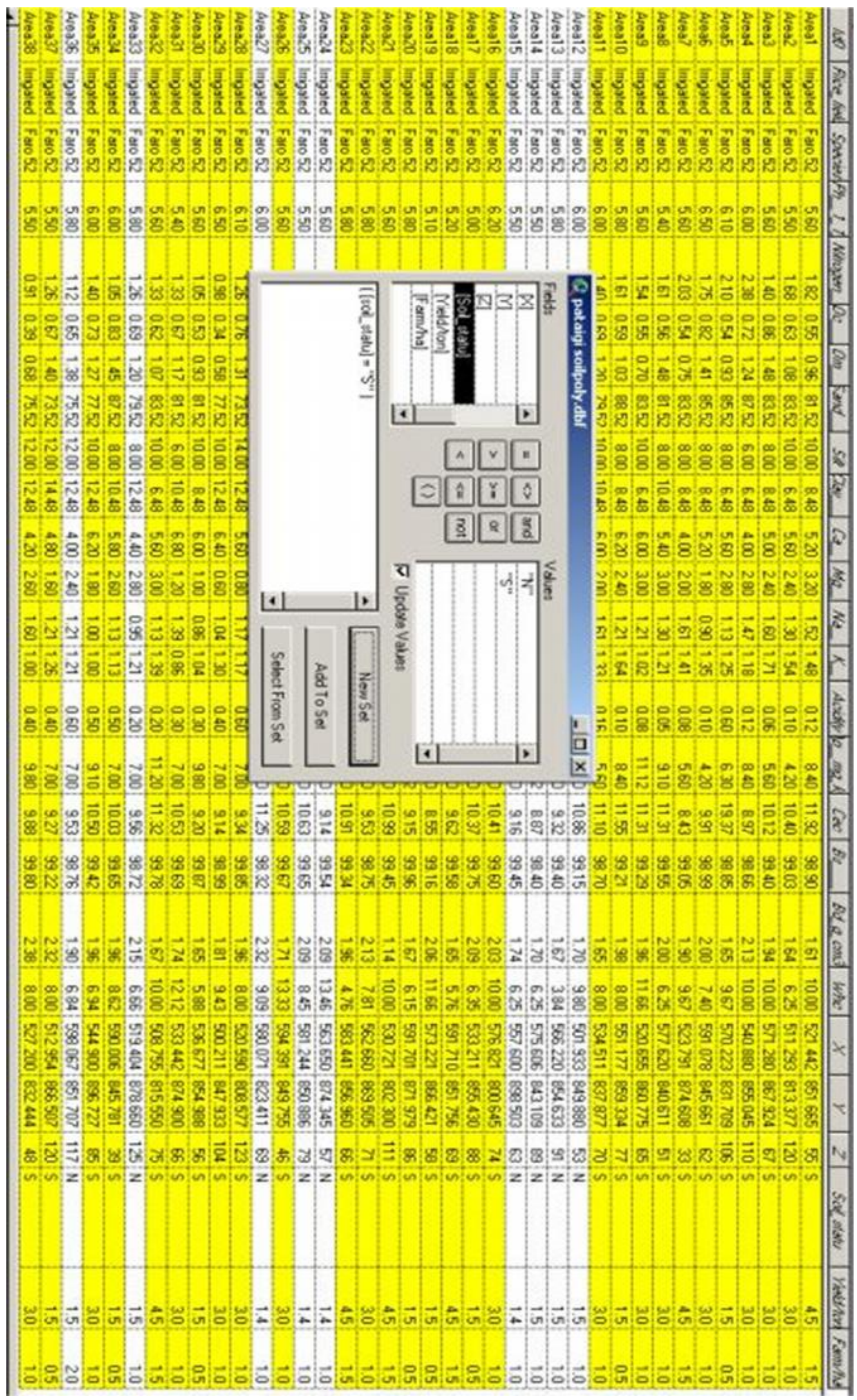
TABLE 5: Soil properties with Low Content Status.



Shape	Id0	Soil Status	Value
Polygon	Sand	High	>80 (%)
Polygon	Silt	High	<30 (%)
Polygon	Clay	Medium	<15 (%)
Polygon	Bulk Density	Low	<3 (g/cm)
Polygon	Water Holding Capacity	Medium	<14(%)
Polygon	pH	Low	<= 6.5
Polygon	Total Nitrogen	Low	<2.5 (%)
Polygon	Organic Carbon	High	<1 (%)
Polygon	Organic Matter	High	<2
Polygon	Sodium	Medium	<2 (%)
Polygon	Calcium	High	<7 (cmol/k
Polygon	Magnesium	High	<5.0(cmol/
Polygon	Potassium	High	<2 (cmol/k
Polygon	Exchange Acidity	High	1 (%)
Polygon	Available Phosphorus	Medium	<12(cmol/k
Polygon	CEC	Low	<12
Polygon	Base Saturation	High	>90(%)

The soil properties in the low content category are presented in table 5. The soil properties appeared in yellow. These are soil properties that reduces rice yield. They are the most limiting properties essential in rice growth and development in the study area.

TABLE 6: Result of Queried Database showing "Suitable" Soil Points



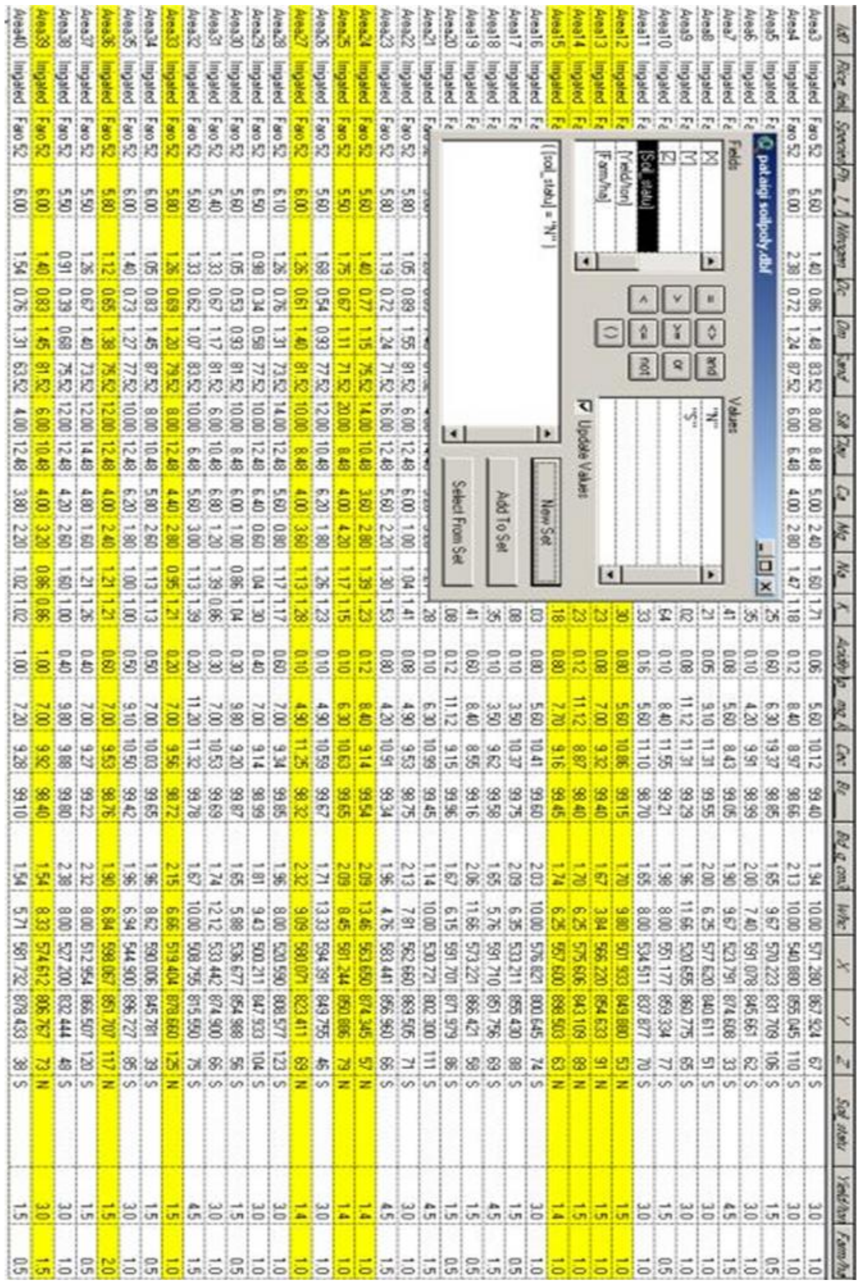


TABLE 7: Result of Queried Database showing "Non-Suitable" Soil Points

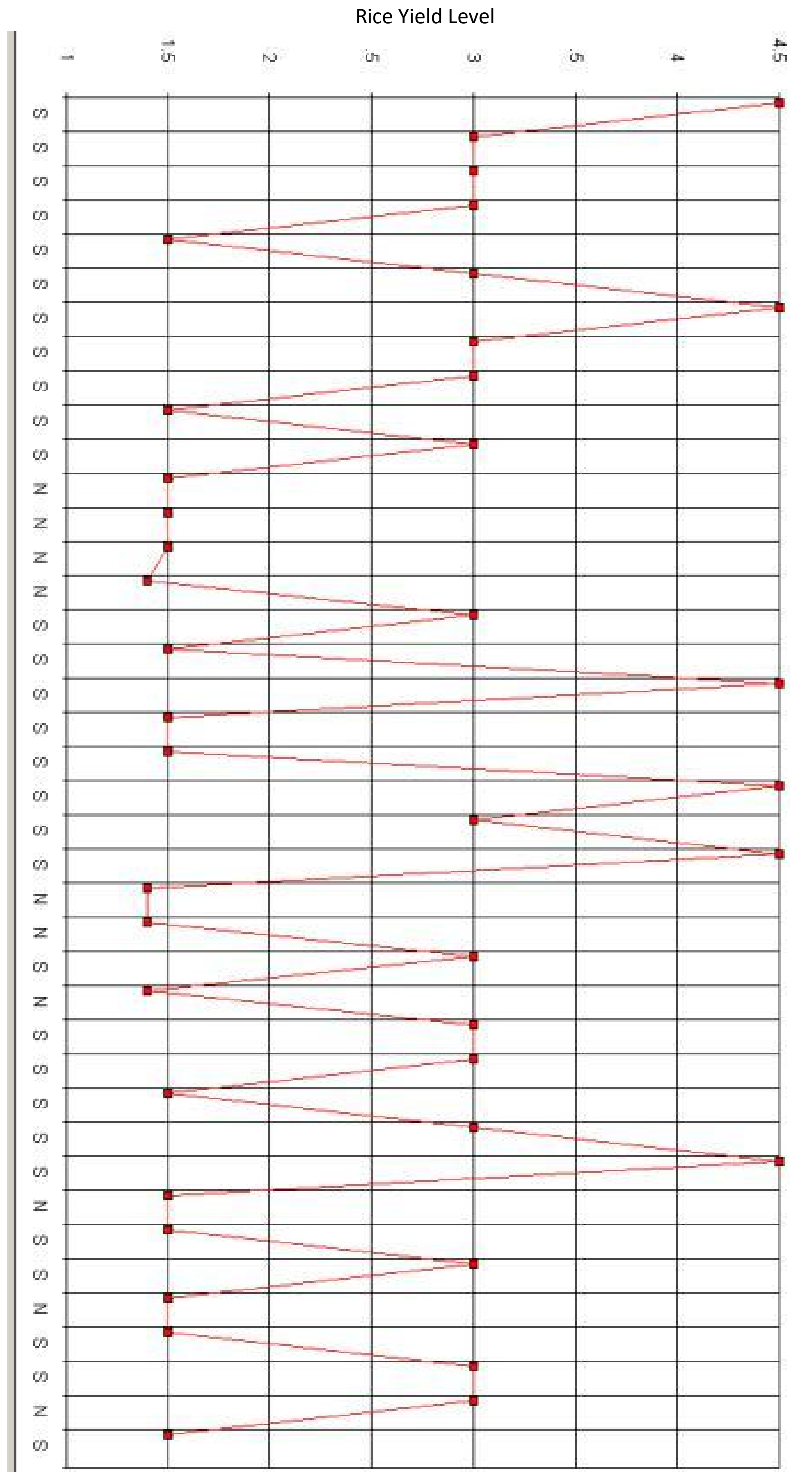


FIGURE 6 : Soil Suitability Chart S= Suitable, N=Non-Suitable

Soil Suitability at the Irrigation Rice Farms

The areas "Suitable" for rice production are identified in table 6. The study shows that 30 locations appeared to be suitable for rice production in this area and these are highlighted in yellow. The soils in this category are tagged suitable based on the yield capacity and their respective farm-size within the sample locations. For example, the study examined the optimum yield of this area at 3.0 t/ha which is far above other observed farm locations. This observation suggests that soil in this area need continuous assessment in order to sustain its productive capability. The yield capacity of the examined soil that is less than 3.0t/ha was termed "non-suitable" (Table 7). This implies that the sampled locations should be managed adequately and improved upon for increased yield.

Generally, it was observed that 30 points out of 40 are found to have suitable soil condition based on the optimum rice yield of 3t/ha bench mark in the study area. This level of yield as observed in the study confirms the findings of the national Project Coordinating Unit (PCU, 2002) which is common to most Irrigated Rice Farms in Nigeria. However, the remaining 10 farm points are found not suitable. This is because the identified farm locations are characterized with low yield (below 3t/ha). It implies that farmers should intensify on soil management techniques and increased land area in order to bridge the gaps of low crop yield within the "Non-Suitable" farmlands.

CONCLUSION & RECOMMENDATION

The study created geo-database to examine soil suitability for rice production in a rice farming community in Kwara state Nigeria. This G.I.S technique was found to be adequate for monitoring and managing soil nutrient for rice growth and development on point to point basis. This, according to Enakeno (2013) will be relevant for the new rice policy of Nigerian government which aimed to ban rice importation by 2015. The technique will boost local production and meet local consumption as well as enhancing surplus for export. In the light of the above, the study recommends adoption of geo-database in identifying areas that is subject to excess or insufficient soil nutrients within the rice farm by farm managers. However, such database should be regularly up-dated such that farm managers have access to up to date information on each feature under consideration and at the same time improve upon them to guide the farmers in their farming activities.

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