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Soil Quality Assessment of Savannah Sugar Company (Dangote Group) Farm, Numan, Adamawa State.(1975-2012)

PiusDauda AWHARI[1], Bobby ShekarauLUKA[2], TaitiyaKenethYUGUDA[3]
[1]*Department of Agriculture and Bio-Resources Engineering,Taraba State University, Jalingo*
[2,]*Department of Food Science and Technology, Federal University Wukari, Taraba State*
[3]*College of Environment, Hohal University, Nanjing. China*

ABSTRACT: *Soil physicochemical properties were determined for soils at Dangote farm to examine the37-year of assessment done by kenting Africa Resources Service Division and some selected field (P, G and K). A total of 81 soil samples at 27 selected units were collected. The samples were taken at incremental depths of 0-20 cm down to a depth of 60cm in each unit and average chemical properties of the soil in the Sugarcane plantation were determined. The sample were investigated for soil quality and compared with the result by Kenting Africa Resource Service Division (1975) which were conducted from the inception of the company. It was observed that; soil quality of Savannah Sugar Company irrigated land has not significantly changed and still remain within the minimum required limits for favourable growth of sugarcane plantation, and the data collected can be used to forecast future tendencies of the investigated parameters to change using appropriate tools its it is therefore recommended that regular soil test and record of soil quality test results should be kept for year in and out comparison.*
Keywords: *Soil quality, Sugarcane, pH, EC, ESP, soil comparison*

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I. INTRODUCTION

[1]Defined soil quality as the capacity of a specific soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. Thus, soil quality assessment reflects biological, chemical, physical properties, and engineering processes, and their interactions within each resource unit [2].

Suitability of Soil quality is a medium for mineral uptake for plant growth; a sink for heat, water, and chemicals; a filter for water; and a biological medium for the breakdown of wastes. Soil interacts intimately with water, air, and plants and acts as a damper to fluctuations in the environment.

There are many factors that affect soil quality deterioration, including changes in land use types from forest to arable land application of acid fertilizer and herbicides and the consequences from intensive land use [3]

Soil degradation through erosion, compaction, loss of biological activity, acidification, salinization, or other farm mechanization processes can reduce the quality of soil. These processes reduce soil quality by changing the soil attributes, such as nutrient status, organic, texture, available water-holding capacity, soil structure, soil pH and maximum root depth of the plant.

Sugarcane grown under irrigation in arid and semi-arid region is frequently adversely affected by soil salinity. The crop is moderately sensitive to salinity, with threshold for yield reduction at 1.7 dS/m [4]. The Salinity in the root zone of sugarcane decreases sucrose yield, through its effect on both, biomass and juice quality [5]. The salinity of soil or irrigation water reduces sugar stalk yield by reducing both the stalk population and weight. [6] found that each dS/m increase in the root zone salinity decreases stalk population by 0.6 stalk/m^2 and individual stalk weight by 0.15 kg, resulting in a stalk yield decrease of 13.7 t/ha. It has been estimated that globally that, approximately 40% of land under irrigation is salt-affected [7]. This problem is prevalent in soils under irrigated sugarcane (*Saccharum*sp.), especially in areas of low rainfall and high evaporative demand [8].

Decrease in the crop yield potential could be due to biotic and abiotic stresses; for the abiotic stresses, salinity is a major factor that increases day by day due to lack of proper management of soils [9].
Sugarcane is an important industrial and economic crop in Nigeria and in many countries of the world. Sugarcane produces numerous valuable by-products such as alcohol (ethanol) used by the pharmaceutical industry, ethanol used as a fuel, chip board manufacturing and press mud used as a rich source of crop production [10] [11].This study was formulated to find out if soil salinity affects sugarcane growth in savannah sugar irrigation district, because sugarcane yield seems to be disproportional to the seasonal hectarage of landcultivated.

II. MATERIALS AND METHOD

The study area is the Sugarcane Plantation of Savannah Sugar Company located in Numan Local Government Area (L.G.A) of Adamawa state, Nigeria. It lies between latitude $9^0$10'N- $9^0$39'N longitude $10^0$25'E-12^0 55'E (Fig. 1). The hectarage for the plantation covers over 27,000 ha. The climate of the area is characterized by two distinct climatic seasons; Wet and Dry seasons, respectively. The wet season starts from April and ends in October while the dry season starts from November to the month of March of the preceding year. The mean annual rainfall is 676 mm; the wettest months are August and September. The annual mean temperature is 30^0C with minimum temperature in the period from November to February when the North East trade winds originated in the Sahara desert, reduces the air temperature considerably.

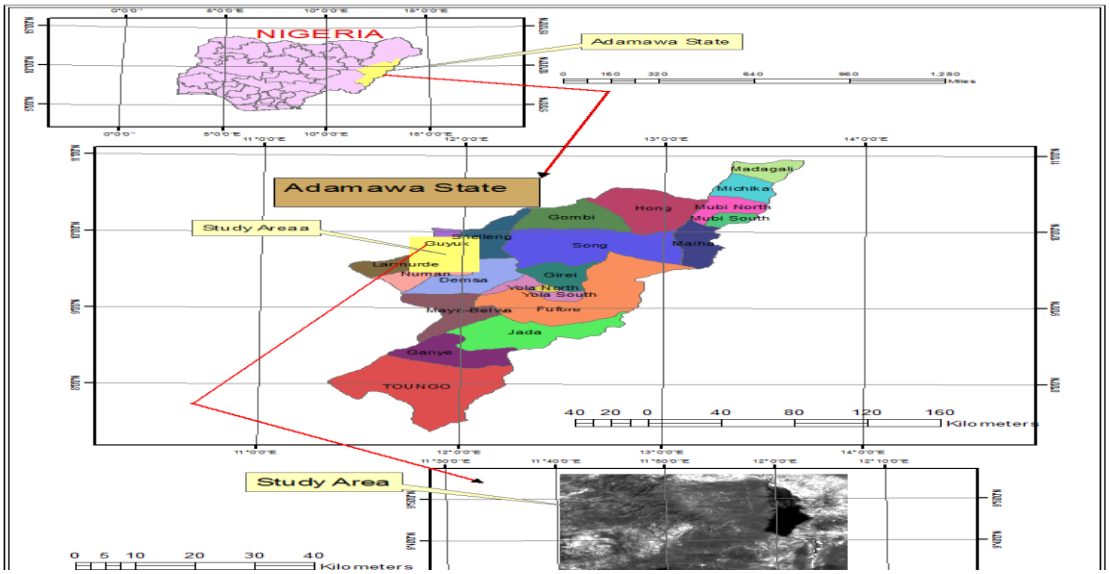

Fig 1: Map of Adamawa State showing the location of Numan and SSCL.

Sources:[12]

III. SOIL SAMPLE COLLECTION

Soil samples were randomly collected from the plantation. During the sampling, necessary precaution was taken to avoid sampling errors including abnormal occurrence in the field. A total of 81 soil samples at 27 selected units were collected. The samples were taken at incremental depths of 0-20 cm down to a depth of 60cm in each unit. Thus, the samples were taken at 3 different points in field plot P, G and K, respectively. They were carefully packaged and labelled for the laboratory analysis. Screw auger was used for the samples collection.

IV. RESULTS AND DISCUSSION

*pH:*Table 1 presents the average chemical properties of the soil in the Sugarcane plantation. The results of pH (6.30 to 7.20) of soil is slightly acidic on the surface and tends to be slightly alkaline with the increase in depth. This range of pH 6.30 to 7.20 is ideal for growing most sugarcane in Savannah region [13]

Table 1: Chemical Properties of the Soil at Plots P, G and K

Depth (cm)	pH(H_2O)			EC (ds/m)				CEC		SAR			ESP			OMC		
	P	G	K	P	G	K	P	G	K	P	G	K	P	G	K	P	G	K
0-20	6.33	6.30	6.40	0.65	0.65	0.70	39.40	43.90	50.50	0.32	0.17	0.16	3.20	1.60	1.20	1.10	1.21	1.15
20-40	6.67	6.60	6.60	0.71	0.70	0.70	45.10	49.30	48.20	0.31	0.31	0.30	3.10	2.90	2.90	0.81	0.77	0.79
40-60	7.17	7.20	7.10	0.74	0.74	0.70	50.40	41.80	41.80	0.28	0.44	0.41	2.80	4.10	4.00	0.62	0.47	0.55

SOURCES: FIELD SURVEY, 2012

These pH values (6.30 to 7.20) are very close to those obtained in (KARSD, 1975)from depth of 0-60cm given as pH 6.3 to 7.1 in Table 2 as deduce from (Kenting Africa Resource Service Division LTD 1975). This shows that, the pH of the soil ranged from slightly acidic to slightly alkaline at the time of plantation establishment. This range of pH values indicates that the soil in the sugarcane plantation changed slightly from acidic to slightly alkaline as the depth of the soil increases. Thus, the top soil is more acidic than the subsoil. Although, the optimum pH for sugarcane is about 6.5 [14], however, sugarcane can be successfully grown on soils with a pH value of even 4 as reported by[15]

EC: Table 1 presents the average result of electrical conductivity (EC) of the soil determined in 2012 in the study reported herein. The EC values ranged from 0.65 to 0.74 dS/m, which is less than the threshold value of 1.7 dS/m for yield reduction in sugarcane production [4]. The values of EC in 1975 as obtained from the depth of 0 – 60 cm are presented in (Table 2). All the values were below the threshold value of 1.7 dS/m [16]. Thus, these values indicate no salinity risk to the soil, since no value was found to be close to 4dS/m, which is the critical limit [17] for indicating a soil to be saline

Table 2 Table of comparison between pH, EC and SARin 1975 and 2012 at P

Depth (cm)	pH		EC		SAR	
	1975	2012	1975	2012	1975	2012
0-20	6.30	6.33	1.30	0.65	1.40	0.17
20-40	7.10	6.67	1.40	0.71	1.80	0.31
40-60	6.70	7.17	0.20	0.74	1.10	0.44

Sources: Field Survey, 2012 and Messer Kenting Africa Resource Service Division Ltd, 1975

Table 3 Table of comparison between EC, SAR and pH in 1976 and 2012 at Plot K

Depth (cm)	pH		EC		SAR	
	1975	2012	1975	2012	1975	2012
0-20	7.50	6.40	0.06	0.70	0.40	0.16
20-40	7.40	6.60	0.10	0.70	0.17	0.30
40-60	7.40	7.10	0.05	0.70	0.48	0.41

Sources: Field Survey, 2012 and Messer Kenting Africa Resource Service Division Ltd, 1975

Table 4 Table of comparison between EC, SAR and pH in 1976 and 2012 Plot G

Depth (cm)	pH		EC		SAR	
	1975	2012	1975	2012	1975	2012
0-20	6.30	6.40	0.004	0.65	1.04	0.17
20-40	7.10	6.60	0.014	0.70	1.74	0.31
40-60	6.70	7.10	0.10	0.74	1.06	0.44

Sources: Field Survey, 2012 and Messer Kenting Africa Resource Service Division Ltd, 1975

V. SOIL SODICITY CONTENTS

Cation Exchange Capacity (CEC): The CEC of a soil is primarily influenced by soil texture and organic matter content. CEC is a major controlling agent of stability of soil structure, nutrient availability for plant growth, soil reaction to fertilizer and other ameliorants. The values of CEC range from 39.4 to 50.50 cmol/kg of soil as presented in (Table 1). The values of CEC can be considered moderate for the sugarcane production[18]. The soil has CEC above 20cmol/kg. This soil characteristic show that the soil has tight soil structure with high clay content, poor internal drainage. The CEC can give insight into soil quality and site characteristics. Higher CEC values indicate more clay particles present in the soil .

Sodium Absorption Ratio (SAR):The Sodium Adsorption Ration (SAR) (Table 1) indicate values ranging from 0.16 to 0.44 at incremental depths of 20 cm down to a depth of 60cm for the soil. This indicates that the susceptibility of the soil to alkalinity hazard is low. Thus, the soil is safe and normal for sugarcane production under irrigation. [19]found the SAR value between 1-10 in a soil as acceptable for sugarcane production. ESP values are presented in (Table 4.1) show that the values were between 1.2 and 4.1 %. These values are far below the threshold limit of 15 % that could have a negative influence on the sugarcane production [20]

VI. CONCLUSIONS

This study has demonstrated that after 37-years long-term agricultural operation and different agriculture input to the soil (addition of fertilizer such as Urea, and NPK), there is no much significantly different in the soil quality or salinity that may affect the sugarcane growth or production. These indifferent in soil quality may be due to agricultural land that are not been use or abundant for agricultural operation or insufficient fund to cover large area of land for sugarcane farming.

Moreover, since this experiment was conducted, many soil samples analysis may have been conducted by different research organization or individual, but no record was on ground to compared with the present 2012 experiment (this may be due to transition of the company from Federal Government to Dangote group), that why, the result ofKenting Africa Resource Service Division Ltd conducted at the inception of the operation in 1975 were used for the purposed to ascertain the level of soil quality for sugarcane production in the study area.

VII. RECOMMENDATION

Its therefore recommended that regular soil test and record of soil quality test results should be kept such that regular comparison or soil indicator will be noted.

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