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MAGNITUDE OF SOIL SALINITY HAZARD IN DAUSA FADAMA, DIGOL VILLAGE, DANBATTA LOCAL GOVERNMENT AREA OF KANO STATE.

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ABSTRACT

Soil salinization and sodication are identified as one of the major processes leading to land degradation and loss of fertile agricultural lands worldwide. The magnitude or level of soil salinity in the study area was computed using EC values recorded in ds/m. These values were used to classify the soil into different classes based on the extent or severity of their salinity. It was found that more than 90 percent of the soils of the fadama fall within the EC classes that ranges from very low salinity class to low salinity class. This shows that the structure of the soils of the fadama is having larger silt and sand particles because its EC readings are generally lower. This is because fine textured soils are generally more prone to salinization compared with coarse-textured soils. The area classified as very high salinity is situated within the lowest point of the fadama. Deep tillage can be applied in order to improve drainage by breaking up the compacted soil surface and hard pans which restrict downward flow of water. Application of crop residues will lead to decreases of salt accumulation since there will be less evaporation from such residue covered surfaces. Such surfaces would have high soil moisture content that can keep the soil less saline. Cultivation of crops with long tap roots etc. are all recommended for combating soil salinity in the study area.

***Keywords**: Electrical Conductivity, Soil Fertility, Halophytes, Crop Residues, Deep tillage.*

INTRODUCTION

Soil salinization and sodication are identified as one of the major processes leading to land degradation and loss of soil fertility (FAO, 2009). Waterlogging and salinity are found to be the most widespread forms of land degradation the world over (Mehta *et al.*, 2012). They are threatening some of the most productive lands currently under irrigated agriculture. They become a source of serious environmental concern for those areas for which suggested climate change scenarios predicts aridity increase or sea-level rise (FAO, 2009). They are moreover, common problem in arid and semi-arid regions of the world which are characterized with high evaporation, poor drainage and irrigation system. Under such conditions soluble salts tends to accumulates on the surface thereby influencing soil properties and ultimately leading to its fertility loss (FAO, 2005, Aswaf *et al.*, 2016).Soil salinity influences soil properties and cause land degradation and the reduction of productivity of agricultural lands (Wu *et al.*, 2012).

Salinization can be caused by either natural process or human activities (Wang *et al.*, 2016). Naturally occurring salinity is not a problem because it enhances the productivity of an ecosystem and its diversity. In addition, salinity is a natural inherent condition of many ecosystems which contributed to global biodiversity by supporting halophytes (FAO, 2011). Human-induced soil salinization is the menace that is posing serious problem for agriculture in dry land environments and has greatly affected land productivity and even caused cropland abandonment (Wu *et al.*, 2014). A combination or interplay of a number of natural and human factors can be responsible for soil salinization in a place. Soil salinity can be brought about by the presence of excessive salts on the top layer of the soil resulting in the deterioration of its chemical and physical properties (FAO, 2009). Likewise, areas that have a large difference between summer rainfall and evaporation have the greatest potential for evaporative concentration of salts to accumulate from shallow ground water systems.

Research shows that the content of water soluble Na^+ ions in soil layers rises rapidly with temperature, but is not closely related to atmospheric humidity (Li *et al.*, 2014 in Wang *et al.*, 2016). A rise in soil temperature greatly enhances the accumulation of salinity in soil especially in its 10-15 cm layers (Li *et al.*, 2014 in Wang *et al.*, 2016). Furthermore, soil salinization is affected by the depth of the ground water, evaporation, Total Dissolved Solids (TDS) and quality of recharge water (Wang *et al.*, 1993 as cited in Wang *et al.*, 2016). Under strong evaporation and small water table depth caused by irrigation on alluvial plain, phreatic water readily evaporates with the likely results of accelerating ground water depletion both quantitatively and qualitatively thereby enhancing upwards transfer of salts associated with the ground water and subsurface unsaturated zone to surface soil and inducing secondary soil salinization (Wang *et al.*, 2016).

Similarly, the nature of the soil plays a significant role in salinity management because it is the physical buffer between rainfall and groundwater recharge. Healthy soils increases water retention and support active plants growth using more soil water thereby minimizing the amount of water passing through the root zone to recharge ground water. Poor land management practices may lead to excessive loss of top soil through erosion, compaction of top soil and sub-surface soil, soil structure decline, depletion of organic matter and increased acidity. Fine textured soils are generally more prone to salinization compared with coarse-textured soils (Quan *et al.,* 2013). Soils differ in their permeability-that is, their ability to take water. The least permeable are usually the most vulnerable to salt accumulations because water cannot move through them readily. Cement-like formations underlie some soils and aggravate the problems of drainage (USDA, 1958). Poor farm management practices such as wrongful application of fertilizer, over watering or over irrigation and so on contributes to soil salinity (Khalid and Yusuf, 2018).

An investigations and assessment of soil salinization becomes basic and important in order to deal with environmental issues and food shortage globally (Wang *et al.,* 2016). Assessment of soil salinity in irrigated fields, identification of its causes and evaluation of the appropriateness of related management practices are needed (Wang *et al.,* 2016). Therefore, it is of great importance to quantify the spatial distribution of salinity and its changing trend in space and time and its driving forces (Wu *et al.,* 2014). Timely detection of soil salinity, prediction and mapping of its severity and extent will enable decision makers to decide what necessary actions should be put in place especially in areas with strong saline soils in order to protect output and thereby sustain agricultural lands and natural ecosystems (Al-Khaier, 2003).

Adequate information on the extent and magnitude of soil salinity is needed for better planning and implementation of the effective soil reclamation programs (Abdel Fatah *et al.,* 2009). Understanding and quantifying the magnitude and pattern of soil salinity variability in space and time are necessary in determining cost-effective management zones and in managing variability in a site-specific way (Quan *et al.,* 2013). The practice of Conservation agriculture (CA) would have significant effects on soil salinity dynamics in irrigated fields. Application of crop residues will lead to decreases of salt accumulation since there will be less evaporation from such residue covered surfaces. Such surfaces would have high soil moisture content that can keep the soil less saline (Gorji, 2016).This research was conducted in order to determine the magnitude or level of salinity hazards in the study area in order to help policy makers in the area to have a clear picture of the problem and devise ways of curving out the menace which is causing serious reduction in their crop yields. This is seriously affecting the livelihood of the people of the area and hence the need for this research.

MATERIALS AND METHODS

Location of the Study Area: the study area is Dausa fadama and is located between latitudes 12^0 33’41.42’N to 12^0 33’7.86’N and longitude 8^0 32’43.81’E to 8^0 34’19.75’E. Dausa fadama is located in Diggol Village of Danbatta Local Government Area of Kano State. It is bordered by Ajumawa and Masallachi villages to its far south and Dukawa village to its north. It is about three kilometer long fadama and has no stream or river as its source. It is a wide depression where water seeps out throughout the year (Field Work, 2014).

Geomorphology: the area is underlain by sedimentary formation of marine and terrestrial origin (Olofin and Tanko, 2002, Tanko, 2003, Olofin, 1987). The average elevation of this area is 420 m above sea level (Field Work, 2014).

Drainage: the surface drainage of the area consists of disappearing flows. It is drained by one of those disappearing streams such as Gari and Tomas which drains towards the northeastern part of Kano. The fadama is either an ancient lake, or an exposed acquiper or it could be part of the disappearing or abandoned channels of River Thomas or River Jakara which finally empty their waters into Chad formation through the process of through flow (Tanko, 2003 and as opined by Olofin). In some areas, these abandoned channels are marked by marshes, lakes or depressions. Farmers draw water from the depression for irrigating their farmlands with the help of generators which pumped the water onto the farmlands.

Climate: the climate of the area is the tropical wet and dry climate, classified by koppen as Aw. The temperature is averagely warm to hot throughout the year at about 25 ^{O} C (Olofin and Tanko, 2002). The monthly rainfall distribution is characterized by one peak (single maximum) which is usually attained in August (Buba, 2009).

Soil: the Soils of the area is classified into ferruginous tropical soils by FAO/UNESCO genetic classification. These are Kaolinite and iron dominated tropical soils. They are well matured red and brown soils of the savannah (Yusuf, 2010). The soils of the area is generally sandy in the upland and in the lowlands or along the fadama are clayey and hydromorphic in nature (Field Survey, 2014).

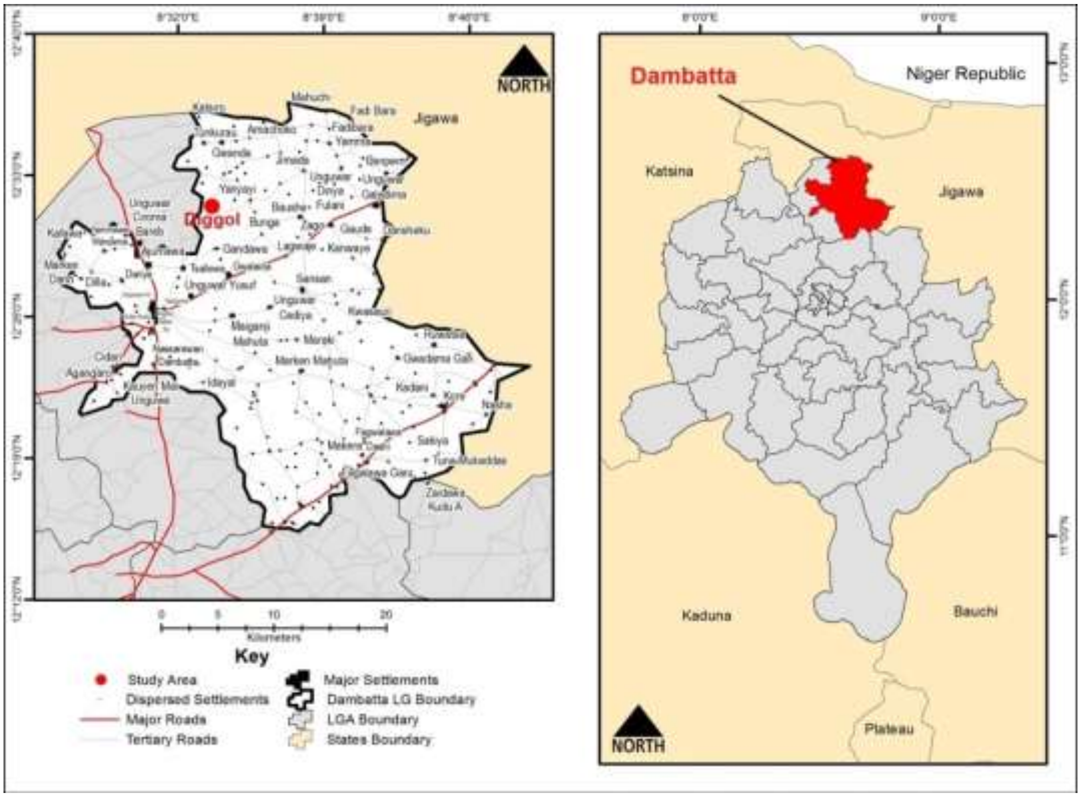

Fig. 1: Map of Danbatta showing the study area.

Plate 1: Showing salt-flakes features in the portion of the study area

Plate 2: Showing swollen soil clays which led to crust formation and reduced water transmission, diffusion of gases across the soil surface and emergence of plant seedlings through the soil of the fadama.

Sampling Technique: Systematic sampling technique was used to take samples along the fadama at an interval of 100 m by 100 m on either sides of the fadama (i.e. right and left), at depth increments of 0-30 cm using soil auger (diameter 5 cm). A total of 123 geo-tagged soil samples were taken and they were subjected to laboratory analysis for the determination of their soil electrical conductivity values. Systematic sampling technique was adopted because of the heterogeneous nature of the soil of the fadama.

Statistical Analysis: Central tendencies like range, mean, minimum and maximum values of soil EC were computed.

Methodology: the magnitude or level of soil salinity in the study area was computed using USDA, NRCS's standard of 2012. This standard used EC values recorded in ds/m and classified the soil into very low, low, medium, high, very high and excessively very high salinity classes. All EC values that range from 0-0.15 ds/m are classified as very low, 0.15-0.50 ds/m are classified as low while those EC values that range from 0.51-1.25 ds/m are regarded as medium. All those EC values that range from 1.26-1.75 ds/m are considered as high. Finally, EC values that are between 1.76-2.00 ds/m are classified as very high.

RESULTS AND DISCUSSION

The overall values of EC recorded in the study area ranges from 0.003 ds/m to 2.00 ds/m and this is in agreement with the findings of Mindari *et al.,* (2015) whose EC value of soil samples ranges from 0.64-1.83 dS/m. This is also in agreement with the findings of Khan *et al.,* (2008) whose values range from 0.73 - 2.3 ds/m. From figure 2 it is evident that more than 90 percent of the soils of the fadama fall within two classes i.e. very low salinity class (0-0.15 ds/m) to low salinity class (0-15-0.50 ds/m). In both very low and low salinity classes, crops will be starved of nutrients if that soil lacks enough organic matter. Similarly, the area classified as very high salinity class is very small and is limited to or situated within the lowest point or depression of the fadama. And this is in agreement with the findings of the (USDA, 2014) that stated that salts move with water, low areas, depressions or other wet areas where water accumulated their EC values tends to be higher in EC than surrounding higher-lying, better drained areas. This area will be too severe for seedlings or cuttings to thrive. Finally, areas with very high salinity class i.e.1.76-2.00 ds/m are very small and are concentrated around a small portion of the fadama. Here, plants usually stunted or developed yellowish coloration and some plants will severely be dwarfed seedlings and rooted cuttings frequently died (USDA, 2012).

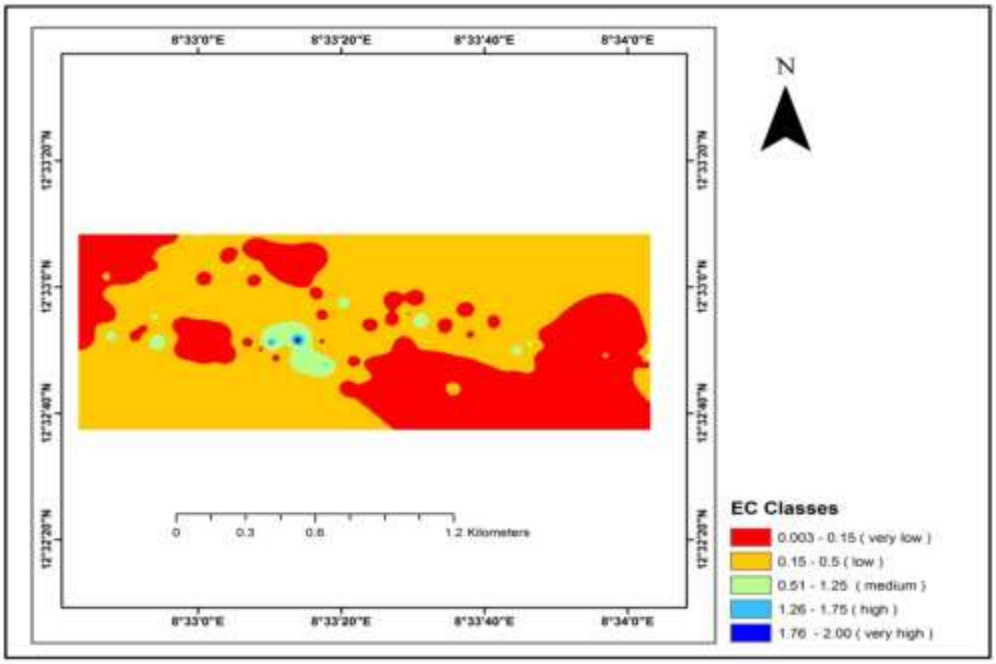

Fig. 2: Showing magnitude of soil salinity hazard in Dausa fadama.

CONCLUSION AND RECOMMENDATION

This study revealed that the soil of the fadama is generally low in EC readings and this is attributed to the structure of the soil of the area which characteristically contains larger silt and sand particles and hence low in EC values. Poor drainage, nature of the geology of the area coupled with its high water table depth induces waterlogging and sodicity in the area which eventually led to yield decrease. Salinity is not the main cause of soil degradation in the area. Sodicity and waterlogging are also the major contributing factor. Deep tillage that will enhance drainage and plant residues application as well as cultivation of crops with long tap roots etc. are recommended in order to remedy the problem of soil salinity and waterlogging in the study area.

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