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SOIL ORGANIC CARBON STOCKS IN SEMI-ARID SALINE SOILS OF DUTSE, NORTHERN NIGERIA

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ABSTRACT

Soil organic carbon (SOC) stocks play a critical role in soil fertility, ecosystem sustainability and climate change mitigation. This study assesses the SOC stocks in semi-arid saline soils of Dutse, Northern Nigeria, a region characterized by low rainfall, high temperatures, and soil salinity challenges. Soil samples were collected from three land use types, including croplands (School farm), permanent crops (NIFOR) and fallow lands (Senate building), at three different depths (0–20, 20-40 and 40–60 cm). The SOC content, bulk density, and soil salinity levels were analyzed to estimate SOC stocks and evaluate the impact of salinity on carbon sequestration. Results revealed that SOC stocks were relatively low with no significant variations with depth, ranging from 1740.34 g C cm^{-2} in the topsoil (0–20 cm), 1910.95 g C cm^{-2} (20-40 cm) to 1870.04 g C cm^{-2} in the subsoil (40–60 cm), with significant variations across land use types ranging from 1040.78 (NIFOR) to 2580.79 (School farm) g C cm^{-2}. Saline soils exhibited reduced SOC stocks compared to non-saline soils, highlighting the inhibitory effect of salinity on organic matter accumulation. School farm showed higher SOC stocks than Senate and NIFOR suggesting that land management practices significantly influence carbon storage. This study underscores the need for sustainable land management strategies to enhance SOC stocks in semi-arid saline soils, thereby improving soil health and contributing to climate change mitigation in the region.

Keyword: Soil organic carbon, Salinity, Sudan savanna, Sustainable agriculture, Jigawa State.

INTRODUCTION

A major environmental issue that impacts agricultural productivity, especially in dry and semi-arid areas, is soil salinity. The semi-arid soils of Dutse are characterized by salinity, which poses a serious risk to sustainable farming practices. In this region, high evaporation rates, limited rainfall, and inadequate drainage frequently exacerbate soil salinity by causing salts to build up in the soil profile (Baba, 2016). High salt concentrations have been shown to have a detrimental effect on soil microbial activity, which hinders the breakdown of organic matter and, as a result, the buildup of organic carbon (Rengasamy, 2010).

Soil organic carbon is one of the major global environmental concerns and challenges, according to the United Nations Environment Program (Victoria *et al*., 2012). In saline soils, organic carbon dynamics are complex. According to Banwart *et al*. (2015), organic carbon in the soil is known to improve soil biodiversity, energy and nutrient cycling, climate regulation, food production and soil water storage. Additionally, it lessens erosion and enhances the physical state of the soil. Soil organic carbon is an essentiality for the sustainability of soil fertility and ecological functions (Lal, 2013). In other words, organic carbon is crucial for maintaining the health of soil because it improves water retention, fortifies soil structure and provides nutrients to plants and soil microbes. According to Rengasamy (2010), salt accumulation in saline soils can negate these benefits by inhibiting microbial activity and delaying the decomposition of organic matter, which reduces organic carbon stocks. This decrease has important implications for soil fertility since organic carbon is an essential indicator of healthy soil and a requirement for sustaining agricultural productivity (Marschner, 2012).

Dutse is located in a semi-arid, dry region of the world with low soil organic carbon (Onokebhagbe *et al*., 2023). Therefore, regulating the soil's organic carbon content is crucial to attaining sustainable agricultural output. Due to the irrigation-heavy farming methods employed there, one of the main issues is the salinity-induced degradation of soil organic carbon that affects the soil's organic carbon balance.

Understanding the relationship between soil salinity and organic carbon availability is essential for managing the soil in this area (Abdullahi *et al*., 2019). Low amounts of organic carbon in the soil have been shown to affect soil fertility and crop yields (Marschner, 2012, Noma and Sani, 2008). Given that agriculture is the primary source of revenue for the Dutse population, this decline has a substantial impact on both food security and economic stability. In order to promote sustainable agricultural practices and mitigate the adverse effects of soil salinity, it is imperative to investigate the relationship between crop yield and the organic carbon store in Dutse saline soils. Soil salinity is a major obstacle to agricultural productivity because of the semi-arid environment of Dutse, which exacerbates soil salt accumulation. Given that agriculture is the primary source of income for the local population, this issue becomes quite concerning. Saline soils impede crop growth by preventing water uptake and nutrient availability (Abdullahi *et al*., 2019). This results in lower agricultural yields jeopardizing area food security in the region.

Although the importance of organic carbon for soil health is well established, little is known about how soil salinity, in particular, affects the storage of organic carbon in the saline

Dutse soils. It is challenging to obtain thorough study on this topic because it restricts the development of effective soil management strategies that could mitigate the detrimental effects of salt on organic carbon and, in turn, on agricultural productivity (Baba, 2016). Thus, this study aims to fill the knowledge vacuum by investigating the effects of soil salinity on organic carbon storage in Dutse. Understanding these effects is essential for managing saline soils, improving soil fertility, and increasing crop yields in this region. Without such measures, the ongoing decline in soil health could lead to further decreases in agricultural output, which would be harmful to food security and the stability of the local economy in Dutse as well as the greater Jigawa State.

Soil salinity is a significant issue in Dutse because agricultural output is heavily reliant on soil health. The area's semi-arid climate, characterised by high rates of evaporation and little rainfall, presents significant challenges for local farmers. To address these difficulties and promote sustainable farming techniques in the area, it is necessary to appreciate the significance of organic carbon stock in saline soils. In-depth research on the specific effects of soil salinity on organic carbon stores in Dutse is sparse, despite the importance of this issue. Due to this information vacuum, local farmers and agricultural planners find it more challenging to implement effective soil management strategies that could mitigate the negative impacts of salinity. By investigating the connection between soil salinity and organic carbon stock, this study aims to gather crucial information that can enhance land management practices, increase soil fertility, and increase agricultural productivity in the region (Abdullahi *et al*., 2019). It is anticipated that the findings of this study will be crucial in the creation of targeted interventions that aid in the preservation and restoration of soil health in salinized environments. The long-term sustainability of Dutse agriculture depends on such actions, which also improve Jigawa State's food security and the livelihoods of local farmers. Therefore, this study was aimed at understanding how soil salinity affects the organic carbon stock in the soils of Dutse, Jigawa State, Nigeria.

MATERIALS AND METHODS

Study Area

The soils for the study were collected from three identified sites under different land use: NIFOR (Lat 11°72'21"N and Long 9°37'10"E; used for permanent tree cropping system), Senate (Lat 11°71'38"N and Long 9°37'32"E; fallow lands) and School Farm (Lat 11°70'89"N and Long 9°38'79"E; cropping lands) within Dutse Local Government Area, Jigawa State as shown in Figure 1. The laboratory analysis was carried out in the Soil Science Laboratory, Faculty of Agriculture, Federal University Dutse, Jigawa State. Most of the Jigawa lies within the Sudan Savannah with elements of Guinea Savannah in the southern part. The state enjoys vast fertile arable land, to which almost tropical crops could adopt.

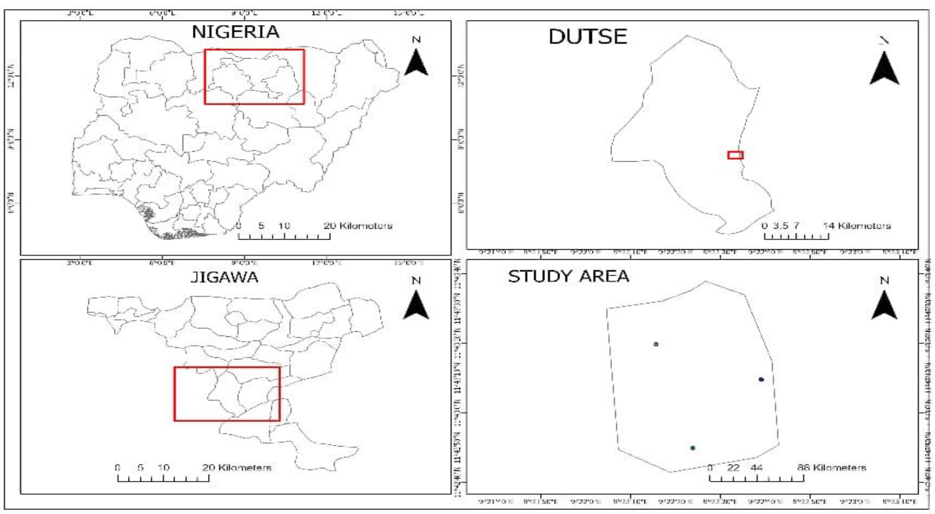

Figure 1: Map of Dutse showing sampling sites.

Soil Sample Collection and Materials Used

A free survey method approach was used in the selection of sampling sites which covered three identified sites. A total number of twenty-seven undisturbed soil samples was collected and used for this study. Three soil samples were collected at each depth per location {0-20 cm depth (3 samples), 20-40 cm depth (3 samples) and 40-60 cm depth (3 samples)} using a soil auger and core samplers. Composite soil samples were randomly collected from 5cm depth of each location, bagged, properly labelled, air-dried, crushed lightly and sieved through 2 mm sieves for determination of physical and chemical properties of soils of the study sites.

Soil Analysis

Baseline parameters of the study soils were determined using appropriate procedures. Soil textural analysis was carried out using the Bouyoucous hydrometer procedure (Bouyoucous, 1962). The textural classes were determined with the aid of

USDA textural triangle. Determined quantities of the soil fractions were expressed in percentages. pH of study soil samples was determined in 1:2.5 ratio using the pH meter as outlined by Thomas (1996). Electrical conductivity of the study soil was measured in a 1:5 soil to water ratio using a conductivity meter (Rhoades, 1996). Soil organic carbon content was determined using the Walkley Black procedure of 1934 as outlined by Nelson and Sommers (1986). Total nitrogen was measured using the Kjeldahl digestion method, which involves digesting the soil with concentrated sulphuric acid to convert organic nitrogen into ammonium, which is then quantified (Bremner & Mulvaney, 1982). Cation exchange capacity (CEC) was determined using the summation method of exchangeable bases and exchangeable acidity (Agbenin, 1995), with results expressed in centimoles per kilogram (cmol kg^{-1}). Available phosphorus (P) in the soil samples was determined using the Olsen procedure outlined by Agbenin, (1995). Soil organic carbon stock (SOCs) which is a product of bulk density, OC concentration and layer thickness (soil depth) was estimated by the following equation outlined by Zeng *et al*. (2021):

$$SOCs = \Sigma\ Db_i C_i D_i \times 10 \quad (1)$$

Where

SOCs is the soil organic carbon stock (g C cm^{-2}), *Db*i is the bulk density (g cm^{-3}) of layer i, Ci is the proportion of organic carbon (g kg^{-1}) in layer i, Di is the thickness of this layer (depth in cm).

Data Analysis

Data obtained from this study was subjected to a Two-way analysis of variance (ANOVA) using the general linear model. Significant means were separated using Tukey factor of mean separation. Relationship between electrochemical properties (pH and EC) and soil organic carbon stock was evaluated using the Pearson tool of correlation analysis. All statistical analysis was carried out using SAS version 9.1 statistical software.

RESULTS AND DISCUSSION

Physical and Chemical Properties of Saline Soils

The results of the physical and chemical parameters of the soils used for this study are shown in Table 1. The textural class indicates sandy soils across the three locations. This is characteristic of soils of the savannah region of northern Nigeria (Brady and Weil, 2002). The sandy nature of the soils is attributed to the parent material which is mainly pre-Cambrian basement complex rocks (Malgwi *et. al*., 2000; Voncir *et. al*., 2008).

The soil reactions were saline and ranged from 7.97 to 8.49 indicating slight neutrality to salinity. Electrical conductivity (EC) values of 4.53, 4.77 and 5.71 dS m^{-1} were obtained from the soils as shown in the Table 1. The high EC values are an indication of high salinity status of the soils according to the limits outlined by Brady and Weil (2002).

Organic matter contents of the soils (4.30, 7.69 and 11.00 g kg^{-1}) were below the critical value of 20 g kg^{-1} reported by Vassilev *et al.* (2013) hence can be regarded as low. The low level of organic matter with a high proportion of sand particles will normally result in low aggregation, low water retention and poor physical stability of the soil and consequently low crop productivity (Woolf *et al.,* 2010). Also, continuous farming, burning and use of the residues such as cereal straws that could have been incorporated into the soil by farmers could possibly have led to depletion of soil organic matter content (Yakubu, 2001). Available P values of the soils were extremely low, falling below the minimum critical value of 8 mg kg^{-1} for Nigerian soil fertility classes (Aduayi *et al*., 2002). The effective cation exchange capacity of the soils were moderate (5.80, 6.08 and 6.27 cmol kg^{-1}). These values fall below and within the ranges of the critical values of < 6 (low) and 6 – 12 (medium) and > 12 (high) reported by Esu (1991) reflecting poor fertility status of the soils.

Table 1: Physical and Chemical Properties of Composite soils samples of The Study Areas

	Locations		
Soil properties	**NIFOR**	**Sch/farm**	**Senate**
Sand (%)	96	95	90
Silt (%)	3	3	7
Clay (%)	1	2	3
Textural class	Sandy	Sandy	Sandy
pH	8.49	7.97	8.13
EC (dS m^{-1})	5.71	4.77	4.53
Bulk density (g/cm^3)	1.36	1.57	1.33
Organic carbon (g kg^{-1})	4.47	6.40	2.50
Organic matter (g kg^{-1})	7.69	11.00	4.30
CEC (cmol kg^{-1})	6.08	5.80	6.27
Available P (mg kg^{-1})	0.09	0.25	0.04

Effects of Location and Depth on Bulk density and %Silt and Clay of Saline Soils

There were substantial differences ($p < 0.05$) in the bulk density of soils across the various locations (Table 2). The School Farm had the highest bulk density of all of the locations (1.57 g cm^{-3}), which was much higher than that of the Senate (1.33 g cm^{-3}) and NIFOR (1.36 g cm^{-3}). According to Smith *et al*. (2016), this implies that there may be more soil compaction at the School Farm as a result of differences in land use, soil management techniques or traffic volume.

However, bulk density was not significantly ($p > 0.05$) impacted by depth. The values showed that soil bulk density stayed relatively constant throughout the soil depth, ranging narrowly from 1.41 g cm^{-3} at 0-20 cm and 20-40 cm depths to 1.45 g cm^{-3} at 40-60 cm depth. This could be explained by uniform soil texture or little variation in compaction between depths (Jones et al., 2020). Additionally, there was no statistically significant interaction ($p > 0.05$) between location and depth, which supported the finding that depth had little effect on bulk density regardless of location (Nabayi *et al*., 2018).

Across the three sites, the percentages of silt and clay also varied, although these variations were not statistically significant ($p > 0.05$) (Table 4.2) and slightly increased with depth when compared to values obtained from surface soil samples as shown in Table 1. Many soils exhibit a higher clay concentrations in deeper layers, notably the B horizon, as a result of illuvial clay deposition. Here, fine clay particles transported from upper horizons settle and enrich the subsoil (Ojedokun *et al*., 2022). The Senate had the most average percentage (31.47%), closely followed by NIFOR (31.09%) and School Farm (30.69%). According to McBratney *et al*. (2014), these minute changes may be the result of inherent variability in parent material or depositional processes across the sites. Several studies (Ya'u, 2015; Ya'u and Maniyunda, 2018) have noted a significant proportion of silt in surface soils, which they attribute to the influence of harmattan dust, especially in Nigeria's Northern Guinea Savannah. Deng *et al*. (2017) claimed that the high silt content of the surface soil is caused by loessal deposits.

Table 2: Effects of Location and Depth on Bulk density and %Silt and Clay of Saline Soils

Factor	Bulk density (g cm^{-3})	% Silt and Clay
Location (L)		
NIFOR	1.36±0.436[b]	31.09±0.683
School Farm	1.57±0.023[a]	30.69±0.621
Senate	1.33±0.061[c]	31.47±0.404
		NS
Depth (cm) (D)		
0-20	1.41±0.053	30.85±0.921
20-40	1.41±0.064	31.17±0.334
40-60	1.45±0.057	31.21±0.291
	NS	NS
Interaction		
L*D	NS	NS

NS denotes no significant differences at p<0.05.

As with bulk density, the percentage of silt and clay was not significantly ($p > 0.05$) impacted by soil depth. At 0-20 cm depth, the values were 30.85% and at 40-60 cm depth, it was 31.21%. This homogeneity implies that the texture of the soil is comparatively constant throughout depths, most likely as a result of little vertical sorting or disturbances throughout time. Neither bulk density nor the proportion of silt and clay showed a significant relationship with location and depth (L*D) ($p > 0.05$). This suggests that location and depth have independent influence on various soil characteristics.

Effects of location and depth on pH and EC of Saline Soils

There were significant ($p < 0.05$) differences in the pH of the studied soils between locations (Table 3). The soil conditions at School Farm were somewhat alkaline, with the highest pH value (7.67), while those at NIFOR (6.49) and Senate (6.13) were slightly acidic. These discrepancies may be related to variances in vegetation types, soil management techniques and land use patterns (Brady and Weil, 2016). The higher pH at School Farm might be the consequence of decreased organic acid inputs or lime application, both of which are typical in agricultural soils (White *et al*., 2020).

Additionally, depth had a substantial ($p < 0.05$) impact on pH. At 20-40 cm depth, the pH was at its greatest (6.98), followed by 0-20 cm (6.83) and at 40-60 cm depth, it was at its lowest (6.48). According to this pattern, deeper layers may have less leaching of basic cations, whilst surface layers may receive more acidic inputs from the breakdown of organic matter (McBratney *et al*., 2014). Nonetheless, there are only minor variations between depths, suggesting that pH profiles are generally stable.

Location had no significant ($p > 0.05$) effect on the EC values (Table 3). Salinity levels were comparable across all locations, with EC ranging from 9.53 dS m^{-1}(Senate) to 9.77 dS m^{-1}(School Farm). The absence of variance indicates that environmental conditions and local management in the research area do not significantly alter soil salinity (Richards, 1954).

Table 3: Effects of Location and Depth on pH and EC of Saline Soils

Factor	pH	EC (dS m^{-1})
Location (L)		
NIFOR	6.49±0.246[b]	9.71±0.035
School Farm	7.67±0.246[a]	9.77±0.030
Senate	6.13±0.253[b]	9.53±0.100
		NS
Depth (cm) (D)		
0-20	6.83±0.125[ab]	9.62±0.095
20-40	6.98±0.423[a]	9.70±0.053
40-60	6.48±0.366[b]	9.75±0.037
		NS
Interaction		
L*D	*	NS

**denotes significant differences at p<0.05, NS denotes no significant differences at p<0.05.*

Depth also did not significantly ($p > 0.05$) affect EC. The values ranged from 9.62 dS m^{-1}at 0-20 cm to 9.75 dS m^{-1}at 40-60 cm, with little fluctuation. Due to either consistent parent material or restricted leaching, this consistency throughout depths suggests a homogenous distribution of soluble salts in the soil profile (White *et al*., 2020). The interaction between location and depth (L*D) was not significant ($p > 0.05$) for EC. This suggests that the effects of location and depth on EC are independent of each other.

Location and depth (L*D) had a significant ($p < 0.05$) interaction effect on pH. According to Smith et al. (2016), this suggests that the impact of depth on pH differed based on the site, which may be related to variations in environmental factors and soil management.

Effects of location and depth on Organic Carbon and Carbon Stock of Saline soils

There were significant ($p < 0.05$) differences in the amount of organic carbon in each location (Table 4). Senate had the lowest OC (2.50 g kg^{-1}), while School Farm had the most (5.40 g kg^{-1}), followed by NIFOR (4.47 g kg^{-1}). These variations could be explained by variances in the sites' organic matter inputs, plant cover and land management techniques. The use of organic fertilizers or the buildup of crop residues may be the cause of the comparatively high OC at School Farm (Lal, 2004). On the other hand, decreased organic matter supplies or higher rates of erosion and decomposition may be the cause of the low OC at Senate (Batjes, 2014). Location and depth had a significant ($p < 0.05$) interaction for organic carbon. According to Smith *et al*. (2016), this suggests that the fluctuation in organic carbon content with depth varies depending on the site, most likely due to site-specific factors such as flora type, soil disturbance and organic matter input. Location-specific variations in carbon stock were also significant ($p < 0.05$). The maximum carbon stock was found at School Farm (2580.79 g C cm^2), followed by Senate (1040.78 g C cm^2) and NIFOR (1890.76 g C cm^2). Given the strong correlation between carbon stock, OC content and soil bulk density, the patterns are consistent with the OC results. School Farm's potential for carbon sequestration, which may arise from sustainable land management techniques, is highlighted by its noticeably larger carbon stock (Post *et al*., 2001). On the other hand, Senate's low carbon stock can be a sign of degraded soil or fewer organic inputs.

Carbon stock was unaffected ($p > 0.05$) by depth (Table 4). 1740.34 g C cm^2 at 0-20 cm, 1910.95 g C cm^2 at 20-40 cm and a little decline to 1870.04 g C cm^2 at 40-60 cm were among the comparatively steady results. There appears to be no stratification of carbon stores in the soil profile, since this constancy is consistent with the trend shown for OC (Batjes, 2014). For carbon stock, the location-depth interaction was significant ($p < 0.05$). This suggests that variations in land use, management and soil processes at each site account for the variation in the link between depth and carbon stock (Lal, 2004).

Table 4: Effects of Location and Depth on Organic carbon and Carbon stock of Saline Soils

Factor	SOC (g kg^{-1})	SOCs (g C cm^{2})
Location (L)		
NIFOR	4.47±0.644^{b}	1890.76±27.611^{b}
School Farm	5.40±0.269^{a}	2580.79±11.094^{a}
Senate	2.50±0.280^{c}	1040.78±13.082^{c}
Depth (cm) (D)		
0-20	3.97±0.653	1740.34±30.950
20-40	4.33±0.570	1910.95±27.044
40-60	4.07±0.594	1870.04±28.889
	NS	NS
Interaction		
L*D	*	*

**denotes significant differences at $p<0.05$, NS denotes no significant differences at $p<0.05$.*

Interaction Effects of Location and Depth on pH, Organic carbon and Carbon stock of Saline Soils

The pH of the soil was greatly impacted by the interaction between depth and location (Table 5). Due to the concentration of basic cations or decreased leaching at this location, School Farm had the highest pH at 20-40 cm depth (8.47), indicating an alkaline environment (Lal, 2004). In contrast, the pH was lowest at Senate at 40-60 cm depth (5.20), indicating acidic conditions that could be caused by the leaching of basic cations or the breakdown of organic debris in this area (Brady and Weil, 2016). Furthermore, differences in parent material, land management and soil biological activity can also be reflected in pH variations between depths and locations. In contrast to the Senate soils, which may have experienced increased leaching and organic acid inputs, the comparatively steady pH in School Farm soils indicates buffering either by agricultural lime or fertilizers (White *et al*., 2020).

The maximum amount of organic carbon was found in School Farm at a depth of 0-20 cm (6.40 g/kg), followed by NIFOR at 20-40 cm (5.80 g kg^{-1}) and 40-60 cm (5.60 g kg^{-1}) (Table 5). This implies that certain depths and locations have more organic matter accumulation and possible carbon sequestration. Organic inputs like crop residues and compost probably helped School Farm, although NIFOR soils might accumulate organic matter because of slower rates of decomposition in little disturbed soils or under tree canopy (Smith *et al*., 2016).

Table 5: Interaction of Location and Depth on pH, Organic carbon and Carbon stock of Study Soils

Treatment	Location	Depth (cm)	pH	SOC (g kg^{-1})	SOCs (g C cm^{2})
1	Senate	0-20	6.37±0.087^{cd}	3.50±0.231^{cd}	1500.46±15.197^{cb}
2	Senate	20-40	6.83±0.231^{bc}	2.20±0.231^{ed}	880.92±9.527^{c}
3	Senate	40-60	5.20±0.061^{e}	1.80±0.208^{e}	740.95±10.865^{c}
4	NIFOR	0-20	7.15±0.035^{bc}	2.00±0.153^{e}	870.34±22.069^{c}
5	NIFOR	20-40	5.63±0.167^{de}	5.80±0.493^{ab}	2320.93±22.069^{ab}
6	NIFOR	40-60	6.68±0.306^{bc}	5.60±0.361^{ab}	2490.03±18.869^{a}
7	Sch/farm	0-20	6.98±0.098^{bc}	6.40±0.208^{a}	2850.22±25.971^{a}
8	Sch/farm	20-40	8.47±0.179^{a}	5.00±0.153^{b}	2540.01±11.199^{a}
9	Sch/farm	40-60	7.56±0.294^{ab}	4.80+0.208^{cb}	2370.15±9.067^{a}

In contrast, Senate at 40-60 cm depth had the lowest OC (1.80 g kg^{-1}), indicating degraded soil conditions with lower organic matter inputs and higher decomposition or erosion (Post *et al*., 2001). In most locations, OC generally decreased from surface layers to deeper layers, which is consistent with the common trend of organic matter accumulation being highest in topsoil due to microbial activity and surface litter deposition (Batjes, 2014).

Carbon stock was also greatly impacted by the location-depth interaction (Table 4.5). At 0-20 cm deep, School Farm had the greatest carbon stock (2850.22 g C cm^{2}), followed by School Farm at 20-40 cm (2540.01 g C cm^{2}) and 40-60 cm (2370.15 g C cm^{2} respectively). These figures demonstrate how bulk density and organic carbon content have a significant impact on carbon storage. School Farm's high carbon stock emphasizes how crucial

sustainable farming methods are to improving soil carbon sequestration (Lal, 2004).
Senate soils at 40-60 cm depth, on the other hand, had the lowest carbon stock (74.95 g C cm^2), which was indicative of degraded soil conditions and a limited amount of organic matter. Because of reduced rates of breakdown and better carbon preservation at depth, NIFOR soils displayed moderate carbon stock values, with higher stocks at deeper layers (e.g., 249.03 g C cm^2 at 40-60 cm) (Brady and Weil, 2016).

Correlation analysis between pH, EC and soil organic carbon stocks

There was a moderately positive correlation between pH and organic carbon stock, as indicated by the correlation coefficient of 0.37 (Table 4.6). This suggests that organic carbon stock tends to rise in tandem with pH. This connection is consistent with previous study by Lal (2004), which shows that soils with pH values close to neutral frequently promote increased microbial activity and the stability of organic matter, which improves carbon storage. The correlation is marginally non-significant ($p > 0.05$), as indicated by the r^2 value of 0.06. A bigger sample size or more data may be needed to confirm statistical significance, even while the trend points to a significant biological or chemical association (Smith *et al.,* 2016).

Table 6: *R* and *P* values of pH and EC correlation with organic carbon stock

	r^2	*P*
pH	0.37	0.06
EC	0.20	0.32

EC and organic carbon stock have a weakly positive correlation, as indicated by the correlation's r^2 value of 0.20. This implies that EC, which measures the quantities of soluble salts, has no effect on the quantity of carbon stored in the soil. Although the research soils do not clearly show this effect, high salt concentrations frequently prevent microbial breakdown, which can delay carbon cycling (Brady and Weil, 2016). There was no significant correlation between EC and organic carbon stock, as indicated by the r^2 value of 0.32. The comparatively low variability in EC values throughout the research locations and depths may be the cause of this lack of significance according to White *et al*. (2020).
The significance of preserving the ideal soil pH for carbon sequestration is highlighted by the somewhat positive correlation found between pH and organic carbon stock. In general, neutral pH levels promote the development of stable organo-mineral compounds and soil microbial activity (Six *et al*., 2002). Due to the high salinity levels in the sites under investigation, the weak and non-significant correlation between EC and organic carbon stock indicates that soluble salts have little effect on the carbon stock in the study soils.

CONCLUSION

A dynamic carbon reserves in the soil influences soil health, soil microclimatic conditions and nutrient cycling. However low levels of soil organic carbon were encountered in the study soils. These low levels can be attributed to the climatic conditions of the immediate environment and salt levels within the soil. The comparative high levels of SOCs encountered in the soils from the school farm show the possibility of a potential response to the use of the right amendments. From this study, soils from the school farm had over the years been amended with compost resulting in the high levels of SOCs despite the salinity levels. This study indicate the need for managerial practices that will increase soil organic carbon stock thereby enhancing productive utilization of the study soils hence increasing crop yield.

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