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IMPACTS OF CLIMATE CHANGE ON SOIL PHYSICO CHEMICAL PROPERTIES OF VEGETABLE FARMLAND UNDER POULTRY MANURE APPLICATIONS IN PORT HARCORT REGION

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Abstract
Climate change will have an effect on soil processes and properties because, soils are connected to atmospheric/climate systems through the carbon, nitrogen and hydrologic cycles. The study examined the impact of climate change on soil physicochemical properties of vegetable farmland under poultry manure applications in Port Harcourt region, Nigeria. The study adopted experimental research design. The nature and source of data was through the primary and secondary sources. The sample frame for the study was gotten from 625m^2 of parcel of vegetable farmland which was divided into a grid system of 5x5 inside each 25m^2. Thus, 2.5 of smaller plots formed the sample frame for the study from which the sample was taken. By using four treatments with three replicates, the study used table of random numbers to select 12 samples. Twelve samples or experimental plots of 5m x 5m was selected from the sample frame. Four levels of treatment 0kg/25m^2, 50kg/25m^2, 100kg/25m^2 and 150kg/25m^2 of poultry manure were applied to the experimental plots using completely randomized design. The method of data collection involved soils being collected 9weeks after the application of the poultry manure (treatment). The soil samples were collected at a depth of 0-30cm using a soil auger. This was done by taking 4 composite samples from each of the plots. The four composite samples were thoroughly mixed while a sample was taken for analysis for all experimental plots with a standard method for physicochemical parameters. Data acquired from the laboratory was subjected to Analysis of Variance (ANOVA) statistical technique. The study showed that the mean soil p^H prior to application of manure was 5.06, indicating an acidic soil. The soil EC mean was 290µs/cm, calcium carbonate was 10mg/kg, organic matter was 1.21%. Mean of total nitrogen was 0.061%, phosphorus 0.14mg/kg. Mean Potassium was 12.73mg/kg, calcium was 12.85mg/kg, magnesium was 65.41mg/kg, iron was 3022.10mg/kg, manganese was 101.63mg/kg, cadmium was 0.15mg/kg, copper was 2.06mg/kg, lead was 2.7x10^3. In the physicochemical properties, treatment effects revealed an increase in soil p^H to 7.97%, Total Nitrogen (TN) to a mean of 132.33%, phosphorus (P) 0.39mg/kg, magnesium (Mg)156.2mg/kg , iron (Fe)9518.1mg/kg and manganese (Mn) 1879.47mg/kg. In all the parameters analyzed, it can be inferred that there was a significant difference in the treatment effects on soil physicochemical properties. The study recommended that soils which have been acidic due to climate change and anthropogenic activities should be corrected with poultry manure that are alkaline in composition; poultry manure should be applied to sandy loamy soil to reduce heavy metal contents; Regular soil test and manure analysis.

Keywords: Climate change, Soil, physicochemical properties, vegetable farmland, poultry manure, region.

Introduction

Climate and soil interact and any change in climate will have an effect on soil contents and physicochemical properties because soils are connected to the atmospheric/climatic systems through the carbon, nitrogen and hydrogen cycles (Brevik, 2013). The intergovernmental panel on climate change (IPCC) reported that the average global temperature is likely going to increase between 1.1 and 6.4^{o}C by 2090-2099 as compared to 1980-1999 temperatures, with the most increase being between 1.8^{o}C and 4.0^{o}C. In many location, climate will influence precipitation pattern globally thereby changing the amount of precipitation received and its distribution over an average year. This situation will affect the environment including the soil (Brevic, 2012). Climate change is a situation in which a change in climate continues in one direction at a rapid rate and for an unusual long period of time (Akamigbo, 2011). The impact of climate change according to Akamigbo (2011) is associated with human factors, illiteracy, low level of technology applied to crop and animal production, type of soils and inadequate policy on climate change. Some of the impacts are, reduction in soil biodiversity, soil erosion, excessive soil wetness, high soil temperature, depletion of soil organic pool, and increased soil acidity. Climate change will threaten food production including vegetable farmlands under manure applications through its effects on soil physicochemical properties and processes.

Climate change have a major impact on soil physicochemical properties especially Carbon and nitrogen which are major components of soil organic matter (Brandy and Well, 2008). Organic matter is important for many soil properties such as its structure formation and maintenance, water holding capacity, cation exchange capacity and for the supply of nutrients to the soil ecosystem (Brevik, 2009). Soils with sufficient amount of organic matter tend to be more productive than soils that are depleted in organic matter. It was noticed earlier that increased atmospheric carbon(IV)oxide (CO_2) would lead to increased plant growth and the soil plant system would help offset increasing atmospheric CO_2 levels (Coughenow, and Chen, 1997; Hattenschwiller, et al., 2002). However, recent studies show that the CO_2 fertilization effect may not be as large as originally thought. As the climate changes, increasing levels of ozone may actually counteract the CO_2 availability, leading to

reduced plant growth under elevated CO_2 and the negative effects of increased temperatures on plant may also cancel out any CO_2 availability may take place.
Nitrogen limitations may negatively affect plant growth (Jarvis, et al., 2010; Zaehle, et al., 2010; and Hangate, et al., 2003). Through climate change and anthropogenic activities, many of our soil on the earth have become more susceptible to erosion by wind and/or water (Zhang, et al., 2004).
One of the basic necessities of man on the earth's planet is food and its production is largely dependent on the fertility of the soil and the management of soil fertility is pre-requisite for continuous food production and sustainability of soil resources (Iroegbu, 2021). Soil is the lose material that covers the land surface of the earth. It is a loose combination of organic and inorganic materials. The organic materials are composed of debris from plants, decomposition of many tiny life forms which inhabit the soil and also manure that is applied to the soil. Soils organic matter play a major role in moisture retention, helping crops to withstand drought, contributes to chemical and biological properties of the soil and also the source of exchange for nutrients, affects the physiology of applied pesticides and contributes to the physical properties of the soil.
In south western part of Nigeria, including the Port Harcourt region, nutrients deficiencies and imbalances are the main constraints to crop and vegetable production. Igwe (2009) and The type and amount of nutrients in poultry manures and the nutrients eventual availability to plants may vary considerably. Some factors affecting nutrient value of applied manure are type of ration fed, method of collection and storage, amount of feed, land preparation and/or water added, time and method of application, soil characteristics, the crop to which the manure is applied and climate change (Bolan, et al., 2004). Increasing levels of various elements (copper, arsenic, etc) and inorganic salts (sodium, calcium, potassium, magnesium, etc) in feed will increase their concentrations in manure. Poultry manure is usually quite dry (20-25% moisture) and can be spread easily (Wiedemann, 2015). There is concern about the potential toxic effects to plants of high concentrations of heavy metals and salts in soils as a result of high application rates of manure to the land. It is necessary for farmers to perform regular soil tests and manure analysis to monitor the balance of nutrients in the soil on their farms especially on the land receiving heavy manure applications. It is necessary that the farmers should limit the rate of manure application to the needs of crops grown on the land. Nutrient availability is affected by both physical and chemical factors, and will be different for each nutrient contained in the manure (Adekiya, et al., 2020). This noticed in nitrogen (25%) which is in ammonium form.
Organic matter and soil carbon are increasingly being recognized as critical to soil health and the long-term sustainability of farming systems. Soil organic matter (SOM) can be reliably increased using additives like poultry manure if applied regularly at higher rates (Warn, 2014). Organic matter amendments are particularly valued in broad core cropping systems where organic matter levels are difficult to maintain. To achieve increases in organic matter, fairly high rates of poultry manure need to be applied regularly. Due to the impact of climate change on soil properties, Poultry manure is ideal for capital inputs to boost fertilizer and soil health (Ndubuisi, 2021).

Naluba (2017) referred to region as the unit area formed by common geologic structure, soil, surface relief, drainage, vegetation and animal life.There has been indiscriminate use of mineral fertilizer without soil test. This has adversely affected the soil physical and chemical properties causing nutrient imbalance (Adeleye, et al., 2019). Moreover, the use of mineral fertilizers on the continuous basis in tropical soils has been associated with reduced crop yield, increased soil acidity and nutrient imbalance (Ojeniyi, 2002; Mbah and Mbagwu, 2006). However, over the years, there has been diverse improvement and modification in farming practices. Increasing cost of synthetic fertilizers have resulted in many farmers adopting poultry manure as substitutes for synthetic fertilizers. The use of this manure as an alternative to commercial fertilizers is promising as it simultaneously addresses the issue of rising costs of inorganic fertilizers and disposal of wastes from animal operations (Nahm, 2002). Poultry manure (PM) is a good option among organic manures which has the potential to provide nutrients for raising crops and improving soil fertility on sustainable basis (Noosheen, et al., 2021; Zydelis and Lazauskas, 2019; Dikinya and Mufwanzala, 2010). Under the present climatic condition in the region, Poultry manure (PM), not only extended the nitrogen (N) supply for a longer period, but also help in improving ion-exchange and water holding capacity of soil.

Benefits from higher rate of manure applications under the present climatic condition include: increased water holding capacity, improved soil structure and better infiltration. Manure supplies are broad complement of micronutrients especially for farming land that has been cropped continuously for long periods of time. It contains Sulphur, calcium, manganese, zinc and copper; all of which can be valuable for cropping and pastures. In addition to nitrogen and phosphorus, poultry manure contains trace elements like arsenic (As), copper (Cu), and zinc (Zn). Manures are best applied to crops such as corn, small grains and vegetables; in one dose just before soil tillage. But climate change will threaten crop production including vegetable farmlands under manure applications through its effects on soil physicochemical properties. A deteriorating environment of this nature caused by climate change puts man and other living components on the planet earth at risk. Therefore, examining impact of climate change on soil physicochemical properties of farmland under poultry manure applications in the Port Harcourt region is a way of monitoring soil qualities under the application of poultry manure. In spite of the works done by other researchers, dearth of information on the impact of climate change on soil physicochemical properties under manure application in the Port Harcourt region is lacking (Ndubuisi, 2021).
Therefore, the aim of this research is to examine the impact of climate change on soil physicochemical properties of farmlands under poultry application. The significance of this study is that since the study relates to climate change properties and farming, its findings will assist agricultural extension workers to understand more about the application of poultry manure to soil; the impact it will have on the environment and how it will also assist the farmers in the management of poultry manure given the present increasing climate change.

Materials and Methods

Geography of the study area

The region known as the Port Harcourt region is located between latitudes $4^{o}44^{I}58^{II}$N and $4^{o}56^{I}46^{II}$N and longitudes $6^{o}53^{II}$E and $7^{o}08^{I}37^{II}$E with an estimated land area of 664 square kilometers (Emenike and Orjinmo, 2017). The region lies along the Bonny River, 66 kilometers upstream from the Gulf of Guinea popularly known as the oil city. It is bounded in the East by the Otamiri/Imo River and on the West by New

Calabar River, North by Imo/Abia States and South by Degema/Bonny LGAs. Figure 1 shows the study area.

Port Harcourt region (Greater Port Harcourt) covers eight local government areas. They are Port Harcourt, Obio/Akpor, Okrika, Ikwerre, Oyigbo, Ogu/Bolo, Tai and Eleme Local Government Areas (Kpalap, 2020). The topography of the region consists of low lying plains generally less than 20m above sea level and gently in North-South direction to the sea. Its climate is tropical humid, influenced by land and sea breezes. The average temperature for every month is above 18^{o}C. The region experiences two seasons: the dry season (October to May) and wet season (April to October) with an annual rainfall averaging about 2500mm. Temperature within the region is constantly high with a mean maximum of about 34^{o}C and a mean minimum of about 21^{o}C with its peak between months of April and October. The sun is virtually overhead throughout the year. Daylight hours are longer because of the long duration of solar radiation. These climatic conditions have an influence on the physicochemical properties of the soil and soil processes which in turn affects the growth of plants and farming activities in the region.

The region consists of Deltaic plain soils which are formed in the wetland and upland areas. The wetland Deltaic soil has sand (75%) with low clay content which increases down the subsoil. Surface soil colors are brown or very dark grayish brown. Surface soils are well drained having no mottles. The soils are strongly acidic (p^{H} 4.5) but acidity decreases down the profile. Organic matter content is low (2.5%). The carbon to nitrogen ratio is fairly high. Generally, the soils of the region consist of reddish-brown sandy clay loam, brown sandy soil, ligule grew, slightly organic fine sandy soils, silt clay and dark organic clay soils (Igwe, 2021; Clifford, 2021). The eight local government areas constitute the population of the region with a 2020 projected population of 3,351,436 (Kpalap, 2020). However, for the purpose of this study, two local government areas were purposely taken representing 25% of the entire population. They are Port Harcourt local government area (Phalga) and Obio/Akpor LGA (Obalga) with a 2020 projected population of 3,019,981 at a growth rate of 2.7% (Igwe, 2021). Port Harcourt is the capital city and economic hub of Rivers State.

Research methodology

The study used experimental research design. First, we identified the experimental unit and the number of replicates that were used. Then, we examined how treatment levels were assigned to experimental units at random. This was done by listing the treatment levels and assigning a random number to each. By sorting out the random number, we produced a random order for application of the treatments to experimental units. The nature and sources of data was mainly through primary source and also from secondary sources. The sample frame for the study was gotten from 625m^2 of parcel of vegetable farmland which was divided into a grid system of 5x5 inside each 25m^2. Thus, 25 of smaller plots formed the sample frame for the study from which the sample was taken. By using four treatments with three replicates, the study used table of random numbers to select 12 samples. Twelve samples or experimental plots of (5 m x 5m) was selected from the sample frame. Four levels of treatments -0kg/25m^{2,} 50kg/25 m^2, 100kg/ m^2,and 150kg/m^2 of poultry manure were applied to the experimental plots. The method of data collection involved soils being collected 9 weeks after the application of poultry manure (treatment). The soil samples were collected at a depth of 0-30cm using the soil auger. This was done by taking 4 composite samples from each of the plots. The four composite samples were thoroughly mixed while a sample was taken for analysis for all experimental plots with a standard method for physicochemical parameters. The data acquired from the laboratory was subjected to Analysis of Variance (ANOVA) statistical techniques. The statistical software package used was IBM SPSS 20.0 version. The results obtained were presented in tabular form. Thus, the one-way analysis of variance (ANOVA) was employed to test for the hypothesis 1 (HO1): which states that there is no significant variation on poultry manure treatments on soil physical properties at depth of 0-30cm; and hypothesis 2 (HO2): which states that, there is no significant variation on poultry manure treatments on soil chemical properties at depth of 0-30cm.

Data presented on soils physico-chemical properties before poultry application showed mean clay content of 18.67%, silt of 5.60%, and sand of 75.73%. The textual class of the soils was sandy loamy. Soil pH is the most commonly measured parameter in soil investigation. It is also a major determinant of which species will grow well. This is because, it showed soil to be either acid, neutral or alkaline. From Table 1, mean soil pH prior to the application of manure was 5.06 indicating an acidic soil. The measurement of electrical conductivity (EC) is used as a means of appraising soil salinity. From the table, the soil EC ranged from 289 us/cm to 291 u/cm with means of 290 u/cm. Mean soil calcium carbonate is 10mg/kg. The soil organic matter ranged from 1.212% to 1.216% with mean of 1.21%. Estimates of soil organic matter (50m) are frequently based on organic carbon. This is expressed as organic matter (%) = total organic carbon (%) x 1.72. Total nitrogen ranged from 0.059% to 0.061% with mean of 0.061%. Available phosphorus is one of the key nutrients needed by plants.

Infarct, it is second to nitrogen. It is often determined to indicate supply of this element. In this study, soil phosphorus ranged from 0.13 mg/kg to 0.14mg/kg with mean of 0.14mg/kg. Soil potassium exists in the form of mineral k, exchangeable k and solution k. The primary source is from the weathering of minerals. Fertilizer additions also add to soil k and to lesser extent the mineralization of SOM. Potassium value from the soil ranged from 12.82mg/kg to 12.888mg/kg. Magnesium value of the soil ranged from 65.38mg/kg to 65.44mg/kg with mean value of 65.41mg/kg. Iron is a major component of most soils. Although widely distributed, iron deficiencies can occur due to its low solubility in alkaline (cancerous) soils and also in phosphate fixation. The soil is rich in iron and ranged from 3031.6mg/kg to 3032.9mg/kg with mean of 3032.10mg/kg.

Manganese is widely distributed in soils derived from igneous rock and sedimentary rocks. Its availability is generally highest in mild acid soils but can be very low in strongly acid peats. Manganese value in the soil ranged from 101.24mg/kg to 101.84mg/kg.

Measureable amounts of cadmium occurred in many soils and plant materials. It is introduced into the environment through its use in pigments, electroplating, galvanizing and allow manufacture. Cadmium in the soil ranged from 0.14mg/kg to 0.16 with mean value of 0.15mg/kg. Copper is generally in soil derived from igneous rocks and tends to be lower in extremely acid and alkaline soils. Copper value ranged from 2.06mg/kg to 2.07mg/kg. Lead ranged from 2.16mg/kg to 2.19mg/kg with mean value of 0.65mg/kg. Zinc level ranged from 4.27mg/ka to 4.41mg/kg with mean of 4.32mg/kg.

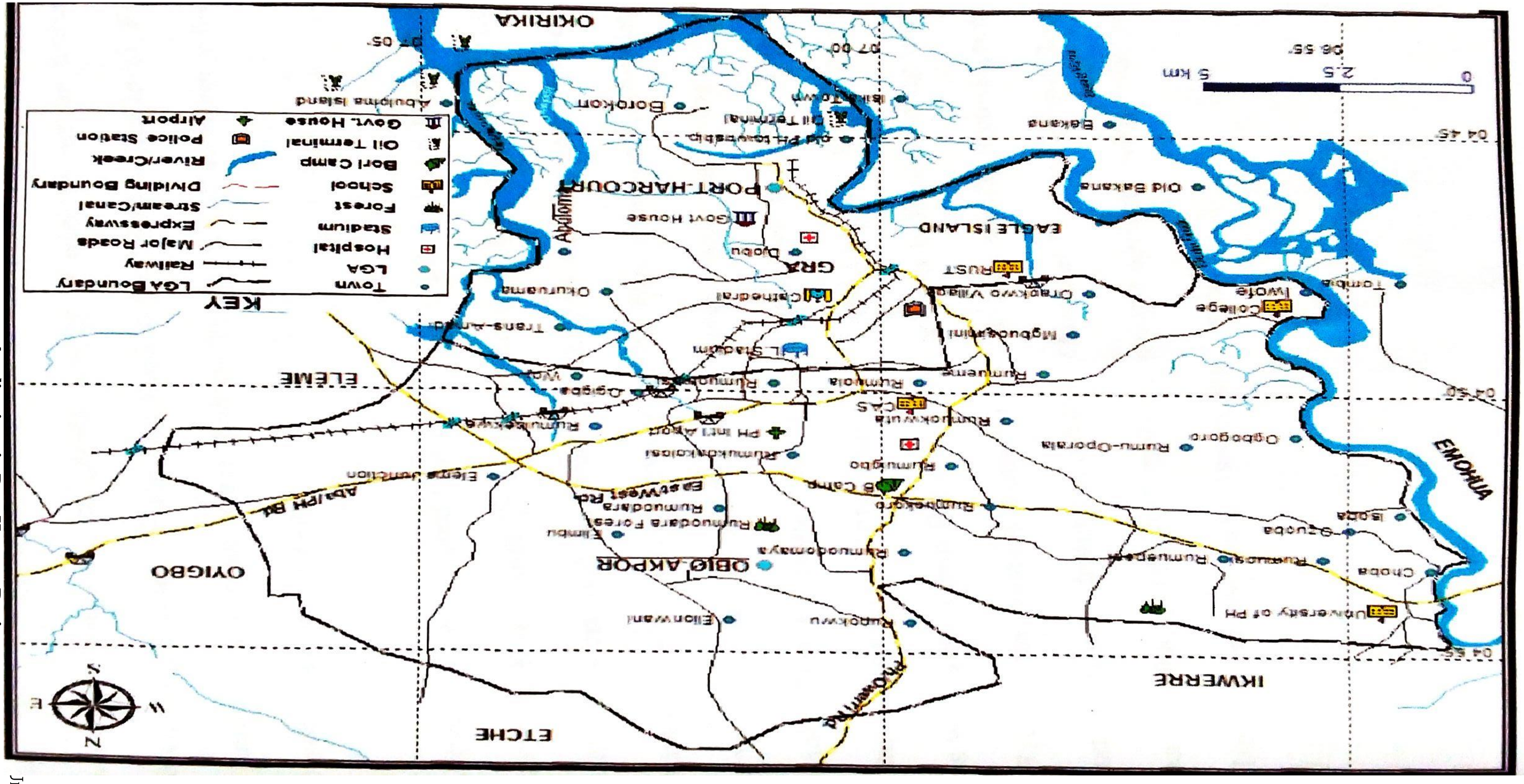

Figure 1: Map of Port Harcourt and Obio/Akpor Local Government Areas.
Source: Cartography and GIS, Dept. of Geography and Env. Mgt. UNIPORT.

Results and Discussion

Results of Initial Soil Properties

Table 1: Results of the soil properties before the application of poultry manure

Soil Properties	Unit	Value			Mean (Depth 0-30cm)
Clay	%	19	18	19	18.67
Silt	%	5.4	5.8	5.6	5.60
Sand	%	75.6	76.2	75.4	75.73
Textural Class		SL	SL	SL	
pH		5.06	5.08	5.05	5.06
Electrical Conductivity	(µs/cm)	290	291	289	290.00
$CaCO_3$	(mg/kg)	10	10	10	10.00
Organic Matter	%	1.214	1.212	1.216	1.21
Total Nitrogen	%	0.061	0.06	0.059	0.06
Phosphorus, P	mg/kg	0.14	0.14	0.13	0.14
Potassium, K	mg/kg	12.74	12.73	12.72	12.73
Calcium, Ca	mg/kg	12.82	12.86	12.88	12.85
Magnesium, Mg	mg/kg	65.44	65.38	65.4	65.41
Iron, Fe	mg/kg	3032.9	3031.6	3031.8	3032.10
Manganese, Mn	mg/kg	101.81	101.84	101.24	101.63
Cadmium, Cd	mg/kg	0.16	0.14	0.16	0.15
Copper, Cu	mg/kg	2.07	2.06	2.06	2.06
Lead, Pb	mg/kg	2.18	2.19	2.16	2.18
Nickel, Ni	mg/kg	0.62	0.68	0.64	0.65
Zinc, Zn	mg/kg	4.27	4.29	4.41	4.32
THB	CFU/g	2.6×10^3	2.8×10^3	2.66×10^3	2.69×10^3

SL – Sandy Loamy
THB- Total Heterotrophic Bacteria

Table 2: Results of Poultry Manure Nutrients Composition

Poultry Manure Composition	Unit	Value			Mean
Ph		8.39	8.34	8.56	8.43
Organic Carbon	%	39.39	39.19	39.27	39.28
Total Nitrogen	%	3.405	3.411	3.418	3.41
Phosphorus, P	mg/kg	0.23	0.25	0.23	0.24
Potassium, K	mg/kg	226.69	226.46	226.48	226.54
Calcium, Ca	mg/kg	2512.7	2513.2	2512.4	2512.77
Magnesium, Mg	mg/kg	111.3	111.1	111.2	111.20
CN ratio	mg/kg	11.57	11.37	11.48	11.47
Iron, Fe	mg/kg	579.15	579.3	579.26	579.24
Manganese, Mn	mg/kg	126.66	126.48	126.92	126.69
Cadmium, Cd	mg/kg	0.7	0.71	0.69	0.70
Copper, Cu	mg/kg	17.7	17.25	17.03	17.33
Lead, Pb	mg/kg	13.32	13.17	13.19	13.23
Nickel, Ni	mg/kg	6	6.01	5.99	6.00
Zinc, Zn	mg/kg	55.93	55.74	55.89	55.85

The results of table 2 showed the nutrients composition of poultry manure used in this study. The range of the manure pH was from 8.39 to 8.56 with mean of 8.43 indicating a moderately alkaline. Organic carbon ranged from 39.19% to 39.39% with mean of 39.28 /o and total nitrogen ranged from 3.405% to 3.418% with mean of 3.41%. Phosphorus (P) ranged from 0.23 mg/kg to 0.25 mg/kg with mean value of 0.24 mg/kg while potassium (K) ranged from 226.46 mg/kg to 226.69 mg/kg with mean of 226.54 mg/kg. Calcium ranged from 2512.4 mg/kg to 2513.2 mg/kg with mean values of 2512.77 mg/kg. Magnesium ranged from 111.1 mg/kg to 111.3 mg/kg with mean value of 111.20 mg/kg. Carbon/nitrogen (C/N) ranged from 11.37 mg/kg to 11.57 mg/kg with mean value of 11.47 mg/kg. Iron (Fe) ranged from 579.15 mg/kg to 579.3 mg/kg with mean values of 579.24mg/kg. Manganese ranged from 126.48 mg/kg to 126.92 mg/kg with value of 176.69mg/kg. Cadmium (Cd) ranged from 0.69 mg/kg to 0.71 mg/kg with mean value of 0.70mg/kg. Copper (Cu) ranged from 17.03mg/kg to 17.70mg/kg with mean value of 17.33mg/kg. Lead (Pb) ranged from 13.17mg/kg to 13.32 mg/kg with mean of 13.23 mg/kg. Nickel (Ni) ranged from 5.99mg/kg to 6.01mg/kg; while zinc (Zn) ranged from 55.74mg/kg to 55.93mg/kg with mean of 55.85mg/kg.

Hypothesis Testing

The following tables present data and results of the hypotheses testing on the effects of poultry manure on physico-chemical properties of the soil.

Table 3: Effect of Poultry Manure on Soil Physical Properties

Replicate	% Sand	% Silt	% Clay
R1	75.60	5.40	19.00
R2	75.40	5.60	19.00
R3	75.70	5.30	19.00
R1	75.30	5.40	19.30
R2	75.50	5.60	18.90
R3	75.60	5.30	19.10
R1	75.30	5.50	19.20
R2	75.40	5.40	19.20
R3	75.40	5.60	19.00
R1	75.60	5.40	19.00
R2	75.40	5.50	19.10
R3	75.30	5.60	19.10

Table 3 showed the results of various treatments i.e T_0: 0kg/25m^2; T_1:50kg/25m^2; T_2:100kg/25m^2 and T_3:150kg/25m^2 on soil physical properties. The significant of the treatment of (poultry manure) on the soil physical properties is shown in Table 3.

Table 3: Hypothesis 1

ANOVA

		Sum of squares	df	Mean Square	F	Sig.
Sand	Between groups	.012	2	.006	.266	.772
	Within groups	.198	9	.022		
	Total	.209	11			
Silt	Between groups	.022	2	.011	.780	.487
	Within groups	.125	9	.014		
	Total	.147	11			

Clay	Between groups	.015	2	.008	.529	.606
	Within groups	.128	9	.014		
	Total	.143	11			

At $\alpha = 0.05$, p-value = 0.772 for sand and since p-value > a, the researcher accepts H_0. Therefore, there is no significant variation on sand content due to the effect of treatment (poultry manure). The same applies to clay content as p-value = 0.606. However, there is significance variation on the silt content (p-value = 0.487).

The paired samples statistics shows the descriptive statistics for the variables, including the mean value. The Test of Homogeneity of the Variance shows the results from a Levene's test for testing the assumption of equal variances. This test is concerned with whether or not the variances of the categories are different from one another. The column (Sig.) shows the p-value for this test. If the p-value is larger than 0.05, we can use the suits from the standard ANOVA test. However, if the p-value is smaller than 0.05, it means that the assumption of homogeneity of variance is violated and we cannot trust the standard ANOVA Results. Instead, we focus on the results from the Welch ANOVA.

Since the p-value for the Levene's test in this study for sand and silt (0.002 and 0.001 respectively which was smaller than 0.05, we instead focus on the next table; Robust Tests of Equality of Means. The same principle as for the standard ANOVA test applies here: if the p-value (in the column Sig.) is smaller than 0.05. It is shown that only silt (0.305) value were smaller than p-value = 0.05. It means that we have a statistically significant variation (at the 5 % level) in our variable (silt).

Table 4: Effect of Poultry Manure on Soil Chemical Properties

Replicate	Ph	Nitrogen	Phosphorus	Potassium	Calcium	Magnesium	Iron	Manganese
R1	5.06	3.405	0.23	226.69	2512.7	111.3	579.15	129.66
R2	5.05	3.702	0.21	229.04	2542.4	124.4	568.12	127.63
R3	5.04	3.412	0.28	224.73	2533.12	110.84	581,02	128.21
R1	5.03	123	0.362	0.2	57.81	1883.8	3172.2	141.83
R2	5.04	125	0.359	0.6	55.23	1881.3	3163.8	143.25
R3	5.04	122	0.368	0.1	49.61	1889.5	3177.8	144.08
R1	5.04	126	0.381	0.19	38.92	1891.1	3177.5	155.7
R2	5.05	126	0.388	0.14	39.38	1884.4	3175.6	156.12
R3	5.03	127	0.389	0.12	37.91	1887.3	3170.9	153.48
R1	5.05	131	0.388	0.17	37.05	1899.3	3178.4	159.1
R2	5.05	132	0.392	0.12	36.94	1866.9	3180.2	154.38
R3	5.05	134	0.394	0.09	38.01	1872.2	3159.5	155.07

Table 4 showed the results of various treatment i.e T_0: 0kg/25m^2; T_1:50kg/25m^2; T_2:100kg/25m^2 and T_3:150kg/25m^2 on soil chemical properties. The significant of the treatment (poultry manure) on the soil chemical properties is shown in Table 5

Table 5: Hypothesis 2

ANOVA

		Sum of squares	df	Mean Square	F	Sig.
Ph	Between groups	.001	2	.000	.677	.532
	Within groups	.001	9	.000		
	Total	.001	11			

Nitrogen	Between groups	1.666	2	.833	.000	1.000
	Within groups	34633.924	9	3848.214		
	Total	34635.591	11			
Phosphorus	Between groups	.001	2	.000	.093	.912
	Within groups	.047	9	.005		
	Total	.048	11			
Potassium	Between groups	2.961	2	1.480	.000	1.000
	Within groups	115566.889	9	12840.765		
	Total	115569.849	11			
Calcium	Between groups	94.733	2	47.367	.000	1.000
	Within groups	13906123.027	9	1545124.781		
	Total	1390217.760	11			
Magnesium	Between groups	123.229	2	61.615	.000	1.000
	Within groups	7037559.717	9	781951.080		
	Total	7037682.946	11			
Iron	Between groups	59.063	2	29.531	.000	1.000
	Within groups	15172803.295	9	1685867.033		
	Total	15172862.358	11			
Manganese	Between groups	4.509	2	2.254	.013	.987
	Within groups	1520.605	9	168.956		
	Total	1525.113	11			

At α = 0.05, p-value = 0.532, 1.000, 0.912, 1.000,1.000, 1.000,1,000 and 0.987 for pH, nitrogen, phosphorus, potassium, calcium, magnesium, iron and manganese respectively and since all the p- values > a, the researcher accepts H_0. Therefore, there is no significant variation on chemical properties of the soil due to the effect of treatment (poultry manure).

The paired samples statistics shows the descriptive statistics for the variables, including the mean, standard deviation, confidence interval for the mean etc.

Discussion

4.1: Soil physicochemical properties before poultry manure application

A confirmation of Robust Tests of Equality of Means were performed which showed all variables were greater than p-value = 0.05 (0.400,1.000,0.900,1.000, 1.000, 1.000, 1.000, 0.988, for pH, nitrogen, phosphorus, potassium, calcium, magnesium, iron and manganese respectively. Since the p-value (in the column Sig.) is greater than 0.05, it means that we do not have a statistically significant variation (at the 5 % level) in our variables for soil chemical properties.

The soil physicochemical properties before the application of poultry manure shows a mean p^H value of 5.06 indicating an acidic soil. This is similar to the works of Nwite and Ake (2018). Soils that are neutral or slightly acidic are suitable for agriculture. Clay, silt, and sand were also high with values of 18.67%, 5.60% and 75.73% respectively. Soils electrical conductivity was also found to be high with mean value of 290μ/cm.

The study revealed that with the application of poultry manure, the p^H value increased with increasing rate of manure application. The highest p^H recorded was 7.97 at 50% application rate (T_5) and the least being 5.08 for control (T_1). The study is consistent with the study of Nwite and Ake (2018). The study showed that the organic carbon decreases from 39.39% to 7.249% with soil treatment (poultry manure). The study showed that soil total nitrogen increased from T_0: 0kg/25m^2 mean of 3.51% to T_3: 0kg/25m^2 mean of 132.33%. this result is consistent with the works of Fatin, et al., (2019) and Nwite and Alu (2018). The study found the significant difference between the means of some groups as seen in the Table. Soil phosphorus (P) increased from T_0: 0kg/25m^2 mean of 0.24mg/kg to T_3: 0kg/25m^2 mean of 0.39mg/kg. This study found significant difference between the means of some groups. Soil potassium (K) decreased drastically from T_0: 0kg/25m^2 mean of 226.82mg/kg to T_3: 0kg/25m^2 mean 0.13mg/kg. Soil calcium (Ca) also declined linearly from T_0: 0kg/25m^2 mean of 2529.41mg/kg to T_3: 0kg/25m^2 mean 37.33mg/kg. Soil magnesium (Mg) increased from T_0: 0kg/25m^2 mean of 1879.47mg/kg mean of 115.51mg/kg to T_3: 0kg/25m^2 mean of 1879.47mg/kg. This result is consistent with the works Ewulo and Sanni (2015). Soil iron (Fe) increased from T_0: 0kg/25m^2 mean of 1728.29mg/kg to T_3: 0kg/25m^2 mean 9518.1mg/kg. this result is consistent with the works of Fatin et al (2019) and Nwite and Alu (2018). Significant differences were also found between the averages of some groups. Soil manganese (Mn) increased from T_0: 0kg/25m^2 mean of 128.5mg/kg to T_3: 0kg/25m^2 mean of 156.2mg/kg. This study found significant difference between the means of some groups and is consistent with the works of Fatin, et al., (2019) and Nwite and Alu (2018).

The study shows that although climate change may lead to corresponding changes in soil physicochemical properties and processes, the application of poultry manure to the farm will help to improve the soil condition of vegetable farmland and eventual improvement on food production on the farmlands of the region.

Conclusion and recommendation

Climate and soils interact. Soils are linked to the atmospheric/climatic systems through the carbon, nitrogen and hydrological cycles. For this reason, climate change will have an impact on soil physicochemical properties and processes. The aim of this study was to examine the impact of climate change on soil physicochemical properties under vegetable farmland application in the Port Harcourt region of Rivers State, Nigeria. The study revealed that even though climate change will have significant impact on soil physicochemical properties which will in turn threaten food production, the application of the poultry manure will help to improve the soil condition of cultivated vegetable farmlands which will in turn boost food production. Based on these, the study made the following recommendations:

1. Soils which are acidic in nature due to climate change should be corrected with poultry manure that are alkaline in composition.
2. Poultry manure should be applied to sandy loamy soils to reduce heavy metal contents.
3. Since climate change may alter soil properties, the policy makers (government), relevant agents, agricultural extension workers, and the Ministry of Agriculture should identify the regions concerned, and plan and send trained field workers that will assist the farmers to perform regular soil tests and manure analysis to monitor the balance of nutrients in the soil on the farms.
4. Integration of organic fertilizer (poultry manure) is recommended for environment friendly sustainable agriculture.
5. Farmers should limit the rate of manure application to the needs of the crop grown on the land.

References

Adeleye, E.O., Ayeni, L.S. and Ojeniyi, S. O. (2019). Effect of poultry manure on soil physico chemical properties, leaf nutrient contents and yield of yam (Dioscorea rotundata) on Alfisol in SouthWestern Nigeria. *Journal of American Science*. 6(10):871-878

Adekinya, A. O.; Agbeda, T. M.; Ejue, W.S.; Aboyesi, C. M.; Dunsin O.; Aremu, C. O.; Awolabi, A. O.; Akinlola, D. F. and Adesola, O. O. (2020). Biocha poultry manure and NPK fertilizer: sole and combine effects on soil properties and ginger (Zingiber officinale Roscoe) performance in tropical Alfisol. *De gruyter,* 5, 30-39.

Akamigbo,G.N. (2011).Climate change and Nigerian soils: vulnerability, impact and adaptation. African Agro Science Journal. Doi.4314/as.vi1.68723.

Brady, N. C.and Well, R. R. (2008). *The nature and properties of soils.* 14th USA Perason printicehall, upper saddle river.

Brevick, E. C. (2013). The potential impact of climate change to soil properties and processes and corresponding influence in food security. *MDPI: Agriculture* 2013, 3(3) 398-417. https://doi.org/10.3390/agriculture3030398

Brevick, E. C. (2012). Soils and climate change. Gas fluxes and soil processes. *Soil horizon* p. 53 (google scholar) (cross ref).

Brevick E. C. (2009). Soil health and productivity. *In soils, plant growth and crop production.* Uerheye, W. Ed., *encyclopedia of life support systems (EOLSS). Development under the auspices of the UNESCO.* EOLSS publishers. Oxford, UK.p, 69.

Bolan, N. S.; Adriano, D. C. and Mobimairaja, S. (2004). Distribution and bioavailability of trace elements in livestock and poultry manure by-products. *Critical reviews in environmental science and technology*. 34: 291-338.

Clifford, A. B. (2021). *The impacts of urban land use on soil characteristics in the Port Harcourt metropolis.* Unpublished Ph.D Thesis, PGS, IAUE, Port Harcourt.

Coughenow, M. B.; Chem, D.X.(1997). *Assessment of grassland ecosystem responses to atmospheric*

change using linked plant-soil process *models.* Ecol.,802-827 (google scholar).
Dikinya, O. and Mufwanzela, N. (2010). Chicken manure enhanced soil fertility and productivity; effects of application rates. *Journal of Soil Science, Environment and Management.* 1:46-54.
Emenike, G. C. and Orjimo, C. (2017). Vehicular emmissions around bus stops in Port Harcourt metropolis, River State, Nigeria. *European Journal of Research in Social Sciences* 5(3): 2056-5429.
Ewulo, B. S. and Sanni, K. O. (2015). Effects of poultry manure, NPK 15-15-15 fertilizer and their combination on vegetation growth and yield parameter of tomato (Lycopersicon esculentun var Mill*). New York science journal*. 8(4), 28-33.
Hattenschwiller, S.; Handa, I. T.; Egli, L.; Assholf, R.; Ammon, W. and Korna, C. (2002). Atmospheric CO_2 enrishment of alphine tree conifers. *New phetol.* 156, 363-375.
Hungate, B. A.; Dukes, J. S.; Shaw, M. R.; Luo, Y.; Field, C. B. (2003). *Nitrogen and climate change.* Science 2003, 302, 1512-1513.
Igwe, D. (2009). *Perspectives on regional development planning*. Port Harcort. Ikogho Purblishers. p.51.
Igwe, A. A. (2021). *Geo-spatial analysis of the impacts of urbanization-induced activities on pollution stautus of Port Harcourt metropolis, Rivers State.* Unpublished Ph.D thesis, PGS, IAUE, Port Harcourt. Pp. 136-138
Iroegbu, C. S., Asawalam, D. O., Dada, O. and Orji, J. E. (2021). Effect of agricultural wastes on some soil physicochemical properties of aerosol, growth parameters and yield of cocoyam (Xanthosom amafafa) at Umudike, South Eastern Nigeria*. African Journal of Agricultural Research (AJ)*. 16(7). 952-962.
Jarvis, A.; Ranivez, J; Anderson, B.; Leibing and C. Aggarwal, P. (2010). *Scenerios of Climate change and crop production.* Reynolds, M. P. Ed; C. P. I. Anthony Rowe; Chippenham, UK. pp 9-37.
Kpalap S. B. S. (2021). *Evaluation of commuters' perceptions of public and private road transit firms efficiency in Port Harcourt region.* Unpublished Ph.D thesis, PGS, IAUE, Port Harcourt. pp.157-139.
Mbah, C. N. and Mbagwu, J. S. C. (2006). Effect of animal wastes on physico-chemical properties of a dystric leptosol and maize yield in Southern Nigeria. *Nigerian Journal of Soil Science*. 16: 96-103
Naluba, G.N.(2017). Repositioning environmental sustainability in the cites of the Niger Delta sub- region of Africa. *Journal of Social Sciences.* Ignatius Ajuru University of Education, Port Harcourt.14 (1): 69 78.
Nahm, K. H. (2002). Efficient feed utilization to reduce pollutants in the poultry and swine manure. *Critical Reviews in Environmental Science and Technology*. 32: 1-16.
Ndubuisi, A. L. (2021). *Soil physicochemical properties of vegetable farmland under poultry manure applications in Port Harcourt Metropolis.* Unpublished P.hD Thesis. Post Graduate School. Ignatius Ajuru University of Education, Port Harcourt. pp.158-163.
Noosheen, Z.; Muhammad, J. A.; Mahmood, T. M., Syed, Z. A. S.; Sundas, J. H.; Hussan A. K.and Muhammad, I. A. R. (2021). Integrated effect of urea and poultry manure on growth, yield and post-harvest quality of cucumber (Cucumis sativus). *Asian Journal of Agriculture and Biology* (1).381: 1-9.
Nwite, J. N. and Alu, M. O. (2018). Evaluation of different rates of poultry manure on soil properties and grain yield of maize (Zea mays) in a typical Haplustult in Abakaliki, South Eastern Nigeria. *Global Journal of Agricultural Research*. 6(4): 24-35.
Ojeniyi, S. O. (2002). *Soil Management, Natural Resources and Environment.* Ibadan, Ademiran press. pp. 30.
Warn, L. (2014). *Poultry litter: alternative fertilization for pastures and way to increase soil organic carbon.* RIRDC publications. RIRDC project no. PRJ-00669, RIRDC, Canberra. p. 14
Wiedeman, S. G. (2015). *Land application of chicken litter: a guide for users.* Rural industries research and development corporation of Australian government. P.62.
Zaehle, S.; Friedlingsten, P and Friend, A. D. (2010). Terrestrial nitrogen feedbacks may accelerate future climate change. *Geophysics Res*. Lett. P.37.
Zhang, X. C.; Nearing, M. A.; Garbrecht, J. D.and Steiner, J. L. (2004). Downscaling monthly forcasts to stimulate impacts of climate change on erosion and wheat production. *Soil Science SOC.*AM. J. 2004. 68: 1376-1385.
Zydelis, R.; Lazauskas, S. U. (2019). Effect of organic and mineral fertilizers on maize nitrogen nutrition indicators and grain yield. *Zemdirbyste Agriculture*. 106(1):15-20.