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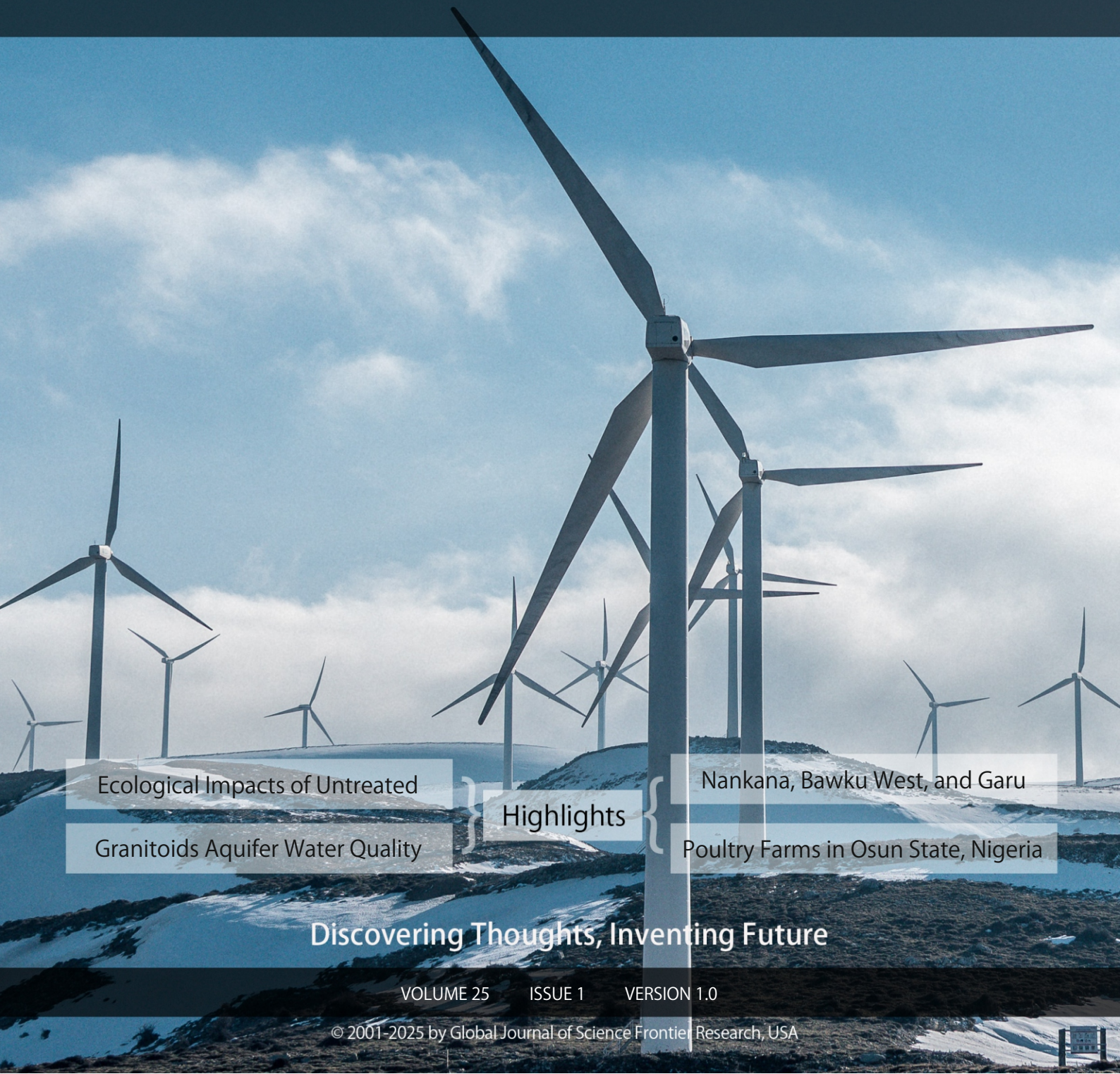

Highlights

Ecological Impacts of Untreated Granitoids Aquifer Water Quality

Nankana, Bawku West, and Garu Poultry Farms in Osun State, Nigeria

Discovering Thoughts, Inventing Future

VOLUME 25 ISSUE 1 VERSION 1.0

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Granitoids Aquifer Water Quality Appraisal in Kassena Nankana, Bawku West, and Garu Tempane Districts in Ghana

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Granitoids Aquifer Water Quality Appraisal in Kassena Nankana, Bawku West, and Garu Tempane Districts in Ghana

Albert Acheampong [α], Geophrey K. Anornu [σ], Gibrilla Abass [ρ] & Augustine Kofi Asante [ω]

Abstract- The most valuable natural resource on Earth is groundwater, which serves more than two billion populaces as a drinking water source worldwide. Despite its vital importance, groundwater has faced significant challenges, particularly in terms of its quality. Therefore, a thorough understanding of groundwater hydrogeochemistry is essential to assess the water needs for domestic use and irrigation use. This research evaluates groundwater quality in granitoid aquifers in the Kassena Nankana, Bawku West, and Garu Tempane districts of Ghana. An integrated approach was used, incorporating The World Health Organization (WHO), the Water Quality Index (WQI), and irrigation indices to offer recommended values for domestic and irrigation purposes. The study utilized a total of 121 groundwater quality reports obtained from the research area's many boreholes. The integrated findings based on the WHO guideline values, WQI, and irrigation indices indicate that nearly 100% of the researched area's groundwater has splendid drinking water quality, while 92% is suitable for irrigation. An extensive groundwater quality evaluation has been conducted in the study area, offering valuable information that can contribute to the studied area's groundwater management and development sustainably.

Keywords: appraisal, aquifers, ghana, granitoid, irrigation indices, water quality index.

I. Introduction

The most important natural resource on Earth is groundwater. Groundwater makes up more than 96% of the available freshwater (Fetter, 2001). It serves more than two billion populaces as a drinking water source worldwide (Carrard *et al*., 2019). Therefore, to achieve Sustainable Development Goal 6, which seeks to ensure that everyone has access to clean and safe drinking water, sustainable exploitation of groundwater must be actively pursued. Approximately 70% of Ghana's populace relies on groundwater due to its generally suitable quality, cost effectiveness, and lower susceptibility to pollution (Akurugu *et al*., 2020). This is the primary source of water for domestic, agricultural, and industrial activities. In these arid zones of Ghana, which have less rainfall with extreme temperatures, there is a heavy reliance on groundwater due to urbanization and intensive agricultural activities.

While groundwater quality is generally considered to be safe, it is essential to conduct thorough hydrogeochemical and hydrogeological assessments of aquifer characteristics in these regions (Acheampong *et al*., 2024). This ensures the water is of the desired quality for domestic use, irrigation, and industrial purposes. Several factors in literature, such as the extent of chemical decomposition, geology, replenishment of water quality, and rock-water interaction, have been identified as influencing groundwater quality (Abanyie *et al*., 2023).

The current study evaluates the quality of groundwater in the Kassena Nankana, Bawku West, and Garu-Tempane districts of Ghana, specifically for domestic and irrigation use. Access to safe water is crucial for minimizing health risks and increasing agricultural productivity, which, in turn, contributes to economic empowerment. The study findings provide a valuable resource for exploring groundwater resources in these three districts for domestic and irrigation purposes.

II. Methodology

a) Study Area Description

Bawku West, Garu Tempane, and Kassena Nankana districts in Ghana's Upper East region were the sites of the study (Figure 1). The "Sudan Savannah climate region," in which these districts are situated, is distinguished by high temperatures and evapotranspiration (Yiran *et al.,* 2016).

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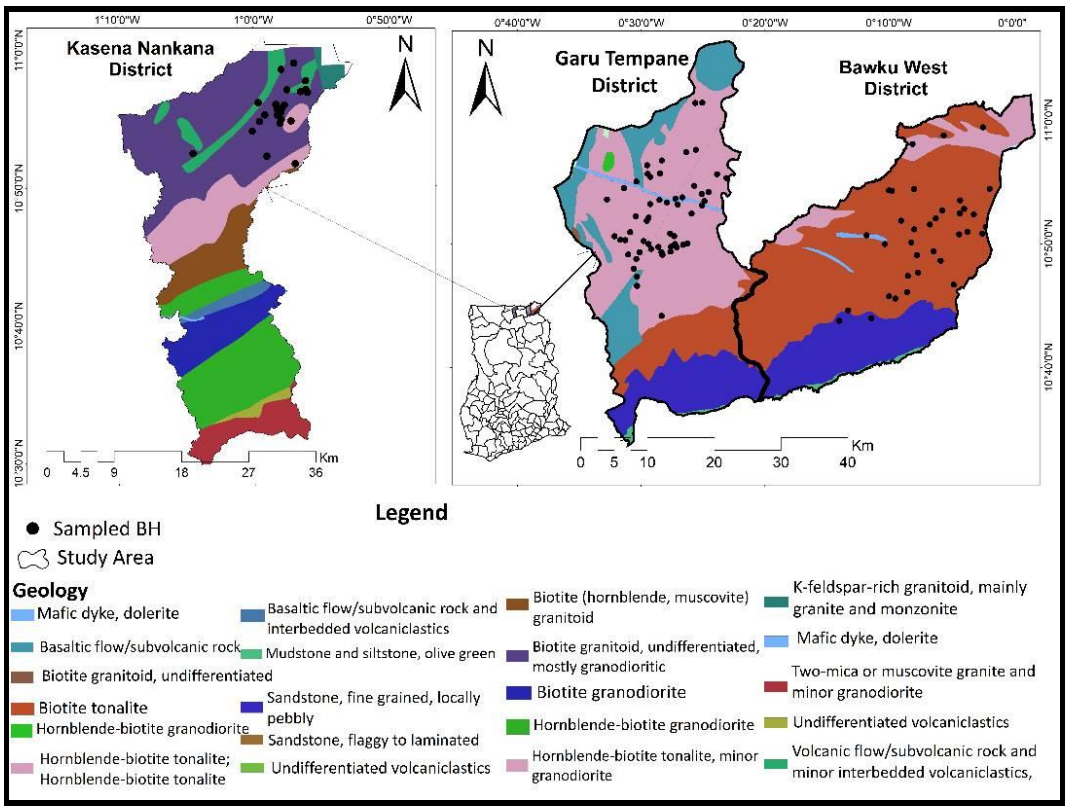

Figure 1: The Study Area Geology Map with Boreholes Sampled

The research region experiences a long dry season that lasts for six to eight months every year, along with an unimodal rainfall pattern that lasts for four to six months (Ghana Meteorological Agency, 2020): May – June to September–October respectively. On average each year, the rainfall amount varies from 800 to 860 mm. The Ghana Meteorological Agency (2020) reports that March through April recorded 40˚C (the monthly maximum mean temperature), while December through January had 18˚C (the minimum average temperature). The interior savannah according to the Ghana Meteorological Agency (2020) records the minimum rainfall amount. Groundwater is the most practically and economically viable source of clean drinking water for the remote and rural communities in these areas because of the dry climate conditions in the study area (Zakaria *et al.,* 2020; Dapaah-Siakwan and Gyau-Boakye, 2000). The study area's primary livelihood is centred around agriculture, with the local population relying heavily on groundwater for irrigation and domestic needs daily.

According to the Geological Survey of Ghana (2009), (granitoid of the "Tamnean" Plutonic Suite) igneous rocks underlie the study area. This includes minor granodiorite, quartz diorite and tonalite. Hardpan: lateritic sandy gravels in a fully cemented clay matrix, make up the majority of the topsoil. There is a micaceous layer underneath this regolith, a mixture of quartz gravels and sand with silt. Granitoids make up the bedrock, claims Acheampong *et al.* (2024). With a few exceptions, the study area's groundwater depth is comparatively shallow, ranging from 12 to 25 meters below the surface of the earth (Acheampong, 2017). Three layers of the district profile - topsoil, regolith, and bedrock have been confirmed by previously drilled logs, which have been drilled down to a depth of up to 50 meters.

b) Water Sampling and Quality Testing

Results of water quality tests were gathered and examined for groundwater samples drawn from 121 boreholes in the research area. The non-governmental organizations and public institutions ran these water quality tests from 2014 to 2021. The groundwater sampling and water quality testing followed the standard protocols proposed by Appelo and Postma (2005) and APHA (1995). The portable HQ40d18 series meter was used to take field readings of electrical conductivity (EC), total dissolved solids (TDS), and pH.

The dominant cations (Ca^{2+}, Na^{+}, Mg^{2+}, and K^{+}) and dominant anions (HCO_3^{-}, NO_3^{-}, Cl^{-}, and SO_4^{2-}) were analyzed at the laboratory of the Water Research Institute (WRI), Accra. The Flame Photometer was used to take the concentrations of $Na^{+}$and K^{+}, while Atomic Absorption Spectrometry (AAS) was used to determine the concentrations of Ca^{2+} and Mg^{2+}. Cl and HCO_3- concentrations were measured using titrimetry, SO_4^{2-} was determined using an Ultraviolet Spectrometer, and NO_3^{-}concentrations were estimated using the Brucine reagent.

c) Data Analyses

Using the anion-cation balanced technique, the water quality results accuracy was checked. This technique postulates that quality water ought to have a neutral charge. Using Equation 1, the charge balance error (CBE) was calculated:

$$\text{CBE} = \frac{(\sum|\text{C}| - \sum|\text{A}|)}{(\sum|\text{C}| + \sum|\text{A}|)} \times 100 \quad (1)$$

Where:

$\sum|C|$ is the cations summation, and
$\sum|A|$ is the anions summation.

Sixty per cent of the computed CBE figures were within the acceptable limit of ±5 to ±10 %. Based on this, the results were deemed suitable for use in the study. The water quality data was spatially analysed with the ArcGIS 10.3.1. The ArcGIS software allows for the interpolation of various derived water quality indices and groundwater quality parameters specific to the study area. Kriging, a commonly used interpolation technique in similar research (Asare *et al.,* 2021; Kawo and Karuppannan, 2018), was employed.

i. *Groundwater Quality Appraisal for Domestic use*

The data was analyzed statistically using the Statistical Package for the Social Sciences (SPSS). The MS Excel® spreadsheet was used to prepare the data for analysis, and then it was transferred to SPSS to determine the descriptive statistics. The water samples' quality was assessed by calculating their Water Quality Index (Horton, 1965). The Water Quality Index (WQI) is generally employed to evaluate groundwater quality (Boateng *et al*., 2016; Patel *et al*., 2023; Zotou *et al*., 2018; Zhang *et al*., 2020; Chegbeleh *et al*., 2020).

This technique assesses the effect of comparative physicochemical parameters on groundwater with its overall health hazard. The goal is to simplify complex water quality results and make them more easily understood and applicable to everyone. After reviewing the literature and considering each parameter's significance in the quality of groundwater, weights were given, with higher weights given to the most significant parameters. Bicarbonate, which has minimal influence on quality evaluation, was assigned the least weight of one (1). A weight of two (2) was assigned to calcium and magnesium because they have a low impact on water quality. EC, pH, Cl^-, and SO_4^- were given weights of four (4) due to their moderate influence on drinking water quality assessment (Tiwari *et al*., 2014).

Nitrate was assigned the highest weight of 5 because it is the most significant factor in water quality evaluation (Boateng *et al*., 2016; Srinivasamoorthy *et al*., 2008). The WHO (2017) guideline values, along with the assigned weights (Wi), are presented in Table 1. Equation (2) was utilized to calculate the relative weight (Wr):

$$Wr = \frac{wi}{\sum_{i=1}^{n} wi} \quad (2)$$

Where:
*Wr (*relative weight),
*wi (*every physicochemical parameter weight), and
*n (*number of parameters used).

Table 1: Parameters With Given Weights for WQI Calculation

Parameter	pH	EC	Ca^{2+}	Mg^{2+}	NO3-	HCO_3^-	SO42-	Cl^-
WHO GV	6.5-8.5	750	75	50	50	200	250	250
Weight (W_i)	4	4	2	2	5	1	4	4

Every parameter quality rating (Qr) was computed per the guidelines of WHO (2017) using Equation (3):

$$Qr = \frac{Ci}{Si} x\ 100 \quad (3)$$

where Qr (quality rating), Ci (concentration of the ith chemical parameter in mg/L), and Si (WHO 2017 guideline value for the ith chemical parameter). Every groundwater sample WQI was subsequently calculated using Equation (4) and classified using Table 3.

$$WQI = \sum_{n}^{i=1} WrQr \quad (4)$$

ii. *Groundwater Quality Assessment for Irrigation*

The water irrigation water quality was evaluated through three irrigation indices - Sodium Adsorption Ratio (SAR), Permeability Index (PI), and Soluble Sodium Percentage (Na%). SAR and soluble sodium percentage (Na%) are commonly employed in determining groundwater appropriateness for sustaining plant growth and crop yields (Asare *et al*., 2021). SAR measures the ratio of sodium ion (Na^+) to calcium ion (Ca^{2+}) and magnesium ion (Mg^{2+}) in the water extracted, making it a crucial index for evaluating groundwater for irrigation purposes (Asare *et al*., 2021). SAR values were calculated for all the samples using Equation (5):

$$SAR = \frac{Na^{+}}{\frac{\sqrt{(Ca^{2+}) + Mg^{2+}}}{2}} \quad (5)$$

With all ion concentrations in meq/L.

Irrigation water with a higher sodium ion (Na^{+}) content can displace Ca^{2+} and Mg^{2+} in soils, resulting in soil formation loss. This, in turn, reduces the potential of the soil in stable aggregate formation (Anim-Gyampo *et al*., 2018). Moreover, it can also decrease the soil's infiltration and permeability capacities, negatively impacting crop yield. In this study, this relationship was evaluated using the following assessment:

$$Na\% = \frac{(Na^{+} + K^{+})}{Ca^{2+} + Mg^{2+} + Na^{+} + K^{+}} \times 100 \quad (6)$$

In the literature, several studies have shown that long-term use of certain groundwater, particularly groundwater high in minerals, can gradually change the soil permeability over time (Khalid, 2018; Doneen, 1975). This alteration in soil permeability is a result of extensive irrigation with large quantities of water containing calcium (Ca), bicarbonate (HCO_3^-), sodium (Na), and magnesium (Mg), which leads to waterlogging, increased alkalinity, and salinity. The groundwater permeability index (PI) assessment in this study was conducted using Equation (7) as described by Doneen (1975).

$$PI = \frac{Na + (HCO_3)}{Mg + Na + Ca} * 100 \quad (7)$$

Concentrations of ions in meq/L.

III. Results and Discussion

a) Physicochemical Parameters

The chemical analysis results reported in Table 2 show that the pH ranges from 5.5 to 7.9, and a mean of 7.0. Approximately 90% of the sampled water has a pH below 7.5, indicating that the water samples are slightly acidic, as shown in Figure 2. The recorded minimum pH values in the samples may be attributed to the granitoid geologic formation found in the study area, which mainly produces acidic groundwater. Specifically, Tempeligo and Yelwoko Agbaribeugo, both in the Bawku West District, recorded pH values of 5.5 and 5.6, respectively. Overall, the study area's pH in the groundwater is deemed appropriate for domestic use. However, for the two outliers with very low pH levels, neutralizing filters containing calcium carbonate or magnesium oxide can be used to make the water safe for consumption.

The water samples in-situ electrical conductivity (EC) varied from a low value of 12.73 µS/cm (at Kameaga, Bawku West District) to a high value of 1,503.64 µS/cm (in Atibabisi, Kassena Nankana East District), and a mean of 326.08 µS/cm. Approximately 95% of the sampled groundwater (Figure 3 and Table 2) falls in the acceptable WHO (2017) drinking water guideline values in terms of EC. Ramesh and Elango (2011) reported that the EC value changes could be dependent on factors such as man-made activities, rock-water interaction, evaporation, silicate decomposition, and ionic exchange. About 5% of the EC values recorded in Bawku West and Kassena Nankana East Districts (Figure 2) exceeded the allowable limits set by the WHO (2017) guidelines, which can be rock-water interaction or silicate weathering.

Table 2: Measured Parameters Statistical Analysis

Parameter	Min	Max	Mean	SD	WHO Guideline Values (GV)	% above WHO GV
pH	5.53	7.92	6.99	0.43	6.5 - 8.5	9.92
EC (µS/cm)	12.73	1503.64	326.08	198.33	750	4.96
Cl^- (mg/L)	0.04	11.27	0.31	1.04	250	0.83
SO_4^{2-}(mg/L)	0.00	7.26	0.27	0.73	250	0.83
HCO3 -(mg/L)	0.11	4.83	1.64	0.92	200	5.79
NO_3^- (mg/L)	0.00	1.13	0.10	0.18	50	0.85
Na^+ (mg/L)	0.02	5.27	0.88	0.84	200	0
K^+ (mg/L)	0.00	0.51	0.05	0.06	100	0
Ca^{2+} (mg/L)	0.00	5.47	0.75	0.98	75	1.65
Mg^{2+} (mg/L)	0.01	3.81	0.71	0.70	50	0

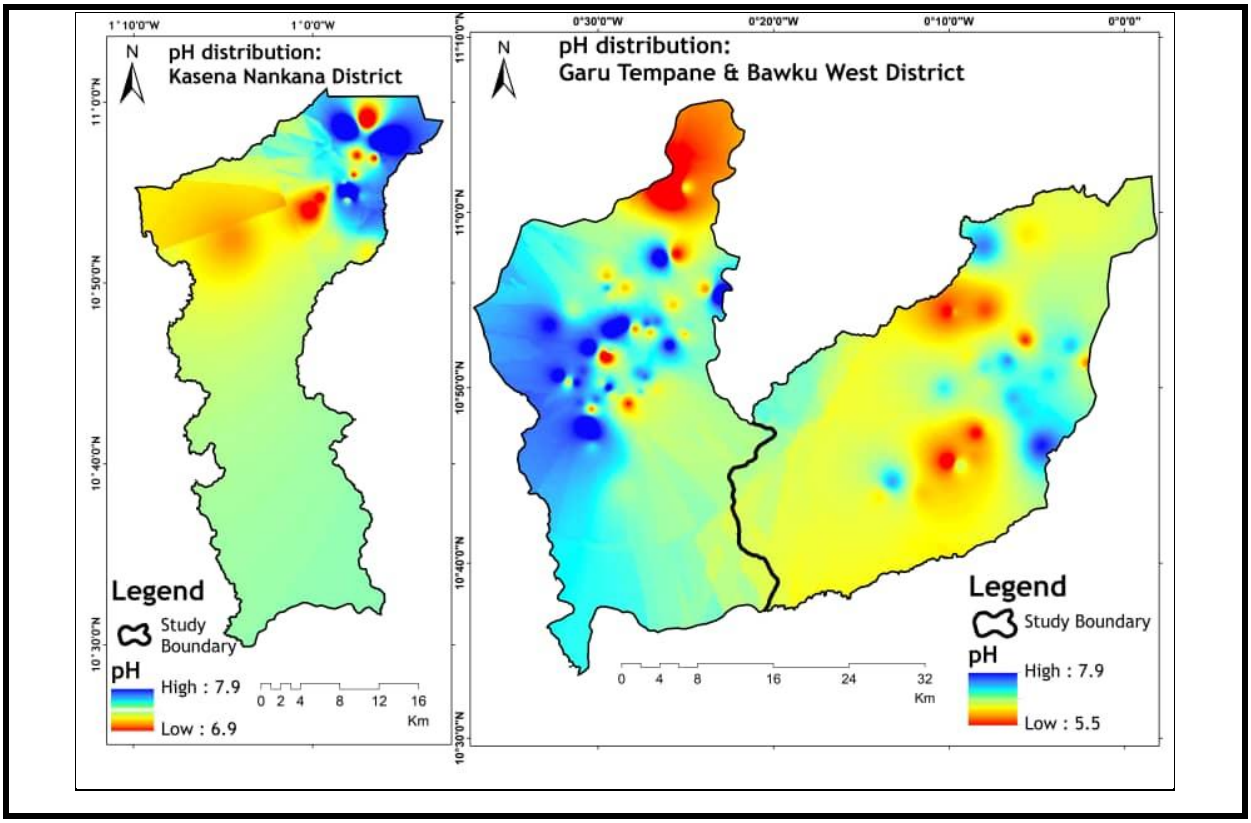

Figure 2: Groundwater pH Distribution of Study Area

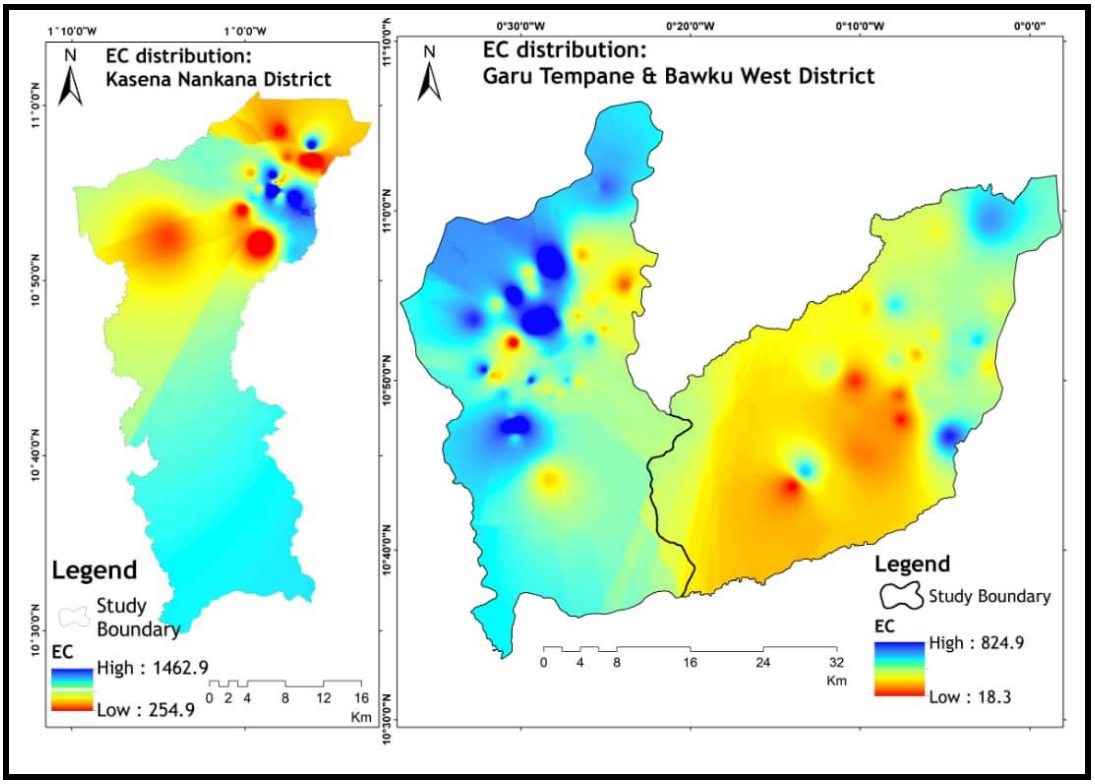

Figure 3: Groundwater Electrical Conductivity Distribution of Study Area

All the dominant ions measured were generally within the allowable limits for potable water according to the guidelines of WHO (2017). The major cation was Na^+, while HCO_3^- was the major anion (Table 4.2). Based on the mean values computed, the order of ions occurrence in the analyzed samples is $Na^+ > Ca^{2+} >$

Mg^{2+} >$K^{+}$for cations, and HCO_3^- > Cl^- > SO_4^{2-} > NO_3^-. $Na^{+}$for anions. $Na^{+}$is commonly found in water, plants, foods, and soils, and it is the most abundant cation within this area.

The study area's sodium ion distribution is shown in Figure 4. The presence of maximum levels of sodium ionsindicates the existence of young or recharging waters. Sodium ions can naturally occur through the weathering of albite (plagioclase feldspar), the dissolution of halite and clay, as well as from sources such as seawater intrusion, and municipal and agricultural waste (Srinivasamoorthy *et al*., 2008). The study area's prevalent minerals are Na-rich feldspars, specifically albite, due to the underlying geology (Anim-Gyampo *et al*., 2018). Therefore, the decomposition of albite could result in the release of sodium ions into the soil, which can then enter the groundwater. This study area is located away from the ocean, waste sites, and halite deposits, and is underlain by granitoids. Thus, the decomposition of the albite (silicate mineral) is likely the primary origin of sodium within this area. Equation 8 illustrates the chemical reaction involved in the decomposition of albite and the generation of sodium ions.

$$2NaAlSi_3O_8 + 2H^+ + 11H_2O \longrightarrow Al_2Si_2O_5(OH)_4 + 2Na^+ + 4H_4SiO_4 \quad (8)$$

(Albite) (Kaolinite) (Silicic acid)

According to the WHO (2017) guideline values, all of the groundwater studied has permissible concentrations of $Na^{+}$for potable water consumption. Therefore, it is desirable for human use, as sodium is an essential nutrient for good health when present in sufficient amounts in water.

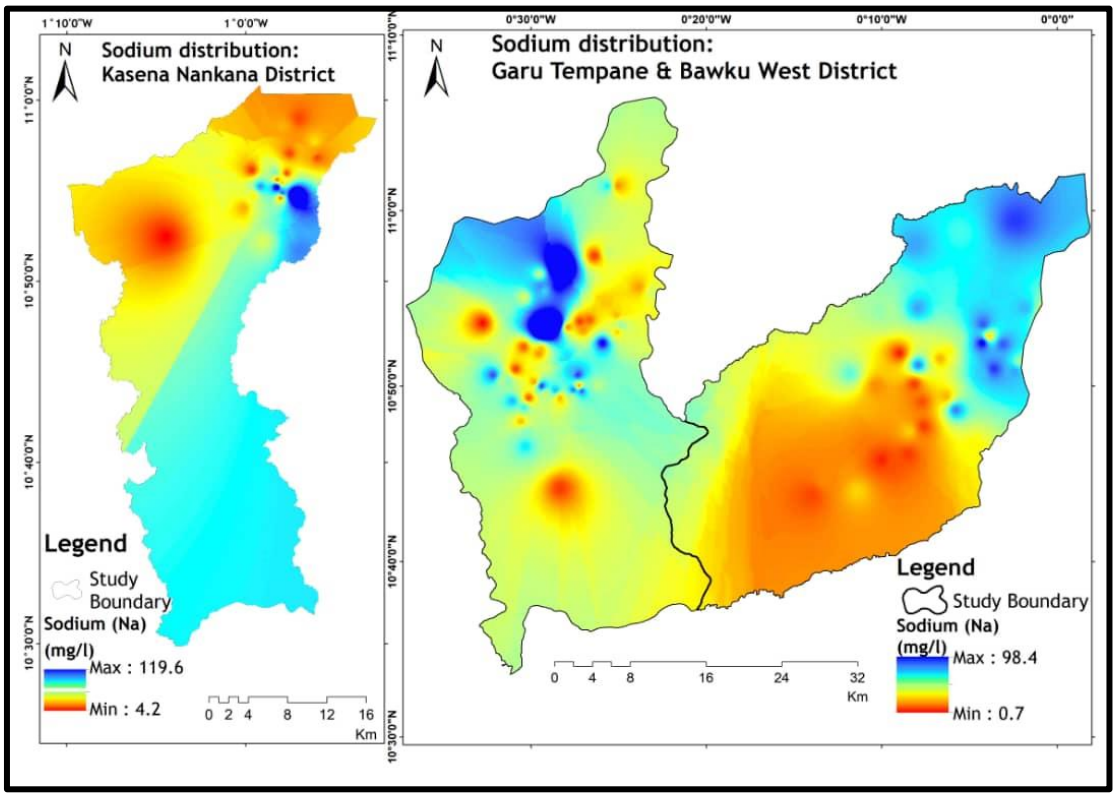

Figure 4: Na^{+} Distribution of Study Area

The Calcium ion (Ca^{2+}) concentration in the groundwater ranges from 0.00 to 5.47 mg/L, and a mean concentration of 0.75 mg/L. Calcium ion is the second most prevalent cation within the area studied. Approximately 2% of Calcium ion concentrations fall outside the acceptable range set by the WHO (2017) guidelines. Silicate mineral (anorthite) decomposition, as well as the dissolution of gypsum, calcite, and dolomite, can naturally release Ca^{2+} into groundwater. Prolonged agricultural activities can also influence Ca^{2+} release to groundwater systems (Bohlke, 2002). The study area is characterized by granitoid bedrock and is located at a distance from municipal waste sites. The decomposition of the silicate mineral anorthite appears to be the groundwater's main supply of calcium. Adequate levels of calcium in drinking water are beneficial to human health as they promote bone mass, help prevent certain types of cancer, and can hinder the process of heavy metals being taken in by humans (Bohlke, 2002). However, excessive levels of calcium can have negative

effects on the health of humans, by interfering with the intake of other equally important minerals. The decomposition of the anorthite silicate mineral is depicted in Equation 9:

$$CaAl_2Si_2O_8 + 2H^+ + H_2O \longrightarrow Al_2Si_2O_5(OH)_4 + Ca^{2+} + 4H_4SiO_4 \quad (9)$$

(Anorthite) (Silicic acid)

The analysis of magnesium ion (Mg^{2+}) concentration indicates a range of 0.01 to 3.81 mg/L and an average value of 0.71 mg/L. All magnesium ion concentrations were within permissible limits, according to the WHO (2017) guideline figure of 50 mg/L. The least abundant cation was potassium ion (K^+), with a mean concentration of 0.05 mg/L and a range of 0.00 to 0.51 mg/L. The groundwater sampled had potassium ion ($K^{+)}$ concentrations within acceptable levels, according to the 2017 (WHO) guideline figure of 100 mg/L. It is worth noting that high drinking water with potassium concentrations has been linked to increased blood pressure in several studies (Filippini *et al*., 2016; Cappuccio and MacGregor, 1991; Reddy *et al*., 2015). All the groundwater samples met the desired quality standards for K^+. For anions, the most dominant one is the bicarbonate ion, while nitrate is the least dominant.

Both groundwater and soil organic matter (James, 1984) generate bicarbonate (HCO_3^-) through the oxidation reaction of carbon dioxide (CO2). Approximately 6% of the groundwater samples had HCO_3^- which exceeded the 2017 (WHO) acceptable range for portable water (200 mg/L) (Figure 5). The high bicarbonate ion concentrations could be a result of the soil organic matter abundance and high oxidation resulting from the metabolic activities of microorganisms. Consequently, the origin of HCO_3^- within the study area's groundwater can be attributed to the interaction of silicate minerals with atmospheric CO2. Nitrate concentrations in approximately 1% of the sampled groundwater exceed the 2017 (WHO) guideline figure of 50 mg/L. This low recorded nitrate concentration may be due to reduced use or the absence of nitrogen fertilizers within the area studied.

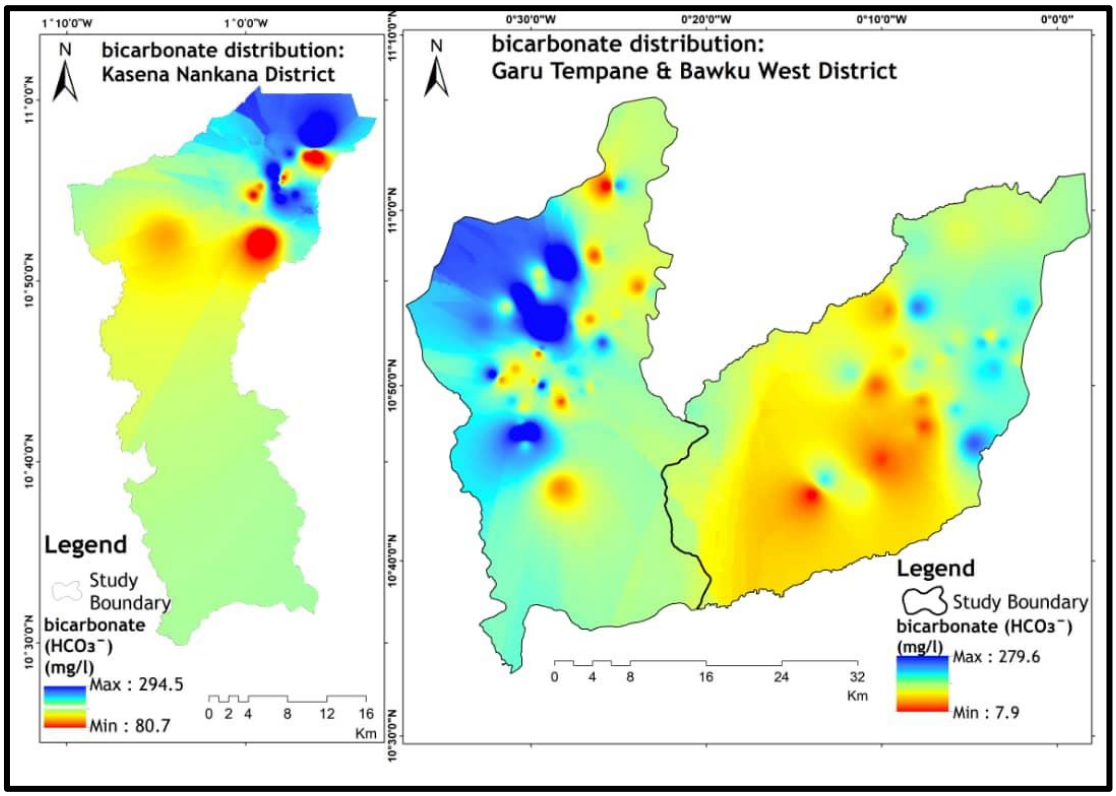

Figure 5: The Study Area HCO_3^- Distribution

The concentrations of chloride range from 0.04 to 11.27 mg/L, and an average concentration of 0.31 mg/L. Approximately 99% of the sampled water had Cl concentrations falling short of the 250 mg/L WHO (2017) guideline value. This falls in the desirable portable water range and makes the groundwater suitable for consumption. Excess chloride in water does not pose significant health risks to humans. However, maximum chloride concentrations could adversely affect the taste of water and potentially make it corrosive. It

may also have a detrimental impact on how permeable and porous a soil would be (Anim-Gyampo *et al*., 2019). The low correlation between Cl and Na^+suggests that the source of chloride is unlikely to be halite but probably comes from precipitation. The concentrations of sulfate in the study area have an average value of 0.27 mg/L and range from 0.00 to 7.26 mg/L. Approximately 1% of the sampled water exceeded the 2017 (WHO) allowable range of 250 mg/L for sulfate in portable water.

b) Water Quality Index Assessment

The analysis, based on the Water Quality Index, reveals that approximately 97% of the study area's groundwater has excellent water quality (WQI < 50) for domestic consumption (Table 3). Figure 6 indicates the study area's WQI distribution.

Table 3: Classes of water and WQI classification (after Sahu and Sikdar, 2008)

WQI Range	Water Type
< 50	Excellent
50 – 100	Good
100 – 200	Poor
200 – 300	Very poor
> 300	Unsuitable drinking purposes

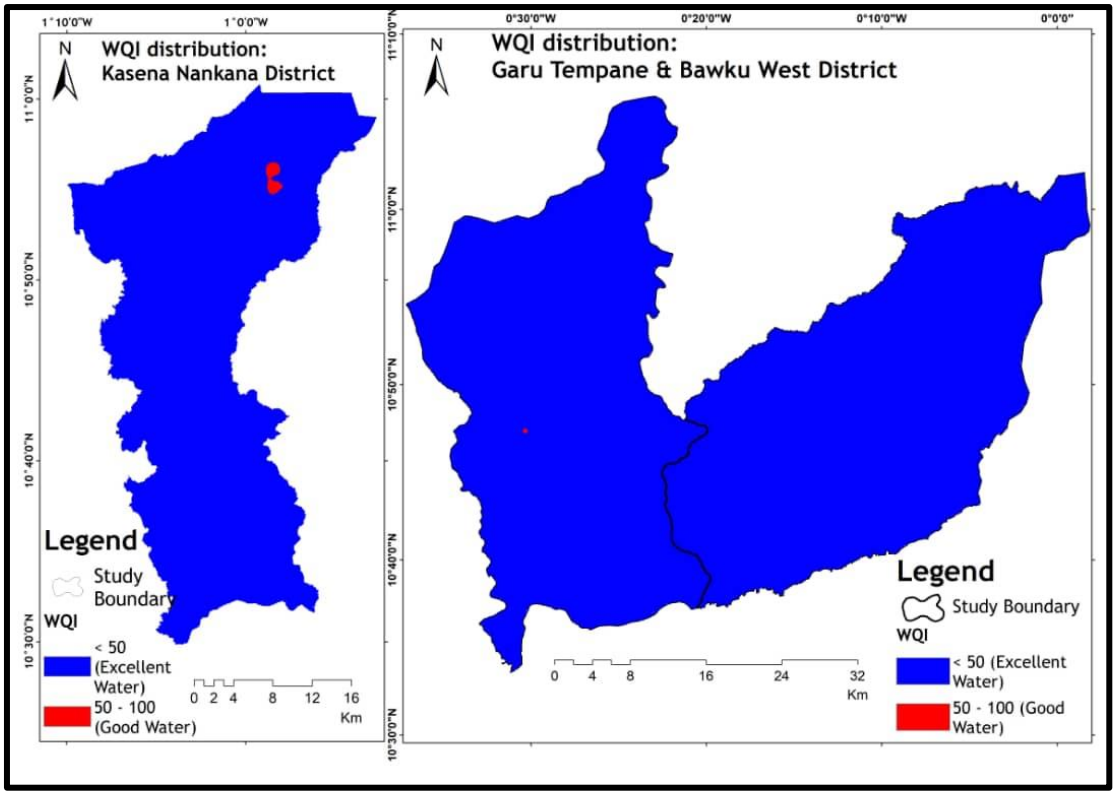

Figure 6: The Study area WQI Distribution

Groundwater Water Types

Three prominent distinct classes of water types were found within this area, and as indicated on the Piper plot (Figure 7): NaHCO3 (46%), which is typical of deep groundwater influenced by ion exchange; CaHCO3 (47%), which is typically from a shallow fresh groundwater source; and CaSO4 (6%), which is typical of gypsum and Acid Mine Drainage. Because of the study area's igneous plutonic origin and generally shallow groundwater table, the dominance of the NaHCO3 and CaHCO3 water types was predicted. Additionally, because there is no mining activity within

the area and granitoid is the main underlying formation, the breakdown of silicate minerals (albite and anorthite) can be the only origin of calcium and sodium in the groundwater. There was only one type of NaCl water detected in the samples; this could be because deep, ancient groundwaters and marine/ocean environments are absent from the region.

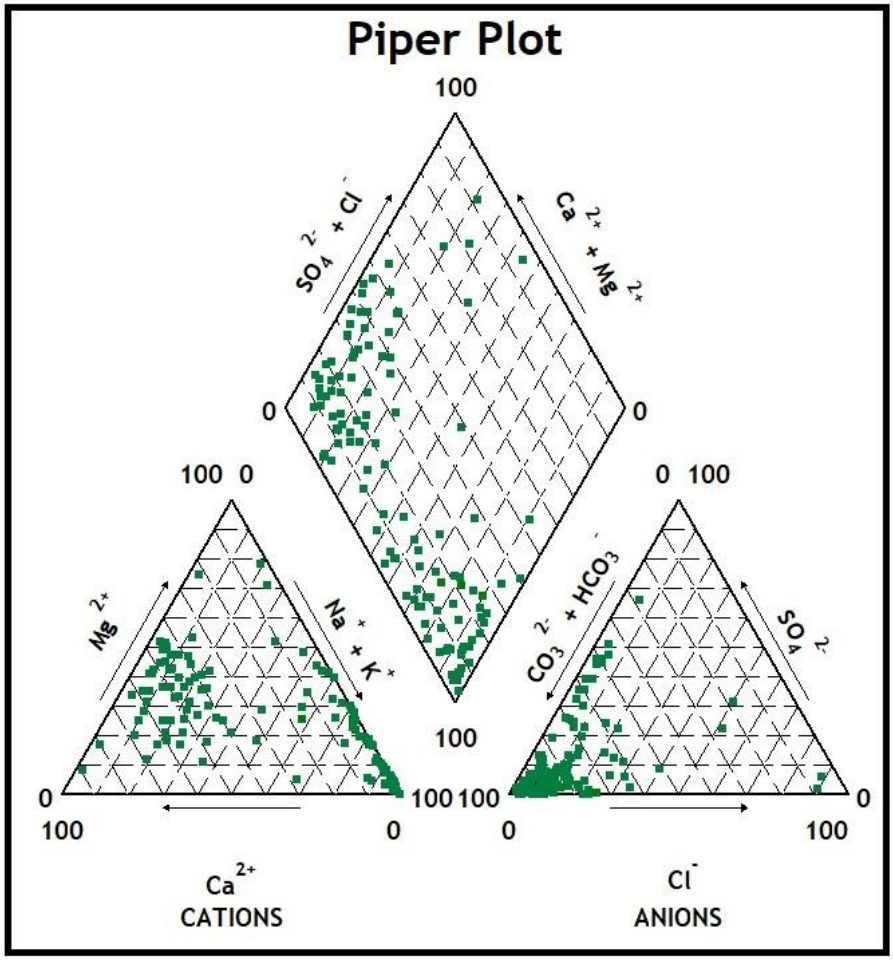

Figure 7: The Study Area Groundwater Piper Plot

c) Groundwater Suitability for Irrigation

The composition of minerals in groundwater influences plants and soils and determines their suitability for irrigation. High saline water can physically damage plant growth, limiting its ability to absorb water. It is thus important for irrigation purposes, to evaluate groundwater to determine its potential to harm crop growth and the living things that consume these crops (Rhoades *et al*., 1992). The irrigation suitability of the groundwater was evaluated using the sodium absorption ratio (SAR), Na%, permeability index (PI), and other classification charts. The study area's spatial distribution of SAR (Figure 8) revealed that approximately 97% (water sampled) had a SAR value of less than 10, categorizing it as excellent for irrigation water use (Shah and Mistry, 2013; Egbi *et al*., 2018).

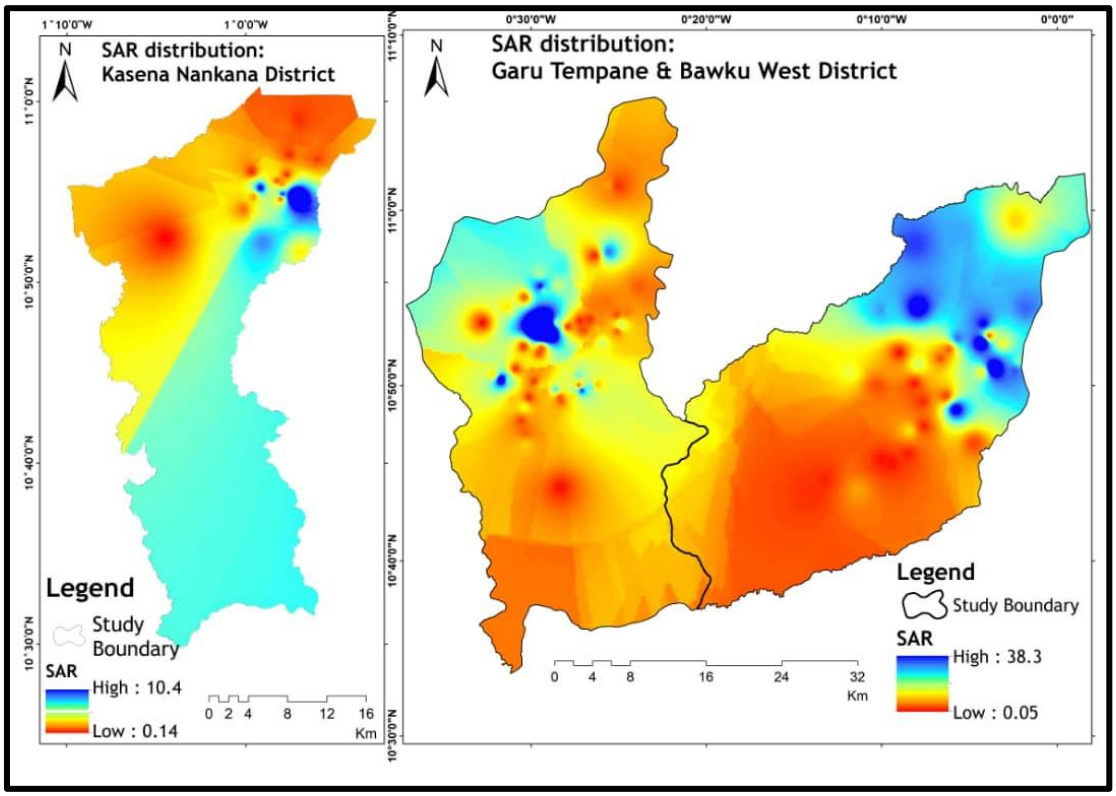

Figure 8: SAR Distribution Within the Study Area

Using Doneen's (1975) classification chart, the analyzed groundwater permeability index (PI) values had about 61% above 75, indicating their suitability for irrigation purposes. About 39% of the samples recorded PI values ranging from 25 to 75 and were classified as moderately fit for purposes of irrigation. Furthermore, the irrigation water classification was performed using the Wilcox (1955) chart. This chart categorizes water into five different classifications according to Na% and the corresponding EC measurement. Hard water indicates a low soluble sodium percentage, while soft water indicates the opposite. In the study area (Figure 10), two classes of irrigation water quality were observed: Class A and Class B. Class A, which accounts for 91% of the samples, represents excellent to good irrigation water quality. Class B, on the other hand, represents 9% of total samples and indicates good to allowable irrigation water quality, as shown in Table 4 and Figure 10. Therefore, the area generally has groundwater of suitable quality for irrigation purposes.

Table 4: Groundwater classification (Wilcox, 1955)

Class	% Samples	Suitability
A	91	Excellent to good
B	9	Good to permissible

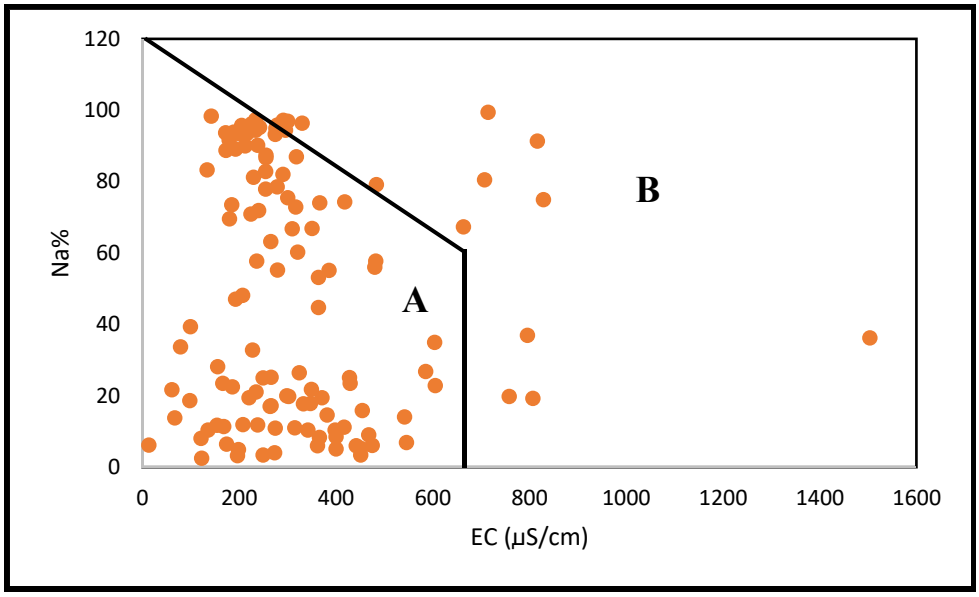

Figure 9: Irrigation Suitability of Groundwater from Na% And EC

In addition, the study area's groundwater was also categorized based on the Wilcox (1948) irrigation classification. This categorization resulted in seven zones, as shown in Figure 10 and Table 5. The distribution of samples across these zones is as follows: 62% in C1-S1 (Zone 1), 30% in C2-S1 (Zone 2), 3% in C3-S1 (Zone 3), 1% in C1-S2 (Zone 4), 2% in C2-S2 (Zone 5), 1% in C3-S2 (Zone 6), and 1% in C2-S4 (Zone 7).

Overall, approximately 92% of the total area exhibits minimal to medium salinity, and minimal sodium hazard water (Table 5 and Figure 10). This indicates that generally, the area's groundwater has the potential for irrigation use in all soils, without causing significant harm (Wilcox, 1948).

Table 5: Groundwater Irrigation Classification (Based on The Hazards of Salinity and Sodium) (Wilcox, 1948).

Zone	% Samples	Classification
1	62	Minimal Salinity with Minimal Sodium hazard (C1-S1)
2	30	Moderate Salinity with minimal Sodium hazard (C2-S1)
3	3	High Salinity with minimal Sodium hazard (C3-S1)
4	1	High Salinity with moderate Sodium hazard (C1-S2)
5	2	Moderate Salinity with moderate Sodium hazard (C2-S2) 6
6	1	High Salinity with moderate Sodium hazard (C3-S2)
7	1	Moderate Salinity with very high Sodium hazard (C2-S4)

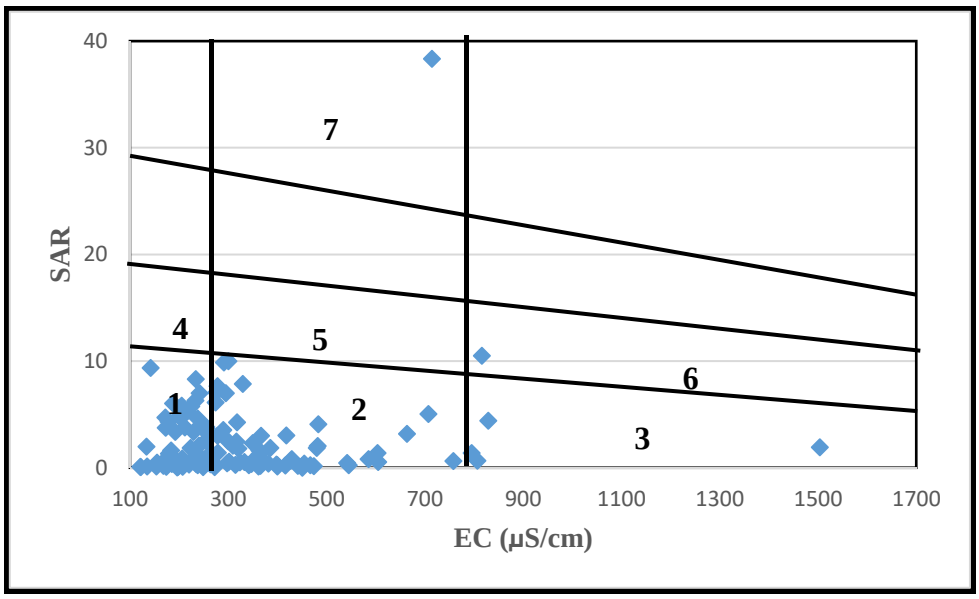

Figure 10: Groundwater irrigation suitability based on SAR and EC

IV. Conclusion

The current research has evaluated the groundwater quality in the districts of Kassena Nankana, Bawku West, and Garu Tempane in Ghana for domestic use and irrigation activities. The geochemistry of the groundwater reveals that it is appropriate for human consumption and irrigation. According to the study area's integrated findings of the WHO (2017) guidelines and the Water Quality Index (WQI), the groundwater is excellent for human consumption. The results of the analysis, based on the irrigation suitability indices (SAR, Na%, PI, and EC versus Na%), demonstrate that about 92% of water studied falls within acceptable limits for irrigation. This suggests that for irrigation activities within the area, the groundwater is generally wholesome.

Sodium, calcium, magnesium ions, chloride, bicarbonate, and sulfate all play crucial roles in the geochemical processes and have a significant influence on the quality of groundwater within the area. Sodium ion is the most abundant cation, while bicarbonate is the prevailing anion. However, bicarbonate is the dominant ion within the area studied. The groundwater quality is primarily influenced by geological factors, with a lesser anthropogenic effect. The information provided in this study guide serves as an exploration guide for water resources within the area, specifically for irrigation and domestic use. However, it is important to note that this study approach has certain limitations. Moving forward, it will be necessary to conduct an assessment of the groundwater quantity and enhance the data collection process to support future studies within the area. These findings will greatly help in the effective, sustained development and management of the study area's groundwater resources.

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Declarations

Conflict of Interest: In both content, financial and non-financial, the writers disclose no competing interests.

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Ecological Impacts of Untreated Chicken Manure on Soil Health of a Few Poultry Farms in Osun State, Nigeria

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Abstract- The present work attempts to determine soil sustainability by recognizing the impact of untreated chicken manure on soil health status by applying the fertility content method in various site usages in a few poultry farms in the Osun State, Nigeria. Nearly all of the chicken manure generated in advanced countries is treated before application, while in growing countries chicken manure treatment is insignificant. Untreated chicken manure soil samples were collected from poultry, arable land, and bush fallow, while forestland sites were served as control. The chemical, primary, and secondary variables were determined utilizing standard procedures, while minor nutrients contents were performed with Flame Atomic Absorption Spectrophotometer after wet acid digestion.

Keywords: land usage activities, untreated chicken manure, chicken sustainable management, soil health status, fertility content.

GJSFR-H Classification: FOR Code: 050302, 070101

Strictly as per the compliance and regulations of:

Ecological Impacts of Untreated Chicken Manure on Soil Health of a Few Poultry Farms in Osun State, Nigeria

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Abstract- The present work attempts to determine soil sustainability by recognizing the impact of untreated chicken manure on soil health status by applying the fertility content method in various site usages in a few poultry farms in the Osun State, Nigeria. Nearly all of the chicken manure generated in advanced countries is treated before application, while in growing countries chicken manure treatment is insignificant. Untreated chicken manure soil samples were collected from poultry, arable land, and bush fallow, while forestland sites were served as control. The chemical, primary, and secondary variables were determined utilizing standard procedures, while minor nutrients contents were performed with Flame Atomic Absorption Spectrophotometer after wet acid digestion. Quality monitoring measures included blank analysis, spike recovery tests, and standard calibrations. Descriptive and inferential statistics were utilized for data analysis. The fertility content ranges were: 1.30–2.38, 1.22–2.36, 1.30-2.39, and 1.32–2.38 for poultry, arable land, bush fallow, and forestland, respectively. Minor spatial variations in contents were found for all the chemical, primary, secondary, and minor nutrient variables in all parts of the study sites. Apart from organic carbon (OC), organic matter (OM), and Zn, the degree of fertility content for all the rest variables was found to be far below the recommended ranges set by Food and Agriculture Organisation for cropland soils. The condition subsequently demands suitable agricultural practices to sustain the fertility content in the sampling. These methods might comprise such measures as spraying untreated liquid manure before spreading and applying onto arable land, forestland, pastures or food crops, devising and adhering to a site-directed integrated nutrient management strategy, intensive land management and cropping techniques, and suitable farming methods.

Keywords: land usage activities, untreated chicken manure, chicken sustainable management, soil health status, fertility content.

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I. Introduction

Naturally, manure from domesticated animals has been cautiously preserved for its utilization as plant manure (*Kanwar, 2001*). Then, as sources of low-cost chemical fertilizers became prolific, interest in the utilization of animal manure reduced to the level that manure was regarded as an unwanted garbage to be getting rid of. It became more challenging to persuade cultivators to purchase and apply manure as a fertilizer on their arable lands due to the inexpensive provision of chemical fertilizers. With rising costs, limited supplies of synthetic fertilizers, and fast growing costs of power, livestock manure is once more observed as a preference nutrient provenance and valuable asset (*Kanwar, 2001*). Arable land growers have been eager once more to give money for livestock manure (litter) and also to compensate vast hauling costs to have these manures dispersed on their fields. The association between livestock waste disposal and ecological quality has been of concern to agronomist engineers and soil classifiers for a while. *Kanwar, (2001)* stated that till the year 1966, the attention had been on describing a range of issues comprising waste minimization, but not many environmental concerns were given focus. In 1971, when the American Society of Agricultural Engineers (ASAE) funded the first international symposium on animal wastes, more focus was committed to the effect on runoff water quality from fields treated with livestock manure *(Kanwar, 2001).*

With the current increase in the chicken sector countrywide and its possible ecological effects, chicken production has been kept under careful observation as before. Above 180 million broilers are reared in the Nigeria per year and generate greater than 932.5 metric tonnes of manure. In July 2017, Osun State ranked 2nd regionally in layer production after Ogun and Oyo. Rapid and intensive growth in the chicken enterprise has caused the problem regarding diffuse source contamination. Many times, the local arable lands, situated adjoining the chicken pens, turn out to be dumping ground for massive amounts of poultry droppings. From diffuse source contamination perspective, soil health status properties of highest interest are nitrogen (N), phosphorus (P), potassium (K),

calcium (Ca), magnesium (Mg), sulphur (S), and minor nutrients (Cu, Fe, and Zn). Each of these variables occurred in the chicken litter and can contaminate soil.

Chicken industry negatively affects the ecosystem in several fronts –via harmful disposal of manure and dropping, wastewater out of manufacturing facilities (blood, bone tissues, feathers, among other), birds' cadavers, dust, insects, vermin, odour, among others. Also, concentrated chicken farming is charged with producing heat-trapping gases, acid deposition, and nutrient over-enrichment. The ecological effect of poultry farming counts on several factors, among which are farm capacity, kind, and type of poultry, ecological factors in the manufacturing system, diet constituent supplied to the animals, form and amount of bedding material utilized, age of animals, condition of animals, method of storage/management of manure, and the like. It is acclaimed that, if suitably controlled, waste produced in the poultry factory, particularly manure and dropping, may be an invaluable asset, e.g., it may be utilized as fertilizer, soil improver, livestock feed, or power source (*Rodić et al., 2011*). Other than nutrientsgiven, they amend soil texture, prevent soil erosion, and increase water-retaining volume. Nevertheless, on account of the enormous quantity of litter produced (which transcends crop fertilizer stipulations), the concentration of harmful elements (like heavy elements, pesticide deposits, infectious agents, antibiotics, and others), given off explosive and volatile organic substances into the atmosphere, and, or injudiciously disposal, chicken waste is frequently contaminator as opposed to the invaluable asset. As a result, raisers have to look for ecofriendly healthy means of waste disposal, which unavoidably disrupts their profits*(Rodić et al., 2011).*

The enormous bulk of the poultry litter manufactured in urban areas is treated in processto farming, while in growing countries as Nigeria poultry litter treatment is not essential. The mixture of treated, incompletely treated, and untreated poultry litter is generally utilized for food production purposes *(FAO, 2011)*. The Food and Agricultural Organization evaluates that approximately 40 million hectares all over the globe are cultivated employing untreated poultry litter *(FAO, 2011).*

In poultry litter, the presence of organic, inorganic, and microbiological pollutants is a first phase of disinfection is essential before recycle in farming. To prevent the pollution of soil, crops, and adjoining aquatic resources and respectively the spreading of water transmitted diseasesor soil deterioration, poultry litter must be treated. The degree to which poultry litter has to be treated before crop growing counts on the criteria set in regional or global soil quality standards for crop production *(Manisha et al., 2020).* Soil, the basis of life, is the most indispensible and invaluable natural asset that is irreplaceable speedily. Soil health is an index of the sort of soil features with the requirements of, at a minimum, one biological species in addition to humankind requirement or utilization *(Manisha et al., 2020).* Land fertility is a vital natural asset that can change via geogenic and anthropogenic processes *(Ogunwale et al., 2023).*Alterations in soil qualities in various site usages are perhaps due to biotic relationships among environmental factors such as climate, underlying geological material, topography, land utilization, and earth cover (Ogunwale et al., 2021). Soil fertility is measured by the occurrence or lack of nutrients that have agricultural significance *(Lone et al., 2016).* Soil nutrient component serves a crucial role in defining the soil quality. Healthy agricultural soil will comprise all the indispensable elements in adequate amounts to sustain healthy plant growth throughout its lifespan *(Ogunwale et al., 2021).* Deterioration of soil health has caused a risk to farming efficiency, economic development, and a sound ecosystem worldwide *(Manisha et al., 2020).*

Sustaining soil quality and viable food production, renewal of macro and micronutrients, and inclusion of soil conditioners is an essential in the soil to get best crop produces. If their level in the soil is recognized before the crop is planted, it offers a sound ground for defining the nutrient preconditions for the wanted production *(Amara et al., 2016).* The degree of the positive impacts relies on the regional factors of the given project. The primary adverse effects of recycling treated and untreated poultry dropping in cropland fields are the pollution of soil ecosystems, the probable ruining harvests and aquatic resources, and the inherent threat of adverse effects that contamination outlooks to the exposed living organisms *(Manisha et al., 2020)*. Presently, under organic manure scarce situations, it becomes nearly mandatory for agriculturalists to weigh and utilize any provenances of organic manure, particularly in several zones *(Kumar et al., 2020).*

Thus, fostering suitable land utilization management methods and land utilization design would assist in reducing the deterioration in soil physical and chemical attributes and would guarantee sustainable crop growing and efficiency *(Ogunwale et al., 2023).* Thus, this work was meant to investigate the impact of untreated poultry litter on the soil health and fertility levels inside selected chicken farms divers land use in Osun State, Nigeria. The fertility level was estimated to depict the pollution status in soils at poultry farm various site usages fields. It is, hence, significant to find out the correct quantities of chicken manure that can be employed to arable land to accomplish the perquisitesof crop nutrients in the manure (for food production) and concurrentsustain a healthy ecosystem. In Osun State, data on the most likely impacts of untreated chicken manure application on soil health and different land usage within poultry land is scarce. Longitudinal analysis is, thus, required to fathom the implications of

untreated chicken manure on soil health for Nigerian poultry farm soils.

II. Materials and Methods

a) Description and Suitability of the Sampling Area

The sampling area included Ejigbo, Isundunrin, and Osogbo poultry farms in Osun State, Nigeria (Figure 1). There are two seasons per annum in Osun State and Nigeria at large: wet season and dry season. The wet season usually begins in April and continues till October. The dry season last from November to March and the climates are hot at this period. Rainfall patterns differ indirectly with the latitudinal area but directly with the area of the ITD and rainy season-constituted winds. The average annual rainfall ranges from 206 cm in the northern part to 231.75 cm in the southern part of the Osun State, and maximum rainfall is generally reported in July and August *(Ogunwale et al., 2022).* Average highest standard temperature contents vary from 33.84°C in February to 28.8°C in August, while average lowest temperatures vary from 25.18°C in March to 23.0°C in August. The average annual wind speed ranges from a narrow range of 4.0 to 6.2m/s. Speeds are more incredible from July to August, the period of August break. In line with the data available for the past ten years the standard wind directions is south-westerly. Relative humidity is normally exceeds 70%, particularly during the summit of the wet season. Atmospheric pressure is maximum in November with 58.36 hpa and minimum around August with 51.83hpa (FMARD, 2012). The soil falls under the heavily ferruginous tropical red soils intrinsic in igneous and sedimentary rocks. Due to the dense humid tree cover in the area, the soils are usually deep and of two types, specifically deep clayey soils formed on low smooth hillcrests and upper slopes; and the sandier hill wash soils on the lower slopes. The state Osun is encompassed, by second growth forest and in the northern part, the derived savannah mosaic predominates. An anthropogenic activity, under cocoa plantation, has also substituted the forest. Therefore, the natural tree species have been replaced by oil palm (*Elaeis guineensis*), *Gmelina arborea*, *Tectona grandis*, and thick thickets. Mature forests still found in the Owu forest reserve at the southern part of the state. Nigerian poultry farmer utilize their land in four primary ways which are as poultry farm, arable land, bush fallow, and forestland. Poultry land made up of poultry house. It is located within the compound and intensively cultivated. Heavily manured with poultry dropping and household refuse with crops including plantain, pawpaw, pineapple, banana, plantain, vegetables, fruits, pepper, okra, and tomato. Arable land is extensively cultivated and located some distance off the poultry pen crop grown including yam, cocoyam, potatoes, cassava, maize, rice, soyabean, groundnuts, among others. Bush fallow is a piece of land in the outfield previously farmed but now left to fallow overgrown by weeds to regain more fertility. Forestland/agricultural unproductive area: land area overgrown with tree crops like teak (*Tectona grandis*), Gmelina (*Gmelina arborea*), oil palm (*Elaeis guineensis*), coconut tree (*Cocos nucifera*), cashew (*Anacardium occidentale*), mango (*Mangifera indica*), rubber, coffee, kola nut tree, and so on. The present work was conducted in four various site usages categories, namely: bush fallow (15%), cropland (35%), poultry bird (40%), and forestland/agriculturally unproductive area (water bodies, mountain, hilly) (10%), in Agboola, Odunola, and Worgor poultry factory in Osun State. The choice of the sampling area was based on their land-utilization patterns and sort of human activity in the land. The sampling areas chosen for this study were regarded as suited because all of them have been in business for more than thirty-five years. Besides, the impact of untreated poultry waste on land quality was being studied for the first time.

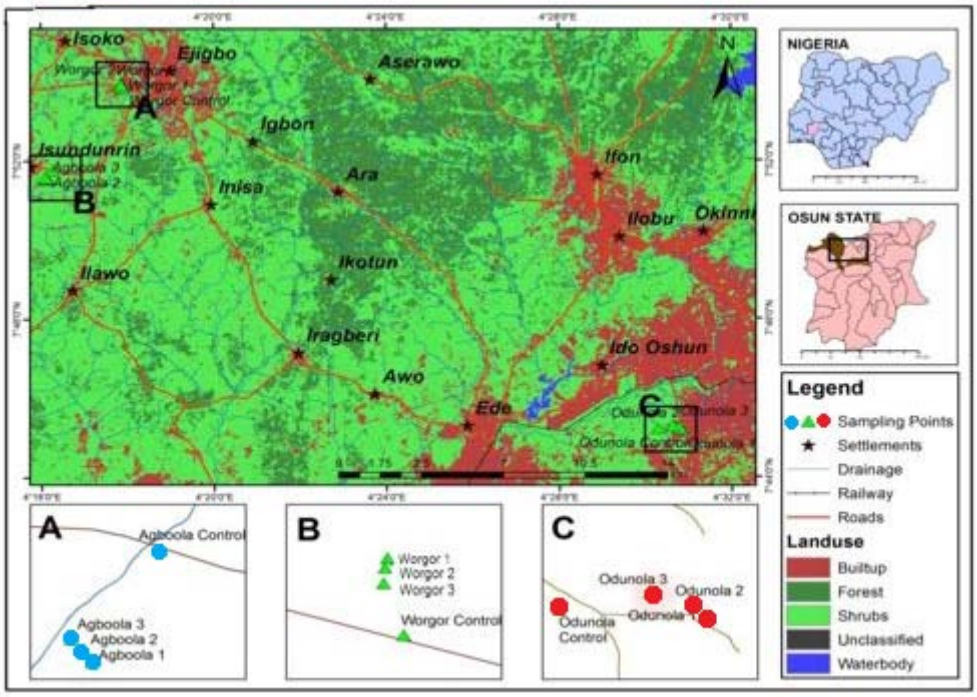

Figure1: Map of the Collection Site Depicting Collection Points

b) Sample Taken, Extraction, and Conservation

The soil samples were taken from 0-15 cmhorizon with the aid of a soil auger from December 2016 to July 2017, utilizing the GPS locations in 12 different sites. Composite soil sampling was performed inside each site usage and bulked together, followed by a standard procedure for sample extraction*(Ogunwale et al., 2021).* All the collected soil samples were naturally-dried after determined pH and EC and then soil samples were dried in shade, pulverized with mortarand pestle, and then sieved via a 2.0 mm sieve. The dried soil samples were kept for further assay of the physical, chemical, and fertility content of soil samples.

c) Determination of Some Physico-chemical properties and fertility assay of Soil Samples

A sum of 13 physicochemical and fertility content, pH, electrical conductivity, organic carbon, organic matter, available nitrogen, available phosphorus, available calcium, available magnesium, available potassium, available sulfur, available copper, available iron, and available zinc were assayed in the laboratory, subsequent the standard treatments which are further explained below:

The pH was conducted in a soil: distilled water suspension 1: 2.5 w/v *(Ogunwale et al., 2021)* as under: 10 g of soil sample was precisely measured into a 50 mL Sarstedt collection tube. Twenty-five (25) mL of high puritydistilled water was put into the soil. The sample was placed on a laboratory shaker and shaken at 30 rpm for 10 minutes. Next, the sample was allowed to rest for 10 minutes and the pH measured. The pH was determined with the aid of Orion Research Digital pH meter/model 301 following being standardized with pH buffer 4 and 7. Soil EC was determined in a 5:1 w/v water/soil suspension using dual range water proof mobile EC meter *(Ogunwale et al., 2021).*

Organic carbon was conducted by a process of wet oxidation method with a procedure that is obtained from the Walkley-Black method *(Ogunwale et al., 2021).* Soil organic matter concentration was performed utilizing the procedure of LOI as expressed by Ikechukwu (2010). Five (5) g of soil sample was correctly measured into a pre-weighed crucible. The mass of soil (M) and the mass of soil and crucible (M_1) were calculated. The sample was put in a reheated high-temperature furnace (400°C) for 4 hours and then left to cool in a desiccator. The sample was re-estimated, and the mass was reported (M_2). The % LOI was computed employing equation (i).

$$\%LOI = \frac{M_1 - M_2 \times 100}{M} \ldots\ldots\ldots\ldots\ldots eqn.(i)$$

The CEC was conducted by preparing the cations with 1 M ammonium acetate buffered at pH 7. Thirty (30) mL of 1 M CH_3COONH_4 was put into 5 g of the soil. The suspension was shaken for 2 hours and then centrifuged for 15 minutes at 6000 rpm. After centrifugation and filtration, the filtrate was transferred into a 120 mL vial and two other volumes of 30 mL CH_3COONH_4 were put in succession after 30 min of shaken and centrifugation. The final filtrates were made up to 120 mL with CH_3COONH_4 solution *(Ogunwale et al., 2021).* Available calcium and magnesium were carried out with the aid of Flame Atomic Absorption Spectrophotometer while potassium (K) was done by

Jenway PFP 7 Flame Photometer. Available phosphorus was determined with the colorimetric micro-vanadate-molybdate procedure reported by Ogunwale et al. (2021). Available nitrogen (AN) was conducted by a revised account of the Kjeldahl technique *(Ogunwale et al., 2021).* A micro-Kjeldahl digestion rack was utilized to minimize the time dictated for the digestion. Available sulfur was performed by turbidimetric procedure *(Ogunwale et al., 2021)*.

d) Minor Nutrients Determination

One gram (1.0 g) of the naturally-dried fine soil sample collected by coning and quartering procedure, was measured and conveyed into an acid rinsed, PTFE beaker containing 10 cm^3 concentrated nitric acid. The combination was gradually heated for 1 hour on a thermostated heating plate at a temperature of 120°C. Each of the solid residues obtained was heated more for 10 minutes with 5 mL 3:1 concentrated HNO_3 and $HClO_4$ combined at 120°C before digestion on a heating plate and digested intermittently to ensure a stable temperature of 150°C above 5 hours till the acid-dense white vapors were eventually vaporized *(Ogunwale et al., 2021)*. The combination was left to cool to ambient temperature and next put into a 25 mL measuring flask and made up to the calibrated level with high purity deionized water afterward washing the reacting flasks, to recover any left-over micro nutrient. The filtrate was then conserved in pre-cleaned polyethylene storage bottles in preparation for assay. To confirm the efficiency of the HNO_3–$HClO_4$ procedure of sample digestion a recovery test was carried out through spiking 1 g of thirty-six (36) and twelve (12) different soil samples each with 1000 cm^3 of stock solutions of minor nutrients (Cu, Fe, and Zn). Minor nutrients, secondary nutrients (Ca and Mg), and primary nutrient (K) contents were conducted applying a FAAS and FP (Chem Tech Analytical Alpha Star Model 4) at the Centre for Energy Research and Development (CERD) of the Obafemi Awolowo University, Ile-Ife, Nigeria. The equipment settings and operational conditions conformedto the manufacturer's recommendations. The equipment was calibrated with analytical quality stock element solutions (1 mg/dm^3) in replications. Each test was carried out in triplicates.

e) Soil Fertility Content Estimation

To assess the fertility content of soils in the collection site, various soil physicochemical parameters that govern nutrient availableness such as pH, EC, available N, P, K, and S, exchangeable Ca and Mg, and available minor nutrient (Cu, Fe, and Zn) were evaluated on the ground of the given ranking sketch (Table 1) revised from Manisha et al.(2020). Soil fertility content (SFC) was determined to describe the available content of each primary, secondary, and minor nutrients at a sequence value by utilizing the formula propounded by *Parkeret al. (1951):*

$$SFC = \frac{(F_{une} \times 1) + (F_m \times 2) + F_e \times 3)}{2F_s} \ldots eqn.(ii)$$

Where

SFC = Soil fertility content

F_s = Sum amount of samples studied for fertility in any defined site

F_{une} = Number of samples that fall under the unelevated class of fertility content

F_m = Number of samples that fall under the moderate class of fertility content

F_e = Number of samples that fall under the elevated class of fertility content

An SFC value below 1.67, from 1.67 to 2.33, and above 2.33 signifiesunelevated, moderate, and elevatednutrientcontent of soil, accordingly (Table 2).

Table 1: Ranking Sketch for Soil Analysis Contents and their Fertility Levels

Soil parameter	Unit	Range		
		Unelevated	Moderate	Elevated
pH		<6.0 (Acidic)	6.1-8.0 (Neutral)	>8.0
EC	μSm^{-1}	<1 (normal)	1-2.0 (Critical)	>2 (Injurious)
TOC	%	<0.5	0.5-0.75	>0.75
TOM	%	<1	1-2	>2
Av.N	$mgkg^{-1}$/ha	<280	280-560	>560
Av.PO_4^{3-}	$mgkg^{-1}$/ha	<10	10-23	>23
Av.SO_4^{2-}	ppm	<10	10-30	>30
Exchangeable Ca^{2+}	Cmol/kg	<1.5	1.5-4.5	>4.5
Exchangeable Mg^{2+}	Cmol/kg	<1.5	1.5-4.5	>4.5
Exchangeable K^+	$mgkg^{-1}$/ha	<110	110-280	>280
Av. Zn^{2+}	ppm	<0.6	0.6-1.0	>1.0
Av. Fe^{2+}	ppm	<4.5	4.5-5.5	>5.5
Av. Cu^{2+}	ppm	<0.07	0.07-0.20	>0.20
Fertility content	Content	I	II	III

Source: Manisha et al. (2020)

Table 2: Fertility Content with Level and Comment

Fertility Content	Level	Comments
I	Under 1.67	Unelevated
II	1.67-2.33	Moderate
III	More than 2.33	Elevated

Source: Manisha et al. (2020)

f) Quality Monitoring

Appropriate quality monitoring procedures and safety measures were performed to ascertain the validity of the results. High puritydistilled water was used throughout the assessment. The glassware was washed correctly, and the chemical reagents were of analytical quality. Reagents blank experiments were applied to check the instrument readings. To confirm the experimental results, a spike recovery test was done by spiking and homogenizing various already investigated samples with diverse amounts of stock solutions of the primary, secondary, and minor nutrients. Even thoughFP and FAAS proffer potential merits such as analytical sensitivity, good analytical detection level, excellent accuracy, and relatively lowpriced, their calibration wascrucial to measure the reaction of the experimental procedure in terms of known amounts to the standards of the primary, secondary, and minor nutrients of interestin order that the response to unknown quantities in the samples may be reliably determined. For the FAAS and FP 15, 12.5, 7.5, 5, 2.5, and 1.0 µg/mL values of each element solution were freshly extracted by doubling dilution to estimate elements in soil samples. These solutions were performed on the FP and FAAS to obtain the working calibration curve, which was used to estimate the values of primary, secondary, and minor nutrients in the samples by automatic interpolation with the calibration curve. The coefficient of variation of repeated measurements was performed for the quantifications to calculate analytical accuracy.

g) Chemical Reagents Employed

Nitric acid was bought from Riedel-deHaen (Germany). Acetic acid, perchloric acid, sulphuric acid, and hydrochloric acid were obtained from Sigma-Aldrich (Germany). Ammonium acetate, ammonium sulfate, ammonium chloride, ammonium metavanadate, potassium chloride, ammonium molybdate, and hydrofluoric acid were purchased from British Drug House (Poole, England). List as mentioned earlier, chemical reagent I (25% of HOAc, $(NH4)_6MO_7O_{24}.4H_2O$and NH_4VO_3made up the volume to 1000 mL) and chemical reagent II (3.2 M CH_3COONH_4 and 1.0 M NH_4Cl) were formulated. These were utilized to develop stock solutions *(Ogunwale et al., 2022).*

h) Data Analysis

The standard deviation for the primary, secondary, and minor nutrients from three replicate measurements was obtained. Computation of the data was done using the mean contents. Analysis of variance (ANOVA) was employed to describe the statistical significant between the means of the primary, secondary, and minor nutrients contents obtained applying SPSS 21.0. Coefficient of variation was utilized to estimate the inner and between site temporal variability of the analytes.

Soil fertility content of four various land utilization fields was calculatedregarding pH, EC, organic carbon, organic matter, primary, secondary, and minor nutrients. The results obtained are indicated in Tables 5-8, and discoursed with the following subheadings.

III. Results and Discussion

a) Soil Properties (pH,EC, %OC, %OM,CEC, and Minor Nutrients)

The properties of soil health differ for diverse forms of soil and thus typifying the soil sample is significant. Tables 4-8indicate the characteristics of the soil taken from poultry farm in Osun State. The soil properties like pH, EC, OC, OM, primary, secondary, and minor nutrients have a direct impact on the mobility and availability of soil nutrients*(Ogunwale et al., 2021).*

Table 3: Mean Raw Data for Soil Samples from December 2016 to July 2017

Site	Parameter pH	EC	%OC	%OM	AN	AP	ASO_4^{2-}	ACa^{2+}	AMg^{2+}	AK^+	ACu^{2+}	AFe^{2+}	AZn^{2+}
A_1	7.42	0.88	1.20	2.07	104	24.50	8.80	1.80	1.02	280	0.31	2.50	1.10
A_2	6.70	1.23	0.91	1.57	78	20.80	6.20	1,10	0.80	160	0.18	1.80	1.04
A_3	7.20	1.45	1.60	2.76	138	30.60	7.50	1.60	0.96	240	0.47	5.05	1.52
A_c	6.10	0.46	1.75	3.02	151	32.90	9.10	1.86	1.06	320	0.16	1.01	0.83
O_1	7.70	0.90	1.38	2.38	119	28.20	36.50	1.54	0.86	240	0.30	4.70	1.31
O_2	7.80	1.62	1.33	2.29	115	21.90	17.00	1.26	0.68	190	0.20	4.10	0.97
O_3	8.20	1.71	1.40	2.41	121	25.80	27.00	1.62	0.84	230	0.26	5.91	1.47
O_c	6.18	0.62	1.83	3.16	158	31.30	38.00	1.70	0.90	260	0.12	1.11	0.68
W_1	7.50	0.73	1.30	2.24	112	48.70	20.60	1.64	0.78	300	0.24	4.26	1.56

W_2	7.40	1.54	1,10	1.90	95	40.40	21.50	1.04	0.64	220	0.19	3.48	1.23
W_3	7.60	1.83	1.58	2.72	136	36.10	24.50	1.30	0.84	270	0.31	6.21	1.69
W_c	6.15	0.58	1.62	2.79	140	50.50	27.00	1.76	0.92	340	0.14	1.30	0.90

Legend:A_1 = Agboola Poultry Site; A_2 = Agboola Arable land; A_3 = Agboola Bush fallow; A_c = Agboola Forestland; O_1 = Odunola Poultry Site; O_2 = Odunola Arable land; O_3 = Odunola Bush fallow; O_c = Odunola Forestland; W_1 = Worgor Poultry Site; W_2 = Worgor Arable land; W_3 = Worgor Bush fallow; W_c = Worgor Forestland

i. *Impact of Untreated Chicken Manureon Soil Reaction (pH)*

The soil reaction is determined by the pH scale. The pH unit varies between 0 and 14, a pH of 7 indicates neutral, pH above 7 denotes alkalinity, and those less than 7 signifies acidity. Soil pH is the most vital factor controlling organic matter decay, microbial processes, types, and degree of nutrient availability or even nutrient absorption by crop plants. The level of nutrients mobilized in the soil ecosystem is a function of pH, attributes of nutrients, redox states, soil reaction, organic matter content, clay content, cation exchange capacity, and the like soil characteristics*(Ogunwale et al., 2022a).*

The pH of the soil examined varied from 7.42-7.70 for poultry sites, 6.70-7.80 for arable land, 7.20-8.20 for bush fallow, and 6.10-6.18 for forestland, respectively (Table 4). Untreated chicken manure is a provenance of neutral constituents. It moderates the soil pH as a result of the decomposition of organic material and presence of organic compounds based nutrients in the soil ecosystem. The forestland indicated a slightly acidic pH owing to the decay of vegetation litter deposits. This denotes a moderate pH content in all the site usage studied (Table 4). The nutrient ranking of all the pH monitored was mild and slightly high as a result of the endless utilization of various kinds of both organic and inorganic manures.

Impact of Untreated Chicken Manure on Soil Electrical Conductivity

The EC is an invaluable variable of soil property for denoting salinity hazard. Electrical conductivity (μS/cm) of soil varied from 0.73-0.90 at poultry sites, 1.23-1.62 at arable land, 1.45-1.83 at bush fallow, and 0.46-0.62 at forestland, respectively (Table 4). The soil fertility content of ECdenotes the unelevated and moderate content in all site usages.

Impact of Untreated Chicken Manure on Soil Organic Carbon

Soil organic carbon (%) of soil varied from 1.20-1.38 at poultry sites, 0.91-1.33 at arable land, 1.40-1.60 at bush fallow, and 1.62-1.83 at forestland (Table 4). This signifies the elevated content of soil OC in all site usages. Owing to waste streamfrom poultry pen, open dumping of untreated chicken manure and open air burning of dried untreated poultry wastes, and presence of ground animals in the bush fallow and forestland causes greater organic contentwhich might havenegative impacts on soil permeability and cause anaerobic conditions in the plant rhizosphere.

Impact of Untreated Chicken Manure on Soil Organic Matter

Soil organic matter (%) of soil varied from 2.07-2.38 at poultry sites, 1.57-2.29 at arable land, 2.41-2.76 at bush fallow, and 2.79-3.16 at forestland, respectively (Table 4). This signifies the moderate and high contents ofSOM in all site usages. Because of animal waste, waste stream from poultry house, recharge from precipitation, baseline pollution values from last decade's manure, elevated organic value may have harmful effects on soil permeability and cause anaerobic conditions in the plant root region. There is just narrow variability in the % SOM except for that of bush fallow in which the % SOM a little moderate. The mean % SOM is 2.23, 1.92, 2.63, and 2.99% for all the site usages. The % SOM adds to the soil CEC and a high content of % SOM leads to a high content of CEC, which will have primaryimpact on the availability of nutrients.

Table 4: Comparative Analysis of Monitored Soil Chemical Variables in Chicken Farm Land Utilization

Soil variables	Percentage of samples falling under limit				
pH	<6.0 (acidic)	6-8 (neutral)	>8.0	Vary	Mean ±SD
Site usage					
Poultry site	0	100	0	7.42-7.70	7.54±0.38
Arable land	0	100	0	6.70-7.80	7.30±0.33
Bush fallow	0	75	25	7.20-8.20	7.67±0.39
Forestland	0	100	0	6.10-6.18	6.14±0.30
EC	<1.0 (good)	1-2 (moderate)	>2 (elevated)		
Poultry site	100	0	0	0.73-0.90	0.84±0.03
Arable land	0	100	0	1.23-1.62	1.46±0.05
Bush fallow	0	100	0	1.45-1.83	1.66±0.08
Forestland	100	0	0	0.46-0.62	0.55±0.02

Organic carbon	<0.5 (unelevated)	0.5-0.75 (moderate)	>0.75 (elevated)		
Poultry site	0	0	100	1.20-1.38	1.29±0.04
Arable land	0	0	100	0.91-1.33	1.11±0.02
Bush fallow	0	0	100	1.40-1.60	1.53±0.06
Forestland	0	0	100	1.62-1.83	1.73±0.07
Organic matter	<1(unelevated)	1-2 (moderate)	>2 (elevated)		
Poultry site	0	0	100	2.07-2.38	2.23±0.08
Arable land	0	75	25	1.57-2.29	1.92±0.06
Bush fallow	0	0	100	2.41-2.76	2.63±0.09
Forestland	0	0	100	2.79-3.16	2.99±0.10

Source: Field Survey, (2017)

ii. *Impact of Untreated Chicken Manure on Soil Primary Nutrients (NPK)*

Available N, P, and K, are primary nutrients for plant growth and development. The levels of these nutrients were assayed and were presented in Table 5. The value of N in the soil varied from 104-119 at poultry sites, 78-115 at arable land, 121-138 at bush fallow, and 140-158 at forestland, respectively (Table 5). The mean kg/Ha N is 111.67, 96.00, 131.67, and 149.67 for all the site usages. The level of N in the soil of all site usages shows unelevated content in all the sites studied (Table 5). In poultry sites, arable land, and bush fallow soils, organic nitrogen has been converted into nitrates by soil microbes to a more significant amount than that obtained in forested areas *(Manisha et al., 2020).*The unelevated N obtained for all the study sites is also owing to the absence of crops and nearly zero NO_3-N leaching or runoff losses during the collection periods. The value of P in the soil ranged from 24.50-48.70 at poultry sites, 20.80-40.40 at arable land, 25.80-36.10 at bush fallow, and 31.30-50.50 at forestland, respectively (Table 5). The mean kg/Ha P is 33.80, 27.70, 30.83, and 38.23 for all the land utilization sites. This signifies the elevated level of P in forestland and poultry sites compared to arable land and bush fallow sites. The presence of rodents, rabbits, giant rats, squirrels, and the like ground and aerial animals in the sites might have contributed to the high levels of P in soil from non-manured fields *(Kanwar, 2001)* or as a result of the accumulation of stable phosphorus nutrients in the soil sampled *(Kanwar, 2001).* The content of K in the soil ranged from 240-400 at poultry sites, 160-220 at arable land, 230-270 at bush fallow, and 260-340 at forestland, respectively (Table 5). The mean kg/Ha K is 273.35, 190, 246.67, and 306.67 for all the site usages. Available K was higher in forestry and poultry sites than in the cropland and bush fallow plots. Recharge from rainwater, waste stream from poultry house, irrigation may be source of primary nutrients from the soil examined and often resulting in elevated PO_4^{3-} contents in the soil. Poultry waste and household wastes of the chicken farm plot (Agboola, Odunola, and Worgor) are deposited into the soil year round that results in the transformation in fertility content of soil in the neighboring sites *(Ogunwale et al., 2021).* This signifies that untreated chicken manure will be helpful to soils in increasing a few of the primary nutrients. Tree growing, particularly the utilization of untreated poultry manure, can efficiently increase soil fertility values, enhancing land fertility *(Manisha et al., 2020).*

Table 5: Comparative Analysis of Studied Soil Primary Nutrients in Poultry Farm Site Usages

Soil primary nutrient	Percentage of samples falling under limit				
Av.N	<280 kg/Ha (unelevated)	280-560 kg/Ha (moderate)	>560 kg/Ha (elevated)	Vary	Mean ±SD
Site usage					
Poultry site	100	0	0	104-119	116.67±6.10
Arable land	100	0	0	78-115	96.00±5.50
Bush fallow	100	0	0	121-138	131.67±7.86
Forestland	100	0	0	140-158	149.67±8.20
Av.P	<10 kg/Ha (unelevated)	10-25 kg/Ha (moderate)	>25 kg/Ha (elevated)		
Poultry site	0	25	75	24.50-48.70	33.80±4.64
Arable land	0	75	25	20.80-40.40	27.70±3.40
Bush fallow	0	0	100	25.80-36.10	30.83±3.80
Forestland	0	0	100	31.30-50.50	38.23±4.70

Av.K	<110 kg/Ha (unelevated)	110-280 kg/Ha (moderate)	>280 kg/Ha (elevated)		
Poultry site	0	75	25	240-300	273.35±10.95
Arable land	0	100	0	160-220	190±9.80
Bush fallow	0	100	0	230-270	246.67±10.70
Forestland	0	25	75	260-340	306.67±12.30

Source: Field Survey, (2017)

iii. *Impact of Untreated Chicken Manure on Soil Secondary Nutrients (Ca, Mg, and S)*

Cation exchange capacity (CEC) expresses the amount of cation exchange sites and the estimate offers a concept of the amount of cation adsorption sites in the soil *(Ogunwale et al., 2022a)*. Exchangeable calcium (Cmol/kg) of soil varied from 1.54-1.80 at poultry sites, 1.04-1.26 at arable land, 1.30-1.62 at bush fallow, and 1.70-1.86 at forestland, respectively (Table 6). The mean Cmol/kg Ca is 1.66, 1.13, 1.51, and 1.77 for all the land usage (Table 6). This signifies the moderate content of soil exchangeable Ca in all the land utilization sites and because of the buildup of Ca residues via untreated poultry manure. Soil exchangeable magnesium (Cmol/kg) of soil varied from 0.78-1.02 at poultry sites, 0.64-0.80 at arable land, 0.84-0.96 at bush fallow, and 0.90-1.06 at forestland, respectively (Table 6). The mean Cmol/kg Mg is 0.89, 0.71, 0.88, and 0.96 for all the land utilization sites (Table 6). This denotes the unelevated content of soil exchangeable Mg in all the studied soils. The content of S in the soil ranged from 8.8-36.60 ppm at poultry sites, 6.20-21.50 ppm at arable land, 7.50-27.00 ppm at bush fallow, and 9.10-24.70 ppm at forestland, respectively (Table 6). The mean ppm is 22.00, 14.90, 19.67, and 24.70 for all the site usages. Available S suggests the moderate value in all land-use sites owing to the moderate buildup of SO_2^{4-} residues by different poultry facilities. Remarkably, untreated chicken manure discharge changes the secondary nutrient content in the soil, which affects the nutrient and element equilibrium among solid and liquid stages of the soil ecosystem *(Manisha et al., 2020)*. Nevertheless, the impact counts on the uptake of these secondary nutrients in the utilized poultry manure (Table 6). Soil lows in secondary nutrients are more prone to leaching. Table 2 indicates the typical secondary nutrient contents for various soils. From Table 2, it may be observed that the secondary nutrients contents at all the sites (Table 2) falls under the moderate rating, aside for, which has an unelevated content for all the sites. The cation adsorption potential of untreated manures in this case will be moderate due to the moderate CEC. Following Manisha *et al*. (2020), CEC contents are regarded as unelevated if less than 1.50 Cmol/kg.

Table 6: Comparative Analysis of Examined Soil Secondary Nutrients in Poultry Farm Site Usages

Soil secondary nutrient	Percentage of samples falling under limit				
Av.Ca	<1.5 Cmol/kg (unelevated)	1.5-4.5 Cmol/kg (moderate)	>4.5 Cmol/kg (elevated)	Vary	Mean ±SD
Land utilization					
Poultry site	0	100	0	1.54-1.80	1.66±0.07
Arable land	0	100	0	1.04-1.26	1.13±0.04
Bush fallow	0	100	0	1.30-1.62	1.51±0.08
Forestland	0	100	0	1.70-1.86	1.77±0.05
Av.Mg	<1.5 Cmol/kg (unelevated)	1.5-4.5 Cmol/kg (moderate)	>4.5 Cmol/kg (elevated)		
Poultry site	100	0	0	0.78-1.02	0.89±0.03
Arable land	100	0	0	0.64-0.80	0.71±0.02
Bush fallow	100	0	0	0.84-0.96	0.88±0.03
Forestland	100	0	0	0.90-1.06	0.96±0.06
Av.S	<10 ppm (unelevated)	10-30 ppm (moderate)	>30 ppm (unelevated)		
Poultry site	25	75	0	8.8-36.60	22.00±3.45
Arable land	25	75	0	6.2-21.50	14.90±2.10
Bush fallow	25	75	0	9.50-27.0	19.67±1.90

Forestland	25	75	0	9.10-38.00	24.70±3.65

Source: Field Survey, (2017)

iv. *Impact of Untreated Chicken Manure on Soil Minor Nutrients (Cu, Fe, and Zn)*

Poultry operations are made up of very significant diffuse sources of minor nutrients. The primary sources of this sort of contamination are impurities from manures, insecticides, waste-based compost, timber preservatives, and rusting of metal items like poultry metallic cages, poultry feeding and rearing implements, roofs, and concrete and barb wire fences *(Ogunwale et al., 2021)*. Poultry manure, sewage sludge, and the like wastes employed in poultry land, arable land, and forestland signify that soil gets polluted with trace elements and the like pollutants. These wastes comprise high content of trace elements (Cu, Fe, and Zn), organic, and inorganic materials that assist in either the movement or bond the trace elements. Given enough time and raindrops, many trace elements could seep out of the soil. This issue has become more severe as utilization of untreated poultry wastes to forest, rangelands, farmland, and land recovery areas has been more commonly used. The purpose for such broad utilization of this practice is that it is cheap *(Ogunwale et al., 2021).*

Elevated content of trace elements in irrigated soils and ground water cause a risk to crop production and the welfare of human beings and faunas. This may take place in four several means: 1) metals may build in plants to values that result in plant injury; 2) metals in plants have detrimental effects on man and animals that feed on these plants; 3) metals might get into open water from agricultural watershed; and 4) metals may move into aquifer and can re-surface with tile drain water in runoff water, thus disturbing undomesticated species and human welfare. A few elements such as Cu, Fe, and Zn might result in injurious effects to aquatic habitat even at content a bit more than typical benchmark values *(Ogunwale et al., 2021).*

As previously reported the content of Cu probablyfound in unpolluted soil varies from 0.07-0.2 ppm *(Manisha et al. 2020)* (Table 1). When these values were compared with the total Cu content found in this study, all the plots indicated moderate and elevated contents. The ppm of Cu extracted from poultry site runs from 0.21-0.30, 0.18-0.20 for arable land; 0.26-0.47 for bush fallow while that of forestland runs from 0.12-0.16 of the total Cu (Table 7). The mean of Cu determined for poultry sites, arable land, bush fallow, and forestland are 0.25, 0.19, 0.35 and 0.14 ppm, respectively (Table 7). The obtainable Cu value was elevated in the poultry site and bush fallow, i.e., 0.25 and 0.35 ppm. The fertility content signifies the elevated content of Cu in the poultry site due to being required in the chicken diet, and it causes many adverse effects in the human system such as ischemia, impaired hemogenesis, and cardiac lesions; skin discolorations, cornification, ossification, reproduction, myelinogenesis of the spinal column, and nervous tissue synthesis; and inhibit growth. Chronic exposure Cu ingestion causes rapid discharge of Cu from the liver storage locations into the blood vessels leading to hematolysis, jaundice, and chlorosis with attending liver necrosis" *(Ogunwale et al., 2021).* Inadequacy in plants increases proneness to diseases such as ergot, which can pose substantial harvest loss in small grains.

Iron is an essential micronutrient for nearly all living organisms. It performs a crucial role in metabolic activities such as DNA production, respiration activity, photosynthesis activities, upkeep of chloroplast components, and activations *(Ogunwale et al., 2021).*All soils investigated have mean Fe content less than that of the FAO for cropland (4.5-55 ppm), aside from bush fallow, whose values was 5.72 ppm. The obtainable Fe value was elevated in the bush fallow plot, e.g., 5.72 ppm. These values are well more than the contents of Fe in all the field plots. The power of Fe to form soluble affinities with soil influences its mobility. In surface soils, Fe associates with organic matter and can produce soluble chelates which are more moveable in the face of fulvic and humic substances *(Ogunwale et al., 2022a).* Soil pH is the most vital factor influencing Fe solubility, sorption, and mobility *(Ogunwale et al., 2022a).* The solubility and mobility of Fe increase with increasing pH *(Ogunwale et al., 2022a).* From the findings at the site, a maximum pH of 8.20 was found in bush fallow (Table 4). Of all the elements, Fe exhibits the highest mobility in the soils at the site.

Zinc is necessary in plants for numerous biochemical activities like cytochrome and nucleotide manufacture, auxin metabolism, chlorophyll synthesis, enzyme function, ion transport, and the upkeep of membrane structure *(Ogunwale et al., 2021).* All of the soils studied are well above the Zn FAO value for arable land and plant uptake (0.6-1.0 ppm) except for forestland, whose mean values was 0.80 ppm. The obtainable Zn value was elevated in the bush fallow plot, e.g., 1.56 ppm. The mobility of Zn is higher in bush fallow than in poultry site, arable land, and forestland for the entire sample analyzed from the area (Table 8). Ikechukwu, (2010) has categorized many trace elements in line with their mobility attributes. He detected that mobility of Zn is the maximum and is the simple to be transported from one matrix to another for it is found as soluble substances at neutral and slightly acidic pH contents.

The elevated content of Cu and Zn was found in the poultry site, and Fe indicates moderate. In the arable

land, Cu signifies moderate, Zn exhibits elevated while Fe was unelevated. In the instance of bush fallow, elevated Cu, Fe, and Zn was found while in the case of forestland, moderate Cu and Zn was found and unelevated level of Fe was available. Continuous deposition of untreated liquid manure, undigested antibiotics, and resistant bacteria may contain trace elements and causes buildup of elevated content of trace elements in soil and so in crop plants (especially edible vegetables), which can be detrimental to crop plants and health threat to faunas and human beings.

In a nutshell, slight variations in fertility content occurred from site to site, a mass of the difference in total nutrient from sites might as well be due to surface soil with various land use practices. Variable parent materials, climate, biota, plant communities, land cover, and human activities would affect the level of soil parameters interrupted by the open raw poultry manures disposal and burning could likewise give rise to the poultry and cropland plots being different from that bush fallow and forested lands. The unelevated nutrients observed from field plots were owing to the high infiltration rate of the soil and the flat topography of the site.

Table 7: Comparative Analysis of Monitored Soil Minor Nutrients in Poultry farm Plot Usages

Soil minor nutrient	Percentage of samples falling under limit				
Av.Cu	<0.07 ppm (unelevated)	0.07-0.2 ppm (moderate)	>0.2 ppm (elevated)	Vary	Mean ±SD
Land utilization					
Poultry site	0	0	100	0.21-0.30	0.25±0.02
Arable land	0	100	0	0.18-0.20	0.19±0.05
Bush fallow	0	0	100	0.26-0.47	0.35±0.04
Forestland	0	100	0	0.12-0.16	0.14±0.02
Av.Fe	<4.5 ppm (unelevated)	4.5-5.5 ppm (moderate)	>5.5 ppm (elevated)		
Poultry site	50	50	0	2.50-4.70	3.82±0.12
Arable land	100	0	0	1.80-4.10	3.13±0.09
Bush fallow	0	25	75	5.05-6.21	5.72±0.18
Forestland	100	0	0	1.01-1.30	1.14±0.03
Av.Zn	<0.6 ppm (unelevated)	0.6-1.0 ppm (moderate)	>1.0 ppm (elevated)		
Poultry site	0	0	100	1.10-1.56	1.32±0.07
Arable land	0	25	75	0.97-1.23	1.08±0.05
Bush fallow	0	0	100	1.47-1.69	1.56±0.09
Forestland	0	100	0	0.68-0.90	0.80±0.04

Source: Field Survey, (2017)

Table 8: Fertility Content of Chemical, Primary, Secondary, and Minor Nutrients in Soils of Chicken Farm

Variable	units	Site Usages							
		Poultry		Arable land		Bush fallow		Forestland	
		FC	FR	FC	FR	FC	FR	FC	FR
pH		1.71	moderate	1.70	moderate	1.75	moderate	1.69	moderate
EC	μS/cm	1.36	Good	1.68	moderate	1.69	moderate	1.40	Good
OC	%	2.36	elevated	2.35	elevated	2.37	elevated	2.35	elevated
OM	%	2.35	elevated	1.90	Moderate	2.34	elevated	2.36	elevated
AN	mg/Ha	1.42	unelevated	1.44	unelevated	1.43	unelevated	1.42	unelevated
AP	mg/Ha	2.34	elevated	1.68	Moderate	2.36	elevated	2.37	elevated
AK	mg/Ha	2.02	Moderate	2.30	Moderate	2.31	Moderate	2.38	elevated
ACa		2.02	Moderate	2.00	Moderate	2.10	Moderate	2.22	Moderate
AMg	Cmol/kg	1.30	unelevated	1.31	unelevated	1.30	unelevated	1.32	unelevated
AS	Cmol/kg	1.73	Moderate	1.70	Moderate	1.71	Moderate	2.34	elevated
Cu	ppm	2.37	Elevated	1.81	Moderate	2.39	Elevated	1.90	moderate
Fe	ppm	1.69	Moderate	1.22	Unelevated	2.35	Elevated	1.32	unelevated
Zn	ppm	2.38	Elevated	2.36	Elevated	2.41	Elevated	1.90	moderate

Source: Field Survey, (2017)

IV. Conclusion

The findings of the present work inferred that prolonged utilization of untreated poultry manure in four site usage areas of poultry farmland, nutrients, total organic carbon, and organic matter on the rise in the soils, but there is concern associated with soil available P accumulation and the moderate buildup of likely minor nutrients, such as Cu, Fe, and Zn. Also, the plot varies from neutral to slightly alkaline soil pH with moderate EC while primary, secondary, and minor nutrients were within the natural limit apart from P and Zn which are more than analytical limit. To reduce needless damage effects from the untreated chicken manure employed to the soil, continuous monitoring of soil health in such zones is necessary. Untreated liquid manure needs to be sprayed before spreading and applying onto arable land, forestland, pastures, or food crops. Furthermore, remediation procedures together with good agronomical practices (GAPSs) as: devising and adhering to a nutrient management strategy, employing just needed manure to be uptake by the crop, manure fertility index, soil and manure analysis, standardization of manure spreader, estimating application proportions, period of application, inspecting manure waste disposal facilities for seepages, following the setback requirements, pH adjustment, organic matter management, fertilizer management, choice of the most suitable plants for a defined soil, and liming materials are essential in the collection site which is regarded as a central factor for soil health amelioration. Finally, permitting process forbids IAFOs application of "manure, litter, and process waste stream" to land below 150ft from any water surface channel to open waters, water drinking, farming wells or sink holes, arable land save the IAFOs offers a 35ft vegetated filter strips or similar option control procedure.

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Conflict of Interests

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Abbreviations: %: Percentage; GPS: Global Positioning System, pH: Potential of Hydrogen ion; EC: Electrical Conductivity, cm: Centimeter, mm: Millimeter, AN: Available Nitrogen, $AvPO_4^{3-}$: Available Phosphate, AvK^{+}: Available Potassium ion, $AvSO_4^{3-}$: Available Sulphate, Ca^{2+}: Calcium, Mg^{2+}: Magnesium, Zn^{2+}: Zinc, Cu^{2+}: Copper, Fe^{2+}: Iron, SFC: Soil Fertility Content, μS/m: Microsiemens per meter; $cmol.Kg^{-1}$: centimole/kilogram; SD: Standard Deviation, and kg/mg: kilogram per milligram, ITD: Inter-tropical Discontinuity; PTFE beakers; LOI: Loss on Ignition; FP: Flame photometer; FAAS: Flame Atomic Absorption Spectrophotometer; IAFOs: Intensive Animal Feeding Operations, FAO: Food and Agriculture Organisation, FC: Fertility content, FR: Fertility rating.

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ISO 14001 Environmental Standard: Process Approach and Identification of Environmental Aspects and Impacts

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Abstract- Environmental management is the management of activities that may have an impact on the environment [1]. It aims to limit polluting emissions and risks to the environment and to save natural resources [2]. Often unsuspected and therefore without us always realizing it, all economic activities can have a considerable impact on the environment [3]. Indeed, the manufacture of products requires the extraction of raw materials and the use of water and energy [4]. Similarly, activities associated with the manufacturing process, such as maintenance, transportation; all have environmental impacts [5]. The environmental management system is a progress tool that integrates the environmental dimension into an organization's strategy, leading it to set objectives, achieve and maintain performance through effective management and promotes anticipation (the forecast).

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Strictly as per the compliance and regulations of:

ISO 14001 Environmental Standard: Process Approach and Identification of Environmental Aspects and Impacts

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Abstract- Environmental management is the management of activities that may have an impact on the environment [1]. It aims to limit polluting emissions and risks to the environment and to save natural resources [2]. Often unsuspected and therefore without us always realizing it, all economic activities can have a considerable impact on the environment [3]. Indeed, the manufacture of products requires the extraction of raw materials and the use of water and energy [4]. Similarly, activities associated with the manufacturing process, such as maintenance, transportation; all have environmental impacts [5]. The environmental management system is a progress tool that integrates the environmental dimension into an organization's strategy, leading it to set objectives, achieve and maintain performance through effective management and promotes anticipation (the forecast).

There is a multitude of guides allowing self-diagnosis by the organization and which make it possible to make an environmental assessment. ISO 14001 is the environmental management standard created by the international organization for standardization [6]. It defines the requirements of a global environmental management system for self-reporting or certification purposes [7]. It is organized in 17 points modeled on quality management, well known for 34 years in the industry. The standard does not establish any absolute requirement for environmental performance, other than a commitment to environmental policy, to comply with legislation and the principle of continuous improvement [8].

Pollution prevention through the identification of the various significant environmental aspects and impacts, which accounted for 70% of the requirements of ISO 14001, is the main environmental improvement point [9]. In addition, since these environmental aspects and impacts can only be identified from the activities, products and services associated with them, this article represents a working method that allows expressing good environmental practices, present in the form of environmental performance indicators that inform in a concentrated and precise manner on the different activities with environmental relevance.

I. Working Methodology

a) General Requirements

The organization must establish and maintain an environmental management system whose requirements are described as follows:

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i. *Environmental Policy*

Management at the highest level must define their organization's environmental policy.

ii. *Panning*

Environmental Aspects:

The organization must maintain procedures for identifying the environmental aspects of the various activities

General Requirements and other:

The organization must maintain a procedure for identifying the legal and other requirements applied to the environmental aspects of the activities.

Objectives and Targets:

The organization must establish and maintain environmental objectives and targets.

Environnemental Management Program:

To achieve these objectives, the organization must establish and maintain one or more programs.

b) Implementation and Operation

i. *Structure and Responsibility*

The environmental management system requirements are established, implemented and maintained in accordance with this international standard.

ii. *Training, Awareness and Competency*

The staff should be made aware of:

- The importance of compliance with environmental policy and environmental management system requirements;
- With significant environmental impacts;
- Their roles and responsibilities to achieve compliance with environmental policy and requirements;
- Potential consequences of deviations from specified operating procedures.

iii. *Communication*

The organization shall establish and maintain procedures for:

- Ensure internal communication between the different levels and functions of the organization;
- Receive, document and respond to relevant requests from external stakeholders.

iv. *Environmental Management System Documentation*

The organization must establish and maintain paper or electronic information and maintain procedures to control all documents required by the standard:

Operational Proficiency

The organization must identify those of its operations and activities that are associated with significant environmental aspects

Emergency Prevention and Responsiveness

The organization must identify potential accidents and emergency situations and be able to react to reduce the associated environmental impacts.

v. *Control and Corrective Action*

Monitoring and Measurement

The organization must regularly monitor and measure activities that may have a significant environmental impact.

Non-compliance, corrective action and preventive action

The organization must define the responsibilities for the analysis of non-conformities, the taking of measures to reduce potential impacts, as well as to commit and carry out corrective and preventive and corrective actions.

Recordings

The organization must establish and maintain one or more programs and procedures for periodic audits of the environmental management system

vi. *Management Review*

The organization's management must review the environmental management system to ensure that it is still appropriate, sufficient and effective, as well as any changes to elements of the environmental management system.

II. Perform Self-Diagnosis

a) Identification of the Most Significant Environmental Aspects and Impacts of the Various Activities:

Environmental aspect: An element of an organization's activities, products or services that may interact with the environment. An aspect is therefore synonymous with impact factor, the aspect is the source of impacts [10].

Environmental impact: Any change in the environment, negative or beneficial, resulting wholly or partially from the activities, products or services of an organization [11].

From the identified activities, products and services, it is still necessary to identify environmental aspects and the impacts associated with them: It is a question of breaking down the activity to identify any operation that may generate nuisances (processes, equipment that has been part of, raw materials, outgoing products, waste or waste generated, resources, fluids and energy used, maintenance and cleaning work of equipment applied to process equipment, etc.).

The decomposition can be done on different levels, from the most general to the most detailed (workshop, manufacturing process, particular equipment) depending on the need to access or not very precise information. For to be more exhaustive, we can, for each activity, study each environment/ area or each nuisance.

The identification of environmental aspects and impacts is made taking into account the situation of the mode of operation (Table 1): Normal (N) as the situation of transitional operation (T) or the Incident operation (I)

Table 1: Situations of Operating Modes

Note	Normal Operation(N)	Transitional March(T)	Incident Operation(I)
1	The event takes place continuously	The event takes place several times a day	The event takes place several times on the site
2	The event takes place at least 50% of the time	The event takes place at least once a week	The event has already happened once on the site
3	The event takes place between 25 and 50% of the time	The event takes place at least once a month	The event has already occurred on similar sites
4	Event takes place at least 25% of the time	The event takes place at least once a month	The event has no known history

The identification of environmental aspects and impacts allows us to see environmental indicators and propose approaches for each indicator that will help us better understand environmental problems, material flows, personal perception and other environmental data.

b) Assessment of Environmental Aspects and Impacts

The process approach and the identification of Environmental Aspects and Impacts allows us to identify:

- Any operation which may generate nuisances (processes, equipment forming part of them, liquid, solid or gaseous discharges, etc.);
- Sensitive points;
- Type of action to be implemented;
- Skills and information required to master processes.

i. *Assessment of Significant Environmental Impacts*

The assessment of environmental impacts is carried out by taking into account three factors (Table 2): «Gravity», «Frequency of occurrence» and «Sensitivity of the receiving environment» and it has 4 stages:

1. *Intrinsic gravity assessment (G):* This involves determining the severity of the environmental impact. For this, it is important to define beforehand the criteria that will be taken into account in order to carry out this evaluation. Criteria such as: toxicity of products, amount of water or energy consumed… what helps to determine the order of magnitude of impacts, either critical, major, limited or minor;
2. *Frequency of occurrence assessment (F):* this involves determining the frequency of occurrence of the Environmental Impact;
3. *The evaluation of the Sensitivity (S):* the sensitivity of the receiving medium is also determined by characterizing the receiving medium (floor tightness for example);

Table 2: Environmental Impact Assessment

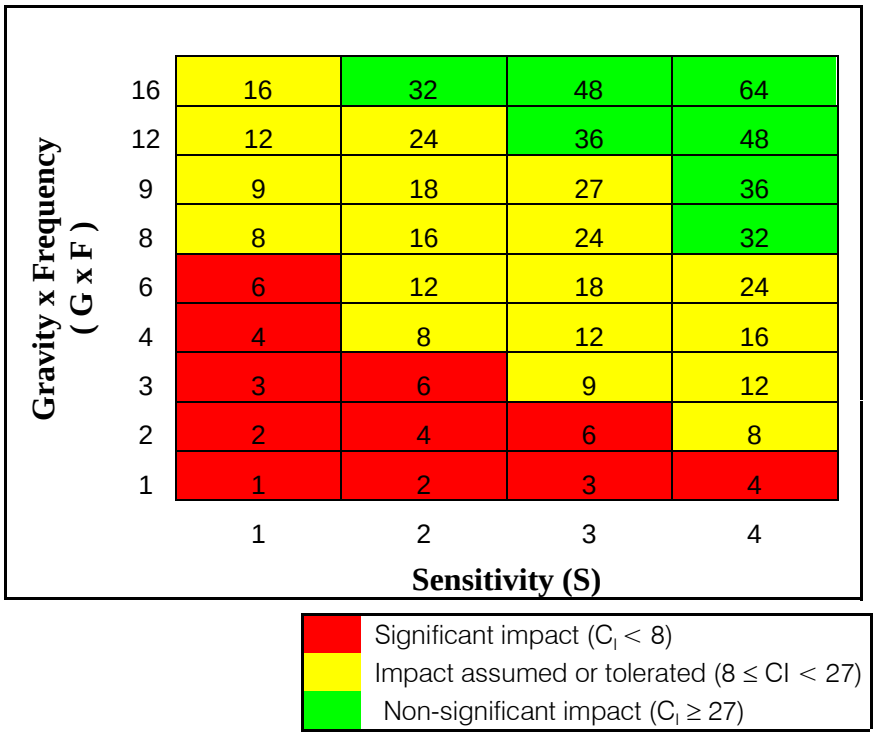
Score/Criterion	Gravity (G)	Frequency (F)	Sensitivity (S)
1	Irreversible damage to living beings (humans, fauna and flora) whether they are internal or external to the organism (critical)	Permanent	Critical
2	Irreversible damage to the environment (major)	Frequent	Important
3	Reversible harm to environment (limited)	occasional	Limited
4	Gene for staff (minor)	Rare	Low

4. Determining the criticality of the environmental impact: Taking into account the previous criteria. This score is obtained by multiplying the elementary scores for each criterion:

$$C_I = G \times F \times S$$

The Table 3 below represents the criticality matrix and determines the significance of the environmental impact:

Table 3: Matrix of Environmental Impact Criticality



ii. *Assessment of Significant Environmental Aspects:*

This part consists of 3 steps, this is to identify 2 other criteria related to the identified environmental aspects:

1. Study of regulatory compliance (C): any aspect not satisfying regulatory constraints and necessarily significant

0	Non-compliant
1	Compliant or non-regulatory

2. Environmental Control Level Assessment (M): Control level is technical, human and organizational. The evaluation must take in to account the principles of prevention

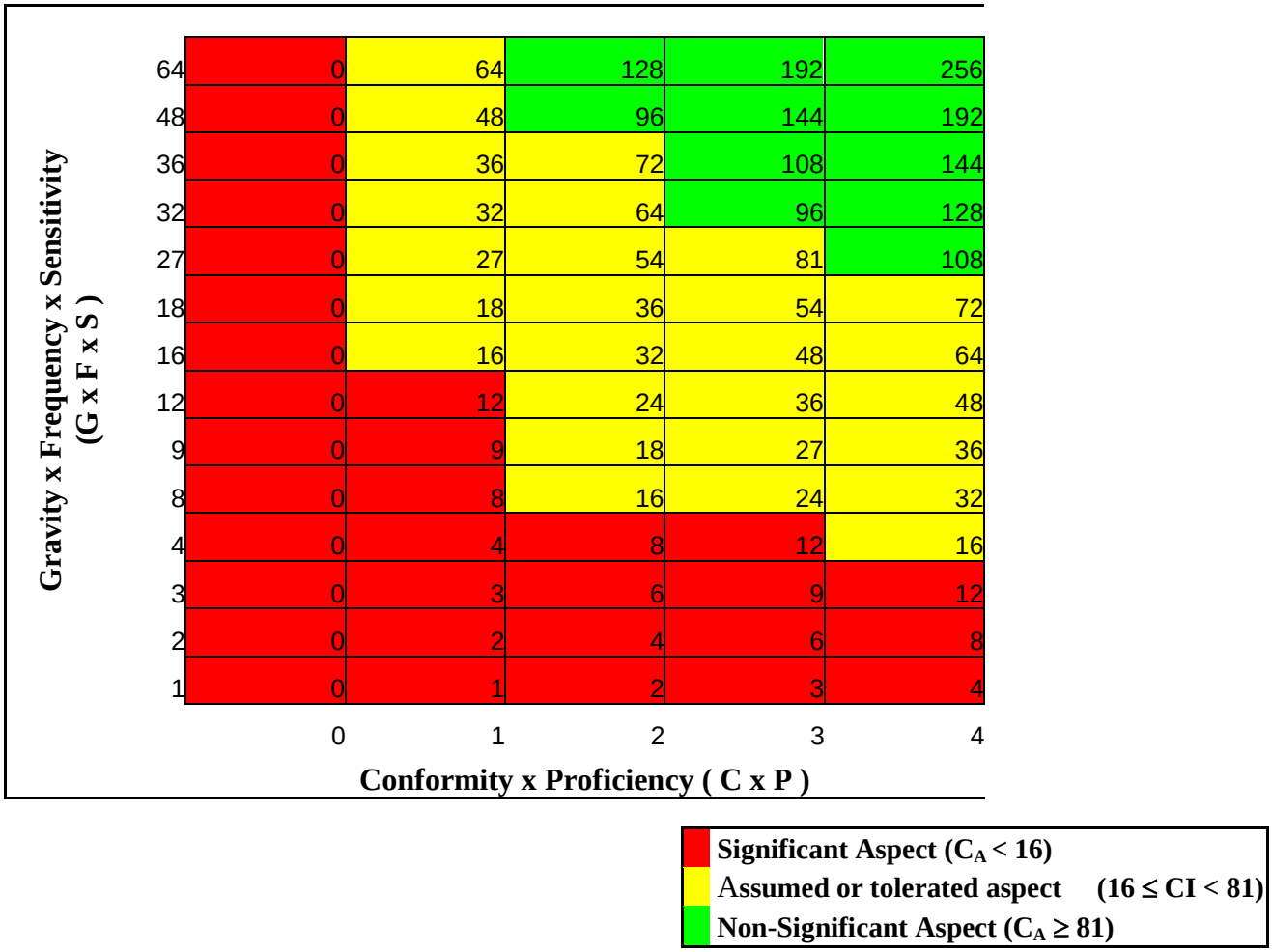
1	Non-existent
2	Low
3	Good
4	maximum

3. Determination of the criticality of the environmental aspect:

$$C_A = C_I \times C \times M$$

The Table 4 represents the criticality matrix and determines the significance of the environmental aspect:

Table 4: Matrix of Environmental Criticality



III. Conclusion

The ISO 14001 standard is the most suitable and appropriate environmental management system for its application, given its commitments and its proactive aspect that does not require an environmental declaration.

In practice, there is a wide variety of methodologies that make it possible to achieve the environmental objective, some of which are limited to a purely formal approach, while others integrate consultation or worker participation.

The methodology proposed in this work allows an improvement of environmental performance in order to achieve a clearly defined goal, the management and protection of the environment in which the activities take place.

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Memberships

Fellows/Associates of Science Frontier Research Council

FSFRC/ASFRC Memberships

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Associates of FSFRC/ASFRC are scientists and researchers from around the world are working on projects/researches that have huge potentials. Members support Global Journals' mission to advance technology for humanity and the profession.

FSFRC

Fellow of Science Frontier Research Council

FELLOW OF SCIENCE FRONTIER RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.

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- Any other original work

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2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

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Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

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Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

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It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

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The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

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The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

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Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

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Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

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Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

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1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

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7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

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14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

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23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

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Key points to remember:

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- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

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Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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