Factorial Analysis on Varying Effect of Poulty Manure NPK Fertilizer on the Growth and the Yield of Maize Crop

(Case Study of Eden Flows Global Resources Ltd Ilaro, Ogun State, Nigeria.)

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ABSTRACT

When the soil fertility is inadequate, it leads to low productivity, which results to one of the factors hindering crop production in Nigeria. It has been attributed to planting of crop consistently without adequate artificial soil nutrient of farm inputs. However, the combination of chemical fertilizer and organic manure is regarded as one of solution to the problem. The treatment consists of NPK fertilizer with fresh weight of maize, NPK with dry weight of maize and NPK with seed yield maize. The factorial ANOVAL model is adopted for the analysis. The result indicates that $F_{cal(10.57)} > F_{tab(0.83)}$ for the poultry manure and $F_{cal(1.54)} > F_{tab(0.83)}$ for NPK Fertilizer, means that both contributes to the fresh plant weight of the maize, while $F_{cal(16.06)} > F_{tab(0.83)}$ for poultry manure and $F_{cal(3.05)} > F_{tab(0.83)}$ for NPK fertilizer respectively have a significance difference by contributing positively to plant seed yield of maize. Also, $F_{cal(0.308)} < F_{tab(0.83)}$ for poultry manure and $F_{cal(0.135)} < F_{tab(0.83)}$ for NPK fertilizer implies that there is no significance difference to dry plant weight. It shows that poultry manure and NPK fertilizer equally contributed significantly to the fresh plant weight of the maize and plant seed yield of the maize but does not contribute positively to the dry plant weight.

Keywords: Fertility, Yield, Factorial, Manure and Growth

INTRODUCTION

Agriculture has been a cornerstone of human civilization for thousands of years, evolving from primitive subsistence farming to complex modern systems that produce food for billions of people worldwide. The domestication of crops, particularly cereals, has significantly influenced economic structures and social dynamics throughout history. Among these crops, maize (Zea mays L.) stands out not only for its adaptability to various climates but also for its pivotal role in global food security and economic development. As one of the most cultivated crops worldwide, maize contributes to the diets of millions, serves as a vital livestock feed, and is a key ingredient in various industrial products. According to the Food and Agriculture Organization (FAO), maize production has steadily increased, reflecting its importance in addressing food security and agricultural sustainability [7].

Good soil health is essential for sustainable agriculture and is characterized by high organic matter content, good structure, and the presence of beneficial microorganisms. Healthy soil promotes efficient nutrient cycling and water retention, which are crucial for crop growth. The introduction of fertilizers, both organic and inorganic, has become a common practice to enhance soil fertility and crop yield. Among these, poultry manure and NPK (Nitrogen, Phosphorus, and Potassium) fertilizers are widely used due to their effectiveness in supplying essential nutrients for crop development.

The growth and yield of maize are heavily influenced by soil health, which is fundamental to sustainable agricultural practices. Healthy soils are rich in organic matter, support diverse microbial communities, and possess good structure and nutrient-holding capacity. Such soils not only provide essential nutrients for crops but also facilitate water infiltration and retention, which are critical for plant development. Fertilization, through

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both organic and inorganic means, is a common practice aimed at improving soil fertility and ensuring adequate nutrient availability for crops. Among various fertilization options, poultry manure and NPK (Nitrogen, Phosphorus, and Potassium) fertilizers are widely used in maize production, each offering unique advantages and limitations.

Poultry manure is a nutrient-rich organic fertilizer that contributes to enhancing soil health. It contains high levels of nitrogen, phosphorus, and potassium, along with trace elements that are crucial for plant growth [6]. The organic matter in poultry manure improves soil structure and increases water retention capacity, which can lead to better crop performance. Research has shown that the applications of poultry manure positively influence maize growth parameters, including plant height, leaf area, and overall yield [9]. [2] highlight that maize cultivated with poultry manure exhibits enhanced root development, which improves nutrient uptake and overall crop health.

On the other hand, NPK fertilizers provide a concentrated source of essential nutrients, which can lead to rapid growth and increased yields during critical growth stages of maize. These fertilizers are particularly effective in delivering nutrients when crops have high demand, contributing to increased productivity [1]. However, the long-term application of chemical fertilizers raises concerns regarding soil degradation, nutrient leaching, and environmental sustainability [11]. Continuous use of NPK fertilizers without integrating organic amendments can diminish soil organic matter and adversely affect soil health.

The integration of poultry manure and NPK fertilizers, known as integrated nutrient management (INM), presents a promising strategy for enhancing maize productivity while promoting sustainable agricultural practices. Research indicates that combining these two fertilization methods can produce synergistic effects, optimizing nutrient availability and improving overall maize yield [15]. [10]. found that maize treated with a combination of poultry manure and reduced rates of NPK fertilizers yielded higher than those treated with either method alone. This approach not only maximizes crop production but also enhances soil health by increasing organic matter content and microbial activity.

The economic and social importance of maize cannot be understated. It serves as a primary food source for millions, particularly in developing countries, where it forms a significant part of the diet. Its cultivation supports the livelihoods of smallholder farmers and contributes to rural economic development [4]. Additionally, maize is integral to animal husbandry, providing feed that sustains livestock production, further embedding its role in the agricultural value chain.

Objective Of Study

The aim and of this research work is to determine the variable effects of Poultry Manure and NPK fertilizer analysis on the growth and yield of maize crop.

The objectives are:

1. Applying of Poultry manure and NPK fertilizer at different levels contribute to the fresh plant weight and dry plant weight of maize crop.

2. The quality of communication between the levels of poultry manure and NPK fertilizer has a significant difference on the maize crop.

3. The application of Poultry manure and NPK fertilizer at different levels enrich the plant seed of maize crop.

4. The quality of interaction between the levels of poultry manure and NPK fertilizer has a significant difference on the plant seed of maize crop.

Problem Of Study

The effective management of soil fertility is crucial for optimizing crops production, Despite the extensive use

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of fertilizers, farmers often face challenges in determining the most effective fertilization strategies that balance cost, yield, and environmental sustainability. The increasing demand for maize as a staple food crop and its economic importance further underscores the need for efficient agricultural practices.

One primary problem is the potential for soil degradation and nutrient depletion caused by the overreliance on synthetic fertilizers like NPK. Research indicates that continuous application of chemical fertilizers without incorporating organic amendments can lead to reduced soil organic matter, decreased microbial activity, and lower overall soil health.

Furthermore, there is limited research on the comparative effects of integrating poultry manure and NPK fertilizers on maize growth and yield under varying environmental conditions. Existing studies focus on the individual impacts of these fertilizers, leaving a gap in knowledge regarding their synergistic effects when used together.

Research Question

1. Does weight of the fresh plant and dry plant affect by the application of the poultry manure and NPK fertilizer at different levels?

2. Is there a significant difference on the maize crop due to the quality interaction between the levels of poultry manure and NPK FERTILIZER?

3. Does plant seeds of the maize crop affected by the application of the poultry manure and NPK fertilizer at different levels?

4. Is there a significant difference on the plant seeds of maize crop due to the quality interaction between the levels of poultry manure and NPK fertilizer?

Hypothesis

H_0: The application of the poultry manure and NPK fertilizer at different levels do not affect the weight of the fresh plant of maize crop.

H_1: The application of the poultry manure and NPK fertilizer at different levels affect the weight of the fresh plant of maize crop.

H_0: The quality interactions between the levels of poultry manure and NPK fertilizer don't have a significant difference on the maize crop.

H_1: The quality interactions between the levels of poultry manure and NPK fertilizer have a significant difference on the maize crop.

H_0: The quality interactions between the levels of poultry manure and NPK fertilizer don't have a significant difference on the plant seed yield maize crop.

H_1: The quality interactions between the levels of poultry manure and NPK fertilizer have a significant difference on the plant seed yield maize crop.

Scope and Limitation of the Study

This study examines all the record of fresh weight, dry weight and seed yield of maize crop from 2021 to 2022 section of planting and harvesting of maize crop from the record department of the Eden Flows Global Resource Ltd IlaroOgun State Nigeria.

Significance of the Study

The significance of this study is to determine if there are variable effects of Poultry Manure and NPK fertilizer

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on the growth and yield of maize crop, if the application of Poultry manure and NPK fertilizer at different levels contribute to the fresh plant weight and dry plant weight of maize crop and plant seed of the maize crop. And to also determine if the quality of interaction between the levels of poultry manure and NPK fertilizer has a significant difference on the maize crop and the plant seed of maize crop.

LITERATURE REVIEW

The Varying Effects of Poultry Manure and NPK Fertilizer on the Growth and Yield of Maize Crop

Maize (Zea mays L.) is a globally important staple food crop with significant nutritional and economic value, especially in many developing regions. Fertilizer application is a primary means of enhancing maize productivity and meeting growing food demands. Among fertilizers, poultry manure and NPK fertilizers are commonly used, each offering distinct benefits and limitations that influence maize growth, yield, and soil health. Understanding these differences is essential for optimizing maize production while considering environmental sustainability and soil fertility. This literature review examines the effects of poultry manure and NPK fertilizer on maize, with an emphasis on recent studies from the past five years.

Poultry manure is a rich organic source of essential nutrients, including nitrogen (N), phosphorus (P), and potassium (K), as well as micronutrients. It enhances soil health by increasing organic matter, improving soil structure, and boosting water-holding capacity. Studies have demonstrated that poultry manure positively impacts soil pH, organic carbon content, and microbial activity, all of which are critical for sustaining soil fertility and supporting crop growth.

For instance, [14] found that poultry manure significantly improves soil nutrient status and water retention, thereby enhancing maize growth. This benefit contrasts with NPK fertilizers, which provide readily available nutrients but lack the organic matter needed to improve soil structure and long-term fertility [14].

Conversely, NPK fertilizers, while effective in delivering nutrients quickly, can contribute to soil acidification over time, particularly with prolonged and exclusive use. This acidification can alter soil microbial activity, reduce nutrient cycling efficiency, and ultimately impact soil structure. However, NPK fertilizers are beneficial for providing an immediate nutrient boost, especially during critical growth stages in maize. According to [11]., balanced applications of NPK are essential for sustaining soil nutrient levels and avoiding nutrient depletion

The effects of poultry manure and NPK Fertilizer on Maize Growth and Yield through Several studies underscore the significant impact of poultry manure on maize growth, particularly in the long term. Its gradual nutrient release benefits soil health and leads to sustained maize yield improvements. [6] observed that maize treated with poultry manure showed enhanced leaf chlorophyll content, larger root systems, and overall biomass accumulation compared to NPK-treated maize. These findings highlight the role of poultry manure in providing a steady supply of nutrients, which is beneficial for crop growth and sustainable yield across multiple growing seasons , on the other hand, is highly effective in promoting rapid vegetative growth due to its immediate nutrient availability. [1] reported that NPK application led to early flowering, improved photosynthetic activity, and higher initial yields in maize, attributed to the fast nutrient absorption rates facilitated by NPK However, the study noted that these benefits diminished over time with continuous use of NPK alone, suggesting that sole reliance on chemical fertilizers might not sustain long-term productivity .

Soil organic matter (SOM) is a key component of soil health, affecting nutrient retention, water infiltration, and microbial activity. Organic amendments like poultry manure are essential for building and maintaining SOM, which in turn promotes nutrient availability and overall soil fertility. Research by [9] found that poultry manure application led to increased microbial biomass, higher enzyme activity, and enhanced nutrient cycling, all of which are vital for healthy maize growth. This is contrasted with NPK fertilizers, which, although beneficial for rapid nutrient delivery, do not contribute to SOM, potentially leading to soil degradation over time [9]. Studying [2] reported that poultry manure-treated soils exhibited higher cation exchange capacity (CEC) than those treated solely with NPK, indicating better nutrient retention and soil structure. This enhanced soil quality was attributed to the organic content of poultry manure, which improves soil’s ability to hold nutrients and water. This finding is supported by [13], who observed that poultry manure positively influenced soil microbial populations,

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resulting in increased nutrient availability for maize over time.

Nitrogen use efficiency (NUE) is a critical factor in crop productivity and environmental sustainability. Efficient nitrogen use reduces the amount of nitrogen lost through leaching, which is particularly important for minimizing environmental pollution. Poultry manure enhances NUE due to its slow nitrogen release, which minimizes leaching risks. [15] observed that poultry manure improved NUE in maize fields, resulting in greater nitrogen retention and reduced nitrogen runoff compared to fields treated with NPK alone. This slower release of nitrogen also supports more consistent crop growth.

Conversely, the rapid nutre from NPK fertilizers increases the risk of nitrogen leaching, especially under heavy rainfall or irrigation. [4] reported substantial nitrogen losses in NPK-fertilized fields, particularly when applied at high rates. This study emphasized the importance of appropriate NPK application rates and timing to reduce nutrient leaching and enhance NUE in maize cultivation.

Poultry manure is widely acknowledged as a more sustainable option than synthetic fertilizers, given its ability to recycle organic waste, reduce dependency on fossil-fuel-based fertilizers, and enhance soil organic matter. The slow-release nature of nutrients in poultry manure reduces the risk of leaching and minimizes greenhouse gas emissions compared to synthetic fertilizers. [10] highlighted that organic amendments, including poultry manure, have a lower carbon footprint and contribute to carbon sequestration, thereby supporting environmentally sustainable maize production [12].

However, poultry manure presents challenges suportation costs, the risk of pathogen load, and the potential for nutrient imbalances if not managed properly. In contrast, NPK fertilizers, while efficient for high-yield production, have a significant environmental impact. Their production is energy-intensive and contributes to greenhouse gas emissions, and improper application can result in nutrient runoff and water pollution. The [8] underscores that long-term reliance on synthetic fertilizers without organic amendments may lead to declining soil fertility and increased environmental degradation.

Frmic perspective, poultry manure is a cost-effective fertilizer option in regions where poultry farming is prevalent, as it reduces input costs and enhances soil fertility, although transportation and application costs can be limiting factors. A study by [5] found that farmers using locally sourced poultry manure reported reduced input costs and improved soil fertility, which offset the higher labor required for manure application. This advantage is particularly relevant in smallholder farming contexts.

NPK fertilizers are more convenient and practical for large-scale s due to their concentrated nutrient content and ease of handling. However, continuous use of NPK fertilizers alone can lead to increased costs over time due to soil degradation and the need for additional soil amendments. [9] recommend integrating poultry manure with reduced NPK application to optimize maize yield while reducing fertilizer costs, emphasizing that balanced fertilizer use is essential for long-term economic viability in maize farming.

Integrate management (INM) combines organic and inorganic fertilizers to achieve optimal crop yield while maintaining soil health. This approach allows farmers to leverage the immediate benefits of NPK fertilizers while harnessing the soil-enhancing properties of poultry manure. [3] found that applying 75% of the recommended NPK dose along with poultry manure significantly improved maize yield, soil health, and sustainability. The integration of these fertilizers enhances maize productivity and soil resilience, supporting long-term agricultural productivity.

In a field trial by [12], combining poultry manure with reduced tion improved maize yield by 30% compared to NPK alone, with marked improvements in soil organic matter and microbial activity. This combined approach not only sustains high maize yields but also reduces dependency on chemical fertilizers, enhancing soil fertility and crop resilience [12].

Poultry manure and NPK fertilizer offer distinct advantages for vation. Poultry manure improves soil structure, increases microbial activity, and provides a steady nutrient supply, making it beneficial for long-term soil health and sustainable productivity. NPK fertilizer, while highly effective for immediate nutrient delivery, may

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume X Issue I January 2025

negatively impact soil health and the environment if used excessively or without organic amendments. Integrated nutrient management, which combines poultry manure and NPK fertilizer, appears to be the most effective approach for optimizing maize yield while preserving soil health and supporting environmental sustainability. Continued research is essential to further refine INM strategies and adapt them to diverse agroecological conditions.

Fertilizers play a crucial role in ensuring that plants receive the nutrients they require for optimal growth and development. Different types of plant fertilizers are accessible to farmers, but the two most common are organic and inorganic. Nutrients in organic products are gradually released while the substance decomposes over time, while artificially synthesized inorganic products allow for the rapid uptake of nutrients by plants. However, the organic type of fertilizer is better for the soil and the ecosystem in the long run. Precision farming platforms simplify fertilizing at varying rates, maximizing the benefits of each fertilizer type. To thrive, plants require a variety of nutrients, which they get from the soil through their roots. Each harvest reduces the soil's potential productivity unless soil nutrients are restored. The correct type of fertilizer for plants can fix nutrient deficiencies. Fertilizers supply plants with the three essential nutrients they need to grow: nitrogen (N), phosphorus (P), and potassium (K), as well as other needed micronutrients. The key parameters of different types of fertilizers used in agriculture are these nutrients and how they are obtained. Many factors, including soil quality, crop type, and application method, can influence fertilizer type decisions. There is a wide variety of fertilizing products available today, allowing farmers to create a nutrient-rich environment for their crops [11].

METHODOLOGY

Method of Data Collection

The type of data collection employed in this research is a secondary source of data. It includes the record of fresh weight, dry weight and seed yield of maize crop from 2021 to 2022 section of planting and harvesting of maize crop from the record department of the Eden Flows Global Resource LTD Ilaro Ogun State. The statistical method use in the data analysis is Factorial ANOVA test for two way analysis of variance.

Factorial ANOVA

Factorial ANOVA stands for Factorial Analysis of Variance. The factorial experimental methodology is preferred to a sequence of experiments investigating the factors separately. The principles of this factorial methodology are the main and interaction effects in its model.

Factorial experiment and is given by:

$$\mathbf{Y_{ijk} = \mu + \tau_i + \beta_j + (\tau\beta)_\mu + \varepsilon_{ijk}}$$

where i= 1,2,3,4; j=1,2,3,4; k=1,2; a=4; b=4; n=2

Y_{ijk} is the k^{th} observation taken under the i^{th} level of NPK and j^{th} level of poultry manure, μ is the overall mean effect, is the level of NPK effect, is the effect of the j^{th} rate of manure, is the effect of interaction between NPK fertilizers and poultry manure and is the random error component. The Latin notations given in equation 1 are as defined below:

a= number of levels of NPK effect.

b = number of rates of poultry manure.

n = number of observations at each level

The model assumes that the population is normally and independently distributed with mean and variance σ^2, that is, $Y_{ijk} = (\mu, \sigma^2)$, the error terms are normally and independently distributed with mean, $\mu = 0$ and variance σ^2, that is, e_{ijk} $(0,\sigma^2)$, the NPK effects and poultry manure rates are additive and sum of their effects are equal to zero, that is,$\Sigma\tau_i = \Sigma\ \beta_j = 0$, the interaction effects of NPK and Poultry manure are additive and their sums are also

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equal to zero and there are abn total observations in the experiment conducted.

ANOVA Table

The Analysis of Variance (ANOVA) shows the statistical use to the test hypothesis about the population mean.

Table 1: Analysis of Variance (ANOVA)

Source of variation	**Degree of freedom**	**Sum of squares**	**Mean of squares**	**F_{cal}**
NPK Fertilizer	a – 1	SSN	A = SSN/(a-1)	A/D
Poultry Manure	b – 1	SSP	B = SSP/(b-1)	B/D
Interaction	(a – 1) (b – 1)	SSI	C = SSI/(a-1)(b-1)	
Error (E)	ab (n – 1)	SSE	D = SSE/ab(n-1)	
Total (T)	abn – 1	SST		

Anova Calculations

From the table 3.3.1.1 gave the partitioning of the total sum of squares into recognizable sources of variation. The total correctedsum of squares (SST) is:

SST= $\sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{n}(Y_{ijk}-\bar{Y}...)$

$\sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{n}(\mathbf{Y_i-\bar{Y}\ldots}) + (\mathbf{Y_j-\bar{Y}\ldots}) + (\mathbf{Y_k-\bar{Y}\ldots}) + \mathbf{Y\ldots} + (\mathbf{Y_{ijk}-Y\ldots})^2$

= $bn\sum_{i=1}^{a}(\bar{Y}_{i...} - \bar{Y}...) + an\sum_{i=1}^{a}(\bar{Y}_{i...} - \bar{Y}...) + b_i = 1aj = 1bYij.-Y.j. + Y\ldots + I = 1bk = 1n(Yijk – Y\ldots)2$

Then SST is given as:

SST = SSN + SSP + SSNP + SSE

The number of degree of freedom with each sum of square is also given in Table 3.3.1.1

Where MSE = *SSE /ab(n-1)*

In computations, the sums of squares are defined as:

SST = $\sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{n} \boldsymbol{Y^2_{IJK}} - \frac{\boldsymbol{Y2_{...}}}{abn}$

SSP = $\sum_{i=1}^{a}\frac{Y_I^2}{bn} - \frac{Y_{...}^2}{abn}$

SSP = $\sum_{j=1}^{b}\frac{Y_j^2}{an} - \frac{Y_{...}^2}{abn}$

The sum of squares between the ab cell totals would be first obtained and referred to as the sum of squares due to subtotals

Subtotals = $SS_{subtotals}$ – SSN – SSP

SSE = SST – SSI – SSP – SSN = SST - $SS_{subtotals}$

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume X Issue I January 2025

Hypothesis Testing

H_0 = There is no significant difference

H_1 = There is significant difference

P-Value

When you perform hypothesis test in statistics, a p-value help you determine the significance of your result. The p-value is between 0 and 1 and interpreted in the following way: a small p-value (typical ≤ 0.05) indicates strong evidence against the null hypothesis, so you reject the null hypothesis.

DATA PRESENTATION AND ANALYSIS

Data Presentation

This is the data collected on the record of fresh weight, dry weight and seed yield of maize crop from 2021 to 2022 cropping section of poultry manure and NPK fertilizer levels from the record department of the Eden Flows Global Resource Ltd Ilaro Ogun State, Nigeria.

Table 2: Sum of Observations in Each Level of The Two Factors for the Fresh Weight of Maize

Poultry Manure (kg/ha)	**NPK fertilizer (kg/ha) (Fresh Weight in gram)**				
	0	**100**	**200**	**300**	**Total**
0	1341	1519	1620	1603	6083
500	1684	1783	1844	1916	7227
1000	1857	1977	2030	2082	7946
1500	2022.6	2119.1	2164	2223.8	8529.5
Total	6904.6	7398.1	7658	7824.8	29785.5

Table 3: Sum of Observations in Each Level of The Two Factors for the Dry Weight of Maize

Poultry Manure (kg/ha)	**NPK fertilizer (kg/ha) (Dry Weight in gram)**				
	0	**100**	**200**	**300**	**Total**
0	510.2	803.2	903.9	957	3174.3
500	896.5	952.3	977.3	991.2	3817.3
1000	964.6	1012.8	1025.7	1046.1	4049.2
1500	1018.4	1065.2	1094	1121	4298.6
Total	3389.7	3833.5	4000.9	4115.3	15339.4

Factoria ANOVA

Factorial experimental analysis is method of studying effect of multiple factors on a response variable. It consist of applying two or more factors at different level to experimental unit. By observing the response variable for all possible combination of factors. It allows the researcher to identify interactions, obtain more information and

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume X Issue I January 2025

improve external validity.

The factorial ANOVA model used to calculate the expected frequencies level of the two factors for the fresh weight of maize.

$$\mathbf{Y_{ijk} = \mu + \tau_i + \beta_j + (\tau\beta)_\mu + \varepsilon_{ijk}}$$

Table 4: Sum of Observations in Each Level of The Two Factors for the Fresh Weight of Maize

Poultry Manure (kg/ha)	**NPK fertilizer (kg/ha) (Fresh Weight in gram)**				
	0	**100**	**200**	**300**	**Total**
0	1341	1519	1620	1603	6083
500	1684	1783	1844	1916	7227
1000	1857	1977	2030	2082	7946
1500	2022.6	2119.1	2164	2223.8	8529.5
Total	6904.6	7398.1	7658	7824.8	29785.5

Corrected factor (CF) = $\frac{\sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{n} Yijk^2}{abn}$

CF = $\frac{Y_{....}^{\ 2}}{abn} = \frac{(29785.5)^2}{4*4*2} = \frac{887176010.80}{32}$ = 2772450.32g/ha

The sums of squares of Poultry Manure (factor) and NPK fertilizer (factor) are:

SS (Poultry manure) = $\frac{\sum_i^a Y_{i...}^2}{bn}$ - CF

= $\frac{6083.20^2+\cdots+8529.50^2}{4*2}$ – 27724250.32

= $\frac{225123704.30}{8}$ - 27724250.32

SS (Poultry Manure) = 416187.415g/ha

SS (NPK) = $\frac{\sum_j^b Y_{j...}^2}{an}$ – CF

= $\frac{6904.60^2+\cdots+7834.80^2}{4*2}$ – 27724250.32

= 27784730.48 - 27724250.32

SS (NPK) = 60480.15625g/ha

The sums of squares of the interaction between Poultry Manure and NPK fertilizer effects, total and error are estimated as:

SS (Poultry Manure/NPK) = $\frac{\sum_i^a\sum_j^b\sum_k^n Y_{ijk}^2}{k}$ – CF – SS(Poultry) – SS(NPK)

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume X Issue I January 2025

$= \frac{1341^2+\cdots+2223.80^2}{2}$ – 27724250.32 – 416212.7113 – 60480.15625

= 479883.685 – 476692.8676

SS (Poultry Manure/NPK) = 3190.81745g/ha

SST = $\sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{n} Y^2_{IJK}$ **–CF**

= 673.5^2+ 667.5^2…+ 1186^2- 27724250.32 = 689866.61g/ha

SST = 689866.61g/ha

SSE = SST – SS (PM) – SS (NPK) – SS (Poultry/NPK)

689866.61 – 416212.7113 – 60480.15625 – 3190.81745

SSE = 209982.925g/ha

ANOVA FOR PLANT FRESH WEIGHT OF MAIZE

Table 5: The estimated results as given above are summarized in Table 4 below

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F_{cal}	F_{tab}
Poultry Manure	3	416212.7	138737.6	10.57	F0.05,(3,15) =0.83
NPK Fertilizer	3	60480.16	20160.05	1.54	F0.05,(3,15) =0.83
Poultry Manure & NPK	9	3190.817	354.5353	0.027	F0.05,(9,15) =0.96
Error (E)	16	209982.9	13123.93		
Total (T)	31	689866.6			

Decision 1: Since Fcal (10.57) >Ftab (0.83) for the Poultry manure; this implies that there is significant difference among the poultry manure levels, and as a result of this, poultry manure has significant contribution to fresh plant weight of maize. And since the Fcal (1.54) >Ftab (0.83) for the NPK Fertilizer; this implies that there is significant difference among the NPK fertilizer levels and thus, NPK fertilizer levels do affect the fresh plant weights of maize positively for bountiful harvest. The result also showed that Fcal (0.027) <Ftab (0.96) and therefore the quality of interaction between the levels of Poultry manure and NPK fertilizer has no significant difference.

The factorial anova model used to calculate the expected frequencies level of the two factors for the dry weight of maize

Table 6: Sum of Observations in Each Level of The Two Factors for the Dry Weight of Maize

Poultry Manure (kg/ha)	NPK fertilizer (kg/ha) (Dry Weight in gram)				
	0	100	200	300	Total
0	510.2	803.2	903.9	957	3174.3
500	896.5	952.3	977.3	991.2	3817.3

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume X Issue I January 2025

1000	964.6	1012.8	1025.7	1046.1	4049.2
1500	1018.4	1065.2	1094	1121	4298.6
Total	3389.7	3833.5	4000.9	4115.3	15339.4

Corrected factor (CF) = $\frac{\sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{n} Yijk^2}{abn}$

CF = $\frac{Y....^2}{abn} = \frac{(15229.4)^2}{4*4*2} = \frac{235297192.40}{32}$ = 7353037.261g/ha

The sums of squares of Poultry Manure (factor) and NPK fertilizer (factor) are:

SS (Poultry manure) = $\frac{\sum_{i}^{a} Y_{i...}^2}{bn}$ - CF

= $\frac{3174.3^2+\cdots+4298.6^2}{4*2}$ – 7353037.261

= $\frac{59521942.38}{8}$ - 7353037.261

SS (Poultry Manure) = 87205.5365g/ha

SS (NPK) = $\frac{\sum_{j}^{b} Y_{j...}^2}{an}$ – CF

= $\frac{3389.7^2+\cdots+4115.3^2}{4*2}$ – 7353037.261

= 7391085.405 - 7353037.261

SS (NPK) = 38048.144g/ha

The sums of squares of the interaction between Poultry Manure and NPK fertilizer effects, total and error are estimated as:

SS (Poultry Manure/NPK)

= $\frac{\sum_{i}^{a}\sum_{j}^{b}\sum_{k}^{n} Y_{ijk}^2}{k}$ – CF – SS(Poultry) – SS(NPK)

= $\frac{1341^2+\cdots+2223.80^2}{2}$ – 7353037.261 – 87205.5365 – 38048.144

= 7507184.03 – 7353037.261 – 87205.5365 – 38048.144

SS (Poultry Manure/NPK) = 3190.81745g/ha

SST = $\sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{n} Y^2_{IJK}$ **–CF**

= $238.2^2+ 272^2\ldots+ 315.3^2$- 7353037.261 = 1567795.279g/ha

SST = 1567795.279g/ha

SSE = SST – SS (PM) – SS (NPK) – SS (Poultry/NPK)

1567795.279 – 87205.5365 – 38048.144 – 28893.0885

SSE = 1413648.51g/ha

The estimated results as given above are summarized in Table 4.2.1.2 below

Table 7: Anova for Dry Fresh Weight of Maize

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F_{cal}	F_{tab}
Poultry Manure	3	87205.54	29068.51	0.308	F0.05,(3,15) =0.83
NPK Fertilizer	3	38048.14	12682.72	0.135	F0.05,(3,15) =0.83
Poultry Manure & NPK	9	28893.09	3210.343	0.034	F0.05,(9,15) =0.96
Error (E)	16	1413649	94243.23		
Total (T)	31	1567795			

Decision 2: Since Fcal (0.308) <Ftab (0.83) for Poultry manure; this implies that there is no significant difference among the poultry manure levels, and as a result of this, poultry manure has no significant contribution to the dry plant weight of maize. Also the Fcal (0.135) <Ftab (0.83) for the NPK Fertilizer; this implies that there is no significant difference among the NPK fertilizer levels and thus, NPK fertilizer levels do not affect the dry plant weights of maize.

Hypothesis:

H_0: The application of the poultry manure and NPK fertilizer at different levels do not affect the weight of the fresh plant of maize crop only

H_1: The application of the poultry manure and NPK fertilizer at different levels affect the weight of the fresh plant of maize crop only

H_0: The quality interactions between the levels of poultry manure and NPK fertilizer don't have a significant difference on the maize crop.

H_1: The quality interactions between the levels of poultry manure and NPK fertilizer have a significant difference on the maize crop.

Decision 3: From result gotten on both fresh and dry plant weight of maize we reject **H_0**: and conclude that there is significant difference among the poultry manure and NPK fertilizer levels, and as a result of this, we accept **H_1 and conclude that** the application of the poultry manure and NPK fertilizer at different levels do affect the weight of the fresh plant of maize crop only. The result also showed that Fcal (0.034) <Ftab (0.96) thus we reject **H_1**: and conclude that the quality interactions between the levels of poultry manure and NPK fertilizer don't have a significant difference on the maize crop.

The factorial anova model used to calculate the expected frequencies level of the two factors for the plant seed yield of maize

Table 8: Sum of Observations in Each Level of The Two Factors for the Seed Yield of Maize

Poultry Manure (kg/ha)	NPK fertilizer (kg/ha) (SEED YIELD in gram)				
	0	100	200	300	Total
0	6455	6992	7716	7980	29143

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500	8031	8646	9156	9712	35545
1000	8107	9936	10584	10975	39602
1500	11018	11622	12058	12650	47348
Total	33611	37196	39514	41317	151638

Corrected factor (CF) = $\frac{\sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{n} \boldsymbol{Yijk^2}}{abn}$

CF = $\frac{Y....^2}{abn} = \frac{(151638)^2}{4*4*2} = \frac{2299408340}{32}$ = 718565095.10g/ha

The sums of squares of Poultry Manure (factor) and NPK fertilizer (factor) are:

SS (Poultry manure) = $\frac{\sum_i^a Y_{i...}^2}{bn}$ - CF

= $\frac{29143^2+\cdots+47348^2}{4*2}$ – 718565095.10

= $\frac{5922912982}{8}$ - 718565095.10

SS (Poultry Manure) = 21799027.65g/ha

Finding the sum of squares of NPK Fertilizer factor

SS (NPK) = $\frac{\sum_j^b Y_{j...}^2}{an}$ – CF

= $\frac{33611^2+\cdots+41317^2}{4*2}$ – 718565095.10

= 722711552,80 - 718565095.10

SS (NPK) = 4146457.65g/ha

The sums of squares of the interaction between Poultry Manure and NPK fertilizer effects, total and error are estimated as:

SS (Poultry Manure/NPK)

= $\frac{\sum_i^a \sum_j^b \sum_k^n \boldsymbol{Y_{ijk}^2}}{k}$ – CF – SS(Poultry) – SS(NPK)

= $\frac{6455^2+\cdots+12650^2}{2}$ – 718565095.10 – 21799027.65 – 4146457.65

= 744991000 - 718565095.10 – 21799027.65 – 4146457.65

SS (Poultry Manure/NPK) = 480420.35g/ha

SST = $\boldsymbol{\sum_{i=1}^{a}\sum_{j=1}^{b}\sum_{k=1}^{n} Y^2_{IJK} - CF}$

= $238.2^2 + 272^2 \ldots + 315.3^2 - 718565095.10$ = 33214118.90g/ha

SST = 33214118.90g/ha

SSE = SST – SS (PM) – SS (NPK) – SS (Poultry/NPK)

ISSN No. 2454-6194 | DOI: 10.51584/IJRIAS | Volume X Issue I January 2025

33214118.90 – 21799027.65 – 4146457.65 – 480420.35

SSE = 6788213.25g/ha

Table 9: Result Summary of ANOVA For Plant Seed Yield of Maize

Source of variation	Degree of freedom	Sum of squares	Mean of squares	F_{cal}	F_{tab}
Poultry Manure	3	21799027.65	7266343	16.06	F0.05,(3,15) =0.83
NPK Fertilizer	3	4146457.65	1382153	3.05	F0.05,(3,15) =0.83
Poultry Manure & NPK	9	480420.35	53380.04	0.12	F0.05,(9,15) =0.96
Error (E)	16	6788213.25	452547.6		
Total (T)	31	3321411890			

Fcal (16.06) >Ftab (0.83), this implies that there is significant difference among the poultry manure levels, and as a result of this, poultry manure has significant contribution to the plant seed yield of maize. The Fcal (3.05) >Ftab (0.83), implies that there is significant difference among the NPK fertilizer levels and thus, NPK

fertilizer levels do affect the plant seed yield of maize. The result also showed that at interaction between the poultry manure and NPK Fertilizer the Fcal (0.12) <Ftab (0.96) and therefore the quality of interaction between the levels of Poultry manure and NPK fertilizer has no significant difference. Thus we reject **H_1**: and conclude that the quality interactions between the levels of poultry manure and NPK fertilizer don't have a significant difference on the plant seed yield maize crop.

SUMMARY OF FINDINGS

This study investigated the varying effects of Poultry manure and NPK fertilizer on the growth and yield of maize crop by considering the poultry manure and NPK fertilizer levels on fresh weight, dry weight and plant seed of Maize in 2021 and 2022 Cropping Sessions from the record department of the Eden Flows Global Resource LTD Ilaro Ogun state.

From analysis result, $F_{cal(10.57)} > F_{tab(0.83)}$ for the poultry manure and $F_{cal(1.54)} > F_{tab(0.83)}$ for NPK fertilizer means that both contribute positively to fresh plant weight of the maize while $F_{cal(0.027)} < F_{tab(0.96)}$ shows that the quality of interaction between poultry manure and NPK fertilizer has no significance difference on fresh plant weight. Secondly, $F_{cal(16.06)} > F_{tab(0.83)}$ for poultry manure and $F_{cal(3.05)} > F_{tab(0.83)}$ for NPK fertilizer respectively have significance difference by contributing positively to plant seed yield of maize, while $F_{cal(0.12)} < F_{tab(0.96)}$ indicates that the quality of interaction between poultry manure and NPK fertilizer does not have significance difference on plant seed yield of maize. Also $F_{cal(0.308)} < F_{tab(0.83)}$ for poultry manure and $F_{cal(0.135)} < F_{tab(0.83)}$ for NPK fertilizer means that there is no significance difference between them. That is both poultry manure and NPK fertilizer does not contribute to dry plant weight of maize.

CONCLUSION

From the research, the results obtained in this study showed that poultry manure and NPK fertilizers strongly contributed significantly to the fresh plant weight of the maize and plant seed yield of the maize but does not contribute positively to dry plant weight of the maize.

From the results of the factorial ANOVA analysis of this finding, it shows that the Poultry manure and NPK Fertilizer contributed greatly to the growth and yield of maize. However, the interaction of the Poultry manure and NPK Fertilizer gave the expression that poultry manure and NPK fertilizer does not have effect the growth and plant seed yield of maize crop .

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RECOMMENDATION

Based on the results of the analysis of this study it is recommended that.

1. Farmers should ensure they make use of fertilizers to help increased the yield of crops.

2. Farmers should use either poultry manure or NPK fertilizer applications for the quality harvest of seed yield of maize as one of these will be sufficient to have quality harvest of the yield of maize.

3. Government should also organize a scheme based on subsequent cropping sessions that would educate the farmers and research institutes on the use of fertilizers on crops and fruits.

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