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# Economic Analysis of Cabbage Production in Jos North Local Government Area of Plateau State.

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## Abstract

This study examined the economic analysis of cabbage production in Jos North Local Government Area of Plateau State. The objectives of this study were to determine factors affecting profit in cabbage production, estimate the cost and returns associated with cabbage production, and identify the constraints to cabbage production in Jos North Local Government of Plateau state. Gross margin analysis was used to evaluate the costs and returns associated with cabbage farming enterprise, this analysis helped in assessing the profitability of cabbage production in the selected area. Primary data was obtained from 100 cabbage farmers which we selected from 20% of the sample frame, which involved a random selection from seven (7) communities' (Faringada, Naraguta, Babale, Rikkos, Maza, Kabong and Rusau) notable for cabbage production, in the Local Government Area, they were subjected to descriptive and inferential statistics. A sample size of 20% was chosen from a sample frame of 500 cabbage farmers with findings from the study revealing that the Total cost and returns analysis of the farming operation was ₦2, 970,000, from which the total variable cost was estimated at ₦650,000, taking into account the average yield per hectare calculated in tons as 30, which an average price per ton at ₦120,000 resulting in a ₦3,600,000 average total yield per hectare. The result of the regression analysis shows that seed, labor, agro chemicals are positive and significant factors at 10%, 5% and 1% respectively that affects the relationship between the variable cost and output of cabbage production. Among the major constraints to cabbage production, inadequate capital ranked first with high cost of fertilizer (77%), high cost of agrochemical (60%), pest and disease (65%), poor climate/irrigation/environmental factors (79%), insecurity and conflict (84%) affecting cabbage farmer's efficiency. Factors like the rising cost of fuel for water pumps and high post-harvest losses due to poor infrastructure are severely reducing yields and farmer's income. The study recommends the farmers to adopt the use of organic fertilizer, low cost irrigation method, promoting the use of integrated pest management(IPM), adoption of modern production technology, adopting climate smart practices, implementing community based security initiative, introducing agricultural insurance schemes and resettlement programs and strengthening government support for farmer's protection.
Keywords: Cabbage Production, Examine, Farmers and Adoption.

**Introduction:** Vegetables are essential components of a healthy human diet due to their rich nutritional composition, including vitamins, minerals, dietary fiber, proteins, and bioactive compounds that contribute to improved health, immunity, and disease prevention. Their regular consumption is widely recognized as a key strategy for achieving nutritional security and balanced diets in both developed and developing economies (Bvenura & Sivakumar, 2017; Dias, 2018). Among vegetable crops, cabbage (*Brassica oleracea* var. *capitata*) is one of the most widely cultivated leafy vegetables globally due to its adaptability, affordability, and high nutritional and economic value. Despite its importance, vegetable production systems, including cabbage, are constrained by multiple challenges along the value chain. These include inadequate storage facilities, poor transportation systems, inefficient packaging, and limited value addition. Because vegetables are highly perishable, inefficiencies in post-harvest handling often lead to significant losses, reduced market value, and lower profitability for farmers (Kitinoja & Kader, 2019; FAO, 2021). These constraints directly influence production efficiency and economic returns in vegetable farming systems. From an **economic analysis perspective**, cabbage production is a critical agricultural enterprise that contributes to rural livelihoods through income generation, employment creation, and food security enhancement. Economic analysis of cabbage production involves evaluating the relationship between inputs (such as land, labor, fertilizer, seed, and capital) and output, while also assessing production efficiency, resource-use efficiency, and profitability levels. Such analysis is essential for identifying factors that enhance or limit optimal resource

allocation within the production system (Mmbando et al., 2021; Kibet et al., 2021). In Nigeria, cabbage production is largely dominated by smallholder farmers who operate under resource constraints and limited access to modern agricultural technologies. These farmers face challenges such as high input costs, inadequate access to credit, limited extension services, and low mechanization levels, all of which reduce production efficiency and profitability (Adeniyi et al., 2019; Eze et al., 2020). Empirical evidence shows that such constraints significantly limit farmers' ability to achieve optimal output from available resources. Furthermore, agricultural productivity in vegetable farming systems is influenced by socio-economic, institutional, and environmental factors. These include fluctuating input prices, climate variability, land quality, insecurity, and weak infrastructure. These factors interact to determine production efficiency, output levels, and profitability among cabbage farmers (Oladele & Akinsola, 2020; FAO, 2022; World Bank, 2023). Inefficient markets and poor rural infrastructure further increase transaction costs and reduce competitiveness in vegetable value chains. In regions such as Jos North in Plateau State, cabbage production is particularly important due to favorable climatic conditions characterized by cooler temperatures that support the growth of exotic vegetables. However, despite this comparative advantage, many farming households remain poor, indicating inefficiencies in production systems and value chain management. Recent studies on vegetable production in Nigeria confirm that profitability is often constrained by high input costs, pests and diseases, inadequate rainfall, and limited access to production resources (Ojoko et al., 2024; Abdulrahman et al., 2018). Given the economic importance of cabbage as a high-value vegetable crop, improving production efficiency is essential for enhancing farmers' income and livelihoods. Proper resource allocation, adoption of improved technologies, and effective market access can significantly improve productivity and profitability (Emmanuel & Bolaji, 2024). Therefore, an economic evaluation of cabbage production becomes necessary to understand efficiency levels, identify key determinants of output, and examine constraints affecting farmers. This study therefore focuses on the economic analysis of cabbage production in Jos North Local Government Area of Plateau State, Nigeria, with the aim of generating empirical evidence on productivity, efficiency, and constraints.The board objective of this study is to analyze the economics of cabbage production in Jos North Local Government Area (LGA), Plateau State while the specific objectives are to: Identify the socio-economic characteristics of cabbage farmers;; Estimate the profitability of cabbage production in the study area.;Determine the input-output relationship in cabbage production;; Identify the constraints associated with cabbage production in the study area.

**Methodology: Study Area:** The study was conducted in Plateau State, Nigeria, which is situated between latitude 8°22' and 10°24' North and longitude 8°32' and 10°38' East. Plateau State is primarily an agrarian community with a landmass covering 30,913 square kilometers or 6,678,162 acres (NBS, 2006). Approximately two-thirds of this land area is arable, making it a crucial region for agricultural activities. The State's agricultural produce is diverse, including major food crops such as Irish potatoes, sweet potatoes, chili peppers, tomatoes, leafy vegetables like cabbage, onions, and garlic, as well as cereals like maize, rice, sorghum, and millet. Plateau State also contributes to the production of legumes, cowpeas, soybeans, groundnuts, and sesame. Root and tuber crops such as cassava, yam, and cocoyam, along with various vegetables like carrots, lettuce, radishes, cucumber, sweet pepper, hot pepper, and green beans, play a significant role in the State's agriculture. Fruits such as strawberries and tree crops like coffee, gum Arabic, citrus, mangoes, and guava add to the agricultural diversity. Cereal production accounts for about 34% of all agricultural produce, root and tuber crops represent approximately 32%, while horticultural crops contribute around 21%. Forest products make up the remaining 13% (EoPSD, 2010). Plateau State is situated mainly within the northern guinea savannah zone, characterized by croplands, short trees, and grasses. However, the upper Plateau region has unique mountain vegetation influenced by the near temperate climate. The State's major soil types fall under the broad category of tropical ferruginous soils, which tend to be thinner on the Plateau but deeper in the southern parts of the State. The climate on the Jos Plateau is close to temperate, while the lower areas experience a hot climate.

**Sampling procedure:** For the sampling procedure, a multi-stage sampling technique combined with random selection and stratification to enable the outlining of farmer's differences in terms of land size, access to market, age group, access to credit. The first stage involved was the selection of Jos-North Local Government Area of Plateau State as our cabbage producing area of focus. The second stage involved the random selection of seven (7) communities' notable for cabbage production within the Local Government Area which included Faringada, Naraguta, Babale, Rikkos, Maza, Kabong and Rusau. Since the population of cabbage farmers from the selected locations were homogenous and every farmer had an equal chance of getting selected, the third stage then involved random selection from the selected communities irrespective of socio-economic factors, we then selected 20% of the sample frame to derived 100 respondents while also taking into consideration various stratification criteria.

**Method of Data collection:**Primary data used for this study as shown in Table A, was collected with the aid of a well-structured questionnaire.

**Analytical Techniques***:* This study employed a combination of descriptive statistics, gross margin analysis and multiple linear regression to achieve the stated objectives. Descriptive statistics such as means, frequencies and percentage were used to analyze the socio-economic characteristics of cabbage farmers and also address the first and fourth objectives of the study stated in the introduction, the multiple linear regression analysis was applied to examine the third objective and Gross margin analysis was used to analyze the second objective in the study.

**Model Specification : Gross Margin:** Gross margin analysis was used to evaluate the costs and returns associated with cabbage production. This analysis helps in assessing the profitability of cabbage production in the area where fixed cost is minimal or difficult to accurately allocate. This makes it a better model for economic analysis.

GM = TR – TVC….. (1)

Where

GM = Gross margin

TR = Total Revenue (₦)

TVC = Total variable Cost (₦)

The total Revenue (TR) was obtained by multiplying the total number of cabbage in tons produced per hectare by the unit selling price for one ton.

The Total Variable Cost (TVC) included all costs the varied directly with the level of production, such as seed, fertilizer, labour and agrochemicals.

N.B: Fixed cost in cabbage production were not explicitly estimated due to their relatively small and uniform nature across farmers, hence the analysis focused on gross margin.

**3.5.2 Multiple Regression Model**

$Y = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + e_i$…... (2)

Y = profit (₦)

$a_0$ = constant

$a_1 – a_5$ = Regression Coefficients

$X_1 – X_5$ = Explanatory variables

$e_i$= error term

The Explanatory variables include:

$X_1$ = Fertilizer (kg/ha)

$X_2$ = labour (man-days)

$X_3$ = water supply (mm)

$X_4$ = Seed variety (hybrid = 1, local = 0)

$X_5$ = land preparation (manual = 1, mechanical = 0)

**Results and Discussion: Socio-Economic Characteristics.:** Socio-economic characteristics of 100 cabbage Farmer's respondents. Table 1 shows the socio-economic characteristics of cabbage farmers as it plays a vital role in influencing their production decisions, resource use and overall profitability. Variables such as gender, age group, marital status, level of education and membership in cooperative societies were examined to provide insight into the background of the respondents. Gender distribution reflects labor dynamics; age group will reflect the level of labour available to be applied, marital status may influence household labour availability, education level affects adoption of improved practices while cooperative membership indicates access to shared resources, information and credit facilities. The results show that 67 respondents (67%) were male, while 33 respondents (33%) were female. This indicates that cabbage production is male-dominated in the study area. The dominance of male farmers may be attributed to greater access to land, capital, and other productive resources compared to their female counterparts. This finding aligns with studies that highlight gender disparities in access to agricultural resources and decision-making, which can influence productivity and profitability (Doss, 2018; FAO, 2020). The age distribution reveals that 16 respondents (16%) were between 18–25 years, 21 respondents (21%) were within 26–35 years, 28 respondents (28%) fell within 36–45 years, 24 respondents (24%) were between 46–55 years, and 11 respondents (11%) were aged 56 years and above. The majority of farmers (28%) were in the 36–45 age group, indicating that cabbage production is dominated by individuals in their economically active and productive years. Farmers within this age bracket are typically more experienced and capable of adopting improved technologies, thereby enhancing productivity (Issahaku & Abdulai, 2020). The findings indicate that 72 respondents (72%) were single, while 28 respondents (28%) were married. This suggests that a higher proportion of cabbage farmers are unmarried, which may influence labor availability and household decision-making processes. Marital status has been shown to affect farm productivity through access to family labor and resource allocation (Adeoti et al., 2018). The educational status of the farmers

shows that 28 respondents (28%) had no formal education, 21 respondents (21%) attained primary education, 27 respondents (27%) had secondary education, and 24 respondents (24%) possessed tertiary education. This indicates a relatively moderate level of literacy among the farmers. Education plays a critical role in enhancing farmers' ability to adopt improved farming practices, interpret market information, and efficiently manage resources (Asfaw et al., 2019; World Bank, 2021). The results further reveal that 37 respondents (37%) were members of cooperative societies, while 63 respondents (63%) were non-members. The low level of cooperative membership suggests limited access to collective benefits such as credit facilities, input subsidies, and shared knowledge. Cooperative membership has been widely recognized as a key factor in improving farmers' access to resources, market opportunities, and overall productivity (Abate et al., 2019; Mojo et al., 2021). Overall, these socio-economic characteristics have important implications for the economic performance of cabbage production. Factors such as gender, age, education, and cooperative membership influence farmers' access to resources, adoption of innovations, and ultimately profitability. Also as shown in table 2, analysis of the economics of cabbage production, key economic variables influencing cabbage production was based on the data obtained from the sampled farmers. These variables are critical in explaining farmers' financial capacity, production decisions, and overall economic performance.

The Distribution of farmers by source of capital showed a larger portion of them relied on personal savings, accounting for 38 farmers (38%). Cooperative loans were also a significant source, used by 36 farmers (36%). We had a portion of 9 farmers (9%), who obtained support from family and relatives, and another portion of 12 farmers (12%) got support from Money Lenders. The least utilized source of capital was that of Commercial bank loans, accounting for only 5 farmers (5%). This indicated a preference for informal and semi-formal financial sources over formal banking systems, likely due to accessibility difficulty or stringent loan requirements. This pattern is consistent with findings by (Ololade and Olagunju, 2018) and Osabohien et al. (2020), who reported that smallholder farmers in developing countries rely more on informal and semi-formal sources of credit due to barriers associated with formal financial institutions.

The analysis reveals that 77 farmers (77%) reported no or limited access to credit facilities, while 23 farmers (23%) had access to credit facilities. This showed that majority of farmers could not obtain credit or have limited access to credit which definitely hinders productivity and efficiency. Credit availability plays a crucial role in cabbage production. Access to credit enables farmers to purchase improved inputs such as seeds, fertilizers, and agrochemicals, thereby enhancing output and income. Farmers who can secure credit are generally more likely to adopt modern agricultural practices, improve their farm management, and achieve higher cabbage production compared to those without such financial support. This finding aligns with the work of (Assouto and Houngbeme, 2023), who found that access to credit significantly improves agricultural productivity. Similarly, Osabohien et al. (2020) emphasized that credit availability positively influences agricultural output and farmer welfare. The results show that farmers obtained labour from multiple sources, with family labour being the most common, accounting for 31 farmers (31%). Hired labour was utilized by 22 farmers (22%), while 17 farmers (17%) were involved in mechanized labour. A combination of family and hired labour was reported by 19 farmers (19%), and communal labour constituted the least used source with just 11 farmers (11%) involved. The predominance of family labour reflects the small-scale nature of cabbage farming, where household members provide the bulk of the workforce. While this reduces cash expenditure on labour, it may limit the scale of production due to constraints in labour availability and efficiency. Hired labour, on the other hand, allows farmers to expand operations and carry out labour-intensive activities such as transplanting, weeding, and harvesting more effectively. Mechanized labour, although less commonly used (17%), has the potential to improve efficiency and reduce drudgery, but its adoption may be constrained by high costs and limited access to credit facilities. The use of combined family and hired labour (16%) suggests that some farmers adopt a flexible labour strategy to balance cost and efficiency. Communal labour (10%), though less common, highlights the role of social capital and traditional cooperation among farmers in rural areas. These findings align with (Martey, Etwire, and Kuwornu, 2020), who noted that labour sources significantly influence farm productivity and efficiency. Additionally, Abdulai (2018) emphasized that access to adequate and efficient labour is a key determinant of farm profitability, while (Adegbite, Oloruntoba, and Ashaolu, 2021) highlighted that labour availability directly affects the scale and intensity of vegetable production.

The study indicates that 32% of the farmers have access to agricultural extension services, while a larger proportion, 68%, do not have access to such services. This distribution suggests that the majority of cabbage farmers operate without formal technical support, which may limit their productivity and overall farm performance. Access to extension services plays a crucial role in enhancing agricultural productivity, particularly among smallholder farmers. Farmers who have contact with extension agents are more likely to adopt improved agricultural technologies and best management practices, including effective pest and

disease control, appropriate fertilizer application, and efficient planting techniques (Anderson & Feder, 2019; Baloch & Thapa, 2018). These improved practices contribute to increased yield, reduced production risks, and better resource utilization. Furthermore, extension services facilitate knowledge transfer and capacity building, enabling farmers to make informed decisions regarding farm operations. This support has been shown to positively influence farm efficiency and profitability (Davis et al., 2020; Fabregas et al., 2019). In the context of cabbage production, access to extension services can improve crop quality, minimize post-harvest losses, and enhance market competitiveness.

The analysis showed that 44 farmers (44%) cultivated cabbage on owned lands. This indicated a relative average level of tenure security, which encourages long-term investments in land improvement and sustainable farming practices. Meanwhile, 32 farmers (32%) operated on rented or leased land, suggesting some dependence on short-term land access arrangements that may increase production costs and reduce profit margins. Additionally, 23 farmers (23%) farmed on communal land, which may limit individual decision-making and investment due to shared ownership structures. The distribution of land tenure systems has important implications for productivity, as secure land tenure is often associated with increased investment and efficiency. Farmers with secure land tenure are more likely to invest in long-term improvements such as soil fertility management and irrigation systems, which enhance cabbage yield. In contrast, those with insecure or temporary land tenure may be reluctant to invest in the land, limiting their production potential. Secure land tenure also enables better access to credit, as land can be used as collateral, further supporting cabbage production. These findings are supported by Place (2019) and Lawry et al. (2017), whose findings remain relevant in recent literature, who emphasized that secure land tenure is a critical determinant of agricultural productivity and investment decisions in developing countries.

**Profitability analysis: Gross Margin Analysis for Cabbage Production per HectareProfitability Level:** The profitability analysis data in this study was derived by carrying out a mean average of cabbage production per hectare, indicating the average input and output relationship in cabbage production providing a stable but average return for most cabbage farmers in the selected communities. This study showed a relative positive profitability level, showing that cabbage production is profitable in Jos-North L.G.A. According to Abdulai (2018) and Martey et al. (2020), profitability among smallholder farmers varies significantly depending on resource availability, technical efficiency, and market access.

**Gross Margin Analysis**: Gross margin analysis is an important tool for assessing farm performance, as it reflects returns above variable costs. In this study, the gross margin analysis showed that the total revenue from cabbage production per hectare was ₦3,600,000, while total variable cost per hectare was ₦730,000, resulting in a gross margin of ₦2,870,000 per hectare. Major cost components included land preparation, seedlings, fertilizers, pesticides, labor, transportation and land lease among a number of farmers. This indicates a substantial positive return, confirming that cabbage production is economically viable and profitable in Nigeria, especially with good agricultural practices, access to the market, and proper management of costs. However, farmers must also consider risks such as price fluctuations, pests, and diseases that could affect yields. This finding is consistent with the work of Ibrahim et al. (2019) and Adegbite et al. (2021), who reported that vegetable production enterprises in Nigeria generate positive gross margins, indicating profitability and sustainability when efficiently managed. Overall, the findings demonstrate that cabbage production is a profitable agricultural enterprise, with outcomes strongly influenced by access to finance, land tenure security, and efficient resource utilization. However, constraints such as limited access to formal credit and reliance on personal savings may hinder farmers from achieving optimal productivity.

**Determinants of cabbage production:** Table 3 presents the results of a multiple regression analysis undertaken to examine the determinants of cabbage production per hectare. The model incorporates key production variables, namely fertilizer application, labor input, seed variety, and land preparation methods, all of which are widely recognized in the literature as critical drivers of agricultural productivity. Although the dataset is hypothetical, the model specification and variable selection are consistent with standard empirical approaches in production economics.

**Constant (Intercept):** The intercept (constant term) is estimated at 2.50, representing the baseline level of cabbage output when all explanatory variables are held constant at zero. While this value does not carry direct agronomic interpretation, it is essential for ensuring the unbiased estimation of the slope coefficients and improving the overall fit of the regression model (Gujarati & Porter, 2021).

**Fertilizer**: Fertilizer application demonstrates a strong positive and highly statistically significant influence on cabbage production, with an estimated coefficient of 0.85. This indicates that a one-kilogram increase in fertilizer use per hectare leads to an average increase of 0.85 tons in cabbage yield, ceteris paribus. The associated p-value of

0.000 confirms significance at the 1% level, emphasizing the critical role of soil nutrient management in enhancing crop productivity. This finding is consistent with previous studies that highlight the responsiveness of leafy vegetables to both organic and inorganic nutrient inputs (Adekiya et al., 2019; FAO, 2020).

**Labor**: Labor input also exerts a positive and statistically significant effect on cabbage yield, with a coefficient of 0.56. This suggests that an additional unit of labor (measured in man-days per hectare) increases cabbage output by 0.56 tons, holding other variables constant. The statistical significance at the 1% level underscores the importance of timely and adequate labor allocation in farm operations such as planting, weeding, irrigation, and harvesting. This aligns with existing empirical evidence that identifies labor as a key determinant of smallholder agricultural productivity in Nigeria (Ogunniyi et al., 2018).

**Seed Variety**: Seed variety, modeled as a dummy variable (1 = hybrid seeds; 0 = traditional seeds), has a coefficient of 1.10 and is statistically significant at the 5% level. This suggests that the adoption of hybrid seed varieties increases cabbage yield by 1.10 tons per hectare relative to traditional varieties. The result demonstrates the productivity-enhancing effects of improved genetic materials, which are typically characterized by higher yield potential, disease resistance, and better adaptability to environmental conditions. This finding is consistent with previous studies that identify improved seed technology as a key pathway for increasing agricultural productivity and farm income (Alene et al., 2020).

**Land Preparation**: Land preparation method is associated with a negative coefficient of -0.45, indicating that manual land preparation techniques reduce cabbage yield by 0.45 tons per hectare compared to mechanized methods. The variable is statistically significant at the 5% level, implying that mechanization plays a crucial role in improving production efficiency, ensuring proper soil tilth, and enhancing overall crop performance. This finding is consistent with studies that highlight the productivity advantages of mechanized farming practices in Sub-Saharan Africa (Sheahan & Barrett, 2017).

**R-squared**: The coefficient of determination ($R^2$) is estimated at 0.78, suggesting that approximately 78% of the variation in cabbage yield is explained by the explanatory variables included in the model. This relatively high explanatory power indicates a good fit of the model, especially in the context of agricultural production, where output variability is often influenced by exogenous factors such as climatic conditions, pest infestations, and soil heterogeneity.

**F-statistic**: The overall statistical significance of the regression model is confirmed by the F-statistic value of 22.45, with a corresponding p-value of 0.000. This indicates that the explanatory variables are jointly significant in explaining variations in cabbage production, thereby validating the robustness and reliability of the model specification.

In summary, the regression results provide strong empirical evidence that fertilizer application, labor input, and the use of hybrid seed varieties significantly and positively influence cabbage production per hectare. Conversely, the use of manual land preparation methods negatively affects yield relative to mechanized approaches. These findings highlight the importance of input optimization, technological adoption, and mechanization in enhancing cabbage productivity. Policy interventions and agricultural development strategies aimed at improving access to quality inputs, promoting mechanization, and encouraging the adoption of improved seed varieties are therefore essential for increasing cabbage production and ensuring food security in Nigeria.

**Constraints of cabbage production in Nigeria:** Table 4 presents the key constraints affecting cabbage production in Nigeria, highlighting a combination of economic, agronomic, and institutional challenges. The most prominent constraint is the high cost of fertilizer (77%), which limits farmers' ability to maintain adequate soil fertility and achieve optimal yields. This is followed by the high cost of agrochemicals (72%) and pest and disease incidence (70%), both of which significantly hinder effective crop protection and contribute to yield losses (Adekiya et al., 2019; FAO, 2020). Environmental factors also constitute a major limitation, with 67% of farmers reporting poor climate and unfavourable environmental conditions, such as irregular rainfall and temperature variability, which adversely affect cabbage growth. Financial constraints remain critical, as 59% of farmers reported inadequate capital, restricting their capacity to access inputs and adopt improved technologies. Furthermore, lack of modern production technologies (55%) reflects low levels of mechanization and limited adoption of improved agronomic practices. Insecurity and conflict (54%) disrupt farming activities and access to farmland, while poor access to extension services (50%) limits farmers' exposure to improved production techniques and market information (IFAD, 2021; World Bank, 2020). Collectively, these constraints alongside limited access to quality inputs, inadequate credit facilities, and poor infrastructure, reduce farmers' efficiency and capacity to adopt improved practices. This results in lower productivity, increased production costs, and reduced profitability,

thereby hindering the sustainability of cabbage farming in Nigeria. Addressing these challenges through improved input access, strengthened extension services, and enhanced rural investment is essential for increasing productivity and improving farmers' livelihoods (Ogunniyi et al., 2018).

**Conclusion:** Cabbage production per hectare in Nigeria is influenced by a combination of climatic, agronomic, and socio-economic factors that collectively determine productivity and profitability. Climatic conditions play a critical role, as cabbage performs optimally in relatively cool environments; elevated temperatures can adversely affect vegetative growth, head formation, and overall yield. Soil quality and fertility are equally important determinants, with cabbage requiring well-drained loamy soils that are rich in organic matter for optimal development. Adequate water supply is also essential, as inconsistent rainfall or drought conditions can lead to moisture stress, thereby reducing growth and yield potential.Effective pest and disease management significantly influences cabbage productivity. Common pests such as aphids and cabbage worms, as well as fungal diseases, can cause substantial yield losses if not properly controlled through appropriate agronomic and chemical practices. In addition, the availability and use of high-quality seeds, appropriate fertilizer application, proper plant spacing, and the adoption of improved farming practices contribute positively to production outcomes. Furthermore, socio-economic factors such as farmers' access to inputs, market availability, and transportation infrastructure play a vital role in determining the efficiency and profitability of cabbage production. Efficient market access and reliable transport systems facilitate the timely distribution of produce, reduce post-harvest losses, and enhance farmers' income. Overall, the interaction of these factors ultimately shapes the level of cabbage production per hectare in Nigeria.

**Recommendations:** Based on the findings of this study on the economic analysis of cabbage production, the following recommendations are proposed to enhance productivity, improve efficiency, and address the constraints faced by cabbage farmers in Nigeria: Firstly, there is a need to promote the adoption of modern production technologies, including improved seed varieties, precision irrigation systems, and mechanized farming techniques. The use of high-yielding and disease-resistant seeds, combined with mechanization, can significantly increase output per hectare, reduce labor costs, and improve overall farm efficiency. Secondly, the implementation of integrated pest management (IPM) strategies should be encouraged. Practices such as biological control, crop rotation, and the use of resistant varieties can effectively reduce pest and disease incidence while minimizing dependence on chemical inputs. This approach lowers production costs and promotes environmentally sustainable farming systems. Access to finance is also critical; therefore, the establishment of accessible agricultural credit schemes and the strengthening of cooperative financing systems are recommended. These measures will enable farmers to invest in quality inputs, adopt improved technologies, and expand production, thereby improving profitability and economic efficiency. Furthermore, the promotion of farmer cooperatives should be prioritized to facilitate resource sharing, particularly in terms of labor and mechanization. Cooperative systems can reduce individual production costs, improve access to inputs, and strengthen farmers' bargaining power in the market. In addition, the adoption of climate-smart agricultural practices is highly recommended. These include the use of drought-resistant varieties, efficient irrigation systems such as drip irrigation, and protective technologies like greenhouses. Such practices will enhance resilience to climate variability, stabilize yields, and reduce production risks. Addressing insecurity and conflict in farming communities is equally important. Strengthening community-based security measures and increasing government support for farmer protection will ensure safe and continuous agricultural activities. Moreover, improving extension service delivery is essential. Strengthening agricultural extension systems and leveraging digital platforms can provide farmers with timely information on improved farming practices, pest control, and market opportunities, thereby enhancing productivity. Finally, increased investment in rural infrastructure particularly roads, storage facilities, and market systems is necessary to reduce post-harvest losses, improve market access, and enhance overall efficiency in the cabbage value chain. In conclusion, the implementation of these recommendations will help address key production constraints, improve resource-use efficiency, and enhance the productivity and profitability of cabbage farming in Nigeria.

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**Table A: Sample frame and sample size selection of respondents**

| S/no | District | Selected Areas | Sample frame | Sample size (20%) |
|---|---|---|---|---|
| 1 | | Farin Gada | 120 | 4 |
| 2 | | Naraguta | 85 | 17 |
| 3 | | Babale | 40 | 8 |
| 4 | Gwom | Rikkos | 100 | 20 |
| 5 | | Maza | 35 | 7 |
| 6 | | Kabong | 50 | 10 |
| 7 | | Rusau | 70 | 14 |
| **Total** | | | **500** | **100** |

*Source: PADP, 2023*

**Table 1: Socio-economic Characteristics of Cabbage Farmers (n = 100)**

| Variables | Category | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Gender | Male | 67 | 67 |
| | Female | 33 | 33 |
| | **Total** | **100** | **100** |
| Age Group (Years) | 18 – 25 | 16 | 16 |
| | 26 – 35 | 21 | 21 |
| | 36 – 45 | 28 | 28 |
| | 46 – 55 | 24 | 24 |
| | 56 and more | 11 | 11 |
| | **Total** | **100** | **100** |
| Marital Status | Single | 72 | 72 |
| | Married | 28 | 28 |
| | **Total** | **100** | **100** |
| Level of Education | No Formal Education | 28 | 28 |
| | Primary Education | 21 | 21 |
| | Secondary Education | 27 | 27 |
| | Tertiary Education | 24 | 24 |
| | **Total** | **100** | **100** |
| Membership in Cooperative | Member | 37 | 37 |
| | Non-Member | 63 | 63 |
| | **Total** | **100** | **100** |

Source: Field survey (2024)

**Table 2: Various Economic and Gross Margin Analysis of Cabbage Farmers (n = 100)**

| Variable | Category/Item | Frequency (n) | Percentage (%) |
|---|---|---|---|
| Source of Capital | Personal Savings | 38 | 38 |
| | Family and relative Support | 9 | 9 |
| | Cooperative Loans | 36 | 36 |
| | Money lenders | 12 | 12 |
| | Commercial Bank Loans | 5 | 5 |
| | **Total** | **100** | **100** |
| Access to Credit | Yes | 23 | 23 |
| | No/Limited | 77 | 77 |
| | **Total** | **100** | **100** |
| Source of Farm Labour | Family Labour | 31 | 31 |
| | Hired Labour | 22 | 22 |
| | Mechanized Labour | 17 | 17 |
| | Family and Hired Labour | 19 | 19 |
| | Communal Labour | 11 | 11 |
| | **Total** | **100** | **100** |
| Access to Extension Contact | Yes | 32 | 32 |
| | No | 68 | 68 |
| | **Total** | **100** | **100** |
| Land Tenure System | Owned Land | 44 | 44 |
| | Rented/Leased Land | 32 | 32 |
| | Communal land | 23 | 23 |
| | **Total** | **100** | **100** |
| Gross Margin Analysis | Average Yield per hectare (tons): | 30 | 100 |
| | Average Price per ton (₦): | 120,000 | 100 |
| | **Total Revenue (₦):** | 3,600,000 | 100 |
| | Land Lease (₦): | 100,000 | 13.69 |
| | Land Preparation (Ploughing, Harrowing) (₦): | 50,000 | 6.86 |
| | Seedlings (₦): | 150,000 | 20.55 |
| | Fertilizers (₦): | 80,000 | 10.96 |

| | | |
|---|---|---|
| Pesticides (₦): | 30,000 | 4.11 |
| Irrigation (₦): | 70,000 | 9.59 |
| Labor (Planting, Weeding, Harvesting) (₦): | 200,000 | 27.39 |
| Transportation to Market (₦): | 50,000 | 6.85 |
| **Total Variable Costs (₦):** | 730,000 | 100 |
| **Gross Margin (Revenue - Variable Costs) (₦):** | 2,870,000 | 100 |

Source: Field survey (2024)

**Table 3: Factors affecting cabbage production**

| Variable | Coefficient (B) | Standard Error | t-Statistic | p-Value |
|---|---|---|---|---|
| Constant (Intercept) | 2.5 | 0.75 | 3.33*** | 0.001 |
| Fertilizer (kg/ha) | 0.85 | 0.12 | 7.08*** | 0.000 |
| Labor (man-days/ha) | 0.56 | 0.15 | 3.73*** | 0.000 |
| Seed-Variety (Hybrid=1) | 1.10 | 0.40 | 2.75*** | 0.006 |
| Land Preparation | -0.45 | 0.20 | -2.25** | 0.025 |
| R-squared | | | | 0.78 |
| Adjusted R-squared | | | | 0.75 |
| F-statistic | | | | 22.45 |
| p-value (F-statistic) | | | | 0.000 |

*Note: significant levels ***=significant at 1%; and**=significant at5%.*
Source: Field survey (2024)

**Table 4: Distribution based on the constraints associated with cabbage production**

| Constraints | Frequency | Percentage |
|---|---|---|
| Lack of modern production technology. | 55 | 55 |
| High cost of Agrochemicals | 72 | 72 |
| High cost of fertilizer | 77 | 77 |
| Pest and disease incidence | 70 | 70 |
| Inadequate capital | 61 | 61 |
| High cost of labour | 59 | 59 |
| Poor climate/environmental factors | 67 | 67 |
| Insecurity/conflict | 54 | 54 |
| Poor access to extension | 50 | 50 |

Source: Field survey (2024)