



Farm Level Challenges and Factors Affecting the Sources of Income among Pepper Farmers in Kaduna and Kano States, Nigeria

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ABSTRACT

This study investigated farm level challenges and factors affecting the sources of income among pepper farmers in Kaduna and Kano States, Nigeria. A simple random sampling design was utilized to select 200 pepper growers. Primary data were employed utilizing a well-structured questionnaire. Data were evaluated utilizing descriptive statistics, Gini-Coefficient, Kendall's coefficient of



concordance, and Multinomial Logit model. The results show that the mean age of pepper farmers was 46 years, with an average of 13 years of attendance in school education. They are smallholder farmers with an average of 1.27 ha of pepper farms. Approximately, 70% (140) of pepper farmers belong to high income inequality group, while 30% (60) belongs to low income inequality group. The main sources of income include farm income (34.04%), non-farm income (27.66%), and off-farm income (25.53%). The significant factors affecting the sources of farm income among pepper growers include education ($P < 0.01$), experience ($P < 0.05$), access to market ($P < 0.01$) and access to inputs such as fertilizer usage ($P < 0.01$). The significant factors affecting the sources of non-farm income include age ($P < 0.01$), cooperative membership ($P < 0.10$), and access to market ($P < 0.01$). The study recommended improved infrastructures such as better roads, irrigation systems, and improved market access. Furthermore, improved access to credit, and providing fertilizers, pesticides, and improved seeds at subsidized rate can reduce farmers' costs and increase productivity.

Keywords: Farm level challenges, income inequality, Nigeria, pepper farmers, sources of income

INTRODUCTION

Spices play a vital role in our food through its flavor, taste and aroma which are acceptable to consumers (Yahaya et al., 2020). Pepper is the third most popular vegetable in the world behind tomatoes and onions. It is one of the essential vegetables that is cultivated in sub-Saharan Africa (Olutumise, 2022). Pepper (*Capsicum species*), particularly chili pepper, is a widely cultivated and economically important crop in Nigeria, serving as a staple spice, vegetable, and a significant source of income for numerous rural households (Alabi et al., 2023). Nigeria is a major producer of pepper in Africa, with states like Kaduna, Kano, Katsina, and Plateau being prominent cultivation centers (National Bureau of Statistics, 2020). The crop's importance extends beyond household consumption, contributing significantly to food security, poverty alleviation, and rural development through employment and income generation along its value chain (Dennis and Kentus, 2018). Pepper cultivation forms a crucial part of the agricultural landscape, particularly within irrigation schemes and rain-fed farming systems. The diverse agro-climatic conditions in these regions support various pepper varieties, catering to both domestic and international markets (Olutumise, 2022). The economic contribution of pepper farming to the livelihoods of



smallholder farmers in these states cannot be overemphasized, as it often serves as the primary source of income, spice for cooking food, enabling farmers to meet household needs, invest in education, and accumulate assets (Alabi et al., 2023). Despite its immense potential, pepper production in Nigeria, is faced with challenges that significantly impact farm productivity, profitability, and consequently, the income-generating capacity of farmers. The output of pepper is 30% lower in developing nations that in advanced ones, even with the increased production and high market price of pepper. The pepper sub-sector is characterized by smallholder farmers that faced the challenges of poor quality, poor output, little value addition price unpredictability, and supply disruptions. To cope with the inherent uncertainties and challenges of pepper farming, smallholder farmers in Nigeria often adopt diversified income strategies. Their income sources typically extend beyond the income from sale of pepper. For many pepper farmers, the revenue generated from the sale of fresh and/or dried pepper constitutes the largest share of their household income (Idowu & Adebayo, 2017). More so, studies indicated that pepper production can be profitable in Nigeria, with positive net farm incomes reported in various regions (Mohammed, 2015; Adaigho & Tibi, 2018; Alabi et al., 2023). However, the magnitude of this income is highly variable, influenced by factors such as yield, market prices, access to efficient marketing channels and information, seasons and lack value chain addition. Gender differentials in profitability have also been observed, with male farmers often achieving higher gross margins due to factors like access to resources and extension services (Alabi et al., 2023). To mitigate the risks associated with price fluctuations, pest outbreaks, or adverse weather conditions, many pepper farmers engage in crop diversification. This involves cultivating other food crops like rice, maize, sorghum, millet, tomatoes, or legumes alongside pepper (Abdullahi & Bala, 2020). This strategy provides alternative income streams, spreads agricultural risks, and can enhance soil health through rotational cropping (Abdullahi and Bala., 2020). Furthermore, pepper farmers are likely to integrate of livestock rearing with crop farming which is a common practice among rural Nigerian farmers, including those involved in pepper production (Abubakar & Umar, 2017). Raising small ruminants (goats, sheep), poultry, or even cattle provides additional income from the sale of animals or their products (milk, eggs). Livestock also serves as a crucial source of manure for crop fertilization and acts as a readily available asset for emergency cash needs during periods of low agricultural income. Recognizing the limitations and risks of relying solely on agriculture, many pepper farming households engage in various off-farm and non-farm income-generating activities. These can include petty



trading, artisanal work (e.g., tailoring, carpentry), wage labor on other farms or in non-agricultural sectors, and remittances from family members working in urban areas (Umar & Danladi, 2018; Adeoye & Oladele, 2017). These income sources are critical for supplementing agricultural earnings, particularly during lean seasons, and for providing a safety net and cushion effect against agricultural shocks. Studies of Hayran & Gul (2019) showed that off-farm income can positively affect the technical efficiency and boost productivity of agricultural production especially among pepper farmers by allowing farmers to invest in better inputs and technologies (Hayran & Gul, 2019). The extent and type of off-farm engagement are often influenced by factors such as age, household size, education levels, and proximity to urban centers (Hayran & Gul, 2019). High levels of income inequality among pepper farmers can lead to various negative socio-economic consequences. It can perpetuate poverty within the farming communities, hinder investments in education and health, and potentially contribute to social unrest (World Bank, 2019). Addressing these disparities is crucial for fostering inclusive growth and sustainable development in Nigeria's agricultural sector. Policies aimed at improving access to resources, strengthening farmer cooperatives, enhancing market linkages, and providing targeted support to vulnerable groups (e.g., women) are essential to mitigate income inequality among pepper farmers.

Farm-Level Challenges in Pepper Production

Pepper production in Nigeria is characterized by several constraints that limit optimal yield and farmer profitability. These challenges are agronomic, environmental, economic, and institutional or political.

Agronomic and Environmental Constraints.

One of the primary challenges is the prevalence of traditional farming practices and limited access to improved seed varieties (Olowu et al., 2018). Many smallholder farmers rely on recycled seeds, which often result in lower yields and increased susceptibility to pests and diseases. Pest and disease infestations are a major biotic constraint, with issues like pepper leaf curl virus, bacterial wilt, and various insect pests significantly reducing crop yields (Adedeji et al., 2020). Farmers often struggle with effective and affordable pest management strategies, leading to substantial post-harvest losses. Moreso, Climatic variability and change pose significant threats to pepper cultivation, especially in rain-fed systems. Unpredictable rainfall patterns, prolonged dry spells, and occasional flooding lead to crop failures and reduced productivity (Federal Ministry of Agriculture and



Rural Development, 2019). While, irrigation systems exist, particularly in states like Kano, access is not universal, and even irrigated farms can be affected by water scarcity or mismanagement. However, soil fertility degradation due to continuous cultivation without adequate nutrient replenishment is another critical issue. Poor soil management practices and limited use of appropriate fertilizers contribute to declining yields over time (Mohammed & Abdullahi, 2017).

Economic and Market Challenges

Price unpredictability is a pervasive problem for pepper farmers. The perishable nature of pepper, coupled with poor market linkages and the dominance of middlemen, often forces farmers to sell their produce at low prices immediately after harvest, diminishing their profit margins (Mohammed, 2015; Adekunle & Ayodele, 2018). This fluctuation makes income planning difficult and exposes farmers to significant financial risk. Furthermore, Limited access to credit facilities from formal financial institutions is a major impediment to investment in improved inputs, new technology adoption, and mechanization (Nweke & Okoro, 2019). Farmers often rely on personal savings or informal lenders, which may come with high-interest rates, further constraining their economic growth (Mohammed, 2015). High cost of farm inputs, including fertilizers, improved seeds, and agrochemicals, also reduces profitability, particularly for resource-poor farmers (Mohammed, 2015). Finally, infrastructural deficiencies, such as poor rural road networks, exacerbate marketing challenges by increasing transportation costs and leading to higher post-harvest losses due to spoilage during transit (Usman & Sani, 2017). The lack of adequate storage and processing facilities further limits farmers' ability to add value to their produce and access distant markets.

Income Inequality among Pepper Farmers in Nigeria

Despite the efforts of pepper farmers to diversify their income sources, significant income disparities persist within these farming communities, contributing to broader rural income inequality in Nigeria. Income inequality has been a problem affecting every nation in the world especially in sub Saharan Africa Nigeria is not left out (FAO, 2021). Income inequality possess an adverse socio economic and political consequence with the potential to cause instability in the economy and unsustainability of resources (International Monetary Fund, 2023). Income inequality is the extent to which income is evenly distributed within a population (IMF, 2023). low income pepper farmers consume majority of their farmer produce and have very little to improve on their income, while high income pepper



farmers expand their economies of scale to generate more income, this consequently leads to income disparity. Income inequality among pepper farmers is often rooted in differential access to productive resources and opportunities (Alabi et al 2023). Access to land, plays a crucial role in determining yield and income potential. Farmers with larger landholdings or secure land tenure tend to achieve higher returns (Mohammed, 2015). Similarly, access to credit and capital significantly influences a farmer's ability to invest in improved seeds, fertilizers, irrigation equipment, and other yield-enhancing technologies. However, gender-based disparities are also a significant driver of income inequality in pepper farming. Female pepper farmers often face more severe constraints in accessing productive resources such as land, credit, and extension services compared to their male counterparts (Alabi et al., 2023). This unequal access translates into lower productivity and consequently, lower incomes for female-headed households or farms primarily managed by women, as evidenced by lower gross margins for female pepper farmers in Kaduna State (Alabi et al., 2023). Education level and access to agricultural extension services and market information play a crucial role in income differentiation. Farmers with higher levels of education are more likely to adopt improved farming practices, diversify their income sources effectively, and engage in more profitable market linkages (World Bank, 2019). Conversely, farmers with limited education and extension contact often remain in traditional, low-yield farming systems, widening the income gap. The structure of the pepper value chain, particularly the dominant role of middlemen, often contributes to income inequality. Smallholder farmers, lacking direct market access and storage facilities, are vulnerable to exploitation by intermediaries who buy at low farm-gate prices and sell at significantly higher retail prices (Sani & Garba, 2020). This reduces the share of the final product value that accrues to the farmers, thereby exacerbating income disparities. The lack of collective bargaining power among unorganized farmers further compounds this issue.

Farmers in remote areas with poor road networks face higher transportation costs and limited access to lucrative markets, reducing their effective income (Usman & Sani, 2017). Conversely, those closer to urban centers or major markets may have better opportunities to sell their produce at favorable prices. Regional disparities in infrastructure development, such as irrigation facilities, also create income gaps, with farmers in well-irrigated regions like parts of Kano often having more stable and higher incomes compared to those solely reliant on rain-fed agriculture.



MATERIALS AND METHODS

This study was carried out in North West, Nigeria. The simple random sampling design was utilized to select Kaduna and Kano States because pepper is predominantly grown in the two states. A simple random sampling design was utilized to select 200 pepper growers within the two states. The approach was used because it avoids element of bias in selecting the respondent. Secondly, the sampling design gives the likelihood for every grower to have equal chance of being selected. The disadvantages of the simple random sampling design were under-representation of certain sub-groups, time consuming, difficulty accessing lists of the full population, the process may cost individual a substantial amount of capital, cumbersome, sample selection bias can occur, and challenging when the population is heterogeneous and widely spread. The sample frame of pepper producers approximately 400 respondents. The total sample number consists of 100 pepper growers selected each from the two states, respectively. Primary data of cross-sectional sources were utilized based on a well-planned questionnaire that was subjected to validity and reliability test.

This sample number was estimated based on the established formula of Yamane (1967) as follows:

$$n = \frac{N}{1+N(e^2)} = \frac{400}{1+400(0.05)^2} = 200 \dots \dots \dots (1)$$

Where,

n = The sample number,

N = The total number of pepper producers,

e = 5%

The data obtained were analyzed using descriptive statistics, Gini-coefficient, Kendalls' coefficient of concordance, Multinomial Logit model, and t-test statistics.

Gini-Coefficient (GC)

The choice of this formula follows the studies of Taru and Lawal (2011). The Gini-Coefficient is given as:

$$GC = 1 - \sum_{i=1}^n X_i Y_i \dots \dots \dots (2)$$



Where,

GC = Gini Coefficient

X_i = % Share of Each Class

Y_i = Cumulative % of their Sales

Kendalls' Coefficient of Concordance (W)

The choice of this formula follows the studies of Amesimeku and Anang (2021).

The Kendalls' Coefficient of Concordance (W) is stated below:

$$W = \frac{12S}{m^3(n^3 - n) - mT} \quad (3)$$

Where:

n = Number of Attributes or Objects that is Evaluated by Respondents

m = Number of Respondents

S = Sum Overall Subjects

T = Correction Factor estimated for Tied Ranks

$$T = \sum_{k=1}^g (t_k^3 - t_k) \quad (4)$$

Where;

t_k = Number for Tied Ranks for each (k) in 'g' Groups of Ties

Friedmans' Chi Square (χ^2)

$$\chi^2 = m(n - 1)W \quad (5)$$

Multinomial Logit Regression Model (MLRM)

The general MLRM following Maharazu et al. (2024) is defined as:

$$P_r(y_i = j) = \frac{\exp(X_i\beta_j)}{1 + \sum_{k=0}^j \exp(X_i\beta_j)} \dots \dots \dots (6)$$

and to ensure identifiability,

$$P_r(y_i = 0) = \frac{1}{1 + \sum_{k=0}^j \exp(X_i\beta_j)} \dots \dots \dots (7)$$

$$Z_i = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \mu_i \dots (8)$$

Where,

Z_i = Sources of Income (1, Farm Income; 2, Non-Farm Income; 3, Off-Farm Income)

β_0 = Constant Term



$\beta_1 - \beta_6$ = Regression Coefficients

X_1 = Age in Years

X_2 = Education (Years)

X_3 = Experience in Pepper Farming (Years)

X_4 = Cooperative Memberships (1, Member; 0, Otherwise)

X_5 = Access to Market (Kilometer)

X_6 = Farm Size (Hectares)

X_7 = Access to Input (Fertilizer Usage in Kg)

μ_i = Noise Term

The t-Test of Difference Between Means

This is stated thus:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad (9)$$

Where,

$\bar{X}_1$ = Mean of Values in Group 1

$\bar{X}_2$ = Mean of Values in Group 2

s_1^2, s_2^2 = Standard Deviation in Group 1 and Group 2

$n_1 n_2$ = Number of Observation in Group 1 and Group 2

RESULTS AND DISCUSSION

Summary Statistics of Pepper Farms and Farmers Features

The Table 1 provided a comprehensive overview of the socio-economic characteristics of pepper farmers. Here's a discussion of each of the mean values and their implications:

Education

The mean years of schooling of pepper growers was 13 years, Low educational attainment among farmers limits their ability to adopt modern farming technologies, understand extension services, and access financial resources, and this perpetuates low productivity (Alabi et al., 2022).



Age

The mean age of the pepper farmers was 46 years; this suggests the dominance of young farmers in the study area and that pepper growing was primarily undertaken by young individuals. This young farmer can easily adopt modern technologies, as older farmers are often more resistant to change (Alabi., 2023).

Experience

The number of years a farmer spent in farming gives an indication of the practical knowledge he/she has gained on how to cope with production, since experienced farmers are better risk managers than inexperienced ones. The rice farmers had an average of 14 years of experience which reflects that the farmers have deep knowledge of local pepper farming practices. This result is in consonance with the findings of Alabi et al. (2023), who corroborated that farmers with longer years of farming experience would accumulate more and better knowledge and skills in making informed farm decision.

Household size

Household labour helps to mitigate/ cope with the issue of scarce and costly hired labour and help reduce the cost incurred in labour purchase. The mean household size was 8 persons; the result is in line with Anthony (2023) who reported that large household size complement labour and enhance productivity and reduce the cost of hired labour.

Extension Contact

The result shows that 57% of crop farmers had contact with extension agents, while 43% did not. While more than half of the farmers benefit from extension services, a significant proportion remains excluded, which limits the dissemination of modern farming practices. This is in line with the assertions of Oluwole and Odebode (2015) who highlighted the importance of extension services in improving farmers' knowledge, productivity, and income. However, gaps in coverage remain a challenge in rural Nigeria.

Cooperative Memberships

The result shows that 72% of crop farmers belong to farm-based organizations, while 28% do not. Membership in such organizations is relatively low, limiting farmers' access to collective resources, credit, and markets. This highlights the need to promote group-based initiatives to improve farmers' bargaining power. This result is in agreement with the findings of Barungi et al. (2016) who



emphasized the role of farmer organizations in improving resource access, capacity building, and market linkages for smallholder farmers.

Table 1. Summary Statistics of Pepper Farms and Farmers Features

Variables	Unit of Measurement	$\bar{X}_t$	SD
Education	Years	13	4.74
Age	Years	46	6.87
Experience in Pepper Farming	Years	12	4.02
Household Size	Number	9	3.52
Extension Contact	1, Contact, 0; No Contact	0.57	0.16
Farm Size	Hectares	1.27	0.42
Cooperative Memberships	1, Member; 0, Non- Member	0.72	0.17
Output of Pepper	Tons per hectare	3.0	0.17
Price per ton	Naira per tone	350,000	59.781

Source: Field Survey (2024) 1 USD = 1, 500 Naira

Farm size

Table 1 further suggested that the average pepper farmer cultivates 1,27 hectares. This could mean that the farmers are smallholder farmers. Smallholder farmers are predominant in the sub-Saharan Africa.

Output

The average rice yield is 3 tons per hectare suggesting that the farmers were efficient and productive, which points that there are potentials of increase in output.

Measurements of Income Inequalities among Pepper Growers

The result presented in Table 2 suggested a significant disparity in income levels among pepper growers with 70% (140 pepper growers) majority experiencing high inequality, while 30% (60 pepper growers) reflecting low income inequality. This is in agreement with the research of Anyiam, et al. (2023).

Table 2. Measurements of Income Inequalities among Pepper Growers

Measurement	Frequency	Percentage
≥ 0.5 (High Inequality)	140	70.00
< 0.5 (Low Inequality)	60	30.00

Source: Field Survey (2024)



Sources of Income among Pepper Growers

The result presented in Table 3 showed that the farm income is the dominant source, contributing 34.04% of the growers' income. The non-farm income and off-farm income makes up 27.66% and 25.53% respectively of the income, suggesting that a significant portion of households also engage in secondary activities to supplement their earnings. This result is in line with Sahara et al. (2023) who asserted that farmers in Ghana generate income from multiple sources, including pepper and other commodity farming, as well as non-farm activities and households with diverse income sources generally have relatively sustainable livelihoods.

Table 3. Sources of Income among Pepper Growers

Source of Income	*Frequency	Percentage
(a) Farm Income		
(i) Crop Income	120	25.53
(ii) Livestock Income	40	08.51
Sub-Total	160	34.04
(b) Non-Farm Income	130	27.66
(c) Off-Farm Income	120	25.53
(d) Others	60	12.77
Total	470	100.00

Source: Field Survey (2024) *Multiple Choices

Factors Affecting the Sources of Farm Income among Pepper Growers

The chi-square probability as shown in Table 4 revealed that the statistics of likelihood ratio was highly significant at ($P < 0.0000$), this suggests that the model has strong explanatory power. The pseudo R^2 of 0.8025 revealed that 80.25% of the variations in the dependent variable was due to the variations in the independent variables included in the model. This confirmed that the pepper growers choice of the sources of income could be due to fitted covariates, the R^2 estimated the goodness of fit and therefore the model have performed well.

Education

The result suggest that education was positively significant at 1% probability level. This indicates that higher levels of education are associated with an increased likelihood of deriving income from farming activities. This is consistent with the findings of Alabi et al. (2021) that highlighted the role of education in improving agricultural productivity, adoption of improved technologies, and better farm management practices.



Experience

This showed that experience is positive and significant at 5% probability level. This suggested that for each additional year of farming, income is expected to improve by 0.2302 units. This result is in line with findings of Alabi et al. (2021), who reported that experience helps farmers to make better informed decision, increase productivity, management of risks and increase income.

Access to Market

The results in Table 4 further showed that access to market improves farm income by 0.2027 units, this result is statistically significant at 1% probability level. Access to market enables farmers to sell their produce at favorable prices, reduce post-harvest losses, and respond to market demand, thereby increasing income and welfare of the farmers (Omiti et al., 2018).

Access to Input, Fertilizer Usage

The coefficient for access to input, fertilizer usage is 0.2109 and highly significant at ($P < 0.01$) with a marginal effect of 0.2037. This indicates a significant positive relationship, implying that better access to inputs, particularly fertilizers, increases farm income when properly and efficiently utilized. More so, proper use of fertilizers and modern inputs leads to increased agricultural productivity, improved yields and which in turn boost farm income (Ayuya et al., 2015).

Factors Affecting the Sources of Non-Farm Income among Pepper Growers

Age

The coefficient for age on non-farm income was 0.2074. Similarly, to non-farm income, age was statistically significant at 1% probability level. This suggests that age have a statistically significant impact on a pepper grower's propensity to engage in non-farm income activities. The young farmers tend to engaged in other income generating activities easily which can improve income and welfare.

Cooperative Membership

This shows that cooperative membership is positive and significant at 10% probability level. It suggests that cooperative membership significantly increases the likelihood of a pepper grower deriving income from non-farm sources. This could be the benefits enjoyed as cooperatives might offer training programs in non-farm skills, facilitate access to credit for non-farm ventures, or create networks that lead to off-farm employment opportunities for their members



(Fischer & Qaim, 2012). This highlights the multifaceted benefits of cooperative engagement beyond just agricultural production.

Access to Market

This strong positive relationship indicated that better access to markets significantly increases the likelihood of deriving multiple income apart from pepper farming. This is a critical factor for agricultural profitability, farm household welfare and poverty alleviation, as it enables farmers to sell their produce aside pepper at favorable prices, reduce post-harvest losses, and respond to market demand (Omiti et al., 2018).

The Challenges Faced by Pepper Growers

Table 5 presented the Kendall's Coefficient of Concordance results, ranking challenges faced by pepper growers. The Kendall's W (0.283, $\chi^2 = 792.4$, $p = 0.000$) indicated a significant difference of the constraints among farmers.

Lack of Improved Seeds

Lack of improved seeds seen as the most critical issue with a mean value of 40.97, highlighting that lack of improved seeds as a fundamental factor influencing agricultural productivity and investment this is also in agreement with the studies Ayanwale et al. (2018).

Table 4. Factors affecting the Sources of Income among Pepper Growers

Factors	Par	Farm Income		Non-Farm Income	
		Coefficient	ME	Coefficient	ME
Age (X_1)	β_1	0.2207	0.3408	0.2703***	0.2704
Education (X_2)	β_2	0.2420***	0.2924	0.2074	0.2207
Experience (X_3)	β_3	0.3804**	0.2302	0.2042	0.1847
Cooperative Membership (X_4)	β_4	0.1070	0.2307	0.2018*	0.2483
Access to Market (X_5)	β_5	0.2027***	0.2104	0.2309***	0.2706
Farm Size (X_6)	β_6	0.2309	0.2025	0.2317	0.2530
Access to Input, Fertilizer Usage (X_7)	β_7	0.2109***	0.2037	0.2109	0.2801
Constant	β_0	2.3012**		3.0248**	
Log Likelihood = -97.415					
Wald Chi Square = 2648.26					
Pseudo $R^2 = 0.8025$					
Prob $>\chi^2 = 0.0000$					

Source: Field Survey (2024), Par = Parameter, Reference Group = Off-Farm Income; *-Significant at ($P < 0.10$), **-Significant at ($P < 0.05$), *-Significant at ($P < 0.01$)**



Lack of Fertilizer and Pesticides

Lack of fertilizer and pesticides ranking second with a mean of 40.74 which underscores the persistent challenges in agricultural development, particularly in developing countries. Limited access to modern farming technologies and essential inputs such as fertilizers, pesticides significantly hinders productivity and resilience (World Bank, 2020). These are input-related constraints that directly reduce yield and profitability.

Climate Change

Climate change was ranked 3rd, indicating farmers' awareness of its adverse effects on yield, growing seasons, and pest pressure. This outcome is consistent with findings by Tambo and Abdoulaye (2013) who documented that farmers lack access to vital information on how to adapt to climate changes (e.g., climate-smart agriculture, water conservation techniques). This also reduces their ability to mitigate risks such as floods, droughts, and pests.

Low and Unstable Product Prices

This challenge has a mean value of 39.58 suggesting that volatile market prices reduce income predictability and discourage investment in pepper farming. Market and price instability is a common economic barrier to sustainable pepper production (FAO, 2019).

Inadequate Infrastructure (Roads)

Poor road conditions limit market access, increase post-harvest losses, and reduce profitability and farmers' income. This is also in consonance with assertion that infrastructure development is critical for connecting rural farmers to markets (World Bank, 2007). Infrastructure development, such as better roads and transportation services, can mitigate this constraint.

Lack of Extension Services

Ineffective extension services limit farmers' access to modern agricultural techniques, innovations, and critical information. Improving these services through training, resources, and better outreach can enhance farm productivity and resilience.

Pest and Disease Management

Farmers lack sufficient knowledge about pest and disease management, pest outbreaks reduce their ability to boost production, output, enhance productivity which translates to higher income. Extension services, farmer training programs,



and awareness campaigns on pest and disease management in agriculture can address this knowledge gap.

Inadequate Storage Facilities

The cost of water storage solutions is a major constraint. Access to affordable water storage systems, such as tanks and wells, is crucial for managing water resources efficiently and ensuring crop survival during droughts.

Table 5. The Kendall's Coefficient of Concordance Results of the Challenges Faced by Pepper Growers

Challenges	Type of Constraints	Overall Rank	Mean Rank
Lack of Improved Seeds	Production	1	40.97
Lack of Fertilizer and Pesticides	Production	2	40.74
Climate Change	Production	3	40.53
Low and Unstable Product Prices	Market and Economic	4	39.58
Inadequate Infrastructure (Roads)	Market and Economic	5	38.40
Lack of Extension Services	Production	6	38.35
Pest and Disease Management	Production	7	38.34
Inadequate Storage Facilities	Production	8	38.22
Lack of Access to Credit	Financial	9	38.19
Lack of Information	Market and Economic	10	37.99
Underutilization of Labour	Production	11	37.77
Overutilization of Inputs	Production	12	37.61
Low Education Level	Other	13	36.97
Lack of Government Support	Market and Economic	14	36.60
Post-Harvest Handling	Production	15	36.47
Kendall's Coefficient (W)		200	
Chi Square		0.283	
df		792.4	
F-Critical		14	
F-Calculated		94.40	
Asymptotic Significance		254.70	

Source: Computed from Field Data (2024)

Lack of Access to Credit

Many farmers are constrained by financial resources and credit facilities. This restricts their ability to invest in farm inputs and equipment, limiting productivity and output. There is the need for financial literacy programs, agricultural loan awareness campaigns (Alabi et al., 2023).

Lack of Information

Lack of information limits farmers' ability to prepare for adverse weather events, market demands, price stability. Improving early warning systems and



dissemination of information can help farmers take proactive measures to protect their crops, boost productivity and increase efficiency.

Underutilization of Labour

The lack and underutilization of available farm labour is a significant constraint. This issue can lead to reduced productivity, delayed planting and harvesting, and increased labour cost. Overutilization of Inputs, low education level, lack of government support and post-harvest handling where seen as lower challenges encountered by the pepper farmers in the study area.

The Difference between Costs and Revenue in Pepper Farming per Hectare

Since the t- calculated (23.11) is significantly greater than the t- tabulated (1.96), this suggested that there is a statistical difference in the cost and returns in the pepper farming per hectare. This implies that the observed difference between the average costs (₹456, 030.12) and average returns of (₹1,050, 000) further suggests that the pepper production in the study area is economical viable with an average difference of (₹593, 969.88). This aligns with the studies of Olutumise (2022) that pepper farming is profitable.

Table 6. The t-Test of Difference Between Costs and Returns in Pepper Farming per Hectare

Variable	Estimates (Number)
Costs	456,030.12
Returns	1,050,000
Standard Deviation Cost	293,703.40
Standard Deviation Returns	467,317.74
t-Calculated	23.11
t-Table	1.96

Source: Field Survey (2024)

CONCLUSION

The study focused on farm level challenges and factors affecting the sources of income among pepper farmers in Kaduna and Kano States, Nigeria. A simple random sampling design was employed to select approximately 200 pepper growers.

The study confirmed that pepper farming is profitable in the study area. The null hypothesis is rejected, while the alternative hypothesis is accepted. The estimated returns of pepper farming per hectare (₹ 1,050, 000, SD = 467, 317.74) was significantly greater than the cost (₹ 456,030.12, SD = 293, 703.40) at 5% level



of probability. There are significance differences among the challenges faced by pepper growers. The null hypothesis was rejected, while the alternative hypothesis was accepted. The Kendall's W (0.283, $\chi^2 = 792.4$, $p = 0.000$) indicated a significant difference of the challenges among growers.

The major challenges faced by pepper farmers include lack of improved seeds (1st, mean rank = 40.97), lack of fertilizer and pesticides (2nd, mean rank = 40.74), climate change (3rd, mean rank = 40.53), and low and unstable product prices (4th, mean rank = 39.58). The main challenges faced by pepper growers are production constraints, and also, market and economic constraints.

There is a significant relationship between socio-economic factors and sources of income among pepper growers. The null hypothesis was rejected, while the alternative hypothesis was accepted. The significant socio-economic factors influencing sources of farm income among pepper growers include education (0.2420, marginal effect = 0.2924) at 1% probability level and experience (0.3801, marginal effect = 0.2302) at 5% probability level. Similarly, the socio-economic factor influencing sources of non-farm income among pepper growers include age (0.2703, marginal effect = 0.2704) at 1% probability level.

The study established that there is income inequality among pepper farmers in the study area. The null-hypothesis was accepted, while the alternative hypothesis was rejected. Approximately 70% (140 pepper growers) belongs to high income inequality group, while, 30% (60 pepper growers) belongs to low income inequality group.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

- (i) **Improved Access to Credit-** Government and financial institutions should provide credit to pepper growers at low interest rate devoid of cumbersome administrative procedures. This will enable the pepper growers to invest in inputs and technology.
- (ii) **Subsidized Inputs:** The farm inputs such as fertilizer, pesticides, and other inputs should be subsidized at affordable rate, as this can reduce cost and increase productivity.
- (iii) **Improved Infrastructure:** The feeder roads should be constructed, investing in irrigation facilities systems, improve market access, and storage facilities will reduce post-harvest losses.



- (iv) **Government Policies**-Government should make favorable policies that will stabilize pepper prices and address market fluctuations.
- (v) **Value Added Production**-The pepper growers should engage in value added production, this include processing pepper into powder and other products
- (vi) **Extension Services**: This will educate farmers on the best practices for pest control, cultivation and marketing of produce.
- (vii) **Crop Diversification**: Pepper farmers should grow other crops alongside pepper to diversify income sources.
- (viii) **Livestock Integration**: Pepper growers should integrate livestock farming into pepper farming, this will provide manure and other benefits.

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