International Academic Research Consortium Journals (IARCJ)
International Journal of Agricultural Science and Technology
ISSN: 2360-9888. Volume 12, Issue 2
PP 64-78, February, 2025
OTL: 427251-452781-1227
arcnjournals@gmail.com
https://arcnjournals.org

MAIZE CROP PRODUCTION, POSTHARVEST LOSSES AND FOOD SECURITY IN NORTH EAST GEOPOLITICAL REGION: EVIDENCE FROM AKK0 LGA, GOMBE STATE

Iliya Elisha; Sadiq Salisu Abubakar
Department of General Studies, Gombe State Polytechnic Bajoga

Abstract: *Attaining food security has become a policy target by the government in recent years. Thus, the issue of whether there is enough food for the people in the North East region (Gombe state) hinges on crop wastage after harvest despite apparent increases in crop production amidst government efforts. Consequently, this study examined how food crop production and post-harvest losses affect food security in Nigeria, particularly among the North East states. The study used descriptive statistics and Structural Equation Modeling (SEM) for estimation purposes. Result showed that maize crop production is food secured in Akko local government area. Contrarily, result revealed a negative effect of post-harvest losses on food security and the result is statistically significant at 5% level. The study also found that soil fertility, maize crop variety, water/rain availability, labour and farm input determined maize crop production in the study area. While post-harvest losses positively and significantly increase due to physical damage of crop, crop decay and rot, insect and past infestation, storage condition, brushing or crushing. The study concluded that food is secured in Akko local government due to farmers' maize crop production while post-harvest losses adversely affected food security. The study recommended among others that, farmers should adopt the practice of breathable bags to avoid physical damage of crop as well as brushing or crushing. Government and private organization should provide modern storage sealed storage facilities for farmers to help control insect and past infestation to reduce post-harvest losses of maize crop in the study area.*

Keywords: *Crop production, Food Security, Post-harvest losses, Structural Equation Modeling (SEM).*

1.1 Introduction

Over the years, significant progress has been made globally in enhancing human welfare through increased food production via agricultural activities. This production hinges on the availability of arable land and is influenced by macroeconomic uncertainties and consumption patterns, both of which significantly affect agricultural commodity prices (FAO, 2021). Consequently, the value of food production correlates with the area harvested, yield per hectare, and total quantities produced. While the current global food supply is adequate to sustain the population, but

ensuring timely distribution is vital to avoid hunger. However, with the global population expected to reach 9.7 billion by 2050, a significant increase in food production will be necessary to meet future needs (Kennelly et al., 2018). Agriculture's global value added increased by 73% in real terms from 2000 to 2019, reaching $3.5 trillion in 2019 (FAO, 2021). During the same period, total primary crop production rose by 53%, achieving a record high of 9.4 billio n tons in 2019, with sugar cane, maize, wheat, and rice accounting for half of this output. Despite the dramatic increase in food crop production, half of the developing world's population still lacks access to adequate food supplies due to post-harvest yield losses and food insecurity (Khatun & Rahman, 2019). Furthermore, despite the rise in crop production, the global rate of under nourishment increased between 2019 and 2020 during the COVID-19 pandemic. In 2020, nearly 10% of the global population experienced hunger, up from 8.4% in 2019 (FAO, 2021).

In the African region, enhancing farming activities for food security has become a policy priority for many governments (Balana, *et al.,* 2022). Advancement toward achieving food security has been hindered by factors such as low agricultural productivity, rapid population growth, political instability, and civil unrest. However, successes in countries with stable political environments, economic growth, and expanding agricultural sectors demonstrate that effective governance, robust institutional capacities, and well-crafted macroeconomic, structural, and sectoral policies can work together to enhance long-term food security. In most Sub-Saharan African countries, where agriculture constitutes a significant portion of total employment, broad-based growth in agricultural incomes is essential to stimulate overall economic growth. Consequently, the ability of agriculture to drive GDP growth and reduce poverty varies by country (FAO, 2012). Most of the poor and food-insecure populations in Africa reside in rural areas and rely heavily on the agricultural sector for their livelihoods. Efforts to increase food crop production in developing countries like Nigeria have led successive governments to introduce numerous agricultural programs. These initiatives include the National Agricultural Development Fund (NADF, 2002), the National Special Programme on Food Security (2002), the 7-Point Agenda with an emphasis on Food Security (2009), and the current administration's Agricultural Transformation Agenda, all designed to tackle the pressing issues of food insecurity and poverty (Ahungwa, *et al.,* 2017). As hunger persist across Nigerian states due to food scarcity and rising prices, farmers in the North East geopolitical zone seems to suffer losses amidst their effort to increases crops production. Could post harvest loss potentially hindering farmer’s efforts to increase food crop production and depriving them of optimal economic returns from their agricultural activities. Despite these efforts, hunger and poverty persist as significant threats due to limited access to quality food.

1.2 Problem Statement

Efforts to address food insecurity in Nigeria have led to the partnership between the United Nations Development Programme (UNDP) and North East communities, resulting in the distribution of farm inputs to farmers to increase food production (UNDP, 2022). Additionally, persistent increases in government expenditure in economic sectors such as agriculture, particularly in the North East region, are expected to improve food production (CBN, 2022). However, evidence of hunger, food insecurity, and malnutrition remains prevalent in Nigeria's North East region, potentially due to insufficient food production or post-harvest losses among other factors (Segun et al., 2022).

Nigeria's food deficit is attributed to various challenges including limited technical expertise, inadequate financing, poor storage facilities, and inadequate transportation networks (Kitinoja *et al*., 2019). However, the level of production is expected to address food security in the country (Ibrahim, *et al.* 2022) In contrast, Chukwu et al. (2022) argue that the primary challenge of food insecurity in Nigeria stems from insecurity, which leads to the loss of lives and farmland, rather than solely post-harvest losses. As hunger spreads across Nigerian states due to food scarcity and rising prices, farmers in the North East geopolitical zone suffer losses, potentially hindering their efforts to increase food crop production and depriving them of optimal economic returns from their agricultural activities.

Consequently, the issue of whether crop production levels are sufficient to meet the food needs of the North East region hinges on crop wastage. Despite efforts to increase crop production, the persistent issue of post-harvest losses among farmers has drawn scholarly attention and calls for further investigation. This suggests that even in areas with abundant food crops, scarcity may persist due to factors such as crop losses. Understanding why the majority of the North East states such as Gombe engages in crop production yet lacks consistent access to quality food is crucial. Therefore, it is necessary to examine whether post-harvest losses have a significant impact on food security in the region.

1.3 The Study Objectives

The aim of this study is to assess the impact of food crop production and post-harvest losses on food security in Nigeria, with particular emphasis on the North East states. The specific objectives are to:

1. Estimate food crop post-harvest losses in North East region from 2020 to 2023
2. Ascertain how crop food production affect food security in North East region
3. Investigate the impact of crop postharvest losses on food crop production in North East region
4. Examine the effect of crop post-harvest losses on food security in North East region.

1.4 Significance of the Study

Ensuring food security is a paramount goal for every nation in meeting the needs of its citizens. In sub-Saharan Africa, a significant portion of the population faces poverty and contends with food crises. Nigeria, blessed with abundant fertile land and successful food crop harvests, has earned the moniker "the Food Basket of the Nation." However, a substantial amount of these food crops is lost during the post-harvest phase, potentially exacerbating food insecurity issues and squandering valuable resources invested in food production. Achieving universal food security remains a challenging task unless we effectively tackle the challenges posed by post-harvest losses. Understanding the scope of these losses and their impact on food security is crucial for implementing effective preventive measures. This study aims to provide essential insights into these issues.

Furthermore, this research will serve as an educational resource for farmers in the North East geopolitical zone, enhancing their understanding of post-harvest loss and its implications for food security. By contributing to the existing body of knowledge, this study will inspire and guide future research efforts in this field. The study will employ a pragmatic approach, drawing theoretical inspiration from Eliyahu Goldratt's Theory of Constraints (TOC), to explore the connection between post-harvest

losses and food security. This study explored the impact of food crop production, post-harvest losses and food security in Gombe state using Akko Local Government Area as a case study.

2.0 Literature Review

Conceptual Literature

According to FAO (2021), post-harvest losses refer to measurable reductions in both the quantity and quality of a given product. These losses occur due to various objective factors such as inadequate infrastructure, poor management practices, outdated technology, and equipment (Okadonye, *et al.* 2021). Post-harvest losses encompass the cumulative impact of tangible losses occurring during different stages including harvesting, transportation, drying, and storage of crops. Doki et al. (2019) define post-harvest losses as reductions in both the quantity and quality of food products throughout the supply chain. These losses are influenced by factors such as natural conditions, infrastructure, technological equipment, management decisions, and the individual characteristics of practitioners. It is important to recognize that losses can occur in both quantity and quality, reflecting unintended reductions in the volume of food intended for human consumption across all stages of the supply chain, regardless of the cause or final destination.

On the other hand, food production as the process of planting and harvesting crops primarily for human consumption (Edem, 2019). Food production is essential for maintaining global food security by ensuring sufficient access to nutritious sustenance for populations worldwide. Efforts aimed at enhancing food crop production often focus on increasing yields and improving crop quality. This study will not explore food production as a process itself but rather as the outcome of food production within a specific geographical area and timeframe.

Furthermore, food security is attained when all individuals have reliable economic and physical access to sufficient, safe, and nutritious food that meets their dietary needs for an active and healthy life (Biam & Tavershima, 2020). This definition, as refined in 'The State of Food Insecurity 2001', describes food security as a state where every person consistently has physical, social, and economic access to an ample supply of safe, nutritious food that aligns with their dietary requirements and preferences, supporting an active and healthy lifestyle.

Empirical literature

Some scholars have explored the effect of post-harvest losses on food security such as Ogundele (2022) who examined post-harvest loss and food security in Nigeria using descriptive statistics. The study found that crop losses affected food security are primarily caused by issues related to farm-to-market transportation, packaging, repackaging, as well as storage and warehousing activities. Transport losses to crops were highest for rice, followed by maize. Cowpea suffered the greatest amount of loss due to packing and repackaging activities, whereas yam experienced the greatest percentage of loss due to inadequate storage. Though, the study ignored the effect of food crop production on food security.
Nahar, et al. (2024) looked at the impact of crop diversification on food security of farmers in Northern Bangladesh. Using binary logistic regression model the study reported that crop diversified households were food secured compared to that the less crop diversified households in Bangladesh.

In the orange supply chain, post-harvest losses effect of fresh oranges was studied by Obayelu, *et al.* (2022) employing logit regression in Oyo state. With the aid of descriptive and gross margin analysis, the study found that men dominated orange farming, while women dominated orange marketing. Post-harvest losses ranged from 6 to 10 percent for most farmers and wholesalers, but were less than 5 percent for 46.79 percent of retailers. Post-harvest losses were more likely among farmers who were male and gathered oranges in the late afternoon, but less likely among farmers with large households. Among orange marketers, those who used education, smallholding marketing, and storage facilities experienced fewer post-harvest losses. However, the study did not address how post-harvest losses and food production affect food security using its relevant indicators in Gombe state.

A study conducted by Hlatshwayo, et al. (2023) in South Africa looked at the determinants of crop productivity as it affects food and nutrition security. With the use of logit analysis, it showed that most smallholder farmers lack access modern farming and agricultural inputs. Thus, most smallholder farmers were food insecure in the study area. Irrigation systems and involvement in crop production influenced crop productivity positively and ownership of livestock, harvest, and disability in the family have adverse effect on food security status of smallholder farmers.

Debebe (2022) investigated the extent of post-harvest losses across various crops and identified their determinants. The study uncovered significant variations in the perceived annual average losses among different crop types. Key factors contributing to these losses included household size, education levels, wealth status, landholding size, damage from insect pests and rodents due to traditional storage methods, access to extension services, cooperative marketing membership, and proximity to all-weather roads and local markets. Similarly, Okadonye *et al*. (2021) investigated on the post-harvest losses of rice in the Makurdi local government area of Benue State. The findings indicated that rice losses occur at every stage from harvest to consumption, with threshing accounting for the greatest losses. Overall losses varied between 37% and 40% across all stages. Yet, the analysis was not on maize crop production and post-harvest losses as it affects food security in Gombe state. In Gboko and Makurdi local government areas of Benue state, Doki, *et al.* (2019) investigated the causes of orange post-harvest losses using logistic regression. The study found that formal education, harvesting methods, and handling significantly impacted post-harvest losses. In Taraba state, Emodi and Osilem (2018) looked at post-harvest losses of tomatoes and found that most farmers used sodium hydroxide to preserve tomatoes, while others used locally woven baskets. The main challenges faced by tomato farmers included the high cost of storage facilities, inadequate packing technology, and insect and disease infestation.

The reviewed literature showed that researchers have rarely studied the effect of post-harvest losses and food production jointly on food security in the entire Northeastern region, which presents a gap for further investigation. Additionally, the effect of post-harvest losses covering all the basic indicators of food security (food availability, accessibility, and utilization) has not been thoroughly researched in the Northeast hence, the need for investigation. Studies like Doki, *et al*. (2019) and Okadonye *et al.* (2021) looked at the effect of post-harvest losses on food security but was not in Gombe and the studies rarely captured the effect of maize crop production and post-harvest losses in Gombe state using the basic food security indices (food availability, accessibility and utilization).

Theoretical Literature

This study is based on the Malthusian theory of population, formulated by Thomas Robert Malthus in 1798 (Edem, 2019). According to this theory, the rate of population growth greatly exceeds the Earth's capacity to produce sufficient subsistence food for humans. This suggests that, in the near future, food shortages and insecurity are likely. Malthus was the first to highlight the issue of food scarcity, asserting that the growing global population would eventually surpass the planet's ability to sustain it. Edem (2019) emphasized that the theory predicts human population will grow geometrically while food production will only increase arithmetically or at a subsistence level. This imbalance will lead to hunger, poverty, unsanitary living conditions, and diseases unless mitigated by wars, epidemics, or changes in human behavior. Post-harvest losses reduce the efficiency of food production, widening the gap between population growth and food availability. Reducing these losses would make more food available without increasing production, aligning with efforts to counter Malthusian shortages.

3.0 Methodology

a. Research Design

This study will utilize the survey method, selected for its ability to gather information from large population samples. Survey designs are versatile in the range of variables they can examine and facilitate generalizations (Bell, 1996). This approach is chosen because it systematically collects and describes characteristics or facts about a population from a sample considered representative of the entire group. The study focused on farming households, with a sample drawn from North East region with particular emphasis on Gombe state. Special emphasis was placed on farmers who cultivate maize crop in Gombe state. A stratified sampling procedure was employed to select respondent in Akko local government area of Gombe state. The selection involved the three wards Akko local government area which are Kumo district, Gona district and Pindiga district. Additionally, the study utilized the Household Food Insecurity Access Scale (HFIAS), which was developed by Coates, Swindale, and Bilinsky in 2007 for the United States Agency for International Development (USAID) and Food and Nutrition Technical Assistance (FANTA). This scale will be employed to evaluate household food security.

b. Kinds and Sources of Data

This study will have made use of primary data collected from households engaged in crop production. Data will be gathered on various variables, including farmers' socio-economic characteristics (such as sex, marital status, age, and education level), as well as food security, post-harvest losses, and maize crop production. A cross-sectional survey will be conducted, and data will be collected using a well-structured questionnaire administered to farming households.

c. Target Population, Sample Size and Sampling Technique

The target population for this study is household farmers in Akko local government area, Gombe State. however, due to lack of documentary evidence, the exact number of the farmers is the study area is not reported. Consequently, the study adopted the Cochran (1967) formula for unknown population size which was used to determine the sample size. The Cochran (1967) formula for unknown population size is given as:

$$n = \frac{Z^2 * P * (1 - P)}{e^2}$$

Substituting the values:

$$n = \frac{(1.96)^2 * 0.5 * (1 - 0.5)}{(0.05)^2} = 384.16$$

The sample size for household farmers was rounded to 384 respondents since there is no half household (individual). The sample size of 384 was distributed among the three strata (three wards which are Kumo district, Gona district and Pindiga district), giving each council ward equal chance to administer 128 questionnaires.

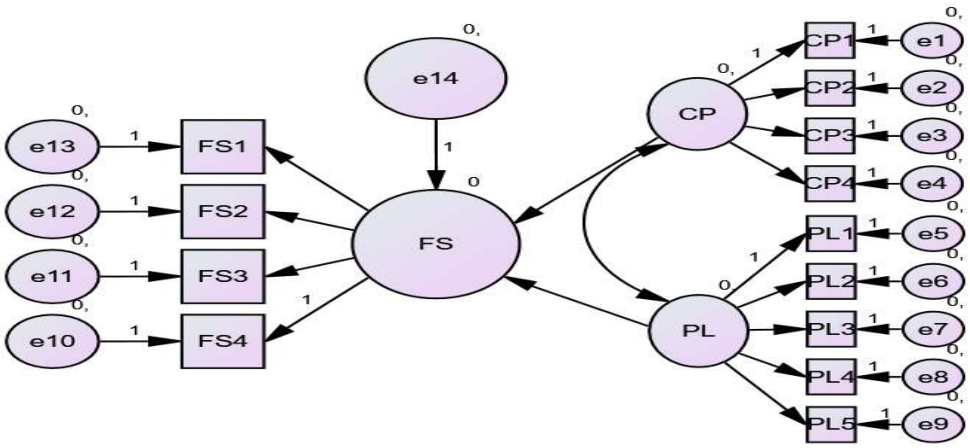
d. Model Specification

The specified model in this section which examined how maize crop production and post-harvest losses affect food security in Akko local government area of Gombe State is written as:

$FS_t = \delta_0 + \delta_1 CP_t + \delta_2 PL_t + \xi_g$

FS_t : Food Security (dependent variable), CP_t : Maize crop production, PL_t : Post-harvest losses, t : Time, $\delta_{0\,:\,\text{Intercept}}$, δ_1- δ_2 : Parameters of the model.

The latent variable FS_t is assessed using indicators like food availability (FS1, food accessibility (FS2), food utilization (FS3), and food stability (FS4). Maize crop production (CP) is measured using four indicators such as soil fertility (CP1), Maize crop variety (CP2), water/rain availability (CP3), labour and farm input (CP4). Furthermore, the latent variable post-harvest losses (PL) is measured by five indicators which are; physical damage of crop (PL1), decay and rot (PL2), insect and past infestation (PL3), storage condition (PL4), brushing or crushing/rough handling of crops during harvest or transportation (PL5).
These indicators simultaneously measure the effect of maize crop product and post-harvest losses on food security based on the specified model. The reliability of the model is ascertained in SEM using the confirmatory factor analysis (CFA) presented in Figure 1:



The a priori expectation of the model is that food crop production in the North East Region has likely been stable or slightly increased from 2020 to 2023 due to improved farming techniques and government support, though affected by climatic conditions and the COVID-19 pandemic. Post-harvest losses remain high due to inadequate storage, poor transportation, and limited preservation techniques, with consistent patterns over four years and spikes during harsh climatic conditions. Higher food crop production levels are expected to improve food security, enhancing food availability and affordability, though seasonal fluctuations may cause temporary shortages or increased prices. High post-harvest losses negatively impact farmers' production decisions, discouraging expansion and investment in high-yield crops, leading to economic strain and reduced income for farmers. Post-harvest losses are detrimental to food security, reducing food availability and driving up prices, disproportionately affecting low-income households and vulnerable populations like small holder farmers and rural communities.

e. Method of Data Analysis

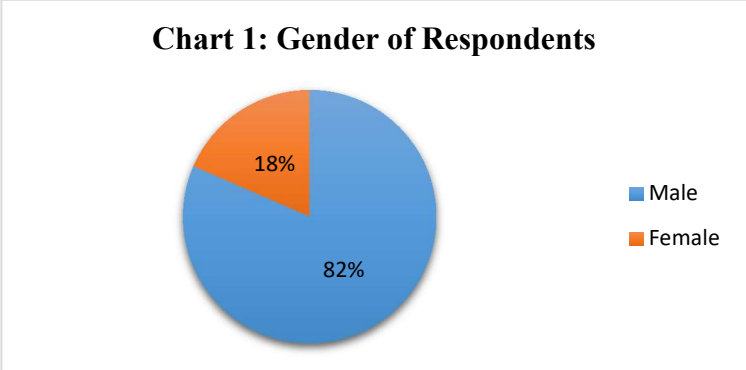
This study made use of descriptive statistics and Structural Equation Modeling (SEM). Descriptive statistical tools, including percentages, charts and percentages to analyze both the socio-economic attributes of the respondents and the primary objective of the study. Structural Equation Modeling (SEM) will be utilized to achieve the study objectives. SEM is an advanced statistical method for analyzing the relationships among constructs, especially those with multiple indicative variables within

the model using primary data. This approach is particularly suitable for this study as it allows for the examination of categorical data, which are prevalent among the variables under investigation. SEM is a robust multivariate statistical technique that utilizes a parametric approach to analyze data, making it well-suited for exploring and understanding relationships among underlying attributes in this research.

4.0 Presentation and Discussion of Findings

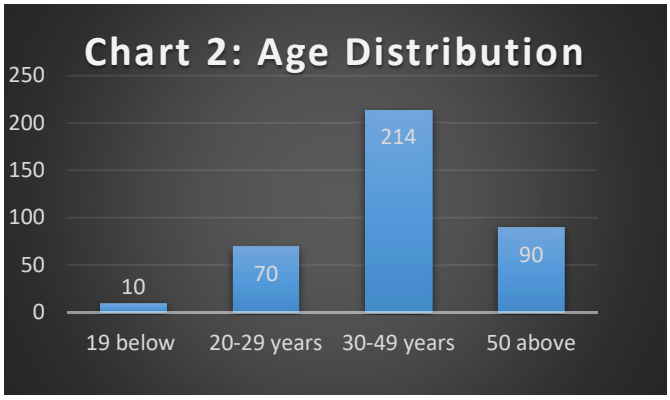
Socio-Demographic data of the respondents

In this section, the socio-economic characteristics of the respondents are explored. The specific socio-economic attributes under consideration encompass gender, age bracket, marital status, and educational qualification/attainment of the respondents in Akko local government area, Gombe state. The use of chart is employed to effectively convey the gathered information. The study administered 384 questionnaires and all were responded and retuned during the field work. The analysis based on gender of respondents is presented in chart 1.



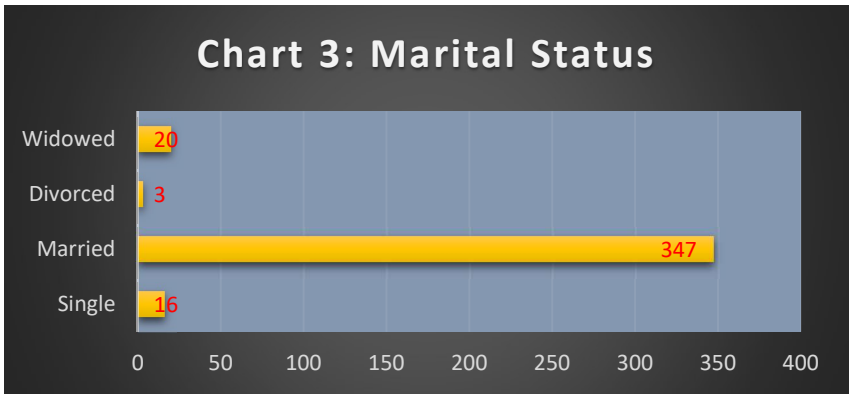
Source: Field Survey, 2024

The data presented in chart 1 indicates that 82% (equivalent to 313 respondents) of the participants were male, while 18% (amounting to 71 respondents) were female. This implies that majority of the respondents within the study area who are famers are male, with females comprising a slightly smaller proportion of the surveyed population.



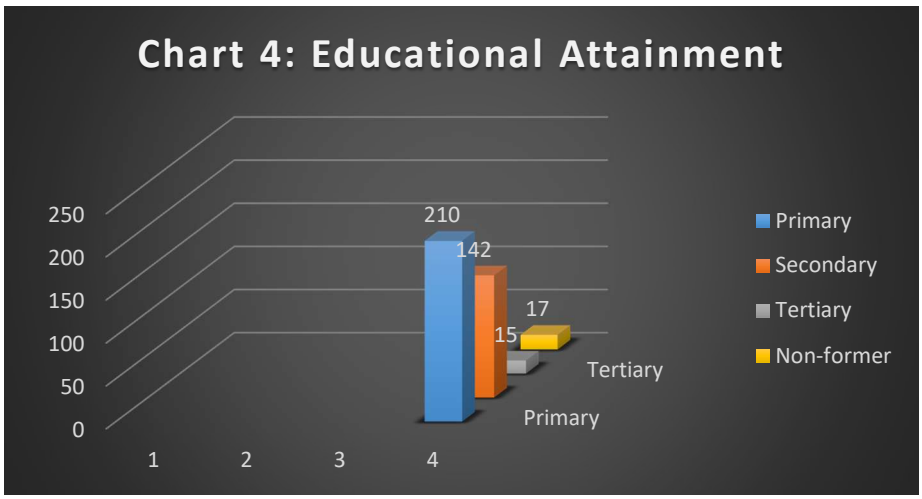
Source: Field Survey, 2024

The age distribution in chart 2 is evident that the age group spanning from 30 to 49 years constitutes the largest portion of farmer that are actively participating crop farming, with a considerable percentage of 56% (equivalent to 214 individuals) falling within this range. The age group below 19 years represents the lowest percentage, recording a significant level of 3% (accounting for 10 individuals). This observation implies that the majority of the respondents are individuals within the age range of 30 to 49 years, which often corresponds to family-oriented individuals and independent residents engaging in economic activities.



Source: Field Survey, 2024

The survey result in Chart 3 revealed the distribution of marital status among the respondents in Akko local government area. About 16 (4%) farmers interviewed were single, 20 respondents which is equal to 5% were widow farmers, 3 representing 1% were divorced, and 347 (90%) who constituted majority of the survey were married famers across the gender. It implies that maize crop production in Akko local government area is mostly carried out by household who are in active married.



Source: Field Survey, 2024

The survey result in Chart 4 showed that majority of respondents (210) attended primary education and it represent 55% of the total sample used in Akko local government area. This is followed by 37% (142 individuals) who attended secondary education, 3% (15 individuals) who have attained tertiary

education, and 5% (17 individuals) with non-formal education. The prevalence of primary education among the respondents aligns with the observation that many are engaged in farming.

To ascertain the effect of maize crop production and post-harvest losses on food security in Akko local government area, the Structural Equation Modelling (SEM) was conducted using SPSS AMOS and the results is presented in Table 1.

Table 1: SEM Estimated Result

Proxy			Unstandardized Estimates	Standardized Estimates	S.E.	C.R.	P	Label
FS	<---	CP	.790	.727	.128	6.168	***	par_11
FS	<---	PL	-.546	.205	.034	-15.94	***	par_2
CP1	<---	CP	1.000	.834				
CP2	<---	CP	.202	.205	.117	1.731	.083	par_12
CP3	<---	CP	1.233	.051	24.2		**	Par-3
CP4	<---	CP	1.233	.901	.051	24.237	***	par_3
PL1	<---	PL	1.000	.894				
PL2	<---	PL	.938	.853	.038	24.755	***	par_4
PL3	<---	PL	1.367	.909	.047	28.827	***	par_5
PL4	<---	PL	1.208	.949	.037	32.504	***	par_6
PL5	<---	PL	1.059	.924	.035	30.077	***	par_7
FS4	<---	FS	1.000	.952				
FS3	<---	FS	1.367	.952	.033	41.726	***	par_8
FS2	<---	FS	1.025	.922	.028	36.043	***	par_9
FS1	<---	FS	.760	.837	.029	26.382	***	par_10
Model Fit Indices: CFI=.907, P = .000, CMIN = 2354.121, NFI =.941								

Source: Output from SPSS Amos

The estimated coefficient of maize crop production (CP) was positive (0.790) and statistically significant at the 5% level. This means increases in maize crop production led to food security in Akko local government area of Gombe State. This coefficient reflects the strength and direction of the relationship between gig economy and household income, indicating a positive relationship between the variables. The result implied that food is secured in the study area as the result of farmers' agricultural practice of maize farming among residents. This result is in line with the a priori expectation that maize crop production is food securable in Akko local government area.

Contrarily, the estimated result revealed a negative (-.546) effect of post-harvest losses on food security and the estimate is statistically significant at 5% level. The adverse effect of post-harvest on food security indicated by this coefficient confirms with the theoretical expectation that as post-harvest losses increases, food security decreases substantially. It suggests that even with the level of maize crop production in the study area, food security is threatened by loss of maize crop after harvesting. It implied that post-harvest losses indicators like physical damage of crop, decay and rot, insect and past infestation, storage condition, brushing or crushing/rough handling of crops during harvest or transportation contributed adversely to food security. The finding is theoretically expected and align

with a priori expectation as well as empirical findings by Okadonye *et al.* (2021) as well as Ogundele (2022) who reported adverse impact of post-harvest losses on food security. Thus, post-harvest losses result to food insecurity in Akko local government area of Gombe state.

Furthermore, the estimated result showed that soil fertility, maize crop variety, water/rain availability, labour and farm input determined maize crop production in the study area. Though, the effect of Maize crop variety (CP2) on crop production is not statistically significant at 5% level compare to other factors suggesting that improvement on crop production in the local government is not based on maize varieties. The study found that post-harvest losses positively and significantly increase due to physical damage of crop, decay and rot, insect and past infestation, storage condition, brushing or crushing/rough handling of crops during harvest or transportation. The finding further revealed that food availability, food accessibility, food utilization, and food stability strongly determined food security in Akko local government area at 5% level of statistical significance.

The goodness of fit of the estimated structural equation model (SEM) was evaluated using various decision rule thresholds. The chi-square (CMIN) value of 2354.121 was significant based on the probability value of 0.00), indicating a significant difference between the observed and model-implied covariance matrices. The Normed Fit Index (NFI) was 0.941, suggesting a good fit of the model to the data. The value of 0.907 was reported for the Comparative Fit Index (CFI), which implied a good fit of the model to the data based on the structure questionnaire.

Conclusion

The study concluded that food is secured in the study area as the result of farmers' agricultural practice of maize crop production among residents. Contrarily, post-harvest losses adversely affected food security in Akko local government area of Gombe State. The adverse effect of post-harvest on food security indicated suggest that even with the level of increase in maize crop production in the study area, food security is threatened by loss of maize crop after harvesting.

Recommendations

The study recommended that to sustain maize crop production, government and private organization should assist maize farmers with farm inputs such as organic matters or fertilizer to improve soil fertility in Akko local government area of Gombe State. To sustain water availability which is a factor for crop production, the irrigation practice should be encourage as water management strategy for constant maize production through the year rather than depending on rain water cropping.

To reduce post-harvest losses which negatively affect food security in Akko local government, farmers should adopt the practice of breathable bags to avoid physical damage of crop as well as brushing or crushing. Government and private organization to provide sealed storage facilities for farmers to control insect and past infestation to reduce post-harvest losses of maize crop in the study area. Post-harvest losses should also be controlled by educating farmers on past and infestation management, as well as proper drying techniques and package process before transporting the harvested crop to avoid food insecurity in Akko local government area.

Acknowledgment

I want to sincerely appreciate Tertiary Education Trust Fund (Tetfund) for sponsoring this research work.

References

Adedokun, B. (2021). Nigeria's Food Insecurity and Its Implications on Sustainable Development Goal (SDG) 2 Amidst the COVID-19 Era. *Journal of Good Governance and Sustainable Development in Africa*, 6(5). 34 -45

Ahungwa, G. T.; Umeh, J. C. & Muktar, B. G. (2017). Empirical analysis of food security status of farming households in North East region. *Journal of Environmental and Food Science*, 6(1). 57-62

Balana B.B, Aghadi C.N. & Ogunniyi A.I. (2022). Improving livelihoods through postharvest loss management: evidence from Nigeria food security. The science, sociology and economics of food production and access to food. *The International Society for Pathology. 14*(1). 249-265

Bello, O. B., Ganiyu, O. T., Wahab, M. K. A., Afolabi, M. S., Oluleye, F., Ige, S. A. & Abdulmaliq, S. Y. (2012). Evidence of climate change impacts on agriculture and food security in Nigeria. *International Journal of agriculture and Forestry*, *2*(2), 49-55.

Biam, C. & Tavershima. T. (2020). Food security status of rural farming households in Benue state, Nigeria. *African. Journal of Food Agric. Nutr. Dev.* 20(2). 15677-15694

Chukwu M. F., Utobo, K. & Ufere N. N. (2022). Effects of Fulani and Herdsman Farmers clashes on Agricultural development in Nigeria. *Economic and Business, 3* (2). 13-20

Debebe, S. (2022). Post-harvest losses of crops and its determinants in Ethiopia: Tobit model analysis. Agriculture & Food Security, 11(13). https://doi.org/10.1186/s40066-022-00357-6

Doki, N. O., Eya, C. I., Tughgba, M. F., Akahi, O. G. & Ameh, A. (2019). Determinants of post-harvest losses of orange in selected local government areas of Benue state. Międzynarodowy Instytut Innowacji "Nauka - Edukacja – Rozwój. Retrieved from https://www.ceeol.com/search/article-detail?id=846448

Edem, E. U. (2019). An analysis of the Malthusian population theory and its prevalence in Nigerian

FAO (2017). Food and Agricultural Organization ://www.fao.org/fileadmin/user

FAO (2019). Global agriculture towards 2050. https://www.fao.org/fileadmin/templates

FAO (2021). The State of Food Security and Nutrition in the World 2021. https://www.fao.org/state-of-food-security-nutrition/2021/en/.

FAO, (2021). The State of Food Insecurity in the World. https://www.fao.org/documents/card.

Hlatshwayo, S. I, Ngidi, M. S. C., Ojo, T. O., Modi, A. T., Mabhaudhi, T., & Slotow, R. (2023) The determinants of crop productivity and its eect on food and nutrition security in rural communities of South Africa. Frontier in Sustainable Food System. 7:1091333. doi: 10.3389/fsufs.2023.10913

Ibrahim, H. Y., Adeola, S.S. & Ojoko, E. A. (2022). Post-harvest loss and food security: a case study of major food crops in Katsina state, Nigeria. *FUDMA Journal of Agriculture and Agricultural Technology,* 8(1). 393 - 403.

Kareem, K. (22022). Crop production in Nigeria is falling and we should be worried. Retrieved from https://www.dataphyte.com/latest-reports/agriculture/crop-production-in-nigeria-is-falling-and-we-should-be-worried/

Kennelly, C., Watson, R. & Hewitt, C. H. (2018). Current global food production is sufficient to meet human nutritional needs in 2050 provided there is radical societal adaptation. *Elementa: Science of the Anthropocene* 6(1). 52

Khatun, M. & Rahman. M. S. (2019). Quantifying postharvest loss of brinjal: A farm level study in Bangladesh..*Journal of Bangladesh Agricultural University, 17*(4). 454–460. https://doi.org/10.3329/jbau.v17i4.44605

Kitinoja, L., Odeyemi, O., Dubey, N. Musanase, N. & Gill, G.S. (2019). Commodity system assessment studies on the postharvest handling and marketing of tomatoes in Nigeria, Rwanda and Maharashtra, India. Journal of Horticulture and Postharvest Research., 2(1). 1–14.

Kruijssen, F., Tedesco, I. Ward, A, Pincus, L., Love, A. & Thorne-Lyman, A. L. (2020). Loss and waste in fish value chains: A review of the evidence from low and middle-income countries. Global Food Security, 26: 1 - 13. https://doi.org/10.1016/j.gfs.2020.100434

Kughur P. G., Ortindi, P.I., Katikpo, G. (2015). Factors affecting farmers' accessibility to agricultural information in Gwer-East local government area of North East region , Nigeria. *International Journal of Information And Communication Technology Research*, 5:10

Nahar, N., Rahman, W. M., Miah, M. A., & Hasan, M. (2024). The impact of crop diversification on food security of farmers in Northern Bangladesh. *Agriculture & Food Security Review, 13*(9), 1-13.

Obayelu, O. A., Dairo, D. O. & Olowe, O.O. (2022). What factors explain postharvest losses of orange fruit (Citrus sinensis) from farm to fork in the tropics? *Agricultura 19* (1). 7-15

Ogundele, F. (2022). Post-Harvest losses and food security in Nigeria: An Empirical Review. African Journal of Agriculture and Food Science 5(3). 77-89

Okadonye, E. O., Idyorough, E. A., Gomez, G. & Korinjoh, M. C. (2021). The nature of postharvest losses of rice among rice farmers in Makurdi Local Government Area of Benue State Nigeria. *Asian Food Science Journal 20*(9). 89-96

Segun,A. S., Musa, A. I., Musa, M. A., Ijabo, O. S., Mohammed, S. Ogo P. M & Chisom, N. (2022). Assessment of post-harvest fish losses among artisanal fishers in northeast Nigeria. *Bangladesh Journal of Fisheries, 34*(1). 131-141

Simona, V. (2020). Prevalence of Severe Food Insecurity in Nigeria 2014-2019. Retrieved 10 September, 2021, from https://www.statista.com/statistics/1135843/prevalence-of-severe-food-insecurity-in-nigeria/

United Nation (2020). Sustainable Development Goals: 17 Goals to Transform our World. https://www.un.org/en/exhibits/page/sdgs-17-goals-transform-world

United Nations Development Programme (2022). Building food security and the future resilience of communities in the Northeast Nigeria. httpsI://www.un.org