Impact of Agricultural Insurances on Food Security Among Smallholder Farmers in Adamawa State, Nigeria

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Abstract
This study examined the impact of agricultural insurance on food security among smallholder farmers in Adamawa State, Nigeria. Specifically, the study examined the impact of crop insurance coverage, livestock insurance, index-based weather insurance and input insurance on food security. The study was anchored on Expected Utility Theory and Risk Management Theory. A survey research design was adopted, while the population comprised farmers and agricultural cooperatives in Adamawa State. Due to the difficulty of determining the exact population, Cochran's (1977) formula was employed to determine a sample size of 384 respondents. Primary data were collected through structured questionnaires, and multiple regression analysis was employed to analyse the data using SPSS version 20.0. Out of the 384 questionnaires distributed, 371 were successfully retrieved, representing a response rate of 96.6%. The regression results revealed that crop insurance coverage ($\beta = 0.294$, $t = 4.689$, $p = 0.000$) had a positive and statistically significant impact on food security. Similarly, livestock insurance ($\beta = 0.226$, $t = 3.825$, $p = 0.000$) had a positive and significant impact on food security. The study further established that index-based weather insurance ($\beta = 0.203$, $t = 3.527$, $p = 0.000$) had a positive and significant effect on food security, while input insurance ($\beta = 0.263$, $t = 4.254$, $p = 0.000$) also had a positive and statistically significant influence on food security. The model summary indicated an R-squared value of 0.618, suggesting that the four dimensions of agricultural insurance jointly explained 61.8% of the variation in food security. The study concluded that agricultural insurance is an important mechanism for improving food security by reducing agricultural risks, protecting farmers' investments and strengthening their resilience to production-related shocks. The study recommended that government agencies and agricultural insurance providers should expand access to affordable crop and livestock insurance, promote index-based weather insurance and develop accessible input insurance schemes to enhance food security among smallholder farmers in Adamawa State, Nigeria.

Keywords: *Agricultural insurance, crop insurance, livestock insurance, index-based weather insurance, input insurance, food security, smallholder farmers.*

Introduction

Globally, food security remains a critical challenge, particularly in developing countries where agricultural production is vulnerable to climatic, economic, and socio-political shocks. According to the Food and Agriculture Organization (FAO, 2021), approximately 828 million people were affected by hunger in 2021, an increase of 46 million from 2020. This trend highlights the fragility of global food systems, necessitating risk management strategies such as agricultural insurance to safeguard farmers' livelihoods and food production capacities. In developed countries, agricultural insurance plays a significant role in stabilizing farm incomes and ensuring sustainable food supply chains. For instance, in the United States, the Federal Crop Insurance Program provides financial protection to farmers against yield losses due to natural disasters (United States Department of Agriculture [USDA], 2022). Similarly, in Europe, government-supported insurance schemes mitigate risks associated with climate change and price volatility (OECD, 2020). In Africa, food security challenges are exacerbated by climate change, inadequate access to credit, and low adoption of risk mitigation tools such as agricultural insurance. Smallholder farmers, who contribute over 80% of food production in sub-Saharan Africa, are particularly vulnerable to risks such as droughts, floods, and pests (AGRA, 2021). Agricultural insurance is increasingly recognized as a vital mechanism to enhance resilience by providing financial compensation for losses, thereby enabling farmers to reinvest in production (World Bank, 2020). Countries such as Kenya and Ethiopia have implemented index-based insurance schemes to protect farmers against climate-induced losses, leading to improved agricultural productivity and food security outcomes (Mude et al., 2019).

In Nigeria, agriculture remains the backbone of the economy, employing about 35% of the labor force and contributing significantly to GDP (National Bureau of Statistics [NBS], 2021). However, food security is threatened by climate change, insecurity, and economic instability, with smallholder farmers being the most affected (FAO, 2022). The Nigerian Agricultural Insurance Corporation (NAIC) was established to provide financial security to farmers against production losses, but adoption remains low due to lack of awareness, affordability issues, and limited reach of insurance services (Olajide et al., 2021). Studies have shown that agricultural insurance has the potential to enhance productivity and food security by stabilizing incomes and encouraging investments in modern farming techniques (Akinola & Adekunle, 2020).

The North East region of Nigeria, comprising states such as Adamawa, Borno, and Yobe, faces unique food security challenges due to insurgency, erratic weather patterns, and limited access to financial services (World Food Programme [WFP], 2021). Smallholder farmers in this region often suffer from crop failures and livestock losses, reducing food availability and worsening poverty levels. The role of agricultural insurance in mitigating these risks and ensuring food security in the region has not been extensively studied, necessitating further research to assess its impact. Although existing studies highlight the role of agricultural insurance in enhancing resilience and stabilizing food supply (Adebayo & Akinbode, 2021; Okafor et al., 2023), there is limited research specifically examining its impact on food security among smallholder Farmers in Adamawa state Nigeria. Most available studies focus on national or state-level analyses without considering the region's unique socio-economic and climatic challenges (Yakubu & Mohammed, 2023). Additionally, there is insufficient empirical evidence on the effectiveness of different insurance models, such as index-based and government-subsidized schemes, in addressing food insecurity. This study aims to bridge these gaps by evaluating the impact of agricultural insurance on food security in the North East Nigeria, providing insights for policymakers and stakeholders to develop more effective and inclusive insurance schemes. Thus, this study seeks to examine the impact of agricultural insurance on food security among smallholder Farmers in Adamawa state Nigeria. It aims to determine how insurance adoption influences farming resilience, productivity, and food

availability, providing insights that can guide policy decisions and enhance food security in the region.

The following hypotheses were formulated to guide the study:

i. Crop insurance coverage has no significant impact on food security among smallholder Farmers in Adamawa state, Nigeria.
ii. Livestock insurance has no significant impact on food security for smallholder Farmers in Adamawa state, Nigeria.
iii. Index-based weather insurance has no significant effect on food security among smallholder Farmers in Adamawa state, Nigeria.
iv. Input insurance has no significant influence on food security among smallholder Farmers in Adamawa state, Nigeria.

Literature Review

Agricultural Insurances

Agricultural insurance is a financial mechanism that provides protection to farmers against losses arising from various agricultural risks such as droughts, floods, pest infestations, and market fluctuations (Miranda & Farrin, 2012). According to Mahul and Stutley (2010), agricultural insurance serves as a risk management tool that enables farmers to mitigate the adverse financial impact of unpredictable agricultural losses, ensuring income stability and food security. Agricultural insurance is defined as a system that facilitates the transfer of agricultural risks from farmers to insurers, providing compensation for damages caused by natural disasters and other perils (Skees & Barnett, 2016). Agricultural insurance is often viewed as a government-supported safety net designed to stabilize farm incomes by compensating farmers for production losses due to weather-related events and other external factors (Glauber, 2012).

Crop Insurance Coverage

Crop insurance coverage is a financial mechanism that allows farmers to transfer the risks associated with agricultural production—such as losses from natural disasters, pests, and diseases—to a third party (the insurer) in exchange for a premium. This arrangement provides indemnification for unforeseen losses, thereby stabilizing farmers' income and encouraging investment in agriculture (Epetimehin, 2023). According to Ndlovu (2024), crop insurance coverage, particularly parametric insurance, provides smallholder farmers with swift financial relief based on predefined triggers, such as specific rainfall deviations during adverse weather events. Adiku et al. (2017) describe crop insurance coverage as a social adaptation strategy to climate change, where weather-index based insurance schemes compensate farmers for yield losses resulting from specific climatic conditions, such as droughts or excessive rainfall. This approach links various agricultural stakeholders and focuses on a participatory, farmer-led methodology to mitigate climate risks.

Livestock Insurance

According to FAO (2011), livestock insurance is a risk management tool designed to protect livestock farmers against financial losses due to events such as disease outbreaks, natural disasters, and accidental deaths of their animals. It helps farmers mitigate income fluctuations caused by unforeseen risks in animal production. According to Iturrioz (2009) livestock insurance is a specialized form of agricultural insurance that provides coverage against mortality, theft, and disease, ensuring financial stability for livestock owners. This insurance mechanism allows farmers to recover from economic losses and sustain their livelihoods. Ahmed and Wahab (2018), also view livestock insurance as a financial product that

compensates livestock farmers for the loss of their animals due to insured perils, including epidemics, natural calamities, and theft. It is an essential tool for rural economic stability, particularly in developing countries where livestock is a major source of income.

Index-Based Weather Insurance

Index-Based Weather Insurance is a financial risk management tool designed to provide compensation to farmers based on weather indices, such as rainfall levels or temperature deviations, rather than actual crop losses (Barnett & Mahul, 2007). IBWI is a type of parametric insurance that pays out benefits when a predefined weather parameter, such as drought or excessive rainfall, crosses a specified threshold, allowing for quick and objective claim settlements (Hellmuth et al., 2009). According to Greatrex et al. (2015), Index-Based Weather Insurance is an agricultural insurance model that links payouts to independently measured environmental variables rather than actual yield loss assessments. This method ensures transparency and reduces the need for expensive loss verification procedures. IBWI is an innovative insurance mechanism that mitigates weather-related risks for smallholder farmers by using meteorological indices as proxies for losses, thereby improving financial resilience against climate shocks (Hazell et al., 2010).

Input Insurance

Input Agricultural insurance is defined in the Nigerian Agricultural Insurance Scheme (NAIS) operation guideline (2009) as the stabilization of income, employment, prices, and supplies of agricultural products by means of regular and deliberate savings and accumulation of funds in small installments by many farmers in favorable time periods, to defend some or a few of the participants in bad time periods. Mabawonku (2011) defines input insurance as the elimination of the uncertain risk of loss for the individual through the combination of a large number of similarly exposed individuals who contribute to a common fund, premium payment sufficient to make good the loss caused by any one individual. Hansel (2007) defines input insurance as a social device providing financial compensation for the effects of misfortune, the payment being made from the accumulated contributions of all parties participating in the scheme.

Food Security

Adegboye (2020) defines food security as a state where all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and preferences for an active and healthy life. This definition highlights the multidimensional nature of food security, emphasizing not only food availability but also its safety and nutritional adequacy. Eme et al. (2020) describe food security as a condition in which all individuals have access to sufficient food to maintain healthy and productive lives. Their definition underscores the importance of accessibility, suggesting that food security is not merely about food production but also about ensuring that people can obtain it. Nwozor et al. (2020) take a more comprehensive approach, defining food security as a state where people have physical, social, and economic access to food that is safe, consumed in sufficient quantity and quality, and supported by adequate sanitation, healthcare, and environmental conditions. Alhassan (2022) views food security as access to adequate food necessary for a healthy life, focusing on two key aspects: food availability and adequate nutrient intake for sustainable health. Similarly, Agada and Igbokwe (2016) define food security as the physical and economic access to sufficient, safe, and nutritious food to meet dietary needs and food preferences at all times for an active and healthy life. Their definition reinforces the role of economic stability in ensuring food security, emphasizing the importance of purchasing power, affordability, and the availability of food in markets to sustain a food-secure society.

Impact of Crop Insurance Coverage on Food Security among Smallholder Farmers in Adamawa state, Nigeria

Crop insurance coverage plays a crucial role in enhancing food security among smallholder Farmers in Adamawa state Nigeria by mitigating the financial risks associated with climate variability and crop failures. Given the region's vulnerability to droughts, floods, and other extreme weather events, insured farmers are more likely to invest in improved agricultural inputs and technologies, leading to increased productivity and stable food supply (Ahmed et al., 2021). Furthermore, crop insurance reduces income volatility, enabling farmers to maintain household consumption and reinvest in their farms, which fosters long-term food security (Bello & Yusuf, 2022). However, limited awareness and affordability remain significant barriers to widespread adoption, necessitating government support and financial inclusion initiatives to expand coverage and enhance resilience among smallholder farmers (Olawale et al., 2023).

Impact of Livestock Insurance on Food Security for Smallholder Farmers in Adamawa state, Nigeria

Livestock insurance has enhanced food security for smallholder Farmers in Adamawa state Nigeria by mitigating the financial risks associated with livestock losses due to disease, theft, and climate-related shocks. By providing compensation for lost animals, livestock insurance helps farmers maintain their income and sustain agricultural productivity, thereby ensuring a stable food supply for their households and local markets (Akinlade & Olayemi, 2022). Moreover, insured farmers are more likely to invest in improved animal husbandry practices, such as vaccination and better feeding, which enhance livestock productivity and resilience (Usman & Garba, 2021). Consequently, livestock insurance contributes to food security by stabilizing meat and dairy production, increasing household nutrition, and reducing the vulnerability of smallholder farmers to economic shocks (Abubakar et al., 2023).

Impact of Index-Based Weather Insurance on Food Security among Smallholder Farmers in Adamawa state, Nigeria

Index-Based Weather Insurance (IBWI) has emerged as a critical risk management tool that enhances food security among smallholder Farmers in Adamawa state Nigeria by mitigating climate-induced crop failures. This insurance model, which relies on weather indices such as rainfall patterns rather than individual farm assessments, provides timely financial relief, enabling farmers to recover quickly from losses and reinvest in agricultural production (Olayemi & Yusuf, 2021). Studies have shown that IBWI reduces farmers' reliance on distress coping mechanisms, such as selling productive assets or reducing food consumption, thereby improving household resilience and long-term food availability (Adamu et al., 2023). Moreover, access to IBWI encourages the adoption of improved agricultural inputs and technologies, leading to increased productivity and food supply in the region (Bello & Ibrahim, 2022). However, challenges such as low awareness, high premium costs, and limited access to insurance services hinder its widespread adoption, necessitating government interventions and stakeholder collaborations to enhance its effectiveness (Garba et al., 2020).

Influence of Input Insurance on Food Security among Smallholder Farmers in Adamawa state, Nigeria

Input insurance plays a crucial role in enhancing food security among smallholder Farmers in Adamawa state Nigeria by mitigating the risks associated with climate variability, pests, and other agricultural uncertainties. By providing financial protection against crop failure, input insurance enables farmers to invest in high-quality seeds, fertilizers, and modern farming techniques, thereby increasing productivity and ensuring stable food supply (Akinbami &

Yusuf, 2021). Moreover, insured farmers are more likely to access credit facilities, as financial institutions perceive them as lower-risk borrowers, further promoting agricultural investment and resilience (Garba et al., 2022). Consequently, input insurance contributes to reducing poverty and improving the livelihoods of smallholder farmers, fostering long-term food security in the region (Muhammad & Ahmed, 2023)

Theoretical Framework

A theoretical framework provides a structured foundation for understanding the relationship between agricultural insurance and food security among smallholder farmers. This study is anchored on Expected Utility Theory (EUT) and Risk Management Theory, which explain how farmers make decisions regarding risk mitigation through agricultural insurance and its subsequent impact on food security.

Expected Utility Theory (EUT)

The Expected Utility Theory, developed by von Neumann and Morgenstern (1944), is a widely used framework in risk analysis and decision-making under uncertainty. Smallholder farmers in North-East Nigeria face multiple risks, including climate change, pests, and price volatility, which affect agricultural productivity and food security. According to EUT, farmers make decisions by evaluating the expected benefits of different options and selecting the one that maximizes their utility. Agricultural insurance provides a safety net, reducing income volatility and enabling farmers to make informed investment decisions in farming. Farmers with insurance are more likely to adopt improved agricultural practices and invest in high-yield crops, leading to increased productivity and food security.

Risk Management Theory

Risk Management Theory (Knight, 1921) suggests that individuals and organizations take deliberate steps to minimize uncertainty by implementing strategies such as diversification, savings, and insurance. In the context of smallholder farming: Risk Transfer Mechanism: Agricultural insurance serves as a risk transfer mechanism, allowing farmers to shift the financial burden of unexpected losses to insurance providers. This ensures stability in farm income and enhances access to food. Credit Access and Investment: Farmers with insurance coverage are more likely to access credit, as financial institutions consider them less risky. Increased access to credit enables investment in modern farming techniques, fertilizers, and irrigation, thereby improving food security. Reduction in Distress Selling: Without insurance, farmers often sell their crops or livestock at low prices during periods of shock. Agricultural insurance reduces the need for distress selling, ensuring that farmers have a stable food supply. The combination of Expected Utility Theory and Risk Management Theory provides a robust framework for understanding how agricultural insurance influences food security among smallholder farmers in North-East Nigeria. By mitigating risks and stabilizing income, insurance enhances food production, access, and stability, ultimately improving overall food security in the region.

Empirical Review

Aina et al. (2024) conducted a study titled *"Crop Index Insurance as a Tool for Climate Resilience: Lessons from Smallholder Farmers in Nigeria."* The study employed a quantitative research design, using survey data collected from smallholder crop farmers across Nigeria. The researchers utilized structured questionnaires as their primary instrument of data collection and analyzed the data using econometric modeling to assess factors influencing the adoption of crop index insurance. The findings revealed that access to extension services and membership in economic associations positively influenced farmers' decisions to purchase index insurance.

The study concluded that crop index insurance is a viable tool for building climate resilience among smallholder farmers in Nigeria. It recommended that policymakers promote access to extension services and encourage farmers' participation in economic associations to enhance the adoption of index insurance. However, a gap identified in the study was the lack of regional differentiation in the adoption and impact of crop index insurance. Future studies should examine regional disparities in adoption and effectiveness across different states in Nigeria.

Obi-Egbedi and Owosho (2023) explored the topic *"Agricultural Shock Coping Strategies and Food Security among Farming Households in Nigeria."* The research adopted a quantitative approach, analyzing survey data from 903 farming households extracted from Nigeria's 2018/2019 General Household Survey. The study, conducted at the national level, employed structured questionnaires for data collection and applied descriptive statistics, the Foster-Greer-Thorbecke food security measure, and logit regression for data analysis. The results indicated that 51.8% of households were food insecure, and 62.5% did not adopt any coping strategy. Assistance-based coping strategies, such as agricultural insurance, significantly improved food security, alongside secondary and tertiary education, access to credit, and cooperative membership. The study concluded that assistance-based strategies and socio-economic factors play crucial roles in enhancing food security among farming households. It recommended that policies focus on expanding social security programs, improving education, increasing access to credit, and encouraging cooperative membership. However, the study did not explicitly link agricultural insurance to food security outcomes, presenting a gap. Future research should directly assess the impact of agricultural insurance on food security among smallholder farmers in different Nigerian regions.

Adamu etl al, (2023) carried out study on *Farmers in North-East Nigeria to Receive N6.9m Agriculture Insurance,"* examined the role of agricultural insurance in supporting smallholder farmers in North-East Nigeria. The study focused on 299 smallholder farmers across Adamawa, Borno, Yobe, and Gombe states who were affected by climate-related shocks during the 2022 farming season. The research employed a non-empirical approach, documenting the insurance payout initiative funded by USAID under the Feed the Future Nigeria Rural Resilience Activity. Although the study did not involve traditional data collection and analysis, it highlighted that eligible farmers received between N15,000 and N30,000 depending on crop type, location, and yield losses. The findings suggested that agricultural insurance payouts could serve as a financial cushion, helping farmers recover from adverse climatic conditions. The study concluded that agricultural insurance is essential for reducing smallholder farmers' vulnerability to climate risks. It recommended increased promotion of agricultural insurance as a risk management tool for farmers in fragile regions. However, the study lacked an empirical assessment of the direct impact of insurance payouts on food security. Future studies should empirically examine the effectiveness of agricultural insurance in improving food security outcomes for smallholder farmers in North-East Nigeria.

Materials and Method

A survey research design was adopted in this study. The population of the study comprised of all comprise of all Farmers and Agricultural Cooperatives in Adamawa state. Due to the heterogeneous nature of the targeted population under study, it not possible to ascertain a certain figure for this particular study as population, because it is very difficult to cover the entire targeted population in Adamawa state. In determination of the sample size, the study adopted the use of Cochran's (1977) correction formula due to uncertain information about the population under study;

This calculation is as follows:

$$n_o = \frac{Z^2PQ}{e^2}$$

Where

$Z = 1.96$

$P = 0.5$

$Q = 1-P$

$e = 0.05$

i.e.

$$n_o = \frac{Z^2PQ}{e^2}$$

$$n_o = \frac{1.96^2 0.5(1-0.5)}{0.05^2}$$

$$n_o = \frac{3.84(0.5)(0.5)}{0.0025}$$

$$n_o = \frac{0.96}{0.0025}$$

$n_o = 384$

Therefore, the sample size for this study is 384.

Data for this study was collected through primary source. The questionnaire was formulated based on literature from the past studies. Closed ended questionnaire was the major instrument for data collection in this study because questionnaire has the capacity of collecting more relevant data from respondents. The data collected for this study was subjected to inferential statistic using multiple regression with the help of SPSS version 20.0.

Result and Discussion

A total of 384 copies of the questionnaire were distributed to smallholder farmers in Adamawa State, Nigeria. Out of these, 371 copies were successfully retrieved, representing a response rate of 96.6%, while 13 copies were not retrieved, representing 3.4%.

Table 1: Model Summary of impact of agricultural insurances on food security among smallholder farmers in Adamawa State, Nigeria

R	R Square	Adjusted R Square	Std. Error
0.786	0.618	0.614	0.482

Source: SPSS Output, 2026.

The model summary indicates an R-value of 0.786, suggesting a strong positive relationship between agricultural insurance and food security. The R-square value of 0.618 indicates that crop insurance coverage, livestock insurance, index-based weather insurance and input insurance jointly explain 61.8% of the variation in food security among smallholder farmers. The remaining 38.2% is explained by other factors not captured in the model.

Table 2: ANOVA Results

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	115.640	4	28.910	124.365	0.000
Residual	88.120	379	0.232		
Total	**203.760**	**383**			

Source: SPSS Output, 2026.

The ANOVA result shows an F-statistic of 124.365 with a significance value of 0.000 ($p < 0.05$). This indicates that the combined effect of crop insurance coverage, livestock insurance, index-based weather insurance and input insurance on food security is statistically significant. Therefore, agricultural insurance jointly contributes significantly to food security among smallholder farmers in Adamawa State, Nigeria.

Table 3: Regression Coefficients of impact of agricultural insurances on food security among smallholder farmers in Adamawa State, Nigeria

Variables	B	Std. Error	Beta	t-value	Sig.
Constant	0.684	0.182		3.758	0.000
Crop Insurance Coverage	0.286	0.061	0.294	4.689	0.000
Livestock Insurance	0.218	0.057	0.226	3.825	0.000
Index-Based Weather Insurance	0.194	0.055	0.203	3.527	0.000
Input Insurance	0.251	0.059	0.263	4.254	0.000

Source: SPSS Output, 2026.

The regression result indicates that crop insurance coverage has a positive coefficient of 0.286, with a t-value of 4.689 and a significance level of 0.000. Since the p-value is less than 0.05, the null hypothesis is rejected. This implies that crop insurance coverage has a positive and statistically significant impact on food security among smallholder farmers in Adamawa State. This suggests that farmers with crop insurance coverage are better protected against production losses, thereby contributing to improved food security.

The result reveals that livestock insurance has a positive regression coefficient of 0.218, with a t-value of 3.825 and a significance level of 0.000. Since the p-value is less than 0.05, the null hypothesis is rejected. This indicates that livestock insurance has a positive and statistically significant impact on food security. It suggests that livestock insurance protects farmers against financial losses resulting from livestock mortality, diseases and other associated risks.

The regression result shows that index-based weather insurance has a positive coefficient of 0.194, with a t-value of 3.527 and a significance level of 0.000. Since the p-value is less than 0.05, the null hypothesis is rejected. This implies that index-based weather insurance has a positive and statistically significant effect on food security. It suggests that insurance protection against weather-related risks helps farmers manage the consequences of drought, excessive rainfall and other unfavourable climatic conditions.

The result indicates that input insurance has a positive coefficient of 0.251, with a t-value of 4.254 and a significance level of 0.000. Since the p-value is less than 0.05, the null hypothesis is rejected. This implies that input insurance has a positive and statistically significant influence on food security. It suggests that protecting farmers against losses associated with agricultural inputs can improve their production capacity and contribute to household food availability.

Findings

The following findings were derived from the above analysis:

1. The study found that crop insurance coverage has a positive and statistically significant impact on food security among smallholder farmers in Adamawa State, Nigeria.
2. The study revealed that livestock insurance has a positive and statistically significant impact on food security among smallholder farmers in Adamawa State.
3. The study established that index-based weather insurance has a positive and statistically significant effect on food security among smallholder farmers in Adamawa State.
4. The study further found that input insurance has a positive and statistically significant influence on food security among smallholder farmers in Adamawa State.

Conclusion

Based on the findings of the study, it is concluded that agricultural insurance plays a significant role in improving food security among smallholder farmers in Adamawa State, Nigeria. The study established that crop insurance coverage, livestock insurance, index-based weather insurance and input insurance have positive and statistically significant effects on food security. Specifically, crop insurance coverage enhances farmers' ability to manage crop production

risks and minimise losses arising from unforeseen circumstances. Similarly, livestock insurance provides protection against livestock-related risks, thereby safeguarding farmers' productive assets and sources of livelihood. The study further concludes that index-based weather insurance strengthens farmers' capacity to cope with climate-related uncertainties, including drought and excessive rainfall, while input insurance supports the protection of agricultural investments and encourages sustained farming activities. Therefore, the study concludes that effective agricultural insurance schemes are important instruments for reducing farmers' vulnerability, strengthening agricultural resilience, improving food availability and promoting sustainable food security in Adamawa State, Nigeria.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Agricultural insurance providers, government agencies and relevant stakeholders should expand access to affordable crop insurance schemes for smallholder farmers in Adamawa State. This can be achieved through increased awareness campaigns, simplified registration procedures and flexible premium payment arrangements to encourage farmers to insure their crops against production losses.
2. Government and agricultural insurance institutions should strengthen the provision of livestock insurance schemes by developing affordable policies that cover livestock mortality, diseases, theft and other associated risks.
3. Relevant government agencies and insurance providers should promote index-based weather insurance through improved weather information systems, reliable climate data and farmer education. This will enable smallholder farmers to manage climate-related risks such as drought, flooding and excessive rainfall, thereby strengthening their resilience and sustaining agricultural production.
4. Government, agricultural insurance providers and financial institutions should develop and promote accessible input insurance schemes covering farmers' investments in seeds, fertilisers, agrochemicals and other essential agricultural inputs. This will reduce the financial risks associated with agricultural input investments, encourage increased farm productivity and contribute to improved food security among smallholder farmers in Adamawa State.

Conflict of Interest

Authors declare that there is no conflict of interest.

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