



ANALYSIS OF INSECURITY IMPACT ON RURAL WOMEN PARTICIPATION IN CROP PRODUCTION IN NORTH-EAST, NIGERIA

ABSTRACT

*This study analyse the impact of insecurity on the participation of rural women in crop production North-East, Nigeria, with the sole aim of focusing on the severity of insecurity challenges particularly insurgency, which disrupted agricultural activities across the farm area and to highlight areas they may require policy intervention for improvement. Purposive, snowball, and simple random sampling method was employed for the selection of 403 respondents with the aid of well-structured questionnaire along with interviews. The data were analysed using probit model. The results revealed that insecurity affects rural women participation significantly. Where annual income has a positive and statistically significant at ($p < 0.005$). The marginal effect of farm income is (0.287), which means that every naira increase in farm income results in 28.70% increase in the chance of participating in crop production. The result further revealed that the frequency of attacks is negative (-2.588^{**}) and statistically significant ($p < 0.005$). This means that an increase in the frequency of insecurity attacks will reduce rural women's participation significantly, pseudo R^2 of 0.221 and log likelihood indicating that 214.119, the model had best fit for the data. The study therefore recommend policy maker should developed security strategy to mitigate incessant attack, this can only be successful when concerted effort by community leader, stakeholder NGOs and government.*

Keywords: Women, Insecurity, Crop, production, Probit, Participation

INTRODUCTION

The world's food demand has continuously increased, yet numerous conflicts and natural disasters across the globe have impeded agricultural output. Recently, conflict in Ukraine intensified demand for food, especially cereal crops, and the price of food has skyrocketed more than previous years (World Bank, 2023a). The Nigerian government has prioritised poverty reduction as a means of enhancing economic development, recognising the critical role of rural women in nation-building (Ogbari *et al.*, 2024). Female farmers play an integral part in rural community with substantial contributions to agricultural output and give services to other related sectors.

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They participate greatly in agricultural tasks such as land preparation, crop production, horticulture, livestock management, marketing, and processing, as well as domestic obligations (Pathak, 2022). Nigerian development intervention reported that women have been deprived from direct access to resource that enhances productivity (Onifade & Iderawumi 2019). This could be as a result of gender inequality, social attitude, conflict and discriminatory tactics. Hence, female farmer contribute meaningfully in crop and livestock production. Lawansson (2008) agree that statistically, full participation of labour force and qualitatively via educational qualification and skilled labour female farmers make less contribution compare to men.

Agriculture continues to be one of Nigeria's largest economies and the primary source of income for rural dwellers (Ayeni *et al.*, 2023). Female farmers engaged in both subsistence and commercial agriculture (Pathak, 2022). However, several factors inflict their participation, most notably the devastating effects of insecurity caused by insurgency, banditry, kidnapping, and farmer-harder conflicts. Insecurity not only restricts women's access to farm inputs, but also threat to lives, limiting their participation in agricultural activities. It has been acknowledged that female farmers have been marginalized and underutilized, which has had a negative impact on people's economic and wellbeing, leading to economic impoverishment.

Insecurity can have a negative impact on women's participation in crop production by restricting free movement, limiting access to markets, making it difficult to obtain training, and limiting access to extension services. It can also cause psychological trauma, which leads to stress, anxiety, and an inability to participate in agricultural activities. Finally, insecurity can cause crop damage, theft, and a loss of livelihood.

However, findings has established significant contribution of women in agricultural production, This study explore the effects of insecurity on rural women's participation in crop production in North-east Nigeria, and to provide appropriate recommendations with resilient mindset that can withstand the challenges of insecurity in order to enhance the full participation of rural women in North-east, Nigeria.

Hypothesis:

H_0 : insecurity does not influence participation of rural women in crop production

H_1 : insecurity influence participation of rural women in crop production

Literature review

Theoretical framework

Frustration-aggression-theory (FAT), also recognised as frustration-aggression-displacement (FAD) theory, is a theory of aggressiveness presented in 1939 by Dollard John, Neal Miller, Leonard Doob, Orval Mowrer, and Robert Sears, and further refined by Neal Miller in 1941 and Leonard Berkowitz in 1968. Similarly, Przybylski *et al.* (2013) further opined that the aggressiveness results from a person's efforts to achieve a goal being blocked or frustrated. This implies that, the hypothesis, dissatisfaction usually proceed before aggression or violent behavior and violence is a sure result of frustration. Miller and Sears reformulated the concept to propose that frustration leads to violent behavior. Frustrations theories are vital in ensuring bad feelings and limiting effectiveness and participation; therefore, it is critical to balance emotions before reacting to team frustration. Low-wage and often informal work in any agri-business firm, from the aforementioned literature, depravity of socioeconomic factor, political rights, sexual harassment and violence. All of these factors limit ability to participate properly. Dare *et al.* (2017) focused on FAT, which has demonstrated a systemic failure or structural fault in a specific society, this is associated with frustration and aggressiveness that leads to criminality and violence.

Conflict theory (CT) was proposed by German philosopher Karl Marx in the 19th century, and it was applied in a variety of fields of study, particularly social issues, education, and workplaces. Sociologists further explain conflict theory in terms of inequality and competition over limited resources. This theory focuses on how conflict and insecurity can disrupt agricultural systems. Women often bear the brunt of these disruptions, affecting their ability to participate in farming. According to research by Thomas and Reed (2018), both conflict and war have a significant effects on changes in women's participation in civil society. Understanding conflict dynamics can help policymakers promote women's participation to agricultural recovery. Hence, Ragasa *et al.* (2022), opined that women's empowerment is a structural evaluation for nations and stakeholders that assesses the level of managerial services and inclusion in the government's agrifood system and finds gaps and opportunities for improvement. Women's time spent on domestic tasks, which they handle well, has hindered their ability to participate in agricultural training. (Eissler *et al.*, 2021).

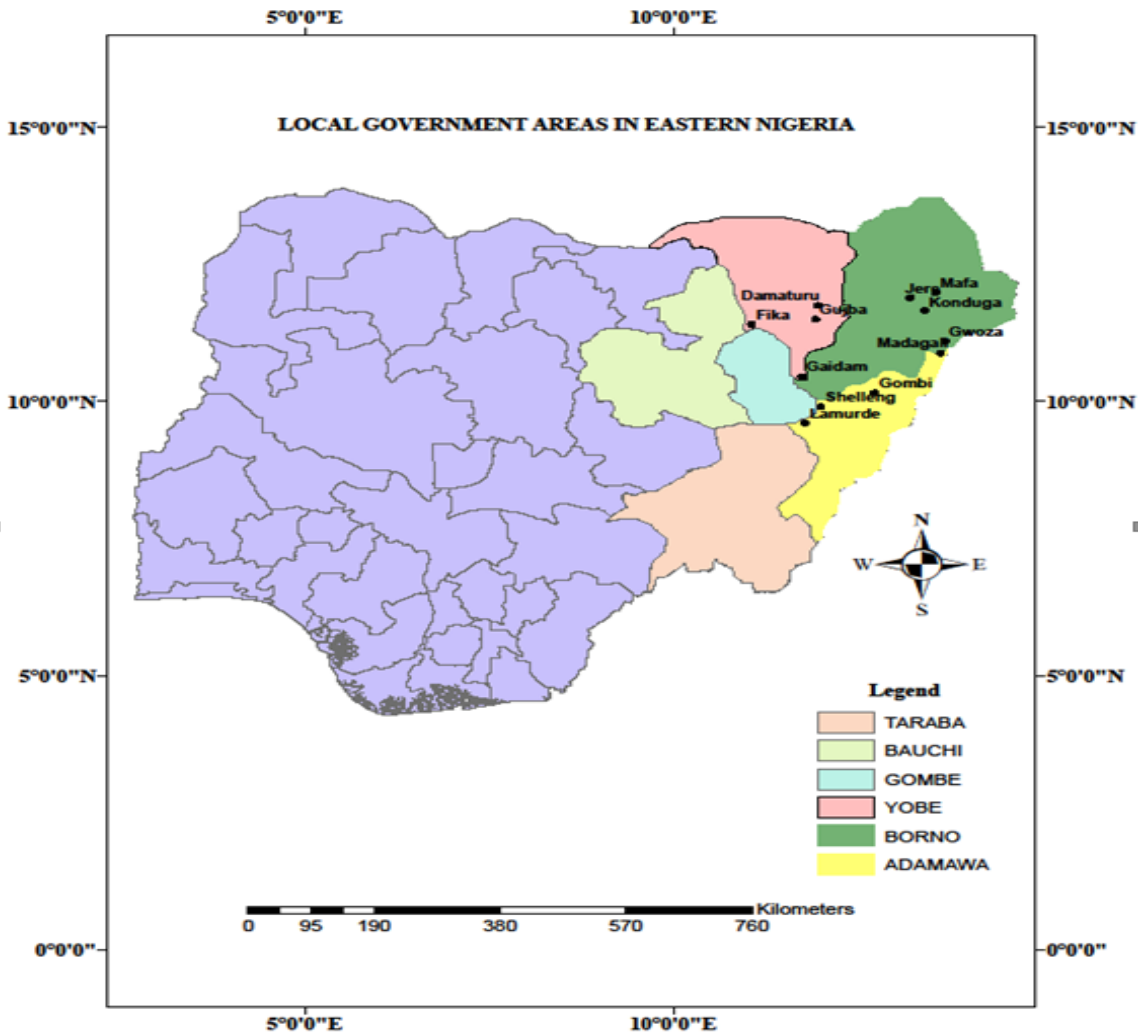
Economic Theory of Participation: Several studies have been conducted on the issues of the theory of participation, including the endeavor to focus on bottom-up planning or "People Centered Development" and the belief that ordinary people can monitor their own development. This notion supports stakeholder

participation in the development process (Burkey, 1993; Oakley, 1991; and Bryant & White 1982). This theory suggests that economic incentives drive participation in crop production. Insecure conditions may reduce productivity, leading women to withdraw from agriculture. The relevance of this theory is enhance economic support and market access can incentivize women's participation even in insecure contexts

MATERIAL AND METHOD

Study Area

The study was conducted in the northeast Nigeria, in 2024. The region is situated in northern part of the country, and lies between the latitude 6 28" N and 13 44" N, and longitude 8 44"E and 14 38" E. the region comprised of six states these are as follows Adamawa, Borno, Bauchi, Gombe, Taraba and Yobe. The north east region was established in 1967 and in 1976 was divided into Borno, Bauchi and Gongola states. Until 1991 Yobe state was carved out of Borno, and Gongola state was split into two Adamawa and Taraba making the total of five. Yobe state was created on August 27, 1991. In 1996, Gombe state was carved out of Bauchi State making the total of six as it remain up till date. North east Nigeria have a landmass to e 272,395km² accounting for 29.45% of the total area of Nigeria's overall landmass. The northeast region has a projected population of 31,458,265,426 based on 13.52% growth rate used on NPC (2006) population. . The territory is bordered by Cameroon to the east, the Niger and Chad Republics to the north, North-Central Nigeria to the west, and South-East Nigeria to the south. Geographic diversity has been one of this zone's most distinguishing traits since the state's inception in 1996. It has towering mountains and dissected plains. The climate is predominantly continental in character, with vegetation ranging from dense guinea savannah to thorny acacias and sparse annual grasses. The soil varies in composition; some are good for irrigation, crop production, and animal husbandry. However, the country faces significant levels of instability, particularly in the North-East, where "Boko Haram" has become a danger to agricultural activity. Many agricultural companies in the North-East have been disrupted and are unable to operate properly as a result of the "Boko Haram" plague. Insecurity in the North-East has cost immeasurable amounts of material and human resources in recent years.



Sampling procedure and data collection

Purposive, snowball, and simple random sampling was employed for the selection of the respondents. Adamawa, Borno, and Yobe were purposefully chosen out of six states because the intensity of insecurity attacks was greater than in other states. Second, four (4) Local Government Areas (LGAs) were purposefully picked from each agricultural zone within the States to ensure thorough coverage of areas where rural women's production was severely impeded. Thirdly, three (3) wards were purposefully selected from each LGA, for a total of thirty-six (36) wards, taking into account the devastation of violent attacks. Finally, the snowball method was used to pick respondents from the 36 wards in the study area, as shown in Table below. As a result, 403 respondents were duly and thoroughly interviewed and employed in the analysis of the study.

Table 1: Sample Size and Sample Location in North East Nigeria (n: 403)

| STATE | LGA | WARD I | WARD II | WARD III | No | Total |
|---------|----------|--------------|---------------|--------------|------|-------|
| | | | | | Res. | |
| Adamawa | Lamurde | Lafiya(16) | Lamurde(9) | Suwa(11) | 36 | 152 |
| | Shelleng | Bakta(11) | Bodwai(10) | Gundo(9) | 30 | |
| | Gombi | Gombi.N(12) | Gombi.S(14) | Garkida(16) | 42 | |
| | Madagali | S/Vapura(13) | W/Chakawa(11) | Madagali(20) | 44 | |
| Borno | Gwoza | Gwoza(9) | Guduf(11) | Warabe(10) | 30 | 118 |
| | Konduga | Kawuri(11) | Auno(9) | Dalori(13) | 33 | |
| | Mafa | Mafa(9) | Abbari(11) | Anadua(9) | 29 | |
| | Jere | Jere(10) | Alau(8) | Dala(8) | 26 | |
| Yobe | Fika | Fika(12) | Mubi(13) | Turmi(11) | 36 | 133 |
| | Damaturu | Gabir(10) | Damaturu(11) | Murta(13) | 34 | |
| | Gujba | Gujba(11) | Wagir(10) | Mutai(9) | 30 | |
| | Gaidam | Hausari(10) | Gumsa(12) | Ashekeri(11) | 33 | |

Source: Design by the Author based on the information in the region

Data analysis

Probit Model

Probit model was used to analyse the level of rural women participation in crop production. Women participation in crop production were assigned to discrete choice variables (Yes or No) whereby selected women were asked individually indicating whether she participates in crop production’ or ‘not participates in crop production. Using probit model to justify or ensure that calculated probability fall between zero and one. It also produces better results when the probabilities are modest or big, prior analysis may also justify utility analysis.

$$Y = \begin{cases} Y_i * & \text{if } Y_i * > 0 \\ 0 & \text{if } Y_i * \leq 0 \end{cases}$$

Oni *et al.* (2005) employed probit model to analyse factors influencing loan default among poultry farmers in Ogun State, Nigeria. The probit model is expressed as

$$Y = \beta_0 + \beta_1 X_1 + \epsilon_1 \dots \dots \dots (1)$$

Where Y is dichotomous dependent variable which can be explained as;

Y = 1, if women participate,

Y = 0, if women did not participate,

β_0 = the intercept

β_n = regression coefficients that explain the probability of participation by rural women,

X_n = independent variables

ϵ_i = the error term.

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 +$$

$$\beta_{10}X_{10} + \beta_{11}X_{11} + \beta_{12}X_{12} \dots \dots \dots (2)$$

$$Y_i = \beta_0 + \beta_1AIC + \beta_2ATL + \beta_3YEXP + \beta_4FMS + \beta_5AGE + \beta_6EDU + \beta_7MRST + \beta_8ACC + \beta_9FQA + \beta_{10}SEI + \beta_{11}LTS + \beta_{12}DSFH \dots \dots \dots (3)$$

The rural women demographic variables are as follows

- X₁ = Annual Income, (Naira)
- X₂ = Access to Labour (dummy: Yes =1; No = 2)
- X₃ = Years of Experience (YEXP) (Years),
- X₄ = Family Size, (FMS)(Numbers)
- X₅ = Age, (Years)
- X₆= Education (EDU) (dummy: Yes =1; No = 2)
- X₇= Marital Status (MRST) (Dummy; Married = 1, Otherwise = 0),
- X₈= Access to credit (ACC) (Dummy; Yes =1, No = 0),
- X₉=Frequency of attacks, (FQA) (Regularly = 2, occasionally = 1),
- X₁₀= Still experiencing insecurity (SEI) (Dummy; Yes =1, No = 0)
- X₁₁=Land Tenure system, (LTS) (Dummy; Yes =1, No = 0)
- X₁₂= Distance from homestead to farm land (DSFH) (Km), (very far = 1, far = 2 and not far = 3 points)

Table 2: A priori expectation for the independent variables in the models

| S/n | Independent variables | Definition and measurements | Expected signs |
|------|--------------------------------------|---|----------------|
| i | Annual Income | Naira | Positive |
| ii | Access to Labour | Dummy: Yes =1; No = 2 | Positive |
| iii | Years of Experience | Years | Positive |
| iv | Family Size | Numbers | Positive |
| v | age | Years | Positive |
| vi | Level of education | Dummy: Yes =1; No = 2 | Positive |
| vii | married | Dummy; Married=1, Otherwise = 0 | Positive |
| viii | Frequency of attacks | Regularly = 2, occasionally= 1 | Negative |
| ix | Frequency of attacks, | Regularly = 2, occasionally= 1 | Negative |
| x | Still experiencing insecurity | Dummy; Yes =1, No = 0 | Negative |
| xi | Land Tenure system, | Dummy; Yes =1, No = 0 | Negative |
| xii | Distance from homestead to farm land | Distance in Kilometer (very far = 1 far = 2 and not far = 3 points) | Negative |

Source: Design by the author base on a priori expectations

Level of Women Participation in Crop Production in North-East Nigeria

The Probit regression results provide insights into the women's participation in crop production in North-east Nigeria, considering various socioeconomic and contextual factors. The pragmatic findings indicated in Table 4.18 likelihood of -214.11872. Pseudo R² of 0.221 all are significant at 1% and 5% percent probability level except Family Size, Marital status, still experience attacks and Land tenure; this established that the model has the goodness fit.

Table 3: Level of Women Participation

| Level of women participation (1 if fully active in crop production and 0 if otherwise) | Coefficient | St. Err. | t-value | p-value |
|--|-------------|----------|----------------------|---------|
| Annual Income (Naira) | 0.287** | 0.128 | 2.250 | 0.024 |
| Access to Labour (1 if Yes, 0 otherwise) | 0.386** | 0.167 | 2.310 | 0.021 |
| Years of Experience (in number of years) | 0.126*** | 0.019 | 6.570 | 0.000 |
| Family Size (Numbers) | 1.094 | 0.781 | 1.400 | 0.161 |
| Age (in years) | 0.039*** | 0.011 | 3.370 | 0.001 |
| Level of education (Years of schooling) | 0.039*** | 0.013 | 3.000 | 0.003 |
| Marital status (1 if yes, 0 otherwise) | 0.371 | 0.351 | 1.060 | 0.291 |
| Access to Credit (1 if yes, 0 otherwise) | 0.163 | .158 | 1.040 | 0.301 |
| Frequency of attacks (number of attacks) | -2.588** | 1.098 | -2.360 | 0.018 |
| Still experiencing insecurity (1 if yes, 0 otherwise) | -0.230 | 0.297 | -0.770 | 0.438 |
| Land tenure (1 if yes, 0 otherwise) | -0.195 | 0.174 | -1.120 | 0.261 |
| Distance from homestead to farm (1 if yes, 0 otherwise) | -0.200* | 0.108 | -1.850 | 0.064 |
| Constant | -5.299*** | 1.515 | -3.500 | 0.000 |
| Mean dependent var | 0.573 | | SD dependent var | 0.495 |
| Pseudo r-squared | 0.221 | | Number of obs | 403 |
| Chi-square | 121.770 | | Prob > chi2 | 0.000 |
| Akaike crit. (AIC) | 454.237 | | Bayesian crit. (BIC) | 506.224 |
| Log likelihood | -214.11872 | | | |

Note: Note: *** and ** indicate $p < 0.01$ and $p < 0.05$ significance level respectively;

Annual Income of Rural Women Crops Farmers:

From Table 3: The positive coefficient (0.287) suggests that an increase in annual income is associated with a higher likelihood of women being fully active in crop production. This effect is statistically significant at the $p < 0.05$ level, this implies that as long as rural women farmers have access to financial facilities in the study area, rural women will continue to engage in agricultural production. Implying that higher income

positively influences women's participation. The marginal effect of farm income is 0.287, which means that every naira increase in farm income results in a 28.70% increase in the chance of participating in crop production. This finding aligns with Etim *et al.* (2020). Women with greater financial means may invest more in farming inputs, equipment, and technology, thereby increasing their participation and productivity in crop production. Policymakers could consider initiatives aimed at boosting women's income through various means such as providing access to microfinance, training in income-generating activities, or facilitating market linkages for their agricultural produce.

Access to Labour of Rural Women Crop Farmers:

The coefficient of 0.386 indicates that having access to labour positively influences women's participation in crop production and $P < 0.021$ which is statistically significant at $P < 0.05$. This suggests that as long as there's availability of labour in the study area, rural women will be resilient in crop production. This result is in conformity with Olaleye *et al.*, (2009) who reported that family labour is critical, comprising a strong suit of the farm output. Access to labour can ease the burden of farm work, allowing women to allocate their time and energy more efficiently, thereby enhancing their involvement in crop production. Policies that promote community-based initiatives, cooperative farming arrangements, or investment in mechanisation could help improve access to labour for female farmers in North-east Nigeria.

Years of Experience of Rural Women Crop Farmers:

From Table 3: The coefficient of 0.126 reflects a significant positive relationship between experience and female farmer's participation in crop cultivation. This effect is highly significant ($p < 0.01$). This implies experience plays a crucial role, increase in experience will lead to participation in crop production by 12.6%. This finding highlights the role of knowledge, skills, and accumulated expertise acquired over time in shaping women's engagement in agricultural activities. Women with more experience are likely to possess better farming techniques, problem-solving abilities, and resilience to challenges, thus contributing more effectively to crop production. Efforts to support training programs, extension services, and mentorship opportunities could facilitate the development of women's agricultural skills and enhance their long-term engagement in farming. The results corroborate with Adetomiwa *et al.* (2020).

Family Size of Rural Women Crop Farmers:

The coefficient for family size (1.094) suggests a positive relationship between the number of family members and women's participation in crop production, although statistically insignificant at the predictable

levels ($p < 0.05$). The family size has a positive and statistically insignificant, coefficient indicating that there is indirect relation between family size and participation. A one-unit increase in family size leads to increase in participation of crop production. In contrast Folarin *et al.* (2021) stated that the contribution of females in the agricultural sector is substantially lower in Nigeria. The result further revealed that there's need to enhance the employment of female in the Nigerian economy for higher agricultural productivity, but the evidence for this relationship is not strong enough to confidently assert its significance. Several interpretations can be drawn from this result. One possibility is that larger families may have greater labour resources available for agricultural work, as more family members can contribute to farm activities. In such households, women may be more likely to engage in crop production alongside other family members, reflecting a division of labour that emphasises collective participation in farming tasks. Additionally, larger families may face greater economic pressures or rely more heavily on agricultural livelihoods, motivating women to contribute actively to crop production to meet household needs.

Age of Rural Women Crop Farmers:

The coefficient for age (0.039) suggests there is cordial and positive relation between old age and women's participation in crop production. This finding indicates that as women grow older, they are more likely to be fully active in agricultural activities. The age has a positive coefficient and it is statistically significant $p < 0.05$. This also indicate that there is direct relationship between age and women's participation. An increase in the age by one unit will result in increase in the participation in crop production. This observation is consistent with Asfaw *et al.* (2022). One possible interpretation of this result is that with increasing age, women accumulate knowledge, skills, and experience relevant to agricultural practices. Older women may have spent more time engaging in farming activities, thereby acquiring valuable insights into crop management, pest control, soil fertility, and other aspects critical for agricultural productivity. Additionally, older women may have stronger social networks within the farming community, access to resources, and established roles within the household or community that support their active involvement in crop production.

Education of rural women crop farmers:

The coefficient for the level of education (0.039) shows significantly and positive association between years of schooling and women's participation in crop production. This finding suggested advance educational attainment are relatively link with greater likelihood of women being fully active in agricultural activities. The educational level shows a positive coefficient that is statistically significant ($p < 0.05$). This also suggests

that there is a direct correlation between age and involvement. A one-unit increase in educational level will result in increased participation in crop cultivation by 3.90%. The significance of this relationship is underscored by the low p-value of 0.003 this results is in harmony with Abadega, (2021) and Hagos *et al*, (2020) who stated that Schooling improves skills and knowledge, allowing for greater competency in the production and advertising operations. Schooling also permits manufacturers to contact extra info and innovative prospects, as well as to evaluate the aforementioned data. One interpretation of this result is that education equips women with valuable knowledge, skills, and resources that enhance their capacity to engage effectively in crop production. Women with more years of schooling may have access to formal agricultural training, extension services, and information networks, enabling them to adopt modern farming techniques, utilise agricultural inputs efficiently, and make informed decisions about crop management practices.

Marital Status of Rural Women Crop Farmers:

The coefficient for marital status (0.371) suggests a positive relationship between marital status and women's participation in crop production, nevertheless it is insignificant at the predictable levels ($p = 0.291$). The results is similar to Hlatshwayo *et al*. (2022) who found that marital status it is not statistically significant with $p < 0.739$. This implies that being married may be link by means of slightly advanced likelihood of women fully active in agricultural activities, but the evidence for this relationship is not strong enough to reject null hypothesis. There are several possible interpretations for this result. One perspective is that marriage may provide women with access to additional labour, resources, or support networks, which could facilitate their engagement in crop production. For example, married women may benefit from assistance with farm work from their spouses or extended family members, enabling them to allocate more time and effort to agricultural activities. Additionally, marriage may confer social status, recognition, or responsibilities within the community, encouraging women to participate actively in productive endeavours.

Contrary to a priori expectations, access to credit and land tenure do not significantly impact women's participation in crop production, as indicated by their non-significant coefficients. Access to credit and land tenure has p value is 0.301 and p value is 0.261 respectively. This finding suggests that while access to credit and secure land tenure are important for agricultural development, they may not be immediate determinants of women's active participation in crop production in this context. It's possible that other factors such as cultural norms, gender roles, or institutional barriers may mediate the relationship between access to credit/land tenure and women's engagement in agriculture, warranting a more nuanced examination.

Frequency of Attacks by Insecurity on Rural Women Crop Farmers:

The negative coefficient (-2.588) for the frequency of attacks by insurgents implies that a higher incidence of attacks negatively affects women's participation in crop production. The frequency of attacks by insecurity on rural female farmers has a negative coefficient, which is statistically significant at 5%. This suggests that there is a causal relationship between the frequency of insecurity-related attacks and rural women participation. An increase in the frequency of insecurity assaults will reduce rural women's participation. The coefficient of the frequency of farmer assaults due to insecurity has comply with a priori expectations, but statistically significant at 5%. This finding underlines the detrimental impact of insecurity and conflict on agricultural livelihoods, particularly for vulnerable populations such as women in conflict-affected areas. Heightened security risks can disrupt farming activities, displace populations, and erode agricultural assets, thereby limiting and threatening women's ability to engage in productive activities this results validated by Adegbami (2013). Addressing security challenges through conflict resolution, peace building efforts, and targeted interventions to protect agricultural livelihoods is crucial for promoting women's participation and resilience in agriculture.

Still Experiencing Insecurity on Rural Women Crop Farmers:

The coefficient for "Still experiencing insecurity" (-0.230) suggests a negative relationship between ongoing insecurity and women's participation in crop production, but this relationship is not statistically significant at conventional levels (p value is 0.438). This implies that the tendency for women in areas experiencing insecurity to be less actively involved in agriculture, the evidence in this study does not support a conclusive association between ongoing insecurity and women's participation in crop production this research is in line with (Odeniyi 2022). There are several possible interpretations of this result. Firstly, ongoing insecurity may indeed have a detrimental impact on women's ability to engage in agricultural activities. In conflict-affected regions such as North-east Nigeria, insecurity can disrupt farming operations, displace populations, damage infrastructure, and undermine livelihoods, thereby limiting women's opportunities to participate in crop production. Factors such as fear for personal safety, restrictions on movement, and damage to agricultural assets may all contribute to reduced agricultural engagement among women in insecure environments.

Distance from Homestead to Farm by Rural Women Crop Farmers:

The marginally significant negative coefficient (-0.200) suggests that proximity to the farm, as measured by the distance from the homestead, has a modest but perceptible effect on women's participation in crop production. This finding implies that shorter distances may lower barriers to farm access and facilitate women's involvement in agricultural activities by reducing transportation costs, time constraints, and logistical challenges. Interventions aimed at improving transportation infrastructure, establishing community gardens or decentralised farming facilities closer to residential regions, could aid lessen the negative effect of distance on women's participation in crop production.

The pseudo-R-squared value of 0.221 indicates that approximately 22.1% of the variance in women's participation in crop production can be explained by the variables included in the model. While this value may not capture all the factors influencing women's agricultural engagement, it suggests that the selected independent variables collectively contribute to understanding variations in women's participation to a moderate extent. Pseudo R-squared, also known as Nagelkerke's R-squared, provides an estimation of the proportion of variance explained by the model relative to the total variance in the dependent variable. Furthermore, the chi-square value of 121.770 associated with the model's significance test indicates that the overall model is statistically significant. The associated p value is 0.000, which is less than the conventional significance level of $p < 0.05$, suggests that the observed chi-square statistic is unlikely to occur by random chance alone. Therefore, reject null hypothesis that none of the independent variables with significant effect on women's participation in crop producers, providing evidence in support of the alternative hypothesis that at least one independent variable influences women's participation.

Overall, these statistical indicators affirm the validity and relevance of the regression model in explaining variations in women's participation in crop production in North-east Nigeria. While the included variables collectively account for a significant portion of the observed variance in women's participation, there may still be unobserved factors or measurement errors that contribute to residual variance. As such, further research and analysis may be warranted to refine the model and explore additional determinants of women's agricultural engagement in the region. Nonetheless, the significant model and explanatory power of the included variables provide valuable insights for policymakers, practitioners, and researchers seeking to understand and address factors shaping women's roles in agricultural development.

Model Diagnostic Test Statistics

The Pseudo R-squared value of 0.221 indicates that the model explains 22.1% of the variance in the likelihood of female farmer's participation. This suggests a moderate fit of the model to the data. While it is not as high as some other measures of fit, it does imply that the model accounts for a significant portion of the variability in the dependent variable, though there is still a considerable amount of unexplained variance.

The Chi-square statistic of 121.770 with a p-value of 0.000 indicates that the overall model is statistically significant. This suggests that, when considering all the independent variables together, the model significantly predict the likelihood of crop female farmers. The high p-value implies that the collective impact of the independent variables on the dependent variable it is strong enough to reject the null hypothesis, which posits that the independent variables have significant effect on the likelihood of female crop farmers.

The Akaike Information Criterion (AIC =454.237) and the Bayesian Information Criterion (BIC = 506.224) are used to compare the goodness-of-fit between different models. Lower values of AIC and BIC generally indicate a better model fit. In this context, the AIC and BIC values provide a basis for model comparison rather than direct interpretation. They help in assessing the relative quality of this model compared to others by penalizing the model for complexity (number of parameters), with the goal of avoiding over fitting while finding the best balance between goodness-of-fit and model simplicity.

While the Pseudo R-squared indicates a moderate fit, the Chi-square test reveals that the model as a whole is statistically significant, suggesting that the independent variables collectively predict participating crop female farmers. The AIC and BIC are useful for model comparison, with lower values indicating potentially better models, but they do not provide direct insights into the statistical significance of the current model.

Summary and Conclusion

The rural women's participation reveal a complex interplay of factors shaping their engagement in crop production. Access to credit facilities, marital status, education, age, family size, farming experience, farm size, annual income, and access to subsidised inputs emerge as pivotal factors positively influencing participation. Simultaneously, the study highlights that insecurity acts as a substantial deterrent, the ongoing dread of violet attacks has resulted to a decrease in the desire of female farmers to actively participate in crop production, thus aggravating food insecurity in north-east Nigeria, emphasising the importance of bolstering security measures to enhance women's involvement in agriculture. North-east was severely

affected as an insecure environment because insecurity limit rural women's freedom of movement and access to markets, insecure environments caused psychological trauma affecting women's ability to participate in crop production

Recommendations

These recommendations are rooted in the empirical evidence derived from the investigation and are designed to offer practical and effective solutions to address the identified challenges. They serve as pragmatic guidelines for policymakers, stakeholders, and implementers, providing a clear and actionable pathway for sustainable advancements for women in crop production in North-east region. In response to the pronounced impact of insecurity on the participation of female farmers in agricultural output:

- (1) Government and non-governmental organization should prioritise and enhance security measures in the studied areas.
- (2) It is imperative to give proper counseling to rural women affected with insecurity because they often experience post- traumatic stress disorder which require counseling to ease depression.
- (3) Rural women should provide economic empowerment in order to regain financial stability.
- (4) Collaborative efforts involving local authorities, law enforcement agencies, and community leaders should be undertaken to mitigate the impact of farmer-herder conflicts, Boko Haram insurgency, banditry, and kidnapping.
- (5) A secure environment is fundamental to foster conducive atmosphere for sustained agricultural activities and women's active participation in crop production.

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