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Determinants of Variation in Food Security Outcomes of Anchor Borrowers' Programme Participants in Kwara State, Nigeria

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Abstract
This study examined factors associated with variation in household food security outcomes among participants in the Central Bank of Nigeria's Anchor Borrowers' Programme (ABP) in Kwara State. Unlike studies that compare programme beneficiaries with non-beneficiaries, the analysis focused exclusively on registered ABP participants and investigated why food security outcomes differed within this beneficiary population. Primary cross-sectional data were obtained from 197 farming households selected from five purposively chosen Local Government Areas: Ilorin South, Moro, Edu, Patigi and Kaiama. Household food security was measured using the nine-item Household Food Insecurity Access Scale (HFIAS), with households classified into food-secure, mildly food-insecure, moderately food-insecure and severely food-insecure categories. Descriptive statistics, Pearson correlation, ordered logistic regression and robustness checks using binary logistic and negative binomial models were applied. The results indicated that 54.8% of households were food secure, while 45.2% experienced some degree of food insecurity. The ordered logistic model was not statistically significant overall (LR $\chi^2(13) = 13.617$, $p = 0.401$; McFadden pseudo-$R^2 = 0.032$), suggesting that the included socio-economic, farm, institutional and programme-related variables did not jointly explain variation in food security status at conventional significance levels. Nevertheless, sex of the household head was individually significant: male-headed households had lower odds of occupying a more food-secure category (odds ratio = 0.442, p = 0.039), with an estimated 18.8-percentage-point lower probability of being food secure. Age was marginally significant at the 10% level, while programme support value, training, market linkage, education, household size, farm size, land ownership, extension visits, off-farm participation, livestock keeping and modern input use were not significant in the ordered model. The findings suggest that gender-responsive programme delivery and better measurement of household-level shocks are important complements to agricultural credit interventions. The results are associational and should not be interpreted as causal effects.

Keywords: *Anchor Borrowers' Programme; household food security; HFIAS; beneficiary households.*

I. INTRODUCTION

Food security remains a multidimensional development concern because the availability of food at national or community level does not necessarily guarantee that individual households can obtain sufficient, safe and nutritious food. Household food security is commonly understood in relation to the availability of food, economic and physical access, utilisation and stability over time. For rural households whose livelihoods depend heavily on agriculture, food security is shaped not only by the quantity of crops produced but also by income, access to markets, household composition, productive assets, institutions and exposure to shocks. Consequently, household food security outcomes may vary substantially even among households operating in similar agro-ecological and policy environments.

The experience-based measurement of food insecurity has become important because it captures households' direct experiences of constrained food access, including anxiety about food, reduced dietary quality and reductions in food quantity. The Household Food Insecurity Access Scale (HFIAS) operationalises these experiences through a set of occurrence and frequency questions referring to a defined recall period (Coates et al., 2007). Its value for agricultural and development research lies in its ability to capture food-access difficulties that may not be visible in production or income indicators alone. Food insecurity is therefore not simply a reflection of low agricultural output; households may experience food-access constraints even when they cultivate crops, particularly where income is seasonal, input costs are high or market access is weak.

In Nigeria, the relationship between agricultural livelihoods and food security is shaped by structural constraints, price instability, climate-related shocks and uneven access to productive resources. National and international assessments continue to identify food insecurity as a major challenge, while research among Nigerian farming households demonstrates that household characteristics,

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access to credit, farm resources, extension services and livelihood diversification can be associated with food-security outcomes (Aboaba et al., 2020; Kehinde et al., 2021; Omotayo et al., 2022; Wudil et al., 2023). However, the direction and strength of these relationships are not necessarily uniform across settings or household groups.

One policy response to constraints in agricultural finance has been the Central Bank of Nigeria's Anchor Borrowers' Programme. Established in November 2015, the ABP was designed to link smallholder farmers with agricultural processors and other anchor firms, while facilitating access to production finance and inputs and strengthening connections along selected commodity value chains (Central Bank of Nigeria [CBN], n.d., 2021). The programme's logic is that timely access to finance and inputs, coupled with market linkages, can improve production, farmers' incomes and the supply of agricultural commodities. These pathways may in turn improve household food access. Nevertheless, programme registration does not guarantee that every registered farmer receives the same quantity, timing or quality of support, nor that participating households possess equal capacity to convert support into improved food-security outcomes.

Evidence from Kwara State illustrates the relevance of examining the programme at household level. Ayinde et al. (2018) assessed the CBN rice intervention in the state, while Ojo et al. (2023) examined ABP and food security among smallholder maize farming households. Ojo et al. reported a positive programme effect but also found that the effect varied with household characteristics. Such evidence indicates that average programme effects can conceal important differences between participating households. A related body of Nigerian research has identified gender, education, household size, farm size, land tenure, off-farm activities and extension contact as potential correlates of household food security (Ayantoye, 2022; Kehinde et al., 2021; Omotayo et al., 2022; Wudil et al., 2023).

Despite this evidence, an important analytical question remains: among households already enrolled in the ABP, which characteristics distinguish those with better food-security outcomes from those experiencing food insecurity? This question differs from asking whether beneficiaries are better off than non-beneficiaries. A beneficiary-only analysis is relevant because programme implementation and delivery can vary within the register, and households may differ in demographic characteristics, farm resources, institutional access and livelihood strategies. It is also useful for programme refinement because the policy concern is not only who is enrolled, but whether the intervention reaches and benefits participating households in ways that translate into improved food access.

This study addresses this question by analysing variation in food security outcomes among ABP beneficiary households in Kwara State. The specific objective is to identify the socio-economic, farm-level, institutional and programme-related factors associated with household food security status. The study contributes in three ways. First, it focuses on variation within the beneficiary group rather than comparing beneficiaries with non-beneficiaries. Second, it uses an experience-based household food-access measure and retains the ordinal nature of the food-security categories in an ordered logistic model. Third, it interprets the results in light of the homogeneity of the study population and the limitations of cross-sectional data. The central contribution is therefore a context-specific assessment of the extent to which observable characteristics explain differences in food security status among ABP participants.

II. LITERATURE REVIEW AND ANALYTICAL FRAMEWORK

2.1. Household food security as an outcome

Food security is multidimensional. The internationally accepted definition emphasises that all people should have physical, social and economic access at all times to sufficient, safe and nutritious food that meets dietary needs and food preferences for an active and healthy life (FAO et al., 2024). At the household level, food security is commonly discussed through availability, access, utilisation and stability. These dimensions are related but analytically distinct. Agricultural production can improve availability, while income and market access influence the ability to acquire food. Utilisation concerns the ability to consume food of adequate quality and derive nutritional benefit from it. Stability reflects whether access and consumption can be maintained over time despite seasonal or unexpected shocks.

Sen's (1981) entitlement perspective is relevant to household food security because it shifts attention from aggregate food supply to the resources and claims through which households command food. A household may live in an agricultural area or produce food and still experience food insecurity if its income, assets or exchange entitlements are inadequate. Barrett (2010) similarly argues that food insecurity measurement must recognise the distinction between food availability and access, and the importance of reliable indicators. These perspectives support an analysis that combines household experience measures with information on household, farm and institutional characteristics.

The HFIAS is based on the premise that inadequate access to food produces predictable experiences that can be measured through household responses to a set of questions. The nine occurrence questions cover anxiety about food, inability to eat preferred foods, eating a limited variety, eating foods that are not desired, eating smaller meals, eating fewer meals, having no food in the household, going to sleep hungry and going a whole day and night without eating. Frequency responses are used to derive an overall score,

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with higher scores representing more severe food-access constraints (Coates et al., 2007). The scale is particularly relevant to this study because the dependent variable is household food-access experience rather than farm output alone.

Household dietary diversity provides a complementary perspective on food access and diet quality. The Household Dietary Diversity Score (HDDS) counts food groups consumed by household members over a specified recall period and is often used as a proxy indicator of household access to a variety of foods (Swindale & Bilinsky, 2006). However, HDDS and HFIAS capture different aspects of food security and should not be treated as interchangeable.

2.2. Agricultural finance and the Anchor Borrowers' Programme

Access to agricultural finance can relax liquidity constraints that prevent farmers from purchasing improved seed, fertiliser, crop protection products, labour and equipment. Credit may also allow farmers to undertake timely operations and increase their ability to market produce. Yet finance does not automatically translate into higher household food security. The outcome depends on whether funds or inputs arrive at the appropriate time, whether the package is adequate, whether farmers have the knowledge and complementary resources to use it, and whether output can be sold under favourable conditions. Where production risks are high or market arrangements are weak, additional credit may not produce the expected improvement in household welfare. Rural livelihood analysis also emphasises the role of diverse assets and income activities in shaping household welfare (Ellis & Freeman, 2004).

The ABP was established by the CBN in November 2015 to create economic linkages across commodity value chains, connecting smallholder farmers with local processors and supporting production finance, input access, training and market relationships (CBN, n.d.). The 2021 programme guidelines describe the operational framework for financing, farmer eligibility, participating financial institutions, anchors and implementation arrangements (CBN, 2021). The programme's expected pathways include improved access to production inputs, increased output and productivity, improved farmer income, stronger market integration and, ultimately, improved food availability and access.

Empirical findings on agricultural credit and food security in Nigeria are mixed partly because studies use different programme settings, outcome measures, samples and identification strategies. Ojo et al. (2023), in their study of smallholder maize farmers in Kwara State, used propensity score matching and regression analysis and reported a positive effect of ABP participation on food security, with heterogeneous outcomes across household characteristics. Ayinde et al. (2018) examined the rice component of the intervention in Kwara State and discussed production and income outcomes alongside challenges in produce delivery. These studies provide a local empirical basis for further investigation but do not eliminate the need to examine differences among beneficiaries.
Research beyond the ABP also demonstrates that credit and institutional support may interact with household characteristics. Aboaba et al. (2020) examined determinants of food security among rural households in Nigeria and identified demographic, farm and credit-related correlates. Wudil et al. (2023) found that food-security outcomes among rice farmers in the Kano River Irrigation Project differed between beneficiaries and non-beneficiaries and were associated with factors including extension contact, farm size, production and education. These studies suggest that agricultural interventions operate within a broader household resource and institutional environment.

2.3. Potential determinants of variation among beneficiaries

Gender of the household head may be associated with food security through differences in access to land, credit, labour, information, productive assets and control over household resources. Gender is not a simple proxy for vulnerability: female- and male-headed households may differ in composition, labour availability, dependency burdens and resource allocation. Kehinde et al. (2021), using data from smallholder maize and rice farmers across Nigeria, found that dimensions of women's empowerment, land tenure and extension contact were associated with household food-security outcomes. The implication is that gender effects should be interpreted in relation to resource access and intra-household arrangements rather than as an inherent difference in capacity.

Age and education may influence experience, decision-making, adoption of improved practices, access to information and the ability to navigate programme institutions. Household size can increase consumption requirements but may also provide family labour and additional earners. These competing mechanisms mean that the expected sign of household size is not unambiguous. Omotayo et al. (2022) showed that food-price pressures and livelihood conditions were important to food insecurity among rural farming households in South-West Nigeria during the COVID-19 pandemic. Ayantoye (2022) also identified household and socio-economic characteristics as correlates of food insecurity among farming households in the Ogbomoso agricultural zone.

Farm size and land ownership can influence production capacity, access to collateral and incentives to invest. Larger farms may provide more land for production but may also require greater labour and input expenditure. Secure land rights can encourage investment and facilitate access to productive resources, although the relationship depends on local land markets and institutional arrangements. Kehinde et al. (2021) found that land tenure characteristics and women's empowerment were associated with food-security outcomes among Nigerian smallholders. Livestock keeping and use of modern inputs may diversify food and income sources, but their benefits depend on scale, productivity, costs and market conditions.

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Extension services can improve farmers' access to technical information, production advice and programme-related guidance. Extension contact may help farmers use inputs appropriately, respond to pests and weather risks, and make production decisions. However, extension visits may be unevenly distributed and their effect may depend on the quality and relevance of advice. Off-farm participation can diversify household income and reduce reliance on seasonal farm earnings, although it may also compete with farm labour. Training and market linkage components of the ABP may similarly influence farmers' ability to translate programme support into production and food-access gains.

Programme support itself can vary in amount and composition. A larger package may relax input constraints, but the relationship between support value and food security can be weakened by delayed delivery, insufficient quantities, input quality, repayment pressure or weak market arrangements. Programme registration should therefore not be treated as equivalent to effective receipt of support. In the present study, programme-related variables included the value of support, training received and market linkage received. The model also included demographic, farm, institutional and livelihood variables to examine whether observable differences explained food-security categories among beneficiaries.

2.4. Research gap and analytical expectations

Existing studies provide evidence that household food security is associated with demographic, farm, gender, land, credit and institutional factors. However, many programme evaluations compare participants with non-participants and estimate an average treatment effect. Such designs answer whether participation is associated with better outcomes relative to a comparison group, but they do not directly identify which characteristics explain variation among households already registered as beneficiaries. The present study addresses this within-beneficiary question. It does not include ABP participation as a binary explanatory variable because all sampled households were programme beneficiaries. Instead, it considers variation in programme support and related services alongside household and farm characteristics.

The analytical expectation is that household food-security categories may be associated with sex and age of the household head, education, household size, farm size, land ownership, extension contact, off-farm participation, livestock keeping, modern input use, value of programme support, training and market linkage. These are empirical expectations rather than assumed causal relationships. Given the cross-sectional design and the use of retrospective household reports, the analysis is interpreted as associational.

III. METHODOLOGY

3.1. Study area and research design

The study was conducted in Kwara State, located in Nigeria's North-Central geopolitical zone. The state has diverse crop and livestock production systems, including rice, maize, yam, cassava, sorghum and soybean cultivation. The agricultural setting and the presence of ABP activities across selected commodity value chains make the state relevant for examining food-security outcomes among programme participants. The study adopted a cross-sectional descriptive and analytical design using primary household survey data.

Five Local Government Areas (LGAs): Ilorin South, Moro, Edu, Patigi and Kaiama, were purposively selected because of their agricultural activity and ABP presence. The sampling design selected two programme-active communities from each LGA and sampled beneficiary households from verified programme registers. The planned sample was 200 households, and 197 completed questionnaires were retained for analysis, representing a usable response rate of 98.5%. The analysis in this article is restricted to these 197 beneficiary households.

3.2. Measurement of household food security

Household food insecurity was measured using the nine-item HFIAS. Each item records whether a specified food-access experience occurred during the preceding four weeks and, where applicable, how frequently it occurred. The responses were aggregated into an HFIAS score ranging from 0 to 27, with higher values indicating more severe food-access difficulty. For the ordered logistic regression, the score was classified into four ordered categories: food secure (0–1), mildly food insecure (2–8), moderately food insecure (9–14) and severely food insecure (15–27). For ease of interpretation, the ordered dependent variable was arranged from the most food-insecure category to the most food-secure category. Thus, a positive ordered-logit coefficient indicates higher odds of being in a more food-secure category.

The categorisation follows the scoring procedure reported in the dataset. It should be noted that the HFIAS is an experience-based measure of food access over a four-week recall period; it is not a direct measure of calorie intake, nutritional status or long-term food availability. The results therefore describe household food-access experiences during the survey reference period.

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3.3. Explanatory variables

The explanatory variables were selected from the study's conceptual framework and empirical literature. Programme-related variables comprised the value of ABP support (measured in units of ₦100,000), receipt of training and receipt of market linkage. Household demographic variables included age and sex of the household head, years of education and household size. Farm and institutional variables included farm size, land ownership, extension visits, off-farm participation, livestock keeping and a modern-input-use index. The model therefore contained 13 explanatory variables. The sample consisted entirely of ABP beneficiaries; consequently, programme participation status was not entered as an explanatory variable.

Variable	Operational meaning in the model	Expected relationship (a priori)
ABP support value	Value of credit and inputs received, per ₦100,000	Positive if support is timely and productive
Training received	Indicator for receipt of programme training	Positive
Market linkage received	Indicator for receipt of programme market linkage	Positive
Age of household head	Age in years	Ambiguous
Sex of household head	Male = 1; female = 0	Empirical; gendered resource access may matter
Years of education	Years of schooling	Generally positive
Household size	Number of household members	Ambiguous
Farm size	Cultivated farm size in hectares	Ambiguous
Land ownership	Owns land = 1; rents/leases = 0	Generally positive
Extension visits	Number of extension visits in the previous 12 months	Positive
Off-farm participation	Participation in off-farm income activity	Generally positive
Livestock keeping	Household keeps livestock = 1	Generally positive
Modern input index	Composite measure of modern input use	Positive

3.4. Analytical techniques

Descriptive statistics were used to summarise household food-security categories and selected characteristics of respondents. Pearson correlation coefficients were examined to identify the direction and strength of bivariate relationships among principal variables. The principal multivariate model was an ordered logistic regression because the dependent variable comprised four ordered food-security categories. Ordered logit preserves the ordinal information in the outcome and avoids collapsing the categories into a simple secure/insecure binary variable. The use and interpretation of ordered response models follow established treatments of ordinal categorical data and limited dependent-variable estimation (Agresti, 2010; Long & Freese, 2014; Wooldridge, 2010).
The ordered logistic model can be expressed as:

$$logit[P(Y_i \leq j)] = \alpha_j - (\beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_{13} X_{13i}), \quad j = 1, 2, 3$$

where Y_i represents the ordered food-security category of household i; α_j denotes the estimated threshold parameters; $X_{1i} \ldots X_{13i}$ represent the explanatory variables; $\beta_1 \ldots \beta_{13}$ are the coefficients to be estimated; and the error term follows the logistic distribution. The coefficients are interpreted in terms of the odds of occupying a higher food-security category, given the ordering used in the study.

The proportional-odds assumption was assessed by comparing the ordered model with an unrestricted multinomial logit specification. The result shows a likelihood-ratio comparison of $\chi^2(26) = 34.528$, $p = 0.122$, indicating that the proportional-odds restriction was not rejected. Average marginal effects were also calculated to show how explanatory variables changed the predicted probability of occupying each food-security category. Robustness was considered through binary logistic and negative binomial specifications of related food-security outcomes.

The null hypothesis tested in this article is that the included socio-economic, farm, institutional and programme-related variables do not jointly determine household food-security outcomes among ABP beneficiaries in Kwara State. Statistical significance was assessed at the 5% level, with 10% results described as marginal rather than statistically significant at the principal threshold.

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IV. RESULTS

4.1. Socio-economic and farm characteristics of respondents

The sample comprised 197 ABP beneficiary households. The mean age of household heads was 49.43 years (SD = 11.10), indicating that respondents were predominantly in the economically active middle-age groups. Men headed 80.2% of the sampled households, while women headed 19.8%. The mean years of schooling was 5.49 (SD = 2.38), and mean household size was 5.91 members (SD = 2.09). Almost half of respondents (47.2%) reported farming as their only occupation, while 45.2% combined farming with off-farm work.

Characteristic	Category / statistic	Frequency / value	Percentage
Age of household head	Mean (SD)	49.43 (11.10)	—
Sex of household head	Male	158	80.2
	Female	39	19.8
Education	Mean years of schooling	5.49 (2.38)	—
Household size	Mean (SD)	5.91 (2.09)	—
Main occupation	Farming only	93	47.2
	Farming and off-farm work	89	45.2
	Non-farming	15	7.6
Farm size	Mean hectares (SD)	2.38 (1.03)	—
Land tenure	Owns land	135	68.5
	Rents or leases	62	31.5
Livestock keeping	Yes	126	64.0
	No	71	36.0
Extension visits	Mean visits in previous 12 months	2.59 (1.80)	—

Farm size averaged 2.38 hectares (SD = 1.03), and 68.5% of respondents reported owning the land they cultivated. Rice was the principal crop for 20.3% of households, followed by millet (17.3%), yam (16.8%), sorghum (14.2%), cassava (11.7%), groundnut (11.2%) and maize (8.6%). Livestock keeping was reported by 64.0% of households. Use of modern inputs was common for fertiliser (89.3%) and improved seed (85.8%), while 67.0% used pesticides or herbicides, 34.5% used mechanisation and 13.7% reported irrigation. Respondents received an average of 2.59 extension visits during the preceding 12 months.

4.2. Distribution of household food-security outcomes

The HFIAS classification showed that 108 households (54.8%) were food secure. A further 57 households (28.9%) were mildly food insecure, 15 (7.6%) were moderately food insecure and 17 (8.6%) were severely food insecure. Thus, 89 households (45.2%) experienced at least some degree of food insecurity, while 32 households (16.2%) were classified as moderately or severely food insecure. The mean HFIAS score was 3.985 (SD = 6.222), with a median of 1 and a range of 0–26.

Food-security category	HFIAS score range	Frequency	Percentage	Cumulative percentage
Food secure	0–1	108	54.8	54.8
Mildly food insecure	2–8	57	28.9	83.8
Moderately food insecure	9–14	15	7.6	91.4
Severely food insecure	15–27	17	8.6	100.0
Total	—	197	100.0	—

These results indicate that a majority of the sampled beneficiaries were food secure according to the study's HFIAS classification, but a substantial proportion continued to experience food-access difficulties. Programme enrolment therefore coexisted with food insecurity for nearly one in two households in the sample. This descriptive result is important because it shows that beneficiary status alone does not imply uniform food-security outcomes.

4.3. Bivariate relationships among the principal variables

The Pearson correlation matrix showed that the bivariate correlations between HFIAS score and the explanatory variables were generally weak. The largest reported correlation with HFIAS was the composite implementation-challenge index ($r = 0.127$, $p = 0.075$), which was marginal at the 10% level but did not meet the 5% criterion. No bivariate correlation with HFIAS reached conventional 5% significance. This weak bivariate pattern preceded the finding that the explanatory variables were not jointly significant in the ordered logistic model.

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Some relationships were observed among the explanatory and intermediate outcome variables. ABP support value was positively correlated with meals per day ($r = 0.286$, $p < 0.001$) and extension visits ($r = 0.333$, $p < 0.001$). Extension visits were positively correlated with household dietary diversity ($r = 0.181$, $p = 0.011$) and weakly correlated with meals per day ($r = 0.118$, $p < 0.05$). Farm size was positively correlated with meals per day ($r = 0.142$, $p < 0.01$). These associations provide contextual information but should not be interpreted as evidence of causal effects.

Pair of variables	Pearson r	Reported significance
HFIAS score – challenge index	0.127	p = 0.075 (marginal)
HFIAS score – dietary diversity	−0.108	Not significant
HFIAS score – ABP support value	0.059	Not significant
ABP support value – meals per day	0.286	p < 0.001
ABP support value – extension visits	0.333	p < 0.001
Extension visits – dietary diversity	0.181	p = 0.011
Farm size – meals per day	0.142	p < 0.01

4.4. Ordered logistic regression estimates

The ordered logistic regression model was not statistically significant as a whole. The likelihood-ratio statistic was 13.617 with 13 degrees of freedom ($p = 0.401$), and McFadden's pseudo-R^2 was 0.032. The model therefore did not provide evidence, at the 5% significance level, that the explanatory variables jointly accounted for variation in the ordered food-security categories. The proportional-odds comparison was also not significant ($\chi^2(26) = 34.528$, $p = 0.122$), so the proportional-odds assumption was not rejected.

Explanatory variable	Coefficient	Std. error	z	p-value	Odds ratio
ABP support value (₦100,000)	−0.0886	0.1388	−0.638	0.523	0.915
Training received	0.1489	0.4117	0.362	0.718	1.161
Market linkage received	−0.1964	0.3532	−0.556	0.578	0.822
Age of household head	−0.0256	0.0136	−1.881	0.060*	0.975
Male household head (=1)	−0.8167	0.3949	−2.068	0.039**	0.442
Years of education	−0.0472	0.0595	−0.792	0.428	0.954
Household size	−0.0712	0.0690	−1.031	0.303	0.931
Farm size (ha)	−0.0029	0.1402	−0.021	0.983	0.997
Land ownership	−0.2767	0.3149	−0.879	0.380	0.758
Extension visits	0.0928	0.0835	1.112	0.266	1.097
Off-farm participation	−0.3401	0.2948	−1.154	0.249	0.712
Livestock keeping	−0.2661	0.3039	−0.876	0.381	0.766
Modern input index	0.0909	0.1737	0.524	0.601	1.095

Model statistics: Log likelihood = −209.073; LR $\chi^2(13) = 13.617$; Prob > $\chi^2 = 0.401$; McFadden pseudo-$R^2 = 0.032$; proportional-odds LR $\chi^2(26) = 34.528$; $p = 0.122$. ** $p < 0.05$; * $p < 0.10$. Source: Field survey, 2025.

Among the explanatory variables, sex of the household head was statistically significant at the 5% level. The coefficient was negative ($\beta = -0.8167$, SE = 0.3949, $z = -2.068$, $p = 0.039$), and the odds ratio was 0.442. Given the ordering of the outcome from severe food insecurity towards food security, this indicates that male-headed households had approximately 55.8% lower odds of being in a more food-secure category than female-headed households, conditional on the other variables in the model. The marginal-effects results showed that being male-headed was associated with an 18.8-percentage-point lower probability of being food secure and an 8.6-percentage-point higher probability of being severely food insecure.

Age of the household head had a negative coefficient ($\beta = -0.0256$) and was marginally significant at the 10% level ($p = 0.060$). Its odds ratio of 0.975 suggests that each additional year of age was associated with approximately 2.5% lower odds of occupying a more food-secure category, holding other variables constant. However, because the p-value exceeded 0.05, this result should be treated as suggestive rather than conclusive.

The coefficients for ABP support value, training, market linkage, education, household size, farm size, land ownership, extension visits, off-farm participation, livestock keeping and modern input use were not statistically significant at the 5% level. Extension visits had the expected positive coefficient ($\beta = 0.0928$; OR = 1.097), but the association was not statistically significant ($p = 0.266$). The programme support value was also not significant ($p = 0.523$), and neither training ($p = 0.718$) nor market linkage ($p = 0.578$) was statistically significant in the ordered model.

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4.5. Average marginal effects

Average marginal effects provide an additional way of interpreting the ordered model by expressing estimated changes in the probability of each food-security category. The predicted mean probabilities were 0.0860 for severe food insecurity, 0.0755 for moderate food insecurity, 0.2889 for mild food insecurity and 0.5496 for food security. These predicted values were close to the observed distribution, with food security being the most common category.

Variable	Severely insecure	Moderately insecure	Mildly insecure	Food secure
Predicted mean probability	0.0860	0.0755	0.2889	0.5496
ABP support value (₦100,000)	0.0068	0.0048	0.0090	−0.0206
Training received	−0.0108	−0.0078	−0.0158	0.0344
Market linkage received	0.0163	0.0109	0.0187	−0.0459
Age of household head	0.0020	0.0014	0.0026	−0.0060
Male household head (=1)	0.0862	0.0484	0.0532	−0.1879
Years of education	0.0036	0.0025	0.0048	−0.0110
Household size	0.0055	0.0038	0.0072	−0.0166
Land ownership	0.0238	0.0156	0.0254	−0.0648
Extension visits	−0.0071	−0.0050	−0.0095	0.0216
Off-farm participation	0.0299	0.0194	0.0303	−0.0796
Livestock keeping	0.0228	0.0150	0.0245	−0.0623

The marginal effects reinforce the importance of household-head sex in the estimated model. The male-head indicator was associated with a 0.0862 increase in the probability of severe food insecurity, a 0.0484 increase in moderate food insecurity and a 0.0532 increase in mild food insecurity, alongside a 0.1879 reduction in the probability of being food secure. These are model-based marginal effects and should be read as conditional associations, not as causal effects of household-head sex.

The estimated marginal effects for several other variables were comparatively small. For example, extension visits were associated with a 0.0216 increase in the probability of food security, while a ₦100,000 increase in ABP support value was associated with a 0.0206 reduction in that probability. These estimates were not statistically significant in the ordered model and should not be used to claim that extension contact or programme support worsened or improved food security.

V. DISCUSSION

5.1. Food insecurity among programme beneficiaries

The finding that 54.8% of the sampled households were food secure indicates that a modest majority of ABP participants reported little or no food-access difficulty under the study's HFIAS classification. At the same time, 45.2% experienced some degree of food insecurity, including 16.2% who were moderately or severely food insecure. This is a central finding for programme implementation: beneficiary enrolment and participation in an agricultural finance intervention do not necessarily eliminate household food insecurity. Food access depends on multiple resources and processes beyond access to a production loan or input package.

The result is consistent with the broader conceptual understanding that food security is determined by the capacity to command food and sustain access over time, not simply by the availability of agricultural production opportunities (Sen, 1981; Barrett, 2010). For smallholder households, income seasonality, household consumption needs, production risk and food-price changes can all affect the ability to acquire food. The four-week recall period of HFIAS also means that households may report food-access difficulties even when their annual harvest or income appears adequate.

5.2. Household-head sex and food-security differences

Sex of the household head was the only explanatory variable significant at the 5% level in the ordered logistic regression. The model indicated that male-headed households had lower odds of occupying a more food-secure category than female-headed households, conditional on the included covariates. The marginal effects likewise indicated a lower predicted probability of food security and higher predicted probability of severe food insecurity among male-headed households. This is an important result, but it requires careful interpretation.

First, the result is conditional on the model and the composition of this particular beneficiary sample. It does not establish that male-headed households are generally more food insecure than female-headed households across Kwara State or Nigeria. Descriptive comparisons showed that 69.2% of female-headed households were food secure compared with 51.3% of male-headed households, but the unconditional differences were not statistically significant at conventional levels. The relationship emerged in the multivariate model, suggesting that the association becomes visible after adjustment for other measured characteristics.

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Second, the finding should not be interpreted as evidence that female-headed households inherently use resources more efficiently. Such an explanation is possible but was not directly tested by the data. Differences in household size, income control, expenditure priorities, remittances, social support, labour arrangements and access to productive resources could all contribute. Kehinde et al. (2021) demonstrate that women's empowerment, group membership, income control, workload and land tenure can be associated with food-security outcomes among Nigerian smallholders. This literature supports a more nuanced interpretation that gender relations and control over resources matter, rather than a simple comparison based on the sex of the household head.

From a programme perspective, the result supports attention to the composition of beneficiary households and the resources they control. Female-headed households constituted only 19.8% of the sample. Programme monitoring should therefore disaggregate beneficiary registration, receipt of inputs, training, extension contact, market access and repayment experiences by sex of household head and by women's control over productive resources. Such monitoring would help establish whether the observed difference reflects programme targeting, household structure or wider gendered access to resources.

5.3. Age and other household characteristics

Age was negatively associated with the probability of being in a more food-secure category and was marginally significant at the 10% level. The result may reflect declining physical capacity, differences in risk tolerance or variation in household life-cycle needs, but these mechanisms were not directly measured. Since the estimate did not reach the 5% threshold, it should be regarded as suggestive. The result also differs from some studies in which age has a positive association with food security, illustrating that the effect of age may depend on local livelihood conditions, household composition and access to labour.

Education, household size and farm size were not statistically significant in the ordered model. This does not imply that these variables are irrelevant to food security generally. Rather, within this relatively homogeneous beneficiary sample, they did not significantly distinguish households across the ordered HFIAS categories after adjustment for the other variables. Ayantoye (2022), Omotayo et al. (2022) and Wudil et al. (2023) report associations between household food security and various demographic or farm characteristics in different Nigerian samples. Differences in geographic coverage, sample heterogeneity, outcome measures and model specifications can explain why those studies identify significant correlates that are not significant in the present beneficiary-only analysis.

Farm size and land ownership were not significant in the ordered logit. This may reflect the relatively narrow distribution of farm sizes among sampled programme participants, or the fact that land access alone does not guarantee adequate food access. The ability to convert land into food security depends on input use, productivity, labour, rainfall, market access and control over the returns from production. The marginally significant land-ownership result in the negative binomial robustness model is worth noting but is not sufficient to claim a robust relationship.

5.4. Extension, programme services and support value

Extension visits had a positive coefficient in the ordered logit but were not statistically significant. This direction is consistent with the expectation that extension can improve production knowledge and the use of farm inputs. The bivariate analysis also found a positive correlation between extension visits and dietary diversity. Kehinde et al. (2021) similarly reported that extension contact was associated with lower severity of food insecurity among smallholder farmers. However, the current multivariate result indicates that the evidence is not strong enough to conclude that extension visits independently predicted food-security category in this sample.

ABP support value, training and market linkage were not statistically significant in the ordered model. This is an important distinction between programme logic and measured household outcomes. A larger support package may improve access to productive inputs, but the effect on food security may depend on the timeliness and adequacy of delivery, farmers' capacity to use the package, production outcomes, produce marketing and the timing of household food purchases.

VI. CONCLUSION AND POLICY IMPLICATIONS

6.1. Conclusion

This study examined factors associated with variation in food-security outcomes among 197 ABP beneficiary households in Kwara State, Nigeria. The HFIAS classification showed that 54.8% of households were food secure, while 45.2% experienced some degree of food insecurity. The ordered logistic regression model was not statistically significant overall, and the null hypothesis that the explanatory variables jointly determine food-security status was not rejected. Sex of the household head was the only variable statistically significant at the 5% level: male-headed households had lower odds of being in a more food-secure category. Age was marginally significant at the 10% level, while programme support value, training, market linkage, education, household size, farm size, land ownership, extension visits, off-farm participation, livestock keeping and modern input use were not statistically significant in the ordered model.

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The study does not conclude that these non-significant variables are unimportant to food security in general. Rather, the findings show that, among the sampled ABP beneficiaries and within the limits of the observed variables and cross-sectional design, the model did not identify a set of predictors that jointly explained variation in HFIAS category.

6.2. Policy implications

1. Strengthen gender-responsive beneficiary management. ABP implementation should monitor the registration and effective receipt of support by sex of household head and should identify barriers faced by female farmers in accessing land, inputs, training, extension and market relationships. Gender-disaggregated monitoring should go beyond counting female beneficiaries and should assess whether women have effective control over productive resources and programme benefits.

2. Improve the quality and timing of programme delivery. Although programme support value was not statistically significant in the ordered model, the ABP's theory of change depends on farmers receiving adequate inputs and finance at a time that matches the production calendar. Participating financial institutions, anchors and programme managers should strengthen verification of actual receipt, timeliness, quantity and quality of inputs rather than relying solely on beneficiary registration records.

3. Integrate extension services with financial support. Extension contact showed a positive association with dietary diversity and a positive, though statistically non-significant, coefficient in the ordered model. Programme delivery should link financing with regular, practical extension support on input use, crop management, climate-risk response, post-harvest handling and farm business planning. The quality and content of extension contact should be monitored, not only the number of visits.

4. Expand household-level food-security monitoring. Programme evaluation should combine HFIAS with complementary indicators such as dietary diversity, meal frequency, food expenditure, seasonal food access and relevant nutrition measures. Repeated measurement across pre-planting, harvest and lean seasons would help distinguish short-term food-access shocks from longer-term livelihood changes.

5. Record household shocks and vulnerability more systematically. Future ABP monitoring instruments should collect information on illness, bereavement, flooding, crop failure, local food-price changes, household dependency burdens and major income shocks. These factors may explain short-term HFIAS variation that is not captured by structural variables such as education or farm size.

6. Support diversified livelihoods and market resilience. Off-farm participation was not significant in the ordered model, but livelihood diversification remains a plausible mechanism for stabilising household income across agricultural seasons. Programme partners should strengthen farmers' access to reliable markets, value addition, storage and non-farm enterprise opportunities where appropriate.

7. Use beneficiary-level evidence for targeting and programme redesign. The results caution against assuming that all registered beneficiaries receive similar support or achieve similar food-security outcomes. Monitoring systems should link beneficiary registers with actual disbursement and input delivery records, service contacts and household outcome measures. Such information can identify households that remain food insecure despite programme participation.

6.3. Limitations and directions for further research

The study is limited by its cross-sectional design, its focus on five purposively selected LGAs and its restriction to ABP beneficiary households. The findings should not be generalised automatically to all farming households in Kwara State or to ABP participants in other states. The HFIAS recall period is four weeks and therefore may not align closely with annual farm and household characteristics. The analysis is also based on reported survey data and cannot eliminate recall error or unobserved confounding. Further research should use panel data to observe seasonal changes in food security, include direct measures of household shocks and intra-household resource control, and investigate whether programme delivery characteristics predict food-security transitions over time.

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