



IMPACT OF ANCHOR BORROWERS' PROGRAMME ON HOUSEHOLD DIETARY DIVERSITY OF SMALLHOLDER MAIZE FARMERS IN EKITI STATE, NIGERIA

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ABSTRACT

The study assessed the impact of the ABP on household dietary diversity among smallholder maize farmers in Ekiti State, Nigeria. A census and multi-stage random sampling procedure were employed to select the respondents for this study. Primary data were collected from 364 smallholder maize farmers (172 participants and 192 non-participants) across the State using digital questionnaires. Descriptive statistics, Household Dietary Diversity Score (HDDS), and Propensity Score Matching (PSM) technique were adopted to analyse the data collected. The result revealed that ABP participants were generally male (60.47%), married (89.5%), well-educated (98% with formal education), and had significantly better access to extension services (67.44%). HDDS results showed that 38.4% of the participants demonstrated significantly higher levels of dietary diversity compared to 33.3% of non-participants, 73.8% of participants consumed more energy-providing food, compared to 44.3% of non-participants, 66.3% of participants consumed protein-rich foods compared to 42.2% of non-participants, 98.3% of participants consumed vitamins and minerals (vegetables and fruits), while only 15.6% of non-participants consumed vitamins and minerals. However, the PSM analysis revealed a statistically significant negative impact of ABP participation on household dietary diversity. Specifically, the Kernel Matching algorithm indicated that ABP participants had, on average, a 3.90-unit lower HDDS than comparable non-participants ($p < 0.01$). Hence, the study concludes that the ABP, as implemented, failed to improve household food security among participating smallholder maize farmers in Ekiti State. The need to overhaul of the ABP's implementation process and monitoring, alongside integrating nutrition, food safety, and preservation training into the extension curriculum is highly recommended, to ensure production gains translate into meaningful and sustainable improvements in household dietary and nutritional security.

Keywords: Food Security, Smallholder Farmer, Maize, Ekiti State.

INTRODUCTION

Food security remains a major global challenge, particularly in developing economies, in spite of advances in agricultural technology (Akpabio *et al.*, 2025). The persistent challenges of hunger, poverty, undernutrition, and malnutrition in Sub-Saharan Africa necessitate a greater focus on sustainable food production to meet the demands of a rising global population.

In Nigeria, food security is a significant and persistent challenge, especially within rural areas where the majority of the smallholder farmers live. Smallholder farmers are the pillar of agricultural production, contributing nearly 90% of the nation's food despite their ownership of a small fraction of the arable land (Akoh, *et al.*, 2025). The United Nations Conference on Trade and Development (UNCTAD) asserts that achieving food security requires recognizing this essential role, as these farmers actively contribute to reducing hunger and poverty (UNCTAD, 2015; Chiaka *et al.*, 2022). Furthermore, smallholder farmers are often considered technically efficient due to their use of household labour and local knowledge, and they are described as biodiversity-friendly because they often rely on livestock manure instead of costly synthetic fertilizers, allowing them to produce substantial yields (Le-Gal, *et al.*, 2023; Omotilewa *et al.*, 2021). However, despite this crucial role, smallholder farmers, who produce most of the food in low-income countries, are especially vulnerable to food insecurity (Chiaka *et al.*, 2022; Cui *et al.*, 2021). Their effort to increase food production and enhance household food security is limited by continuous challenges, including restricted access to land, credit, and essential farm inputs.



To tackle these challenges, the federal government initiated agricultural financing schemes such as the Anchor Borrowers' Programme (ABP). This initiative links smallholder farmers to large-scale processors, providing them with funding and inputs to boost yields and improve market access. The ultimate goal of the ABP is to shift Nigeria toward self-sufficiency, improve farmer incomes, and enhance household food security (Ogunniyi *et al.*, 2021). Despite significant investments, evidence on the ABP's impact on food security at the household level is mixed. Increases in yield or income do not always translate directly into improved food access or diet quality, due to factors like fluctuating market prices, post-harvest losses, and complex intra-household resource allocation. Therefore, this study aims to fill this gap by rigorously assessing the impact of ABP participation on household dietary diversity among smallholder maize farmers in Ekiti State, Nigeria, using the Household Dietary Diversity Score (HDDS) approach. Household Dietary Diversity Score (HDDS) is widely recognized as a robust indicator of nutritional quality and food security, reflecting the variety and adequacy of food groups consumed (Omotoso & Omotayo, 2025).

Ekiti State is an agrarian state in Southwest Nigeria, where food production, such as maize, rice, yams, cassava, etc., is highly important among most smallholder farmers. Maize (*Zea mays L.*) is a critical staple crop, serving as a primary food source and a key component of livestock feed. Its production, which is dominated by smallholder farmers, is central to national food security and rural livelihoods (Baiyegunhi, & Hassan, 2025). Despite its importance and increased harvested area, maize yields remain low, undermining both food availability and farmer incomes (Chiaka *et al.*, 2022). Total maize production in Ekiti State in 2021 is estimated to be around 280,000 (metric tons), cultivated on 155.81 hectares of farmland across the 16 local government areas of the state (Ekiti State Bureau of Statistics [EKSBS], 2020). Maize is employed industrially by flour millers, brewers, makers of bread and confections, and producers of animal feed since it is a versatile commodity that is not only used domestically (Innocent *et al.*, 2022).

Existing empirical literature has explored the impact of the Anchor Borrowers' Programme (ABP) on smallholder farmers in Nigeria, covering different crops and states, such as the effect on rice production in Ekiti (Olanrewaju *et al.*, 2024), and on food security for rice farmers in Kano (Gwadabe *et al.*, 2024) and maize farmers in Kwara (Ojo *et al.*, 2023). However, a significant research gap exists as no prior study has specifically assessed the impact of the ABP on the household dietary diversity of smallholder maize farmers in Ekiti State. This regional focus is critical because food insecurity in Ekiti, a key agrarian state, is alarmingly high and escalating across most local governments (Ekiti State Government, 2022). Therefore, this study aims to assess the impact of ABP on the household dietary diversity of smallholder maize farmers in Ekiti State. Specifically, the study described their socioeconomic characteristics of the maize farmers, estimates the household dietary diversity score of the smallholder maize farmers, and ultimately determined the programme's impact on their food security status.

METHODOLOGY

The Study Area

The research was conducted in Ekiti State, Nigeria. Ekiti State lies between longitudes $4^{\circ} 45'$ and $5^{\circ} 45'$ East of the Greenwich Meridian and latitudes $7^{\circ} 15'$ and $8^{\circ} 5'$ North of the Equator. It is situated entirely within the Tropics. Ekiti State is bounded in the North by Kwara and Kogi States, in the West by Osun State and in the East and South by Ondo State. Ekiti State has 16 LGAs, and are divided into three Agricultural Development Programme (ADP) zones. Zone 1 comprises of five (5) LGAs - Ado, Igede, Ijero, Aramoko, and Efon with its headquarters at Aramako; Zone 2 comprises of five (5) LGAs too - Ikere, Ilawe, Ise, Emure, and Ode, with headquarter in Ikere; while Zone 3 has six (6) – Ikole, Oye, Ido, Iye, Otun, and Omuo with headquarter at Ikole-Ekiti with a total of 128 cells in all the zones (Ekiti State Agricultural Development Programme [EKSADP], 2017). The population of Ekiti State as of 2021 is projected to about 3,908,080 with a tropical climate temperature ranging from 21°C and 31.3°C and high relative humidity (55-56%) (Ekiti State Bureau of Statistics [EKSBS], 2022). Agriculture is the primary occupation of the people, with the cultivation of cash crops like



cocoa, oil palm, kola nut, plantain, bananas, cashew, citrus and timber; and food crops such as rice, yam, cassava, maize and cowpea.

Sampling Procedure and Sample Size

A census and multi-stage random sampling procedure were employed to select the respondents for this study. The census sampling procedure was employed to select all the one hundred and seventy-two (172) participants in the ABP, spread across five (5) clusters (Forest Reserve, Adigboku, Ijero, Otun and Orin) in four (4) LGAs (Ado Ekiti, Ijero, Moba and Ido-Osi) of Zone I and Zone III. To effectively study the impact of the ABP, the control group, which comprised of non-participants from five (5) clusters (Aramako, Okemesi, Iyin Ekiti, Ikole and Isinbode) in Four LGAs (Ekiti West, Irepoden/Ifelodun, Ikole and Ekiti East) within the same zones, were randomly selected through a multistage sampling procedure. The Slovin (1967) formula adopted by Abdullazeez (2019) for the calculation of sample size was used on the assumption of 5% expected margin of error at 95% confidence interval. The formula is expressed as follows:

$$n_0 = \frac{N}{1+N(e)^2}$$

Where: n = the sample size

e = margin of error 5% (0.05)

N = the total population

A total of one hundred and ninety-two (192) non-participants were randomly selected for the study, making a total of three hundred and sixty-four (364) respondents.

Table 1: Distributions of sample size for participants and non-participants

ZONE	PARTICIPANTS				NON-PARTICIPANTS			
	LGA (Block)	Cluster	Population	Sample	LGA (Block)	Cell	Population	Sample
Zone I	Ado Ekiti	Forest Reserve	62	62	Ekiti	Aramako	93	49
		Adigboku	30	30	West	Okemesi	58	30
	Ijero	Ijero	48	48	Irepodun/Ifelodun	Iyin-Ekiti	82	43
Zone III	Moba	Otun	10	10	Ikole	Ikole	78	40
	Ido-Osi	Orin	22	22	Ekiti East	Isinbode	58	30
TOTAL			172	172			369	192

Source: Field Survey, 2024

Method of Data Collection

Primary data were collected from smallholder maize farmers in the selected clusters within Ekiti State, using a structured questionnaire. This questionnaire was developed and deployed digitally using Kobo Toolbox, a mobile data collection platform. Trained enumerators were used to administered the questionnaire to the farmers face-to-face using the Kobo Collect app on Android devices. The digital approach facilitated the collection of data in real time and ensured data accuracy through features such as skip logic and data validation (Kobo Toolbox, n.d.). Data were collected on the socioeconomic characteristics of the smallholder farmers' food security level using the household dietary diversity indicators.

Method of Data Analysis

Descriptive Statistics, such as frequency distribution, percentages, and mean, were used to assess the socioeconomic characteristics of the smallholder maize farmers. The Household Dietary Diversity Score (HDDS) indicator measures how easily affordable a range of meals are for households. (i.e., its capacity to produce, acquire, or otherwise secure food for consumption by every member of the household). Based on self-reporting by households of the 12 food groups consumed over the preceding 24 hours, this indicator's data is generated (INDDX Project, 2018). The HDDS is calculated using the 12 food groups listed below:



- | | |
|--------------------|---------------------------|
| A. Cereals | G. Fish and seafood |
| B. Root and tubers | H. Pulses/legumes/nuts |
| C. Vegetables | I. Milk and milk products |
| D. Fruits | J. Oil/fats |
| E. Meat/poultry | K. Sugar/honey |
| F. Eggs | L. Miscellaneous |

The tabulation of the HDDS is a relatively simple. It can be done by hand or with the aid of computer software such as a database or spreadsheet. First, the HDDS variable is calculated for each household. The value of this variable will range from 0 to 12.

HDDS (0-12)	Total number of food groups consumed by members of the household. Values for A through L will be either “0” or “1”. Sum (A + B + C + D + E + F + G + H + I + J + K + L)
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Table 2: Diversity Categories cut-off value

Dietary Diversity categories	Cut-off Values
Low Dietary Diversity	0 – 4
Medium Dietary Diversity	5 – 8
High Dietary Diversity	9 – 12

Source: Adopted from INDDEx Project, 2018

The Propensity Score Matching (PSM) was adopted to evaluate the impact of ABP on smallholder maize farmers’ food security. The most common evaluation parameter of interest is the Average Treatment Effect on the Treated (ATT), which is defined as:

$$ATT = E(Y_1 - Y_0/P = 1) - (Y_1/P = 1) \quad \dots (1)$$

The propensity score is the probability of the participation for the farm households if given a set X = xi of characteristics

$$P(X) = Pr (P = 1/x = xi) \text{ (Pufahl \& Weiss, 2009)} \quad \dots (2)$$

The propensity scores are derived from the regression models in which these characteristics will be compared. The impact of treatment on the treated (casual effect of participants) was estimated by computing the difference across both groups:

$$ATT = \frac{1}{N_1} (Y_1 - Y_0) \quad \dots (3)$$

Where ATT = Average impact of treatment on the treated, N1 = Number of matches (from regression model), Y1 = the productivity index by participants, Y0 – the productivity index by non-participants. A positive (negative) value of ATT suggests that farm household participants in the programme have higher (lower) outcome variables than the non-participants. This will be used to determine the impact of participation in ABP on smallholder maize farmers’ food security.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Smallholder Maize Farmers in Ekiti State

The result in Table 2 describes the socioeconomic characteristics of smallholder maize farmers in the study area. The Table shows that 60.47% of participants were male, with a mean age of 45.4 years. This implies that maize production is dominated by male farmers, who are in their active, productive age. This corroborates Ojo *et al.* (2023), who reported that 71.7% of the beneficiaries of ABP are male, with a mean of 47.7 years for beneficiaries. The Table also revealed that 89.5% of participants were married, which support the findings of (Ayinde, 2018), with an average of 5 household members. Furthermore, the Table reveals that 98% of the participants have formal education, with a considerable proportion of the participants (45.3%) possessing tertiary education. This result is in line with the findings of Musa *et al.* (2022), who reported that 50% of farmers who participated in government intervention in rice production in Nigeria acquired secondary education, while 40% acquired tertiary education. The mean land holding for maize production for participants



is 1.38 ha and for non-participants is 2.06 ha. This finding is contrary to the findings of Ojo (2023), who reported that the average land holding of the beneficiaries of the Anchor Borrowers Programme among maize farmers in Gombe State exceeds that of the non-beneficiaries. While 67.44% of the participants have access to extension contacts, only 10.94% of the non-participants have access to extension contacts with only 60.34% of the participants having between 1-4 extension visits. This suggests that the majority of the participating farmers had access to critical information from extension agents as reported by Ayinde et al. (2018) in their study Assessment of Central Bank Intervention on Rice Production in Kwara State, Nigeria: A Case-study of Anchor Borrower's Programme, who reported that 62.7% of the participants had access to extension services, while 85% of the non-participants had no access to extension services. The Table also revealed that 61 % of the participants are members of a cooperative society, with 44.76% having between 11-15 years of membership, which aligned with Ojo *et al.*, (2023) that 65% of beneficiaries of the ABP are members of cooperative society.



Table 3: Distribution of Respondents based on Socioeconomic Characteristics

Socio-economic characteristics	Participation (n=172)		Non-Participation (n=192)	
	Frequency	Percentage	Frequency	Percentage
Sex				
Female	68	39.53	19	9.9
Male	104	60.47	173	90.1
Age				
20-29	4	2.33	6	3.13
30-39	49	28.49	17	8.85
40-49	61	35.47	83	42.71
50-59	47	27.33	53	27.6
60 and above	11	6.4	34	17.71
<i>Mean</i>	4		49	
<i>Standard deviation</i>	10.01		11.95	
Marital status				
Single	13	7.56	7	3.65
Married	154	89.53	170	88.54
Others	5	2.91	15	7.81
Household size				
≤ 5	84	48.84	98	51.04
6-10	80	46.51	87	45.31
≥ 11	8	4.65	7	3.65
<i>Mean</i>	5		6	
<i>Standard deviation</i>	2.08		2.36	
Level of education				
No formal Education	2	1.16	20	10.42
Primary Education	21	12.21	26	13.54
Secondary Education	71	41.28	91	47.4
Tertiary Education	78	45.35	55	28.65
Farm size (ha)				
< 1.00	5	2.91	15	7.81
1 - 2.99	154	88.95	136	70.83
3.00 - 6.99	10	5.81	31	17.19
≥ 7.00	4	2.33	8	4.17
<i>Mean</i>	1.38		2.06	
<i>Standard deviation</i>	1.49		1.75	
Extension Contacts				
Yes	116	67.44	21	10.94
No	56	32.56	171	89.06
No of Extension Visits				
≤ 4	70	60.34	21	100
≥ 5	46	39.66		
<i>Mean</i>	4		2	
<i>Standard deviation</i>	2.44		0.80	
Cooperative Society				
Yes	105	61.05	60	31.25
No	67	38.95	132	68.75
Years of membership				
≤ 5	22	20.59	34	56.67
6-10	36	34.29	17	28.33
≥ 11	47	44.76	9	15
<i>Mean</i>	11.07		6.3	
<i>Standard deviation</i>	6.50		3.65	

Source: Field survey, 2024

Household Food Security Status of Smallholder Maize Farmers Using the HDDS

Table 3 shows the food security status of smallholder maize farmers using the Household Dietary Diversity Score (HDDS) index. The findings revealed that the ABP has positively influenced the dietary diversity of smallholder maize farmers in the study area. The Table shows that 38.4% of the participants demonstrated significantly higher levels of dietary diversity compared to 33.3% of non-participants, indicating improved access to a variety of food groups. This is particularly evident in the consumption of energy-providing foods, protein-rich foods, and vitamins and minerals. 73.8% of participants consumed more energy-providing food, compared to 44.3% of non-participants. Also, 66.3% of participants consumed protein-rich foods at higher frequencies compared to 42.2% of non-participants, while the majority (98.3%) of participants consumed vitamins and minerals (vegetables and fruits), only 15.6% of non-participants consumed vitamins and minerals. This suggests that the programme has enabled farmers to increase their intake of essential nutrients. However, both participants and non-participants exhibited similar consumption patterns with 38.37% and 47.67% of participants and 33.33% and 32.81% of non-participants being food insecure (low and medium dietary diversity) respectively. This supports the findings of Adeyemi et al. (2025), who reports that food insecurity remains a significant challenge, with 41.56% of households categorized as moderately or severely food insecure among rural households' dietary diversity and consumption pattern of selected foods in Nigeria Northeast and Northwest regions.

Table 4: Estimation of Smallholder Maize Farmers' Food Security Using HDDS Index

Score range	Status	Participants		Non-participants	
		Freq.	%	Freq.	%
0 – 4	Low dietary diversity (Food insecure)	66	38.37	64	33.33
5 – 8	Medium dietary diversity (Food insecure)	82	47.67	63	32.81
9 – 12	High dietary diversity (Food secure)	24	13.95	65	33.85
Consumption Pattern					
Food Category		Number of times (per week)			
Energy-providing foods (cereals, root and tuber, fats and oils, sugar and sweeteners)	1-3 (Rarely)	45	26.16	105	54.69
	4-6 (Occasionally)	127	73.84	85	44.27
	7-9 (Frequently)			2	1.04
	10 and above (Always)				
Protein-rich foods (pulses, meat, fish, eggs, milk and dairy)	1-3 (Rarely)	45	26.16	98	51.04
	4-6 (Occasionally)	114	66.28	81	42.19
	7-9 (Frequently)	13	7.56	11	5.73
	10 and above (Always)			2	1.04
Vitamins and Minerals (vegetables and fruits)	1-3 (Rarely)	3	1.74	161	83.85
	4-6 (Occasionally)	169	98.26	30	15.63
	7-9 (Frequently)			1	0.52
	10 and above (Always)				
Flavour Enhancers (condiments)	1-3 (Rarely)	172	100	192	100
	4-6 (Occasionally)				
	7-9 (Frequently)				

Source: Field survey, 2024

Impact of ABP on Smallholder Maize Farmers' Household Food Security

Table 5 highlights the Propensity Score Matching (PSM) analysis, which provides evidence of a significant difference in household food security between participants and non-participants of the Anchor Borrowers' Programme (ABP). Across all matching algorithms employed, the estimated difference in mean household dietary diversity scores was consistently negative and statistically



significant at conventional levels. This suggests that participating in the ABP is associated with lower dietary diversity levels than non-participants. The magnitude of the estimated difference varied slightly across different matching algorithms, but the overall direction and significance remained consistent.

The Radius matching produced the largest estimated difference -2.680 , which is highly significant, suggesting that ABP participants, on average, have a 2.68-unit lower HDDS than the non-participants, while the Kernel Matching has an estimated difference of -3.899 , which is also highly significant, suggesting that ABP participants on average, have a 3.90-unit lower HDDS than their non-participants. Nearness Neighbour and Stratification Matching both show negative, but not statistically significant differences (-3.574 and -0.267 , respectively). The statistically significant negative impact found across the robust PSM algorithms (Radius and Kernel Matching) indicates that the Anchor Borrowers' Programme (ABP) did not achieve its objective of improving food security (higher household dietary diversity score) among the participating smallholder maize farmers in Ekiti State. Rather, it appears to be exacerbating dietary vulnerability. which suggests that while the ABP may have positive effects on other outcomes, such as productivity, it did not significantly impact their household dietary diversity. This could be attributed to various factors, such as programme design flaws, economic pressures and the introduction of cluster farming by the farmers' association president, as against the 1 farmer, 1-hectare ABP plan. The result corroborates the findings of Gwadabe et al. (2024), who report that participation in the ABP did not totally remove smallholder rice farmers out of food insecurity status in Kano State, Nigeria.

Table 5: Estimation of Means of Propensity Score Matching for Different Algorithm

Algorithms	Treated	Control	Difference	Std. Error	T-stat
Nearness neighbor	6.187	9.761	-3.574	3.601	-0.990
Radius matching	6.187	8.867	-2.680***	0.347	-7.730
Kernel Matching	6.275	10.175	-3.899***	1.402	-2.780
Stratification matching	2.733	3.000	-0.267	0.624	-0.430

Source: Computed from field survey data, 2024

*** significant at 1% levels of significance

CONCLUSION AND RECOMMENDATIONS

The study concludes that participation in the ABP, while associated with improved access to agricultural inputs, extension services, and higher levels of education and cooperative membership among participants, did not translate into a significant positive impact on overall household food security. The Propensity Score Matching (PSM) results demonstrated a statistically significant negative difference in the mean household food security scores for participants compared to non-participants. This suggests a potential "food security paradox" where the focus on increasing maize productivity through the ABP may not adequately address the complex dimensions of household food security, such as year-round access, stability, or dietary diversity. The findings strongly indicate that the Anchor Borrowers Programme model, as implemented in Ekiti State, had negative impact on the household dietary diversity of smallholder maize farmers in Ekiti State, suggesting a need for strategic adjustments to achieve its food security objectives. Based on the findings of this study, there is a strong need proper implementation and monitoring of Programme registration and loan disbursement to be done in accordance with the ABP objectives and goal. This will strengthen the Programme to meet the specific needs of the smallholder farmers in order to ensure they deliver measurable improvements in household food security beyond mere production gains. The Extension curriculum should include training on nutrition, food safety and preservation techniques for smallholder farmers to understand how to translate increased productivity into improved dietary diversity and food stability for their households.



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