

ECONOMIC PERFORMANCE OF MAIZE PRODUCTION UNDER ANCHOR BORROWERS PROGRAMME IN SOUTHWEST, NIGERIA

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ABSTRACT

The Anchor Borrowers' Programme (ABP) is a key agricultural policy initiative designed to enhance smallholder productivity in Nigeria. However, limited evidence exists on its economic impact on maize production. This study, therefore, investigated the economic performance of maize farmers participating in the ABP in Southwest Nigeria. A multistage sampling technique was used to select 210 maize farmers (beneficiaries and non-beneficiaries) across selected agricultural zones and local government areas in Ogun and Osun States. Data were obtained through semi-structured questionnaires and analysed using descriptive statistics, budgetary analysis, and the stochastic frontier production function. The results revealed a predominance of male farmers among both beneficiaries (75%) and non-beneficiaries (92.5%). Most of the respondents were married, with a mean age of 55.1 years (beneficiaries) and 51.32 years (non-beneficiaries), and an average household size of 7 persons (beneficiaries) and 7 persons (non-beneficiaries). The average farm size was larger for beneficiaries (7.68 ha) than for non-beneficiaries (5.05 ha). Beneficiaries recorded higher total revenue and net farm income (₦309,895.83/ha and ₦178,191.50 /ha) compared to non-beneficiaries (₦279,207.92/ha and ₦142,619.30/ha, respectively). Technical efficiency was also higher among beneficiaries (0.82) than non-beneficiaries (0.78). Fertilisers significantly improved efficiency among both groups (beneficiaries $\beta=0.57$, $p < 0.01$) and non-beneficiaries ($\beta=0.36$, $p < 0.010$). Participation in ABP ($\beta = -4.86$, $p < 0.1$), gender ($\beta = -2.99$, $p < 0.1$), and cooperative membership ($\beta = -2.73$, $p < 0.05$) significantly reduced inefficiency, while farm size ($\beta= 0.12$, $p < 0.05$) and extension visits ($\beta = 2.77$, $p < 0.1$) increased inefficiency. The study concludes that participation in the Anchor Borrowers Programme positively influences profitability and technical efficiency in maize production. Policy efforts should therefore encourage broader inclusion and address inefficiency drivers to enhance programme impact.

Keywords: *Maize production, Anchor Borrowers Programme, technical efficiency, stochastic frontier.*

INTRODUCTION

Agriculture contributed approximately 23.3% to Nigeria's Gross Domestic Product (GDP) and employed over 25 million Nigerians, representing about 30.1% of the total workforce, highlighting its crucial role in national food systems and economic livelihoods (NBS, 2023). Despite Nigeria's potential in agriculture, a critical food security gap persists, particularly in cereal crop production, as the sector is still dominated by smallholder farmers cultivating less than 10 hectares of land, often

with limited access to improved inputs, credit, and markets (Mgbenka and Mbah, 2016; Girei *et al.*, 2018). Maize (*Zea mays L.*) is one of the most important cereal crops in Nigeria, playing a central role in the national food economy and household nutrition Adiaha (2024). It is widely consumed in various forms, including pap (ogi (Yoruba)), tuwo masara (Hausa), donkwa (Hausa), and roasted or boiled corn, reflecting its versatility in Nigerian diets. Beyond direct consumption, maize serves as a key industrial ingredient, particularly in poultry feeds,

where it constitutes approximately 60–65% of feed formulations, as well as in the production of beverages and starch-based product (International Institute of Tropical Agriculture (IITA), 2012; Adiaha 2024).

Nigeria is currently the largest maize producer in Africa, with output increasing from 10.1 million metric tonnes (MMT) in 2014 to 11.6 MMT in 2016 and stabilizing at 11.0 MMT in 2019 (U.S. Department of Agriculture (USDA) 2020). However, national demand for maize has reached 15 MMT annually, leaving a 4.5 MMT production shortfall that threatens national food and feed security (Federal Ministry of Agriculture, 2020). Although production has increased, yield remains well below the global average of 5.1 tonnes per hectare, with Nigeria recording just 1.85 tonnes per hectare (FAO, 2016). This shortfall undermines food and feed security, inflates prices (up to ₦250,000/ton in 2021), and threatens the poultry, food, and beverage industries (Maize Growers, Processors and Marketers Association of Nigeria (MAGPAMAN), 2020; IITA, 2017). Maize farming in Nigeria is highly profitable but remains plagued by systemic inefficiencies including limited access to inputs such as quality seed and fertilizer, pest and disease infestation, inadequate access to affordable credit, weak infrastructure, and low levels of mechanization (Ayinde *et al.*, 2015; Fasina, 2013; Zalkuwi *et al.*, 2010). Compounding these challenges is the hesitancy of financial institutions to support agricultural lending due to perceived high risks, long gestation periods, and weak collateral structures among rural farmers (Ikenga, *et al.*, 2024; Stears Business, 2018). Consequently, lending to agriculture by Deposit Money Banks has remained below 5% over the past decade (CBN, 2017).

These challenges are pronounced in key maize-producing States such as Osun and

Ogun, where smallholder farmers face declining productivity despite growing cultivated areas (FAO, 2015). In Ogun State, maize yield fell from 1.37t/ha in 2009 to 1.31t/ha in 2013, highlighting that increased land use has not translated into higher productivity (FAO, 2015). Similar constraints exist in Osun State, where although maize has become a commercial crop, its production is still dominated by small-scale subsistence farmers using rudimentary tools and traditional farming methods (Olokundun *et al.*, 2014). Several government programmes have attempted to address these issues, including the Agricultural Credit Guarantee Scheme (ACGS), Growth Enhancement Support Scheme (GES), and Fadama Development Project. However, the impact of these initiatives has been undermined by inadequate beneficiary identification, poor implementation, and weak market linkages (Bassey *et al.*, 2016; Nwaobiala, 2019).

To bridge the persistent gaps in production, marketing, and finance, the Central Bank of Nigeria (CBN) launched the Anchor Borrowers' Programme (ABP) in 2015. The ABP was designed to provide smallholder farmers with access to credit in the form of inputs and technical support, and to link them with large-scale processors or anchor firms that guarantee offtake at pre-agreed prices (CBN, 2016). The programme targets crops and livestock with comparative advantage in Nigeria, including maize, rice, poultry, soybean, and fish. Loans are disbursed through participating financial institutions such as Deposit Money Banks and Microfinance Banks, while repayment is structured through harvest collection by anchors (CBN, 2016; Badejo and Adekeye, 2018). Since its inception, the ABP has empowered over 150,000 maize farmers and reportedly increased national maize production from the 7.8 MMT average recorded between 2006 and 2013 to over 11

MMT in the years following its implementation (USDA, 2020).

Despite these achievements, empirical findings on the programme's impact on maize farmers remain inconclusive. While ABP is credited with improved access to credit, inputs, and markets, issues such as delayed input delivery, side-selling, non-compliance with repayment terms, and institutional inefficiencies continue to plague its implementation (Badejo and Adekeye, 2018). Furthermore, limited research exists on whether participation in the ABP translates to improved technical efficiency or profitability in maize production, especially when comparing beneficiaries with non-beneficiaries. Most studies on ABP focus on rice-producing states like Kebbi, while less attention has been given to maize, despite its widespread cultivation and importance to the national food system (Egbuomwan and Okoye, 2017; Kara *et al.*, 2019).

This study addresses this gap by critically examining the economic performance of maize production under the Anchor Borrowers' Programme in Osun and Ogun States. In both states, maize is a principal food and income-generating crop for thousands of smallholder households, yet production remains far below optimal levels due to poor access to productive resources, market information, and institutional support (Sanusi, 2014; Ayinde *et al.*, 2018). The limited involvement of commercial banks in agricultural lending, due to risk perceptions, high transaction costs, and lack of collateral, further complicates the situation (Stears Business, 2018; Okojie *et al.*, 2010). These challenges raise critical questions about the effectiveness of ABP in achieving its intended objectives for maize farmers. This study seeks to examine the socio-economic profiles of programme beneficiaries and non-beneficiaries; assess whether the ABP has significantly improved the profitability,

technical efficiency and production outcomes of maize farmers in Osun and Ogun States; and evaluate the underlying factors influencing efficiency in maize farming. Through this dual-state comparative lens, the study aims to provide robust insights for agricultural policy makers and stakeholders committed to improving food security and economic outcomes for Nigerian maize farmers and also contributes to understanding the role of contract-based agricultural financing in addressing Nigeria's persistent food insecurity and in enhancing smallholder productivity.

MATERIALS AND METHODS

This study utilised a cross-sectional survey design to investigate the economic performance and technical efficiency of maize farmers in Osun and Ogun States, two major maize-producing states in Southwestern Nigeria. The states were chosen purposively due to their active participation in the Anchor Borrowers' Programme (ABP) and their agro-ecological suitability for maize cultivation. Both states experience a humid tropical climate with annual rainfall ranging from 1,000 mm to 1,500 mm and average temperatures between 21.1°C and 31.1°C, conditions which are conducive for maize farming.

Osun State lies between latitudes 5°58'N and 8°07'N and longitudes 4°00'E and 5°05'E, with a total landmass of approximately 9,251 km². It has 30 Local Government Areas (LGAs) divided into three agricultural zones: Iwo, Osogbo, and Ife/Ijesha. The state is bounded in the north by Kwara State, in the east by Ekiti and Ondo States, in the south by Ogun State, and in the west by Oyo State. Ogun State is located between latitudes 6°20'N and 7°58'N and longitudes 2°40'E and 4°35'E, with a geographic area of 16,409.26 km². It has 20 LGAs and shares boundaries with Lagos, Oyo, Ondo States, and the Republic of Benin.

A multi-stage sampling technique was used in selecting the respondents. In the first stage, two agricultural zones were selected from each State based on maize production intensity and concentration of ABP beneficiaries. In Osun State, Iwo and Osogbo zones were chosen, while in Ogun State, Yewa and Remo zones were selected. In the second stage, two Local Government Areas (LGAs) were purposively selected from each zone, based on the availability of both ABP beneficiaries and non-beneficiaries. At the third stage, a list of maize farmers was obtained from the Central Bank of Nigeria (CBN) and the Maize Farmers Association. Using this list as a sampling frame, 15 beneficiaries and 15 non-beneficiaries were selected from each LGA to make an aggregate of 240 respondents. Due to data attrition and incomplete questionnaires, a final sample of 210 respondents was used for the analysis

Primary data were collected through a semi-structured and pre-tested questionnaire administered to maize farmers in the selected LGAs. The instrument captured information on socio-economic characteristics (age, gender, household size, education, farming experience), input use (land size, seed, fertiliser, agrochemicals, labour), access to credit, and participation in ABP. The questionnaire was validated through expert review and pilot testing in non-sampled LGAs in each state. The Cronbach's alpha coefficient for internal reliability exceeded 0.70, indicating satisfactory consistency.

Data were analysed using descriptive statistics and econometric models. Descriptive tools such as frequency, mean, and standard deviation were used to summarise farmers' profiles and input usage. The economic performance of maize production was evaluated using Gross Margin (GM) analysis. The GM was calculated as the difference between total

revenue (price \times quantity of maize sold) and total variable costs (seed, fertiliser, labour, agrochemicals, and transportation). Profitability indicators such as benefit-cost ratio and return on investment were also computed.

Model Specification

Budgetary Techniques

Budgetary analysis was used to determine the cost and return to maize production among farmers for the second objective. It provides an estimate of its profitability. In economic terms, profit represents return to investment in excess of that obtainable elsewhere and the rate of return on investment. It is the summary of the expected income, expenses and profits. Gross margin is the difference between total income and variable costs. The equation is expressed as

$$\text{Gross Margin (GM)} = \text{TR} - \text{TVC}$$

Where; GM= Gross Margin (₦)

TR= Total Revenue (₦)

$$\text{TR} = \text{PQ}$$

Where P is the price of maize/kg (₦), and Q represent quantity of maize (kg) so produced

$$\text{TC} = \text{TFC} + \text{TVC}$$

Where TC= Total cost (₦)

TVC= Total variable cost (₦)

TFC= Total fixed cost (₦)

$$\text{Profit} = \text{TR} - \text{TC}$$

Stochastic Production Frontier

Cobb-Douglas stochastic frontier production was employed to assess the efficiencies and their determinants among maize farmer beneficiaries and non-beneficiaries of the Anchor-Borrowers' programme.

Model specification is as follows:

$$Y_i = f(x_i, \beta) + e_i$$

$$E_i = v_i - u_i$$

Where:

Y_i = quantity of output of the i th farm,

x_i = vector of the inputs used by the i th farm,

β = a vector of the parameters to be estimated,

e_i = composite error term,
 v_i = random error outside the farmer's control and

- u_i = technical inefficiency effects.

Taking the logarithm of both sides, the equation becomes

$$\ln Y = \beta_0 + \beta_1 \ln(x_1) + \beta_2 \ln(x_2) + \beta_3 \ln(x_3) + \beta_4 \ln(x_4) + V_1 - U$$

where:

Y = quantity of maize produced (kg);

β_1 = coefficient of the parameter estimated;

X_1 = fixed input (depreciated)

X_2 = quantity of fertiliser used (kg);

X_3 = labour (man/day);

X_4 = seed (kg); and

V_1-U_1 are as defined earlier parameters;

V_i is the random variable which is assumed to be $N(0, \sigma^2V_2)$, and independent of the U_i , which is a non-negative random variable that accounts for the cost of inefficiency in production, and is often assumed to be $(N(0, \sigma^2U_2))$. The Battese and Coelli (1995) specification was used to create an inefficiency model, which is:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + W_i$$

where:

Z_1 = Age of the farmer (Number of years);

Z_2 = Gender (1=Male, 0=female)

Z_3 = Educational level of farmer (years of schooling)

Z_4 = Household size

Z_5 = Farm size (Ha)

Z_6 = Farming experience (years)

Z_7 = Extension Visit

(1=yes, 0=otherwise);

Z_8 = Access to credit

(1=yes, 0=otherwise)

Z_9 = Cooperative memberships

(1=yes, 0=otherwise)

Z_{10} Participation in ABP

(1=yes, 0=otherwise)

W_i = error term.

RESULTS

Socio-Economic Characteristics of the beneficiaries and non-beneficiaries of ABP

Results in Table 1 revealed that the maize farming sector was male-dominated, with 75% of beneficiaries and 92% of non-beneficiaries being male. This aligns with trends in labour-intensive farming in Nigeria, where men are typically more engaged due to physical requirements. Interestingly, female participation among beneficiaries was relatively high (24%) due to program support services like land preparation and input provision. The mean age for beneficiaries and non-beneficiaries was 55.31 ± 9.25 and 51.32 ± 9.71 years, respectively. This trend, suggesting a gradually ageing workforce, has implications for productivity and underscores the need for youth engagement strategies in agriculture. Most respondents were married, with 93% of beneficiaries and 88% of non-beneficiaries reporting marital status. This demographic pattern suggests an available source of family labour, a crucial factor in smallholder maize production. Educational attainment was relatively high; both the beneficiaries and non-beneficiaries spent an average of 11.68 ± 5.63 and 9.8 ± 5.20 years in school, suggesting a relatively high level of literacy, which can facilitate technology adoption and better farm management. Average household size for beneficiaries and non-beneficiaries was 6.51 ± 2.32 and 6.75 ± 1.91 persons, respectively, reflecting the typical rural household composition in Nigeria. This provides a potential labour pool for on-farm activities and is crucial for enhancing productivity.

Table 1. Socio-economic characteristics of the maize farming households

Variables	Beneficiaries		Non-Beneficiaries		T-Values
	Mean	Std. Dev	mean	Std. Dev	
Male household head	0.75	0.42	0.92	0.50	
Age of the household head	55.31	9.25	51.32	9.71	2.08**
Married Household head	0.93	0.42	0.88	0.45	
Household Size	6.51	2.32	6.75	1.91	1.23
Level of education	11.68	5.63	9.8	5.20	2.73***
Year of experience	22.40	8.99	22.65	9.23	0.22
Maize Farmers Association	1	0	0.45	0.28	
Access to credit	0.78	0.32	0.30	0.31	
Farm size	7.68	2.9	5.05	1.87	8.42***
Land Tenure (rental land)	0.68	0.50	0.50	0.41	
Primary Occupation (farming)	0.65	0.33	0.56	0.23	

Source: Data Analysis (2023) If the *t-ratio* is greater than 2.576, then it is significant at 1%. If the value lies between 1.96 and 2.576, then it is significant at 5%. If the value is between 1.64 and 1.96, then it is significant at 10%. (***), (**), and (*) denote significance at 1%, 5%, and 10%, respectively

Farming was the primary occupation for 65% of the beneficiaries and 56% of non-beneficiaries. While beneficiaries were more likely to treat farming as a main income source, non-beneficiaries diversified into trading and other occupations, possibly due to limited access to farm support services. Regarding farm size, beneficiaries cultivated an average of 7.68±2.9hectares, while non-beneficiaries managed 5.05±1.87 hectares, indicating that ABP participants operate on a relatively larger scale, which may be due to input support and easier access to credit. The mean years of experience in maize farming were relatively comparable: 22.4±8.99 years for beneficiaries and 22.65±9.23 years for non-beneficiaries. Such experience is valuable for optimising input use and coping with climatic and market risks. Land tenure security was low for both groups, with the majority renting land (68% of beneficiaries and 50% of non-beneficiaries). This may limit long-term planning and investment in land improvements. Notably, 100% of beneficiaries were members of farmer cooperatives, compared to only 45% of non-beneficiaries. This reflects the ABP’s entry

requirement and underscores the role of social capital in program access. Access to credit was more prevalent among beneficiaries (78%) than non-beneficiaries (30%). Non-beneficiaries had markedly lower access, reinforcing the barriers they face in adopting modern practices.

Profitability Analysis of Maize Production

Table 2 presents the cost and return estimates for both groups. Beneficiaries earned an average net farm income of ₦178,191.50 per hectare, which is higher than that of the non-beneficiaries (₦142,619.30 per hectare). This difference was statistically significant ($p < 0.001$), indicating that ABP participation enhanced profitability. For beneficiaries, major cost components included inorganic fertiliser (30.47%) and labour (21.58%). Non-beneficiaries, however, spent a disproportionate 46.12% of total costs on fertiliser, reflecting inefficiencies or lack of bulk-purchase discounts afforded to ABP participants. These findings suggest that access to subsidised inputs through ABP plays a critical role in reducing production costs and boosting profitability.

Table 2: Average Costs and Returns to Maize Farming among beneficiaries and non-beneficiaries of anchor borrowers' programme

Items	Beneficiary			Non-beneficiary			T -test
	Average Value	Average Value/Ha	%	Average Value	Average Value/Ha	%	
Farm Size	7.68	1.0		5.05	1.0		
Revenue							
Sales	2,380,000.00	309,895.83		1,410,000.00	279,207.92		
Total Revenue	2,380,000.00	309,895.83		1,410,000.00	279,207.92		9.56***
Variable Costs							
Maize seeds	154,080.00	20,062.50	15.23	103,521.00	20,499.21	15.00	
Pesticides	19,800.00	2,578.13	1.95	24,745.00	4,900.00	3.58	
Organic fertilizers	4,113.50	535.61	0.40	1,414.00	280.00	0.20	
In-organic fertilizers	308,160.00	40,125	30.47	318,150.00	63,000.00	46.12	
Herbicides	29,960.00	3,901.04	2.96	11,100.00	2,198.02	1.61	
Labour cost	218,280.00	28,421.88	21.58	38,885.00	7,700.00	5.63	
Transport cost	12,840.00	1,671.87	1.27	7,423.00	1,469.90	1.07	
Other variable cost	49,220.00	6,408.85	4.87	-	-	-	
Total Variable Cost	796,453.50	103,704.90		505,238.00	100,047.10		6.38***
Fixed Costs							
Land	85,600.00	11,145.83	8.46	58,980.00	11,679.21	8.55	
File	3,850.00	501.30	0.38	1,830.00	362.38	0.26	
Cutlass	21,400.00	2,786.46	2.16	7,706.00	1,525.94	1.11	
Hoes	6,204.00	807.81	0.62	4200.00	831.68	0.61	
Knapsack	13,836.00	1,801.56	1.37	8,250.00	1,633.66	1.19	
Ridger	8,316.00	1,082.81	0.82	3200.00	633.66	0.46	
Other implements	75,830.00	9,873.69	7.50	100,368.51	19,874.96	14.55	
Total Fixed Cost	215,036.00	27,999.48		184,534.51	36,541.49		5.88***
Total Costs	1,011,489.50	131,704.40		689,772.51	136,588.60		8.89***
Gross Margin	1,583,546.50	206,191.00		904,762.00	179,160.79		7.45***
Net Farm income	1,368,510.50	178,191.50		720,227.49	142,619.30		8.53***

Source: Data Analysis (2023). If the *t-ratio* is greater than 2.576, then it is significant at 1%. If the value lies between 1.96 and 2.576, then it is significant at 5%. If the value is between 1.64 and 1.96, then it is significant at 10%. (***), (**), and (*) denote significance at 1%, 5%, and 10%, respectively

Technical Efficiency and Influencing Factors
 The maximum likelihood estimates of the stochastic production frontier model for the beneficiaries and non-beneficiaries of the Anchor Borrowers Program are presented in Table 3. The results revealed the presence of technical inefficiency among both groups of farmers in the study area based on the significance of gamma and the Likelihood Ratio (λ) test. Technical efficiency was higher among beneficiaries (mean = 0.82) than non-beneficiaries (mean = 0.78), although both groups exhibited technical

inefficiencies. This suggests that while both groups have room for improvement, ABP participation enhances productive efficiency. For beneficiaries, fertilizer significantly improved efficiency ($\beta = 0.57, p < 0.01$), indicating that 1% increase in the fertilizer would increase the technical efficiency by 0.57%, while for non-beneficiaries, both fertilizer ($\beta = 0.36, p < 0.01$) and labour ($\beta = 0.47, p < 0.01$) were significant, indicating that 1% increase in fertilizers and labour would increase the technical efficiency by 0.36% and 0.47% respectively. When all data

were pooled, fertilizers ($\beta = 0.46, p < 0.01$) and labour ($\beta = 0.27, p < 0.01$) remained key efficiency drivers.

In the inefficiency model, education and household size reduced inefficiency among beneficiaries ($\beta = -0.31, p < 0.1$ and $\beta = -1.36, p < 0.05$, respectively), while frequent extension visits paradoxically increased inefficiency ($\beta = 1.98, p < 0.05$). This means that a unit increase in level of education would reduce inefficiency by 0.31%, an additional member to the household would reduce inefficiency by 1.26%, and an increase in extension visits would increase inefficiency by 0.32%. Among non-beneficiaries, gender was a critical determinant: being male reduced inefficiency by 0.95% ($p < 0.01$). The negative coefficient of gender indicates that being a male maize farmer would reduce inefficiency by 0.95%, while a unit increase in farm size, farming experience and extension visits would increase inefficiency by 0.04%, 0.04% and 0.93 %, respectively. Conversely, increases in farm size, experience, and extension contacts all contributed to greater inefficiency, possibly reflecting challenges in scaling without institutional support.

For the pooled model, participation in ABP ($\beta = -4.86, p < 0.1$), gender ($\beta = -2.99, p <$

0.1), and cooperative membership ($\beta = -2.73, p < 0.05$) significantly reduced inefficiency, while farm size ($\beta = 0.12, p < 0.05$) and extension visits ($\beta = 2.77, p < 0.1$) increased inefficiency. The positive coefficient of farm size revealed that a unit increase in farm size would increase inefficiency by 0.12%, while the negative coefficient of gender, membership of association and participation in Anchor Borrowers Program indicates that being a male maize farmer, member of cooperatives and beneficiaries of Anchor Borrowers Program would reduce inefficiency by 2.99%, 2.73% and 4.86 % respectively, highlighting the collective benefit of structured interventions.

4.4 Distribution of Technical Efficiency

The efficiency distribution (Table 4) shows that a higher proportion of beneficiaries (52%) achieved technical efficiency above 90%, compared to 41.82% of non-beneficiaries. This further supports the claim that ABP participation enhances farmers' ability to utilise resources optimally. However, notable inefficiencies remain even among programme beneficiaries, with some operating at less than 50% efficiency, indicating room for improvement in resource use and management practices.

Table 3: Determinants of technical efficiency and inefficiency among maize farmer beneficiaries and nonbeneficiaries of the Anchor Borrower Programme in the study area

	Variable	Beneficiary			Non-Beneficiary			Pooled		
		Coefficient	SE	t-ratio	Coefficient	SE	t-ratio	Coefficient	SE	t-ratio
b0	Constant	7.07	1.03	6.88***	0.94	0.93	1.00	5.69	0.66	8.66***
b1	Lnfixedinput	-0.35	0.30	-1.17	0.24	0.16	1.46	-0.14	0.14	-1.00
b2	Lnfertilizer	0.57	0.17	3.44***	0.36	0.10	3.47***	0.46	0.12	3.84***
b3	LnLabour	0.08	0.11	0.69	0.47	0.17	2.80***	0.27	0.07	3.79***
b4	LnSeeds	0.26	0.29	0.90	0.00	0.08	0.04	0.09	0.11	0.87
<i>inefficiency model</i>										
d0	Constant	-0.14	0.99	-0.14	-4.52	2.38	-1.90*	7.02	5.10	1.38
d1	Age of respondent	0.03	0.04	0.61	0.03	0.02	1.30	-0.04	0.04	-1.05

Variable	Beneficiary			Non-Beneficiary			Pooled		
	Coefficient	SE	t-ratio	Coefficient	SE	t-ratio	Coefficient	SE	t-ratio
d2 Gender of respondent	0.05	0.97	0.05	-0.95	0.29	3.31***	-2.99	1.68	-1.78*
d3 Levels of education	-0.31	0.17	-1.87*	0.20	0.14	1.46	-0.23	0.18	-1.27
d4 Household Size	-1.26	0.63	-1.99**	0.41	0.40	1.02	-1.99	1.33	-1.49
d5 Farm size	0.12	0.10	1.21	0.04	0.02	2.03**	0.12	0.05	2.34**
d6 Farming experience	0.02	0.05	0.39	0.04	0.02	2.14**	0.03	0.04	0.68
d7 Extension Visit	1.98	0.95	2.10**	0.93	0.52	1.81*	2.77	0.92	3.02***
d8 Access to Credit	-0.02	0.03	-0.44	-0.43	0.34	-1.27	-0.02	0.02	-0.81
d9 Membership of Cooperative	-0.38	0.90	-0.42	0.00	1.00	0.00	-2.73	1.14	-2.39**
d10 Participation in ABP Programme							-4.86	2.55	-1.90*
sigma2	0.41	0.18	2.29**	0.13	0.06	1.98**	0.79	0.27	2.98***
gamma	0.34	0.24	1.42	0.67	0.19	3.64***	0.71	0.16	4.40***
log likelihood function	-36.63			-5.22			-67.34		
LR test of the one-sided error	27.44			25.62			44.09		

Source: Data Analysis (2023). If the *t-ratio* is greater than 2.576, then it is significant at 1%. If the value lies between 1.96 and 2.576, then it is significant at 5%. If the value is between 1.64 and 1.96, then it is significant at 10%. (***), (**), and (*) denote significance at 1%, 5%, and 10%, respectively

Table 4: Distribution of the beneficiaries and non-beneficiaries of the Anchor Borrower Programme by technical efficiency

Technical efficiency range (%)	Beneficiary			Non-Beneficiary			Pooled		
	F	%	Cum. %	F	%	Cum. %	F	%	Cum. %
0 – 20	0	0.00	0.00	6	5.45	5.45	4	1.90	1.90
21 – 30	0	0.00	0.00	6	5.45	10.90	0	0.00	1.90
31 – 40	8	8.00	8.00	0	0.00	10.90	0	0.00	1.90
41 – 50	4	4.00	12.00	3	2.73	13.63	12	5.71	7.61
51 – 60	4	4.00	16.00	5	4.55	18.18	10	4.76	12.37
61 – 70	0	0.00	16.00	0	0.00	18.18	12	5.72	18.09
71 – 80	8	8.00	24.00	11	10.00	28.18	39	18.58	36.67
81 – 90	24	24.00	48.00	33	30.00	58.18	91	43.33	79.98
91 – 100	52	52.00	100.00	46	41.82	100.00	42	20.00	100.00
Total	100	100.00		110	100.00		210	100.00	
Mean	0.82			0.78			0.79		

Minimum	0.36	0.05	0.05
Maximum	0.96	0.96	0.94

Source: Data Analysis (2023)

DISCUSSION

The findings affirm the positive role of the Anchor Borrowers' Programme in improving the economic performance and technical efficiency of maize farmers in Osun State. The dominance of male farmers aligns with previous reports that maize farming in Nigeria is labour-intensive and male-led (Oladejo & Adetunji, 2012). However, the higher female participation among beneficiaries suggests that government interventions can encourage inclusivity when input and land preparation support are provided. The observed ageing farming population, with a mean age exceeding 50 years, raises concerns about the long-term sustainability of maize production in the region. This is higher than the national average reported by Oladejo and Adetunji (2012) and may impact labour availability and productivity. The higher education levels among respondents suggest potential for improved adoption of innovations (Reimers and Klasen, 2013; Luo *et al.*, 2017). The significant role of cooperative membership, credit access, and extension services among beneficiaries underscores the importance of institutional support, echoing findings by Danso-Abbeam *et al.* (2018) and Lowder *et al.* (2016). The superior profitability and technical efficiency of beneficiaries confirm the efficacy of the ABP. Investment in fertiliser emerged as a key driver of efficiency. However, the finding that extension visits increased inefficiency is counterintuitive and warrants further investigation. This may be due to the quality, frequency, or relevance of extension services provided (Danso-Abbeam *et al.*, 2018).

The inefficiency associated with larger farm sizes and female-headed households among

non-beneficiaries aligns with studies indicating gender disparities and resource constraints in African agriculture (Ogunlela and Mukhtar, 2009). Participation in the ABP, cooperative membership, and male gender consistently reduced inefficiency, highlighting the role of social capital and gender dynamics in enhancing productivity.

CONCLUSION AND POLICY RECOMMENDATIONS

Participation in the Anchor Borrowers' Programme significantly enhanced the profitability and technical efficiency of maize farmers in Osun State, Nigeria. Employing both budgetary techniques and the stochastic frontier model, this study assessed the effect of ABP on the technical efficiency, profitability, and production outcomes of maize farmers in Osun and Ogun States. Beneficiaries recorded higher net farm incomes and efficiency scores than non-beneficiaries. Key drivers of efficiency included fertiliser investment, education level, household labour availability, and programme participation. However, inefficiency persisted among female farmers and larger farm holders, while extension services did not yield expected efficiency gains.

Arising from the findings of this study, the following recommendations are put forward to strengthen the ABP.

1. More maize farmers should be encouraged to participate in government agricultural support schemes, given their proven impact on profitability and efficiency.
2. Secondly, there is a need to strengthen Cooperatives to enhance their synergy in

backstopping farmer beneficiaries. Non-beneficiaries should also be encouraged to join cooperative societies to improve access to credit, inputs, and markets, following the successful model among beneficiaries.

3. Thirdly, to ensure inclusivity in accessing government programmes, there is a need for targeted support for women farmers. Tailored interventions are needed to reduce gender-based inefficiencies, including providing targeted training, inputs, and credit facilities to female farmers.
4. Finally and very importantly, there is a need to attract youth into farming. Policies should be enacted to attract younger farmers into maize production to address the ageing farmer population and ensure sector sustainability.
5. Further research is needed to investigate why extension visits increased inefficiency. Extension services should be restructured to provide more relevant, timely, and farmer-centred support.

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