

# Effect Of Fadama Iii Project On Output And Income Of Rural Farmers In Benue State, Nigeria: Logit And Probit Analysis

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## Abstract

Benue State is the agricultural hub of Nigeria where farmers produce varieties of agricultural produce for both household food industrial inputs and exports. ADAMA is Hausa coinage for irrigable agricultural farm land that offer irrigation and other support to farmers in selected States. FADAMA III is an extension of FADAMA II in the series which captures more States to increase income of FADAMA land and water users. The project made insignificant in-road towards achieving food security due to poor management of the project and attitude of the farmers in Nigeria. The study investigated the effect of agricultural development programmes (ADPs) on the output and income of rural farmers in Benue State, using Fadama III in Benue South senatorial district as a case study. The study used survey method involving a sample of 231 respondents delivered through a structured questionnaire. The data were analyzed quantitatively using proportional odds logistic regression (ordered logit, ologit). Overall, we find that the FADAMA III programme significantly increased the farm output of beneficiaries, moving it from the range 50,000-100,000 tons before the programme to a higher range (101,000-150,000 tons) per annum; and that the programme significantly increased the annual income of the beneficiaries from less than ₦100,000 prior to the programme to above ₦300,000 after. Specifically, the ologit output model indicated that use of machinery, adequate access to input, and soil treatment, each increases the probability of a farmer reporting higher output by 2.8%, 18%, and 11% respectively; and the income. logit model revealed that direct linkage to off-takers increases the probability of reporting a higher income by 19%; whereas group collaboration and good savings culture each decreases the said probability by 40% and 2.4% respectively. The implication is that most of the cultures and opportunities brought about by the Fadama III programme improved the beneficiaries' welfare. The study therefore concludes that the programme had a significant positive effect on output and income growth of rural farmers in the study area. As such, more of such ADPs are encouraged. However, the preceding phase of any future ADP in Benue State should have modules that prioritize record keeping that serves as bedrock to the practice of agriculture as a business rather than as a vocation or culture as this will help beneficiaries to keep track of their output. Secondly, farmers' knowledge on agronomic best practices should be enhanced over time through consistent capacity building workshops to keep farmers abreast with best practices that guarantee increased income at the end of each production phase.

**Keywords:** FADAMA III, ADP, logit and probit, Benue State, Agriculture.

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## I. Introduction

Agricultural growth is regarded as a key instrument of poverty reduction through boost in output and income. Any programme that aims at boosting agricultural growth is a panacea for achieving food security and poverty reduction, most country's such as Malaysia, India, Argentina, Cote d'voire, Burkina Faso, USA etc have achieved sustainable economic growth through government intervention and matchable conscious efforts of the farmers. (Ighodaro 2015)

Nigeria is a dominant agricultural society contributing about 36 percent to its workforce and contributing significantly to the country's GDP, ranking the highest employer of labour in Nigeria. Oluwatoyese (2013) opines that agricultural sector provides the resource impetus to the manufacturing sector (Pharmaceuticals, beverages, automobile part) Therefore the growth of the economy depends so much on agriculture (Ighodaro, 2015) Agriculture remains the leading contributor to Nigeria's economic growth and development. It contributed about 24 percent to the Nation's GDP growth between 2013 to 2019 and increased by about 19 percent in 2023. Agriculture provides the means of livelihood to a great chunk of our population especially the rural dwellers (Statista, 2023).

Given the growth trajectory of the sector and its importance in employment generation as well as providing incomes to most Nigerian household as well as the reduction of poverty (Izuchukwu, 2011) The Nigerian government has not relented in providing interventions and support programmes albeit policies that will ginger more focus on the sector and gearing up agricultural production for consumption, export and inputs for industrial use.

Nigeria is largely endowed with high fertile land mass largest in Africa (NPC, 2011) It is blessed with good vegetation, agro climate, rainfall, arable farmland for agricultural activities (Kamil et al, 2017). Most importantly there exists a massive labour force engaged in agricultural sector and other allied sub-sectors such as agro-business service sector and food retail, distribution and wholesale as well as agro exports (Odatola and Etumnu, 2013)

Kamil et al (2017) opines that empirical studies revealed that the contribution of agricultural output to GDP increased from 29.1 percent to 33.3 percent between the period of 1970 and 1980. However, the growth in the sector began to limp after the collapse of the oil boom leading to food shortages and rural poverty and massive labour-drift to urban centers. The decline in output of agriculture is traced back to the discovery of oil in early 1970s. The oil boom of that period changed the policy dynamics of the government of Nigeria which led to the neglect of the sector.

Successive governments have not relented in providing interventional support to agricultural sector through cock-tails of programmes and policies given the importance of agriculture as a growth driver. Some of the policies currently formulated and implemented are Agricultural transformation agenda (ATA), the Root and Tuber Expansion Program, Agricultural Development Programme (ADP), FADAMA 1-III project that birthed the value chain programme. However, those policies and programmes have suffered the same fate. The sector grapples with limited access to modern farm inputs; poor and marginal profits due to unprofitable pricing of agriculture products, land rent crisis, rising importation of food and agricultural products, lack of synergy between the industrial and agricultural sector and implementation of the programme and policies.

The ADPs were first launched in Nigeria in 1972, two years after the end of the civil war, when Nigeria was facing its first food and fibre (fruits, vegetables, seeds and nuts) shock (Auta, 2010). The project was launched against the background of a Nigerian agriculture which, in the 1950s and 1960s, had attained prominent expertise through complete reliance on small scale farmers. The main and first feature of the ADP was its reliance on the small scale farmers as the central focus for increased food production (Auta, 2002).

The ADP was designed to swiftly respond to the declining fall in agricultural productivity in the 1970s due to massive labour movement out of agriculture into more remunerative activities that were benefiting from the oil boom. Conversely, domestic recycling of oil income provided the opportunity for the government, with World Bank support to implement the ADPs. The programme provided agricultural investment and services, rural roads, and village water supplies. The government's adoption of the ADP concept put the small-holder sector at the center of the agricultural development strategy, and marked a clear shift away from capital-intensive investment projects for selected areas of high agricultural potential.

Through the instrumentality of the ADPs, increase in rural livelihood income to a reasonable extent has been raised through projects like FADAMA III whose core mandate was to sustainably increase the income level of rural dwellers. FADAMA III, also known as Third National Fadama Development Project, was a follow-up of the Second National Fadama Development Project (FADAMA II) implemented between 2002-2008, though Benue State was not involved. FADAMA III project was implemented in all the 36 states of the federation and the Federal Capital Territory (FCT) between 2009-2013. Due to the success of the programme, both in rural, semi-urban and urban areas, Fadama is a household name in Nigeria and is synonymous with development (Benue State Fadama III Compendium, 2009-2013).

Fadama III in Benue State was implemented in 20 out of the 23 Local Government Areas (LGAs). In Benue South senatorial zone, the project was implemented in six out of the nine LGAs which is the study area. The six LGAs are Otukpo, Ogbadibo, Oju, Okpokwu, Apa, and Agatu. The present study therefore investigated the effect of the programme on the output and income of rural farmers in the aforementioned area.

In Nigeria, 70 per cent of the population are involved in agricultural activities upon which they depend for sustenance and survival (Ogebe, Ali, & Olagunji, 2020). However, it is sad to note that the agricultural sector suffers serious neglect and under development. The major indicator is the ever increasing rural-urban drift which is necessitated by the fact that the rural areas are beset with underdevelopment. In a bid to ameliorate this phenomenon, successive governments in Nigeria have executed several agricultural development interventions such as the ADPs.

Generally, the ADPs are aimed at boosting agricultural production as well as contributing to rural livelihood and food security (Inegbedion et al 2018). The project implementation strategies of the ADPs therefore comprised a re-organized and revitalized agricultural extension system, an effective farm input distribution system, an autonomous ADP management unit, a rigorous monitoring system and a joint state/federal responsibility. In addition, the components of the ADPs which constitute the vehicle for achievement of the eye-catching objectives are crop production, on-farm adaptive research, farm input distribution, farmers training, media support, infrastructural development, and project funding (Ugwu, 2007).

These achievements notwithstanding, the project have been constrained by undue political interference by state governments, cash flow instability due to irregular payments of counterpart funding by some state governments, rapid staff turnover in most ADPs and adverse effects of some macroeconomic policies of government, such that the ADPs in most states of the federation now represents a mere symbol of past glory (Auta & Dafwang, 2010). These have negatively affected the consistency in participation by beneficiaries of the project, thereby introducing an inconsistency in the flow of beneficiaries' income, reduced annual income earning, dwindling financial flow, thus making it difficult to stick to the funding instrument (business plan) which has time and season-based components (Abutu, 2014).

The foregoing implies that the ADP in Nigeria requires resuscitating to ensure that it once again will contribute to changing the sphere of agriculture in the country. This is even so because the prospect of food security and the attendant employment generation for the teeming population is in jeopardy. If not reversed, this ugly situation will engender poverty and hunger in the rural areas due to dwindling farm output and low income level. Worst still are the social consequence factor associated with unemployment in midst of natural endowment (fertile land, good vegetation and adequate rainfall) that this study is predicated with special focus on Fadama III project in Benue South Senatorial Zone, to assess the effect of the project on farm output and income of rural farmers, while also identifying challenges confronting the beneficiaries in the study area. Given this background, the study seeks to achieve the following objectives: to determine the effect of the Fadama III programme on beneficiaries farm output in Benue South senatorial zone; ascertain whether the Fadama III

programme has significant effect on beneficiaries' income in the study area; and identify the major challenges beneficiaries in the study area are facing following the Fadama III programme.

### **Theoretical review**

#### **Agricultural extension theory**

This theory propounded by Seaman Knapp in 1914 focuses on the dissemination of agricultural knowledge and practices to farmers. It is relevant when studying how ADP and Fadama III extension services contribute to increased farm output and income generation among rural farmers.

#### **Human capital theory**

This theory emphasizes the role of education, training, and skill development in increasing individual and household productivity. It can be applied to understand how capacity-building initiatives under ADP and Fadama III impact farmers' income-generating abilities. This theory was propounded by Gary Becker in 1964.

#### **Technology adoption theory**

The theory of technology adoption, often associated with the diffusion of innovations theory, was developed by Rogers (1962). He first proposed this theory in his book titled "Diffusion of Innovations," which was originally published in 1962. The theory of technology adoption examines the factors influencing the adoption of new agricultural technologies and practices. It can help explain how farmers in Benue State adopt innovations introduced through ADP and Fadama III, affecting their farm output and income.

Among these theories, the researcher adopted the agricultural extension theory as it is close to the broad and specific objectives of the study.

### **Empirical review**

Akmeta and Saliu (2016), studied the impact of FADAMA project on agricultural development of Kwara State, Nigeria. The study aimed at assessing the impact of low cost improved irrigation technology under the World Bank finance on agricultural production. The study adopted purposive data sampling technique and selected 120 respondents for interview. The study used the student t statistics to measure whether there is a significant effect of output of FADAMA participants in their output. The result revealed that there is a significant difference between the productivity of FADAMA and non FADAMA participants in Kwara State, Nigeria. Ayanwale and Alimi (2004) in a similar study though with different estimation technique found that Fadama project exerted a positive impact on the participants and has a great potential of reducing rural poverty.

Abdul, and Mudassir, (2021) studied the impact of FADAMA III development project on livelihood in Kwara Local Government Area of Sokoto State with the aim of determining the effects of the project on participants income and livelihood. The study adopted purposive sampling technique using a participatory approach. The findings revealed that FADAMA III project recorded success in increasing the income level and livelihood of the beneficiaries.

Omonijo et al. (2014) conducted a study on impact of Agricultural Development Programmes on rural dwellers in Nigeria, using the people of IsanEkiti, Oye Local Government Area of Ekiti State as case study. Empirical result revealed that Agricultural Development Programmes have significantly increased food production in the locality through increased provision of pesticides and improved seeds to farmers, establishment of new infrastructure and provision of fertilizers. However, accessibility of credit by farmers had no significant effect on increased Agricultural productivity.

Eze (2009) in a study of The impact of the national FADAMA II development project in alleviating rural poverty and improving agricultural production in Imo State, Nigeria applied a multi-staged random sampling technique to select the participants for the analysis. The result of the paired t-test showed that the national Fadama II development project impacted positively and significantly on beneficiaries' output, income and labour use level at 5 per cent level of significance.

Inegbedion et al (2018) studied the effect of financing agriculture through agricultural extension services of agricultural development programmes (ADP) in Edo State. Their study was motivated by fall in agricultural productivity and concern to improve domestic agricultural output. The study adopted stratified random sampling technique to select participants for the interview and data collection. The data was analysed using t-statistics and Pearson correlation coefficient. The result obtained revealed that extension services of ADP have impacted significantly on crop development in the selected communities but had no significant impact on employment generation.

In another study by Arigor et al (2023) on the effect of FADAMA III on rice farmers in Abakaliki Local Government Area, Ebonyi State, Nigeria. The study adopted multiple regression analysis and found that FADAMA III project contributed significantly to increase in output and income of the beneficiaries of the project. The study also revealed a positive and significant correlation between farm size, household size of the beneficiaries and the project.

The study by Dare, Sunday, Olumiyiwa and Onyekwere (2014) examined the impact of ADP on rural dwellers in Nigeria. The researchers used multiple linear regression method of analysis from data obtained from administered questionnaires, and the empirical results reveal that ADP has significantly increased food production in the study area through increased provision of pesticides, improved seeds to farmers, infrastructure, and provision of fertilizers.

Umar, (2019) in a study of the assessment of the effect of FADAMA III project on women farmers in Shelleng Local Government Area of Adamawa State, Nigeria. The study adopted descriptive and inferential statistics after collecting data for the study through primary sources. The result revealed a significant increase in

farm size, output and income because of the introduction of new technologies. Their findings also showed that there was improvement in consumption expenditure of the beneficiaries of FADAMA III project.

## II. Methodology

The study adopted econometric method of logit and probit used in estimating qualitative data for cross sectional analysis. Thus, public opinion survey which made use of the researcher’s designed questionnaire was applied. This method was used because the study required primary data from the respondents.

### Model specification

The study used proportional odds (ordered logit) regression method of analysis. In such a case, the dependent variable is categorical and rank-ordered. The central idea behind the ordinal outcomes is that there is a latent continuous metric (defined as  $y^*$ ) underlying the observed responses (Salisu, 2016).  $y^*$  is an unobserved variable whose effect is felt when it crosses certain thresholds. According to Salisu (2016), the general form of the latent variable model is,

$$y_i^* = \alpha_0 + \alpha_1 x_{i1} + \alpha_2 x_{i2} + \dots + \alpha_k x_{ik} + e_i \tag{1}$$

$$y_i^* = x_i' \alpha + e_i \tag{2}$$

$$y_i = j \text{ if } u_{j-1} < y_i^* \leq u_j \tag{3}$$

Where,  $i = 1, \dots, N$ .

The probability that observation  $i$  will select alternative  $j$  is:

$$p_{ij} = p(y_i = j) = p(u_{j-1} < y_i^* \leq u_j) \tag{4}$$

$$= \frac{F(u_j - x_i' \alpha) - F(u_{j-1} - x_i' \alpha)}{F(u_j - x_i' \alpha) - F(u_{j-1} - x_i' \alpha)} \tag{5}$$

For the ordered logit, F is the logistic cumulative distribution function (cdf), defined as,

$$F(z) = \frac{e^z}{1 + e^z} \tag{6}$$

In the output function,  $y_i = (1,2)$  for (low, high) with one threshold; and in the income function,  $y_i = (1,2,3,4,5,6)$  for (<100,000; 101,000-200,000; 201,000-300,000; 301,000-400,000; 401,000-500,000; above 500,000 Naira) with five thresholds.

The output model is specified as,

$$\text{Outputrating} = f(\text{Householdsize, Machinery, Accesstoinput, Soiltreatment}) \tag{7}$$

And the income model is specified as,

$$\text{IncomeAftFDM} = F(\text{Householdsize, Linkage, Collaboration, Savingsculture, Experience}) \tag{8}$$

### Data Presentation

**Table 5: Descriptive statistics of respondents’ household size and farming experience**

Variable	Obs	Mean	Std. Dev.	Min	Max
HHSsize	231	5.536797	2.622177	1	9
Experience	231	13.80519	5.92351	3	28

Source: Field survey, 2023

Data in Table 5 show that the respondents had a mean household size of 6. Smaller family size implies fewer available hands for farm labour. According to Ezihe et al., (2014) the smaller the household size, the higher the need to employ hired labour to augment family labour thereby implying more cost. There is also a mean farming experience of 14 years which implies that the respondents have a good knowledge of farming and can provide objective responses to questions, especially as most of them have been into farming before the Fadama III intervention.

### FADAMA III programme and farm output of beneficiaries

We considered the average annual output level from farming activities of the beneficiaries in the study area before and following the FADAMA III programme (Table 6 here). We discovered that up to 85% of the farmers sampled had annual output level within 100,000 tons before the FADAMA III programme. However, the average annual output level increased to 101,000 - 150,000 tons afterwards. The respondents were also asked to rate their farm output between low and high since benefiting from the Fadama programme (Table 7 here). As indicated in Table 7, 35% of the beneficiaries rated their output *low* as against 65% that rated it *high* following the Fadama III programme in the study area.

Additionally, we investigated the effect of specific Fadama-oriented farming practices on the output of the farmers using an ordered logit (ologit) model. The log odds results and the marginal effects results are available in Appendix II. Of interest here is the later because it shows the marginal effects at each outcome (low & high).

**Table 8: Marginal effects for the ologit result of the output-rating model**

Independent Variable	Low output (dy/dx)	High output (dy/dx)
HHSsize	-.1054528**	.0031353**
Machinery Yes	-.0129064**	.0280968*
Accesstoinput Low	.3301233**	-.110827*
Average	-.4371617**	.1928019*
Adequate	-.2476048**	.1821902*
Soiltreatment Sometimes	.0695137	-.0316957
Regularly	.0139089	.1093098**

Source: Results from STATA 16 [(\*\*) Sig. @ 0.01; (\*) Sig. @ 0.05]

In the first case (second column), the result shows that an increase in household size by one unit reduces the probability of reporting low output by about 11 per cent; use of machinery diminishes the probability of reporting low output by 1.3 per cent compared to not using same; having low access to farm input increases the risk of reporting low output by 33 per cent over having no access at all; but having average access to farm input reduces the risk of reporting low output by 44 per cent over having none; while having adequate access to farm input lowers the likelihood of reporting low output by 25 per cent over having none. Lastly, frequency of soil treatment (sometimes or regularly) has no significant effect on the probability of reporting low output compared to none (no treatment).

In the other result (third column), an increase in household size by one unit increases the probability of reporting high output by 0.3 per cent; use of machinery increases the probability of reporting high output by 2.8 per cent compared to using none; having low access to farm input decreases the risk of reporting high output by 11 per cent over having no access at all; but having average or regular access to farm input raises the probabilities of reporting high output by 19.3 per cent or 18.2 per cent respectively, compared to having none. Lastly, having soil treatment at little intervals (sometimes) has no significant effect on the probability of reporting high output compared to none (no treatment); but having regular soil treatment significantly increases the said probability by 11 per cent.

In summary, household size, use of machinery, average, and adequate access to farm input all lower the probability of reporting low output; while all of that plus regular soil treatment, all increase the probability of reporting high output. Thus, the Fadama III programme had positive effect on increasing farm output of the beneficiaries.

### FADAMA III programme and income of beneficiaries

The data in Table 9 indicates the beneficiaries' income before and after the Fadama III programme (Table 9 here). Following participation in the FADAMA III project, only 2% now earned below ₦100,000 (compared to 63% before), only 8% earned between ₦100,000 and ₦200,000 (compared to 27% before), 25% earned between ₦201,000 and ₦300,000 (compared to 10% before). Interestingly, a whopping 55% now earned between ₦301,000 and ₦400,000 (no one earned this much before), and 6% now earned above ₦500,000 which never happened before. Data in Table 9 implies that the average annual income of the farmers increased from less than ₦100,000 before the Fadama III to around ₦350,000 following its implementation. This appears to suggest a positive effect of the programme on the income of the rural farmers who benefited from the programme.

The study further explored the effect of the programme on beneficiaries' income using the ordered logit (ologit) model. There are six orderings of the dependent variable (income after the Fadama III programme) from 1 (<₦100,000) to 6 (>₦500,000). The independent variables are household size, linkage to off-takers, group collaboration, savings culture, and experience. The log odds results and the marginal effects results are available in Appendix II. We are more interested in the latter because it shows the marginal effects at each outcome (income levels 1-6).

**Table 10: Marginal effects for the ologit result of the income (after Fadama III) model**

Independent Variable	Less than ₦100,000 (dy/dx)	₦100,000- ₦200,000 (dy/dx)	₦201,000- ₦300,000 (dy/dx)	₦301,000- ₦400,000 (dy/dx)	₦401,000- ₦500,000 (dy/dx)	Above ₦500,000 (dy/dx)
HHSsize	-0.0004129	-0.0009102	-0.0014427	.0013764	.000327	.0010623
Linkage Yes	-.02809**	-.07808***	.2568727***	.2216764**	.398567***	.18616***
Collaboration Yes	.0136246*	.0337056**	-.0654477**	-.0573604**	-.0156251	-.03979**
Savingsculture Fair	-.0074629	-.021047	-.0574675*	.0398159	.0153204	.030841*
Good	.0192307*	.0447558*	.0636494*	.064435**	-.0387383**	-.024462*
Experience	-.0007605	-.0016767	.0265754***	.0253552***	.0060231***	.0019569

Source: Results from STATA 16 [(\*\*\*) Sig. @ 0.01; (\*\*) Sig. @ 0.05; (\*) Sig. @ 0.1]

In the first case (second column), the result shows that an increase in household size (HHSsize) has no significant effect on a farmer reporting income less than ₦100,000 (outcome 1); having linkage to off-takers/financiers significantly lowers the probability of reporting outcome 1 by 2.8 per cent compared to having no linkages; engaging in group collaboration slightly increases the probability of reporting outcome 1 by 1.4 per cent compared to having no group collaborations; a fair savings culture, compared to a poor one, has no significant effect on the probability of interest, whereas a good savings culture slightly increases the probability. Lastly, years of farming experience has no significant effect on the probability of interest.

In the second case (third column), the result means that an increase in household size (HHSsize) has no significant effect on a farmer reporting income range ₦100,001-₦200,000 (outcome 2); having linkage to off-takers/financiers significantly lowers the probability of reporting outcome 2 by 7.8 per cent compared to having none; engaging in group collaboration slightly increases the probability of reporting outcome 2 by 3.4 per cent compared to having none; a fair savings culture, compared to a poor one, has no significant effect on the probability of interest, whereas a good savings culture slightly increases the probability. Lastly, years of farming experience has no significant effect on the probability of reporting outcome 2.

In the third case (fourth column), the result means that an increase in household size (HHSsize) has no significant effect on a farmer reporting income range ₦201,000- ₦300,000 (outcome 3); having linkage to off-

takers/financiers significantly raises the probability of reporting outcome 3 by 26 per cent compared to having none; engaging in group collaboration significantly decreases the probability of reporting outcome 3 by 6.5 per cent compared to having none; and a fair or good savings culture, compared to a poor one, each has no significant effect on the said probability. Lastly, a unit increase in number of years of farming experience significantly increases the probability of reporting outcome 3 by 2.7 per cent.

In the fourth case (fifth column), the result means that an increase in household size (HHSIZE) has no significant effect on a farmer reporting income range ₦301,000- ₦400,000 (outcome 4); having linkage to off-takers/financiers, compared to having none, significantly increases the probability of reporting outcome 4 by 22 per cent; engaging in group collaboration, compared to having none, significantly lowers the probability of reporting outcome 4 by 5.7 per cent ; and a fair savings culture, compared to a poor one, has no significant effect on this probability, whereas a good savings culture significantly increases the probability of reporting outcome 4 by 6.4 per cent . Lastly, a unit increase in the number of years of farming experience significantly increases the probability of reporting outcome 4 by 2.5 per cent.

In the fifth case (sixth column), the result in Table 10 means that an increase in household size (HHSIZE) has no significant effect on a farmer reporting income range ₦401,000-₦500,000 (outcome 5); having linkage to off-takers/financiers, compared to having none, significantly raises the probability of reporting outcome 5 by 40 per cent; engaging in group collaboration has no significant effect on the probability of reporting outcome 5; a fair savings culture, compared to a poor one, has no significant effect on the said probability, but a good savings culture decreases the probability of reporting this level of income by 3.9 per cent. Lastly, a unit increase in the number of years of farming experience significantly increases the probability of reporting outcome 5 by 0.6 per cent.

In the sixth case (last column), the result in Table 10 means that an increase in household size (HHSIZE) still has no significant effect on a farmer reporting income range above ₦500,000 (outcome 6); having linkage to off-takers/financiers, compared to having none, significantly raises the probability of reporting outcome 6 by 19 per cent; engaging in group collaboration significantly lowers the probability of reporting outcome 6 by 4 per cent; a fair or good savings culture, compared to a poor one, has no strong significant effect on the said probability. Lastly, number of years of farming experience has no significant effect on the probability of reporting outcome 6.

**Model diagnostics**

First, we checked the Chi-Square statistics of the ologit models and their probabilities. The output mode has a Chi-Sq of 17.58 (p = 0.000) while the income model has a Chi-Sq of 194.85 (p = 0.000). The p-values are significant at the 0.01 level which implies that both models are adequate. Second, we checked for the significance of the latent variables (test for equality of cut points) based on the ordering of the dependent variable (O'Halloran, 2020). In the output model we obtained the result,

```
. test _b[/cut1] = 0
(1) [/]cut1 = 0
chi2( 1) = 18.31
Prob > chi2 = 0.000
```

Source: Results from STATA 16

We therefore reject the null that the cut-point is equal to zero. In other words, the two categories of the dependent variable (low output ~ high output) are significantly different from each other. This means the ologit model for output rating is adequate. Similarly, the result for the income ologit model is,

```
. test _b[/cut1] = _b[/cut2] = _b[/cut3] = _b[/cut4] = _b[/cut5]
(1) [/]cut1 - [/]cut2 = 0
(2) [/]cut1 - [/]cut3 = 0
(3) [/]cut1 - [/]cut4 = 0
(4) [/]cut1 - [/]cut5 = 0
chi2( 4) = 102.48
Prob > chi2 = 0.0000
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Source: Results from STATA 16

we therefore reject the null that the 5 cut-points are equal. Thus, the six categories of the dependent variable (income level < N100,000 ~ above N500,000) are significantly different from each other. This means the ologit model for income level is adequate.

Lastly, we checked for the goodness of fit using of the ordered logit models using the *ologitgof* command in STATA. *ologitgof* is a postestimation command that calculates the ordinal HL, PR, and Lipsitz goodness-of-fit tests (Fagerland & Hosmer, 2017). The p-values must be high (at least > 0.05) for us to conclude there is a good fit. Results are shown below.

**Table 11: Gof result for the ologit outputrating model (Number of observations = 231)**

Number of Tests	groups/patterns	Statistic	df	P-value
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Ordinal HL	10	7.912	8	0.4421
PR(chi2)	98	190	.	.
PR(deviance)	98	175.792	190	0.7622
Lipsitz	10	19.745	9	0.0916

(HL = Hosmer-Lemeshow; PR = Pulkstenis-Robinson)

**Table 12: Gof result for the ologit income model (Number of observations = 231)**

Number of Tests	groups/patterns	Statistic	df	P-value
Ordinal HL	10	58.066	44	0.0759
PR(chi2)	67	189.218	349	0.8231
PR(deviance)	67	296.351	660	1.0000
Lipsitz	10	24.045	9	0.0942

(HL = Hosmer-Lemeshow; PR = Pulkstenis-Robinson)

Source: Results from STATA 16

The results show that the p-values are greater than 0.05, indicating that none of the tests give evidence of lack of fit.

### III. Discussion Of Result

From the ologit result in Table 8, good agricultural practices inculcated in the farmers through the Fadama III programme, such as use of machinery, adequate access to input, and regular soil treatment, significantly increases the probability of a beneficiary in the study area reporting high output level. Hence, we reject the null hypothesis which means that the programme had significant positive effect on beneficiaries' output in the area. This is confirmed by data in Table 6.

Also the ologit result in Table 10. It shows that strategies of the Fadama III programme such as linkage to off-takers, group collaboration, and good savings culture, each significantly increases the probability of a beneficiary reporting a higher income level. We therefore reject the second null hypothesis and conclude that the Fadama III programme had significant positive effect on beneficiaries' income in the study area. This is also confirmed by data in Table 9.

The study finds that the FADAMA II programme has significant positive effect on the output of farmers who benefited from it in Benue South Senatorial District of the State. The average output recorded by farmers before project intervention was in the range 50,000-100,000 tons, but upon intervention, farmers' capacities were built, cooperative existence was encouraged, proper record keeping was emphasized, improved agronomic practices were demonstrated for farmers to adopt, demonstration farms were set up for trial and to encourage adoption which culminated into high inducement/encouragement to farmers for increased production and output, thus taking the output of beneficiaries to a higher range (101,000-150,000 tons).

The findings are similar with those of Arigo et al. (2023) who found that Fadama III has significantly increased farm size, output and income of beneficiaries in Abakaliki, Ebonyi. Akpata and Saliu (2016) and Ayanwale and Alim (2004) findings are in tandem with the findings of this study that Fadama III project has the potentials of increasing incomes and livelihood of rural farmers given the Fadama technologies and incentives.

The study finds that the FADAMA II programme had significant positive effect on beneficiaries' income level in the study area. In a nutshell, their average income rose from less than ₦100,000 (before) to above ₦300,000 (after). The implication of this result is that farmers were earning more after benefiting from the programme. This change could be attributed to the capacity building training, group collaborations, linkage to off-takers, and savings culture that were brought about by the Fadama III programme. Specifically, farmers with direct linkage to off-takers and those with moderate saving culture have increased chances of reporting a higher income level.

The findings of this study is supported by that of Abdul, and Mudassir, (2021) which shows that Fadama III, has a significant positive effect on the income and output of beneficiaries in Sokoto State

Despite the positive effects of the programme in the form of increased output and income, the study uncovered some challenges in the programme that may have inhibited more benefits. Top of them is low access to farm machinery. As much as the beneficiaries would have wanted, they did not always have the machinery needed for commercial farming due to the limited number of available machinery.

A second challenge revealed was delay in accessing farm inputs. The beneficiaries depended on the programme for seedling, fertilizer, and cash crops, but these were not readily available and had to be rationed at times. When this happened, it caused confusion and delay. Luckily, it happened infrequently. Bureaucracy and working in groups also posed some setbacks

The study assessed the effect of agricultural development programme (ADP) on farm output and income of rural farmers in Benue State, using Fadama III in Benue south senatorial district as a case study. From the proportional odds logistic regression, the study finds that (i) use of machinery, adequate access to input, and soil treatment, each increases the probability of a farmer reporting higher output by 2.8%, 18%, and 11% respectively; (ii) direct linkage to off-takers increases the probability of reporting a higher income by 19%;

whereas group collaboration and good savings culture each decreases the said probability by 40% and 2.4% respectively.

#### **IV. Policy Implication And Recommendations**

Based on the findings of this study, the study proffered the following policy

The preceding phase of any future agricultural development programme in Benue State should have modules that prioritize record keeping that serves as bedrock to the practice of agriculture as a business rather than as a vocation or culture. This will help beneficiaries to keep track of their output. Farmers' knowledge on agronomic best practices should be enhanced over time through consistent capacity building workshops to keep farmers abreast with best practices that guarantee increased income.

#### **V. Conclusion**

Based on the empirical evidence presented, the study concludes that the Fadama III programme has a significant positive effect on output and income growth of rural farmers in the study area. The implication is that it has improved the welfare of the beneficiaries.

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