Evaluating the Development Impact of Fadama III project on Smallholder Farmers: Empirical Evidence from Ebonyi State, Nigeria.

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Abstract

According to the World Bank, Nigeria has over 100 million people living below the US$1.90 poverty line. Most of these poor people are rural smallholder farmers. Fadama III project is an ongoing agricultural intervention aimed at alleviating poverty and food insecurity amongst smallholder farmers in Nigeria. The success of this project is important for achieving SDG 1 (no poverty) and SDG 2 (zero hunger) in Nigeria, yet little is known about the developmental impact of this project on smallholder farmers. It is against this background that this study evaluated the development impact of the Fadama III project on the food security, income, and crop yield of smallholder farmers. The study used a quasi-experimental design and propensity score matching to analyze primary data collected from 300 farmers. Data was collected using a questionnaire survey and farmers were sampled using the multistage random sampling technique. The results show that Fadama III reduces food insecurity by 1.3 points on the household hunger scale and increases farmers' income by ₦342553 (local currency) and their crop yield by 1.2 tons per hectare. The study concluded that Fadama III project is successful in contributing to the achievement of SDG 1 and SDG 2 in Nigeria.

Keywords: Fadama III, Crop Yield, Food Security, Farm Income, Smallholder Farmers

Introduction

In Africa, agriculture is an important sector of the economy that contributes 15% of the continent's gross domestic product, employs 65% of the workforce, and serves as the main source of income for most Africans (Kamara et al., 2019). Agriculture has the potential to alleviate poverty and hunger in Africa (NEPAD, 2013). Smallholder farmers are the drivers of most African economies, they contribute significantly to food security, agricultural production, and conservation of biodiversity. Globally, there are 500 million smallholder farms which provides the main source of livelihoods for about 2 billion people (Kamara et al., 2019). Smallholder farmers provides 80% of the food consumed in sub-Saharan Africa and Asia, and provides 70% of the total food required in Africa (UNCTAD, 2015). Smallholder agriculture serves as direct employment for about 175 million people in Africa, and women account for 70% of these smallholder farmers (Beyene, 2014). A large proportion of agricultural exports in African economies are produced by smallholder farmers. In Ghana, thousands of smallholder farmers with farm size that is less than 2 hectares are the main producers of cocoa (UNCTAD, 2015). Through the significant contribution of smallholder farmers, 20% of world's cocoa are produced by Ghana, making Ghana the world second largest producer of cocoa, with cocoa contributing about 8-12% of Ghana's gross domestic product, and 40% of Ghana's foreign exchange earnings (UNCTAD, 2015).

Although smallholder farmers play an important role in the economy, they have been neglected by the international community and policy makers, as a result, smallholder farmers continue to make up a large percentage of the total number of people living below the poverty line (Kamara et al., 2019). The inputs and outputs of most smallholder farmers in sub-Saharan Africa continue to be low because they still make use of traditional agricultural system. Their competitiveness and profitability are highly affected adversely by low productivity. Most of the farmers are not yet prepared to meet agricultural business complex demand, and many still lack the resources and skills to practice commercial agriculture, thus more than 80% continue to produce at subsistence level (Kamara et al., 2019).

In Nigeria, smallholder farmers and their households are still suffering from poverty and food insecurity. Anderson et al. (2017) carried out a national survey of 3026 smallholder

farmers and their households in all 36 states of Nigeria and found that only 27% of the households live above the poverty line, while the remaining 73% live below the poverty line. Their financial status showed that 51% of the households could afford only food and clothes, 20% could not even afford to buy food, 22% could not afford expensive goods but could afford to buy food, clothes and save a little, while only 6% could afford to buy expensive goods. The remaining 1% gave a 'don't know' response (Anderson et al., 2017).

The need to support agriculture and smallholder farmers has led to several agricultural development projects in Nigeria. One of such projects is the Fadama III. It was initiated in 2008 with the aim of increasing the productivity and income for users of rural lands and water resources to reduce rural poverty and hunger (National Fadama Coordination Office, 2019)**.** The project has six main components. The first component, 'capacity building, communications and information', directly improves the human assets of the farmers. This component has activities that increase farmers' human assets such as training on how to develop a business plan (National Fadama Coordination Office, 2019). The second component, 'small-scale community-owned infrastructure', increases the physical assets of the farmers. It involves activities such as construction of new borehole structures, small-scale irrigation structures, groundwater irrigation structures and surface water rehabilitation (National Fadama Coordination Office, 2019). The third component, 'advisory services and input support', increases the human and physical assets of the farmers. This component pays for advisory services that teach the farmers techniques that will help them to make optimal use of their factors of production (improved seeds, fertilizers, and machinery). Here, farmers are also provided with the vital inputs they need to increase their production (National Fadama Coordination Office, 2019). The fourth component, 'support, research and on-farm demonstrations', indirectly increases the farmers' human assets as it involves activities that build capacity for delivering extension services (National Fadama Coordination Office, 2019). The fifth component, 'asset acquisition for individual farmer groups', helps to provide farmers with agricultural equipment and machinery. It also provides farmers with matching grants to enable them to acquire and run agricultural equipment hiring enterprises (AEHEs). Lastly, the sixth component, 'project administration, monitoring and evaluation', develops the human assets of the farmers as they are trained to take part in the implementation and monitoring of the project (National Fadama Coordination Office, 2019).

Although the Fadama III project aims at increasing productivity and reducing poverty and hunger among smallholder farmers, there is little or no empirical evidence of the development impact of the project. To fill this gap, this study answered the question: Does the Fadama III project increase the crop yield, food security, and farm income of smallholder farmers in Ebonyi state, Nigeria? There is a high level of rural underdevelopment and food insecurity in Ebonyi state (Ndukwe and Nwuzor, 2014). Rural dwellers make up about 75% of the total population, and over 90% of the workforce in rural areas engage indirectly or directly in small-scale farming activities (Ndukwe and Nwuzor, 2014). This high level of poverty and food insecurity in Ebonyi State is the reason why it was chosen as the case study for this research to ascertain if Fadama III has contributed in reducing food insecurity and poverty in the State.

This study is relevant to development because Fadama III aims at boosting agricultural productivity and alleviating poverty and hunger amongst smallholder farmers in Nigeria. Thus, the success of the project is important for achieving SDG 1 (no poverty) and SDG 2 (zero hunger) in Nigeria. In the absence of understanding what effects have occurred as a result of the Fadama III project, it is not possible to know if the project is actually contributing to SDG 1 and SDG 2 in Nigeria. Hence it is of development relevance to evaluate the impact of the Fadama III project.

Literature and Theoretical Framework

There is a great deal of literature on smallholder farmers in both developed and developing countries. These include [e.g. Allogni et al., 2008; Ayanwale & Alimi, 2004; Barrett, 2010; Wanyama et al., 2010; Napoli, 2011; Nguezet et al., 2011; Jumoke, 2012; Kinkingninhoun-Medagbe et al., 2014; Medar & Rajpurohit, 2014; Warinda, 2016].

Studies have shown that agricultural projects in the form of new technologies improves the livelihoods of smallholder farmers. Allogni et al. (2008), investigated the impact of new technologies of producing cowpea on the expenditure and income of cowpea farmers in the Republic of Benin. Stratified random sampling technique was used to select 120 farmers for the study. Data were analyzed using multivariate regression and the results show that adopting new cowpea technologies increase cowpea production by 20% and farmer's income by 13%. The weakness of this study is that it lacked theoretical explanation

of the findings. In another study, Wanyama et al. (2010) assessed the impact of soil management technology project on the livelihoods of farmers in Kenya. The project involves training farmers, researchers, and extension workers on integrated soil fertility management technologies and extension methodologies. A semi structured questionnaire was used to collect data from 192 farmers who were randomly sampled. The results show that the household earnings, food supply, livestock and crop yield of beneficiary farmers increased compared to non-beneficiary farmers.

Studies have found that the introduction of NERICA (New Rice for Africa) reduces poverty and increases the income and productivity of smallholder farmers. Nguezet et al. (2011) examined the impact of NERICA on poverty reduction and income among rice farmers in Kano, Osun, and Niger state of Nigeria. The study adopted the instrumental variable estimator. Results show that the implementation of NERICA helped in increasing the per capita income and expenditure of households by 49.1% and 44.0% on average respectively. The limitation of their studies is that although the Sustainable Livelihoods Framework was presented as the theoretical framework, the framework was not used to explain the findings. In another study, Kinkingninhoun-Medagbe et al. (2014) analyzed the impact of NERICA adoption on income and productivity in the Benin Republic. They applied the Sustainable Livelihood Framework and argued that NERICA increases farmers' productivity and income. They also applied the Local Average Treatment Effect technique and empirically showed that the adoption of NERICA has a significant and positive impact on the productivity of farmers and the per capita income of households. However, the positive impact is greater among female farmers' when compared to male farmers'. The research suggests that NERICA targeted at females will significantly increase income, total production, and the productivity of rice compared to when it is targeted at males.

There is empirical evidence that regional agricultural projects improve the productivity and growth of the small farm sector when compared to projects implemented in a single country. Warinda (2016) investigated the impact of regional agricultural projects (projects implemented simultaneously in more than one country, in this case, Kenya, Burundi, Rwanda, Uganda, and Tanzania) on the productivity and growth of small farm sector in East Africa. The author developed a conceptual framework called "Generalized Impact Pathway of Regional Projects" and used it to argue how regional agricultural projects affect the productivity of farmers. He further employed various techniques such as regression analysis, chi-square, descriptive statistics, propensity score matching technique and

empirically showed that regional agricultural projects implemented in East Africa have a more positive and significant impact on agricultural productivity, incomes, innovations, and access to financial services when compared to similar projects implemented in single countries.

In Nigeria, agricultural projects have reduced poverty and increased the income and productivity of smallholder farmers. Ayanwale and Alimi (2004) analyzed the effect of lowland irrigation projects on the income of small-scale farmers and their productivity. The participant's level of technical efficiency was estimated using a stochastic frontier production function model. The findings of the analysis reveal that farm income realized from using the irrigation facilities is about three times higher than their previous farm income before the facility took off. Also, the analysis suggests that the irrigation facility brought about an efficient level of production compared to their previous production level before the irrigation facility. The weakness of their study is that it also lacked a theoretical underpinning. In a more recent study, Jumoke (2012) evaluated the impact of Fadama II agricultural project on the poverty level of farmers in Nigeria. Time series data spanning from 2006-2007 were obtained from the survey conducted by the International Food Policy and Research Institute in 12 World Bank supported Fadama II states. The study employed Foster-Greer Thorbeke weighted poverty indices, double difference estimator, and descriptive statistics to analyze the data collected. The findings show that there is a reduction in the poverty incidence of male beneficiaries by 7.8% compared to a reduction of 34% for female beneficiaries. Also, the study shows a 14.2% reduction in the poverty incidence of beneficiaries that are engaged in upstream farming activities compared to a 7.1% reduction for non-beneficiaries.

Based on the literature reviewed, there is a missing theoretical foundation as most of the studies lacked a theoretical explanation of their findings. This study filled the theoretical gap by explaining findings based on the Sustainable Livelihoods Framework. This framework was initiated by Robert Chambers and Gordon Conway in the 1990s and further developed by the Department for International Development (DFID) in 2000 to describe and analyze the key factors that affect poor peoples' livelihoods. The framework shows that interventions like Fadama III increase livelihoods assets (the human assets, physical assets, financial assets, natural assets, and social assets) available to smallholder farmers. With favorable transforming structures and processes (government policies that affects the access to assets) farmers can fully access these assets. More access to assets helps to

reduce their vulnerability to shocks, seasonality, trends, and stress that could adversely affect their crop yield, food security, and income. Reducing their vulnerability and increasing their assets and access to assets expands their livelihood strategies which leads to positive livelihood outcomes like higher crop yield, food security, and farm income.

Research Design

The study made use of quasi-experimental research design. This type of research designs identifies the impact of an intervention (a "treatment") by comparing treated units to control units (World Bank, 2020). While quasi-experimental methods use a control group, they differ from experimental methods in that they do not use randomization to select the control group. Quasi-experimental methods are useful for estimating the impact of an intervention when it is not ethically or logistically feasible to randomize (World Bank, 2020). The experimental design (Randomized Control Trials) would have been used if the beneficiaries and non-beneficiaries of the Fadama III project were randomly assigned, but this is not the case as the beneficiaries self-selected themselves to participate in the project. To solve the self-selection bias problem that results from self-selection, the study used the quasi-experimental design.

Data Sources and Sampling Technique

The relevant data for this study was obtained from both primary and secondary data sources. This study made use of primary data collected from 300 household of farmers in Ebonyi state. Data was gathered using questionnaire survey. Questionnaire was used for data collection because it is easier and faster to collect reliable and valid data from a large sample size than other data collection methods (Marshall, 2005). The questionnaire was structured into five sections. Section A contained general questions about the respondents, like demographic and socio-economic characteristics. Section B contained questions about their asset ownership and farming practice. Section C contained question about their non-farm income, while section D contained questions about their food security levels. Finally, section E contained questions about their crop yield and farm income for the previous planting season. The questionnaire was administered by the researcher inform of an interview and was then filled by the researcher. The farmers understood the language used to conduct the interview as the researcher conducted the interviews using both the official language of Nigeria (English) and the local language of

Ebonyi state (Igbo) depending on which language was more convenient for the farmers. The researcher recorded all interviews with the consent of the farmers. The researcher held the interviews in rural and urban areas, in individual and group settings, and in locations where the farmers felt comfortable and open to talk to ensure the data collected is reliable.

The questionnaire was face validated by experts and Fadama staff who agreed that the questionnaire is a valid measure of the concept which is being measured. Furthermore, the test-retest method was used to confirm that the questionnaire was reliable. This was done by asking the same 10 farmers on two separate occasions within an interval of two weeks to complete the questionnaire. The response from the two sets of questionnaires was then compared and found to be similar. The sample non-response rate is 0 as the researcher administered the questionnaire and ensured optimum participation of farmers.

The 300 farmers were selected using the multi-stage random sampling technique. In order to have a good representation of farmers in Ebonyi State, all three senatorial zones (Ebonyi North, Ebonyi Central, and Ebonyi South) were considered. In the first stage of the sampling, the researcher randomly selected two local governments from the lists of local governments in each of the three senatorial zones, making a total of six local governments. The six local governments are Abakaliki and Izzi local government from Ebonyi North senatorial zone, Afikpo North and Afikpo South local government from Ebonyi South senatorial zone, Ikwo and Ezza local government from Ebonyi Central senatorial zone. In the second stage, the researcher used the list of Fadama III beneficiaries in these local governments to randomly select 25 beneficiaries from each local government. The researcher applied the criteria of willingness to cooperate and availability to select 25 non-beneficiaries from each local government, making a total of 50 farmers from each local government and 300 farmers (150 beneficiary farmers and 150 non-beneficiary farmers) in total.

The study also used secondary data mainly obtained from journals, books and internet. Moreover, an unpublished document containing data about the farmers was obtained from different offices of the project.

Method of Data Analysis

This study made use of Propensity score matching (PSM) for data analysis. (PSM) is a quasi-experimental method in which the researcher uses statistical techniques to construct an artificial control group by matching each treated unit with a non-treated unit of similar characteristics (World Bank, 2019). Using these matches, the researcher can estimate the impact of an intervention and control for self-selection bias.

According to Rosenbaum and Rubin (1983), the propensity score is the conditional probability of assignment to a particular treatment given a vector of observed covariates. For a formal presentation of the PSM, let the covariates be X_i, the dummy variable D_i be equal to 1 if farmer belongs to the treated group, or be equal to 0 if the farmer belongs to the control group. Y_{i1} and Y_{i0} are the outcome variables (crop yield, food security, and farm income) of treated group farmers and control group farmers respectively.

The propensity score is then given as:

$$P(X_i) = \Pr\{D_i = 1/ X_i\} \ldots\ldots 1$$

The $P(X_i)$ was estimated using a probit regression model, whereas the average treatment effect on the treated (ATT) which is the impact of the intervention was estimated using:

$$\Delta Y_i = E[Y_{i1} /D_i = 1,\ \ p(X_i)] - E[Y_{i0} /D_i = 0,\ \ p(X_i)] \ldots\ldots 2$$

The two groups of farmers were matched based on the following observable covariates: sex, age, marital status, education, primary occupation, years of farming experience, and area of land cultivated. These covariates were used in estimating the propensity scores. The four methods that were used for matching after the propensity scores were estimated are: Nearest Neighbor matching, Radius matching, Stratification matching, and Kernel matching. It is important to know that no matching method is superior to the other, and all the methods should yield the same result as the sample size gets larger. However, a small sample size could make the results differ slightly (Caliendo & Kopeinig, 2008). In cases where the matching methods produce slightly different results, the result from Kernel matching was used for interpretation because it has low variance when compared to other matching methods (Caliendo & Kopeinig, 2008)

Key Variables and its Measurement

Farm income in this study refers to the money value (in local currency) of the total farm produce in the previous farming season. The farm income includes the money value of the produce that is sold and the produce that is consumed by the farmers. Hence, the farm income of the farmers was measured by the total income that would have been generated from the sale of all their farm produce during the previous planting season. The proxy for farm income in this study is income from rice production. Rice was chosen because it is supported by Fadama III and it is also among the most cultivated crop in Nigeria.

Crop yield refers to the amount of crop grown per unit area of land (Medar & Rajpurohit, 2014). In this study, rice yield (measured in tons per hectare) was used to proxy crop yield because it is supported by Fadama III.

Crop yield was measured by:

$$\text{Crop yield} = \frac{\text{Rice produced}}{\text{harvested unit of land}}$$

Several methods were used to collect data needed to compute the crop yield. One of the methods is farmer recall. Here farmers were asked to recall the rice produced and the harvested unit of land (Medar & Rajpurohit, 2014). Another method was the farmer prediction method. Here the farmers were asked the expected quantity of rice to be produced and the unit of land to be harvested. Lastly, crop cards method was used when the farmers kept records of rice produced and area of land harvested (Medar & Rajpurohit, 2014). This study made use of these three methods depending on which method was best for the farmer. However, score cards were mostly preferred in the case where the farmer kept a record of his production and area of land harvested as the method gave the actual value of the rice yield.

Food security refers to circumstances that exist when at all times, people have access to nutritional, safe and sufficient food that satisfies their food preference and dietary needs for a healthy and active life (Barrett, 2010). Food security has four important aspects namely: food availability, food accessibility, food utilization, and food stability (Napoli, 2011). Food availability refers to having sufficient quantities of appropriate food available (WFP, 2009). Food accessibility refers to having adequate income or other resources to

access food (WFP, 2009). Food utilization refers to having nutritious and safe food that provides balanced diets needed to lead a healthy and active life (Napoli, 2011). Food stability means that at all times, food is available, people have access to food, and food is utilized to meet dietary needs to live a healthy and active life (Napoli, 2011).

Food security in this study refers to food accessibility and was measured using the Household Hunger Scale (HHS). The HHS was used because it is a standard tool for universal application, has a standard cut-off available for categorizing households as having or lacking food access, its approach and tabulation method is validated for cross-cultural use (Deitchler et al. 2011). When the HHS was administered, a continuous scale score (with a minimum possible score of 0 and a maximum possible score of 6) was tabulated for each household in the sample by summing the household's responses to three food security questions where never=0 point, rarely or sometimes=1 point and often=2 points. Scores from 0–1, was classified into the little to no hunger category while scores from 2-3 and 4-6 were categorized as moderate household hunger and severe household hunger respectively.

Results and Discussion

Demographic and socio-economic characteristics have been identified as a key determinant of development outcome of interventions (Gebrekidan, 2012). The study therefore examines these characteristics (education, sex, age) and other variable (source of farm power) considered to have very strong contributions to the central theme of this study.

- *Education levels of farmers*

Chart 1 shows that majority of the non-beneficiary farmers either have no education (about 15%) or have primary education (about 18%). Just a few non-beneficiaries have junior (10%) or senior secondary education about (about 7%) while no non-beneficiary has tertiary education (0%). On the other hand, majority of the beneficiary farmers have either junior (about 17%) or senior secondary education (about 20%), while a few (about 5%) of them have tertiary education or primary education (about 2%). This shows that the beneficiary farmers are more educated than the non-beneficiary farmers and level of education goes a long way in influencing farmers' decision to participate in the Fadama III

intervention. In general, most farmers have secondary education (about 54%) while just a few have tertiary education (about 5%).

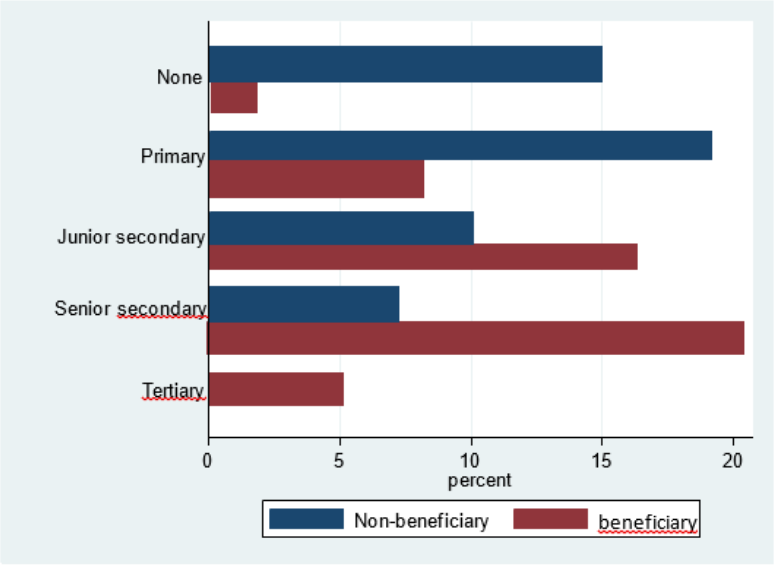
- *Sex and age distribution*

Chart 2 presents the sex and age distribution of farmers. The chart shows that the percentage of male beneficiary farmers (about 35%) is more than two times the percentage of female beneficiary farmers (about 16%). There is no youth (either male or female) beneficiary farmer between the age of 15 to 24 and only a few (about 2.5%) male youth beneficiary farmers are between the age of 25 to 34 years. No female beneficiary farmer (0%) is between the age of 25 to 34 years. This shows that female farmers and youth (either male or female between 15 to 34 years) farmers are under-represented in the Fadama III project.

- *Main source of farm power*

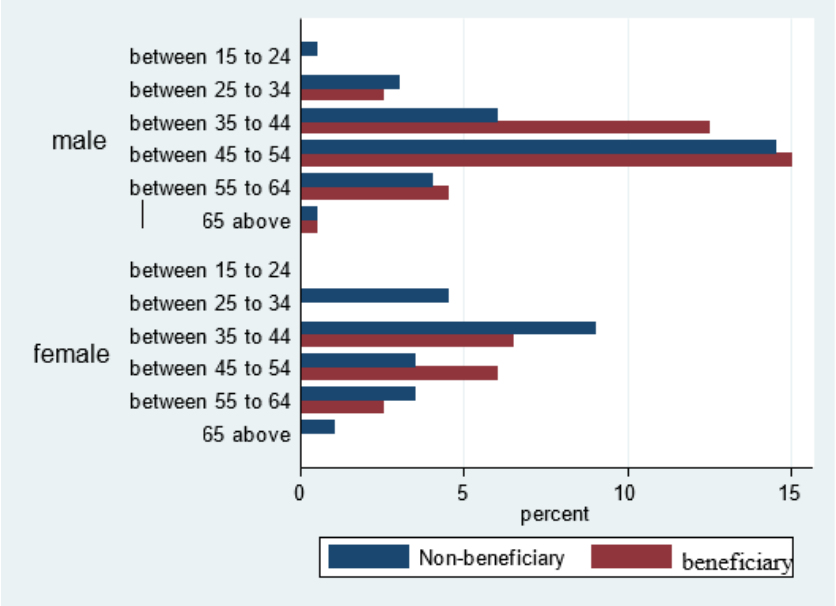
Chart 3 shows that human power is still the main source of farm power for most of the beneficiary (about 42%) and non-beneficiary (about 43%) farmers. Only few beneficiary farmers (about 2.5%) and non-beneficiary farmers (about 1%) use mechanical power for farming. This suggests that there could be some challenges with the fifth component of Fadama III which was supposed to provide the beneficiary farmers with farm equipment and machineries.

Chart 1: Level of education



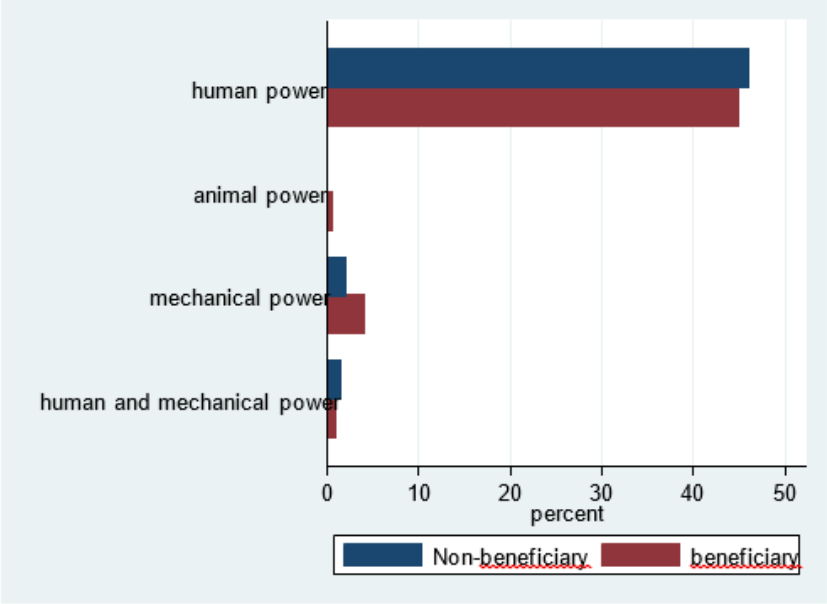
Source: Authors' own compilation

Chart 2: Sex and Age Distribution



Source: Authors' own compilation

Chart 3: Main source of farm power



Source: Author's own compilation

Table 1 shows the descriptive statistics of key variables (crop yield, food security, farm income) for both groups of farmers. The mean crop yield of beneficiary farmers (3.1) is higher than that of non-beneficiary farmers (1.9) by 1.2 tons per hectare. The mean food insecurity of the non-beneficiary farmers (2.5) is higher than that of the beneficiary farmers (1.9) by 1.8 points on the household hunger scale. The mean farm income of the beneficiary farmers (₦634608) is higher than that of the non-beneficiary farmers (₦403642) by ₦230966 (in local currency). The descriptive statistics suggest that Fadama III has a positive impact on the crop yield, food security, and farm income of smallholder farmers.

Table 1: Descriptive statistics of key variables for both groups of farmers

Crop yield (tons per hectare)				
	Obs.	Mean	Min	Max
Beneficiary	150	3.1	2.1	3.3
Non-beneficiary	150	1.9	1.2	2.2
Food security (0–1 no or little hunger; 2-3 moderate hunger; 4-6 severe hunger)				
	Obs.	Mean	Min	Max
Beneficiary	150	2.3	1.9	2.8
Non-beneficiary	150	4.1	2.5	4.5
Farm income (₦ in local currency)				
	Obs.	Mean	Min	Max
Beneficiary	150	634608	416838	845286
Non-beneficiary	150	403642	105695	546953

Source: Author's own compilation

- *Econometric analysis*

The propensity score matching was the main method used to answer the research questions. In line with Katchova (2010), the probit regression was used to estimate the propensity scores.

A source of bias in estimating the impact of Fadama III intervention could be as a result of spillover effects (Sikwela & Mushunje, 2013). For example, it is possible that the non-beneficiary farmers residing near the beneficiary farmers benefitted from the extension services received by the beneficiary farmers. This could lead to an underestimation of the impact of the Fadama III intervention. Another source of bias known as crossover effects could arise from the fact that some non-beneficiary farmers could be benefitting from other agricultural intervention(s) which could affect their crop yield, food security, and farm income (Sikwela & Mushunje, 2013). This could also lead to an underestimation of the impact of the Fadama III intervention. To address the possible spillover and crossover bias, 9 non-beneficiary farmers who were found to be residing near the beneficiary farmers were dropped from the sample in accordance with Sikwela and Mushunje (2013). Two non-beneficiary farmers who are beneficiaries of other community-based agricultural interventions were also dropped from the sample. This procedure reduced the sample size slightly by 11 but eliminated any potential bias that could result from spillovers and crossovers.

Table 2 shows the estimated propensity scores. As mentioned earlier, the probit regression was used to estimate the propensity scores. The region of common support of the estimated propensity scores is [.0762511, .96872045]. The final number of blocks is 5. This number of blocks ensures that the mean propensity score is not different for the beneficiary and non-beneficiary farmers in each block. The balancing property was also satisfied.

Table 2: Estimated propensity score

	Percentiles	Smallest		
1%	.0846999	.0762511		
5%	.1207146	.0846999		
10%	.2264696	.0908954	Obs.	289
25%	.3290143	.0913665	Sum of Wgt.	284
50%	.5331899		Mean	.5260782
			Std. Dev.	.2346637
		Largest		
75%	.7315551	.9181906		
90%	.8473193	.9335479	Variance	.055067
95%	.872901	.9390363	Skewness	-.0841814
99%	.9390363	.9687205	Kurtosis	1.97897

Source: Author's own computation

Table 3. shows the impact of Fadama III on food security, farm income, and crop yield of smallholder farmers. For the result on food security and crop yield, all four matching methods gave similar results at one decimal place, thus we interpreted the result at one decimal place. For farm income, all four matching methods gave slightly similar result so we interpreted the result produced by Kernel matching. The results for food security (ATT -1.3), farm income (ATT 342553), and crop yield (ATT 1.2) were statistically significant at 5% level of significance. This suggests that Fadama III reduces food insecurity by 1.3 points on the household hunger scale. Furthermore, Fadama III increases farm income by ₦342553 (local currency) and crop yield by 1.2 tons per hectare.

Table 3: Impact of Fadama III project on food security, farm income, and crop yield

Food security				
Matching method	Number of treated farmers	Number of comparison farmers	Average treatment effect on the treated (ATT)	t- statistic
Nearest neighbor	115	125	-1.311	4.435***
Kernel	115	125	-1.364	3.856**
Stratification	115	125	-1.323	3.957**
Radius	115	125	-1.322	3.532**
Farm income				
Nearest neighbor	115	125	342643	2.543*
Kernel	115	125	342553	2.635*
Stratification	115	125	342569	2.682 *
Radius	115	125	342624	2.974 *
Crop yield				
Nearest neighbor	115	125	1.23	3.972**
Kernel	115	125	1.27	2.883*
Stratification	115	125	1.26	3.431**
Radius	115	125	1.29	3.035**

* p<0.05, ** p<0.01, *** p<0.001

Source: Author's own compilation

These findings are in line with the expectations of the Sustainable Livelihoods Framework (SLF) which explains how Fadama III intervention causes an increase in farmers' crop yield, food security and income. The explanation is that the Fadama III project comes in as a pro-poor intervention which increases livelihood assets (human assets, physical assets, financial assets, natural assets, and social assets) which farmers could access. Government policies towards Fadama III are favorable and encourage farmers to access the livelihood assets made available by the intervention. With access to more livelihood assets, farmers became less vulnerable to shocks, trends, and stress that could have affected their crop yield, food security, and income adversely. All these enabled the farmers to expand their livelihood strategies by intensifying their agricultural production all year round. This led to desirable livelihood outcomes like higher crop yield, reduced food insecurity and higher income for the smallholder farmers in Ebonyi State.

Conclusion and Recommendations

In conclusion, the analysis show that Fadama III project reduces food insecurity by 1.3 points on the household hunger scale, increases farm income by ₦342553 (local currency) and increases crop yield by 1.2 tons per hectare. Thus, the project is successful in helping to achieve SDG 1 and SDG 2 in Nigeria. How this increase is achieved has been explained using the Sustainable Livelihood Framework. It was also found that most of the beneficiary and non-beneficiary farmers have only secondary education. In addition, young farmers and female farmers were under-represented in Fadama III project. Also, most beneficiary farmers still depend mainly on their human power for farming.

Since most of the beneficiary farmers still depend mainly on human power for farming just like the non-beneficiary farmers, the fifth component of the Fadama III project which helps to provide farmers with agricultural equipment and machinery has to be revised to eliminate all challenges that could be preventing the beneficiary farmers from easily accessing farm equipment and machines. Also, further research is recommended into the factors responsible for the failure of the fifth component. Future agricultural interventions should have a special component that encourages very educated youths and females to participate in agriculture while the female farmers and youth farmers are encouraged to participate in agricultural interventions. Some pre-implementation activities of the component could involve the use of ICT and social media to better agriculture's image across a broad audience of youths and allow for sharing of information and experiences between female and young farmers who are successful. They could also be given a special enrollment quota in agricultural interventions. Lastly, higher level of education is associated with better performance, and majority of the smallholder farmers have only secondary education. There is need to set up programs or incentives to attract very educated people to agriculture and encourage the existing farmers to attain tertiary level of education.

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