



EVALUATING FADAMA III DEVELOPMENT PROJECT IN KANO STATE, NIGERIA: USING DIFFERENCE IN DIFFERENCE ESTIMATION WITH PROPENSITY SCORE MATCHING APPROACH

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ABSTRACT

The main objective of this study is to evaluate the impact of Fadama III development Project on rural poor farmers in Danbatta local government area of Kano state. The study adopted exploratory research, population of this study is made up of 362 household farmers in Danbatta local government area that are Fadama III development project beneficiaries. The study employed difference in difference approach by capturing the before and after period of intervention of Fadama III development project and propensity score matching to compare the beneficiaries and non-beneficiaries with similar covariate or propensity score index, the Data were analyzed using STATA version 14.0. The result shows that marital status, education level and farming experience significantly influence treatment (participation) in Fadama III project by 21%, 37% and 65% respectively while household size does not influence treatment (participation) in Fadama III project. Also, the observed heterogeneities were able to predict treatment (participation) at 71%. And also, household income and productivity have increased; hence the study recommends the need for training sessions in order to employ strategies to reflect best management practices in order to ensure sustainability in agricultural productivity, satisfactory support of storage facilities, awareness creation of insurance policies in agricultural productivity and lastly, improvement in agricultural technologies to increase crop yields.

JEL Classification: C180, C520, Q010

Key words: Difference in difference, Propensity score matching, Fadama III development project

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1. INTRODUCTION

The Fadama III development project was developed based on the lessons learnt from Fadama I and II. The World Bank Fadama III development project was expected to impact the lives of rural farmers, raising their income by 63% (NFDO, 2011). The US\$450 million Fadama III project was being implemented in 36 states of Nigeria and its Federal capital territory (Abuja). However, the financing comprised of US\$250 million from international development agency (IDA) credits and US\$200 million counterpart contribution from Nigeria's federal, state and local government. Moreover, the main aim of the project includes; ensuring sustainable increase in income, reduce rural poverty, boosting food security as well as to contribute to achieving the Millennium Development Goals (MDGs). Therefore, Fadama III development project support the production of four prioritized staple crops, including rice, cassava, sorghum and tomatoes. In addition to financing rural farmers, the project has some components namely, capacity building, communications and information support, small-scale community owned infrastructure, advisory services and input support, the agricultural development programs, sponsored research and on-farm demonstrations, matching grant facility for asset acquisition through groups and project management, monitoring and evaluation.

Fadama III project has a strong rural base, generating concern for agriculture and rural development. Support for agriculture is widely driven by both government and public sector, which has established institutional support in the form of agricultural research, extension, commodity marketing, input supply, and land use legislation, to fast-track development of agricultural and rural economic empowerment through Fadama III financing (Eze, 2014).

Kano state is among the six core states chosen to participate in Fadama III additional financing (AF) project. It has been found to possess a comparative advantage of large irrigable land and irrigation facilities, high production potential and large market, as well as Kadawa, the largest producer of tomato in Nigeria. This provides Kano with advantage to promote the sorghum, rice and tomato value chain, over other core states (World Bank, 2016). Also, in Kano state,

the project is expected to increase the income of over 15,000 farmers since 2013 (Adewumi and Oladujoyele, 2017), that is five years after its implementation. In rural areas, the main occupation is agriculture. The mode of production cultivation and transformation is mainly traditional and is characterized by low productivity as well as underutilization. Most development projects and efforts all over the world are aimed at improving agriculture in all its aspects in order to create better life of its inhabitants. Also, the rural economy holds significant potential for creating decent and productive jobs and contributing to sustainable development and economic growth. It accounts for a significant share of employment and output in many developing countries but is widely characterized by severe decent work deficits and poverty hosting nearly 50% of the World's poor (International Labor Organization, 2014).

Despite the agricultural programs and policies in Nigeria, which impacted the living condition of the rural populace, still the rural areas are characterized by low productivity, inadequate infrastructure, limited access to credit and improved farm inputs, limited educational opportunities and absolute poverty.

Therefore, many studies and reviews have examined the impact of Fadama III development project on income, agricultural productivity, capital formation, gender participation, livelihood, socioeconomic growth and poverty alleviation among the rural farmers. Most of the studies reviewed utilized mainly descriptive statistics in their analysis by looking after the intervention period only, and they provide valuable information that Fadama III development project has positive impact on the rural farmers, although there are conflicting results. And thus, there is need to employ more robust technique of analysis which is basically used in analyzing the impact assessment or treatment evaluation researches (i.e., propensity score matching (PSM) combined with difference in differences (DID) methods). This study employed difference in difference approach by capturing the before and after period of intervention of Fadama III development project and propensity score matching to compare the beneficiaries and non-beneficiaries with similar covariate based on propensity score index.

Moreover, there is no empirical study conducted on the Fadama III development project in Danbatta Local government area of Kano State; this is what motivated us to carry out this study. This type of empirical analysis presents an opportunity routinely to assess the impact of the Fadama III development project. Hence, the main objective of this study is to evaluate the impact of Fadama III

development Project on rural poor farmers in Danbatta local government area of Kano state. In addition, the specific objectives include; to evaluate the project impact on farmer's income, to assess the project impact on household farmer agricultural productivity and lastly to examine the socioeconomic factors that influence household farmers participation in Fadama III development project in Danbatta local government area of Kano state, Nigeria.

2. LITERATURE REVIEW

2.1 THEORETICAL LITERATURE

2.1.1 INDUCE INNOVATIONS MODEL

The model explains the mechanism by which a society chooses an optimal path of technical and institutional change in agriculture. According to the model, technical change in agriculture represents a response to changes in resource endowments and to growth in product demand, changes in institutions are induced by changes in relative resource endowments and technical change. Hayami and Ruttan (1971) provided a consistent and effective framework for analyzing how market, technology development and institutional changes interact to facilitate agricultural development. Hence, their research is widely recognized for farmers' increases in agricultural productivity and income due to effective technology and institutional change. In most countries which have succeeded in achieving rapid technical progress, socialization of agricultural research has been deliberately employed as an instrument of modernization in agriculture. Modernization process has involved development of both experiment station and industrial capacity, capable of producing the biological (or biological and chemical) and mechanical (or engineering and mechanical) innovations adopted to factor supply conditions.

Moreover, the theory of induce innovation to include the process by which public sector investment in agricultural research, in the adaptation of diffusion of agricultural technology, institutional technology, institutional infrastructure that is supportive of agricultural development is directed at releasing constraint on agricultural production imposed by the factors characterized by a relatively low supply.

Hayami and Ruttan (1971), hypothesize that technical change is guided along an efficient path by price signals in the market provided that:

- a. The prices efficiently reflect changes in the demand and supply of products and features.
- b. There exists effective interaction among farmers, public research institutions, and private agricultural supply firms.

Meanwhile, this study adapted the Induce Innovations Model as the underpinning theory.

2.2 PREVIOUS EMPIRICAL LITERATURE

Adetomiwa et al. (2020) empirically examined the impact of the Fadama III development program on food security status of the rural households in South West Nigeria. A total of 600 respondents were sampled. Primary data were used for the study which was collected through a well-structured and pretested questionnaire. The data collected were analyzed using descriptive statistics and Probit regression; the result of descriptive statistics showed that the mean age of the participant and non-participant was 46 ± 16.25 and 46 ± 16.17 respectively. About 46.1% and 23.6% of the participants of Fadama III program in South West Nigeria were involved in crop production and livestock production respectively. The decision to participate in Fadama III program in South West Nigeria was significantly influenced by gender ($p < 0.10$), occupation ($p < 0.01$), extension contacts ($p < 0.01$) and awareness ($p < 0.05$). Based on the food security line created, the majority (84.3%) of the Fadama III program participants were food secure as against 42% of the non-participants. The result of probit regression (first hurdle) showed that gender, farm size, non-farm income, membership in association and income from Fadama III program were significant positive determinants of food security status of participants of Fadama III program while gender and non-farm income were significant positive determinants of food security status of non-participants in South West, Nigeria; however the study appears to be non-parametric so there is need to employ propensity score matching method for robustness.

Madu (2020) analyzed the socio-economic characteristics of farmer participants in the Fadama II project. The Project uses community-driven development approach to target the poor and vulnerable groups. Fadama II Project is first of its kind and the largest agricultural and rural development project in Nigeria. In this study, combination of Propensity Score Matching (PSM) and Double difference (DD) estimator were used to determine average treatment

effect (ATE) on the beneficiaries. Probit regression model was used to determine the relationship between socio-economic characteristics and Project participation. Mean and percentages were also used to describe sources of income and income increases among the farmers. As the findings indicate, the major income source among participants were crop farming, followed by non-farm activities. Beneficiaries' income has increased more than the set target of 20% by the project. The increase was more among the core poor individuals than the moderately and poor participants. The findings also revealed that Fadama II beneficiaries were likely to be female than male, have large household sizes, reside in remote locations and possess more land. However, level of education and ownership of productive assets do not serve as precondition for project participation. There is need to employ similar approach when evaluating the impact of Fadama III project.

In a study, Solomon (2020) assessed the impact of Fadama III interventions on income and poverty alleviation of beneficiaries in Abuja Federal Capital Territory, Nigeria. A sample of one hundred and fifty respondents among the beneficiaries was drawn using multistage sampling technique. Descriptive and simple percentage was used in data analysis. The sampled respondents were mainly males that represent 72% in their middle age-group, about 78% of them had western education. Farming was the major occupation among respondents (70%). Fadama III supported farmers with improved seed varieties, fertilizers, agrochemicals, water pump, sprayer, advisory services and capacity building training. Although, the output translated to increased income and poverty alleviation among the beneficiaries, meanwhile, the study employs descriptive approach, hence there is need to further adopt parametric approach through the use of difference in difference estimator and propensity score matching.

Ovharhe (2020) evaluated the constraints to the Fadama III project in some Niger Delta areas; namely, Akwa Ibom, Bayelsa, and Delta states of Nigeria. A multistage sampling process was engaged to choose a sample of 420 respondents for the study. Data analysis was done using means and ANOVA. Results obtained revealed that some constraints such as inadequate fund ($\bar{x}=3.78$), inadequate inputs support ($\bar{x}=3.35$) and high bureaucracy of donor agencies ($\bar{x}=3.31$) were identified as serious constraints by the respondents. This study employed more or less descriptive statistics (i.e., mean) in making analysis. However, a more robust technique of analysis should be employed (i.e., difference in difference method).

In their research Ominikari, Onumadu, and Gideon (2017) assessed various activities (indicators) made available to farmers for participation on Fadama III agricultural project delivery agency in Bayelsa state, Nigeria. Purposive sampling technique was used to select one hundred and fifty farmers that participated and one hundred and fifty staff from the delivery agency. The data collected were analyzed using frequency count, percentage, mean, standard deviation; and Z-test was used to test the null hypothesis at the 0.05% level of significance. However, they found out that, the Z- test mean response of the delivery agency was 3.793, there was significant difference ($Z = -20.25$) in the mean score response of the delivery agency and participants of national Fadama III project on the various activities available to the farmers at $p \leq 0.05$.

Tsauni and Danlami (2016), carried out the study on social capital formation and implication for achievement of Fadama III project development in Kano State, Nigeria. The study analyzed the data obtained using descriptive statistics and found that the level of social capital created by the Fadama III project among the beneficiary farmers in Kano State has been appreciable. Fadama user households have high level of involvement and participation (67% of the respondents).

3. METHODOLOGY

3.1 RESEARCH DESIGN

Danbatta is a Local Government Area in Kano State, Nigeria. It is located about 49 miles north of Kano city at the Northern border of Kano state with Jigawa state. It has headquarters at Danbatta town. It has an approximate area of 732 km². It is bordered to the north and east by Kazaure and Babura Local Government areas of Jigawa State respectively, and to the south and west by Minjibir and Makoda local Government areas of Kano state respectively. The study adopted exploratory research design; the population of this study is made up of household farmers in Danbatta local government area that are Fadama III development project beneficiaries, which are approximately 362. The household farmers engaged in rice production and processing and sorghum production. Using the Krejcie and Morgan (1970) formula the study arrived at 109 sample sizes. Judgmental sampling technique was employed to select 218 respondents in which 109 are beneficiaries and 109 are counterfactual or non-beneficiary household farmers with the same covariates. The questionnaire was administered to household

farmers i.e., beneficiaries and non-beneficiaries. However, 196 questionnaires from both beneficiaries and non-beneficiaries were retrieved and a response rate of 89.9% was achieved. The study employed difference in difference approach; the idea was to capture the productivity and level of household farmer income before and after period of intervention of Fadama III and propensity score matching to compare the beneficiaries and non-beneficiaries based on their covariates; or in other words propensity score index. The Data were analyzed using STATA version 14.0.

3.2 MODEL SPECIFICATION

This work specified two models in line with the objectives of the study,

Firstly, to achieve objective one and two i.e., to evaluate the impact of the Fadama III project on household farmer income and productivity, the following model will be used in the study:

- (1) $Y_i = \beta_0 + \beta_1 D_{i1} + \beta_2 T_{t2} + \beta_3 D_{i3} * T_t + \beta_k X_{ik} + \varepsilon_i$
- (2) $Outcome\ Var_i = \beta_0 + \beta_1 treat_i + \beta_2 period_t + \beta_3 treat_i * period_t + \beta_k X_{ik} + \varepsilon_i$
- (3) $Outcome\ Var_i =$ level of income/ level of productivity at a particular point in time.

where

- β_0 = the mean outcome of control at baseline year Autonomous variable.
- $\beta_0 + \beta_1$ = the mean outcome for the control group at follow-up
- β_2 = is the single difference between treated and control group at baseline
- β_3 = is the difference in difference or impact
- β_k = coefficient of the controls or observable characteristic
- T_t = it is a dummy variable, 1=treated group and 0= not treated group
- ε_i = the error terms

Second, to achieve objective three, that is to analyze the socioeconomic factors influencing household farmer participation in Fadama III development project in Danbatta local government area of Kano State, Nigeria, this study uses the probit model. It is specified as

$$(1) \quad Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \beta_4 X_{i4} + \varepsilon_i$$

$$(2) \quad TRM_i = \beta_0 + \beta_1 MTS + \beta_2 Edu_i + \beta_3 HDS_i + \beta_4 FRE_i + \varepsilon_i$$

where

TRM_i = Treatment/participation at a particular point in time

MTS_i = Marital status at a particular point in time

EDU_i = Education at a particular point in time

HDS_i = Household size at a particular point in time

FRE_i = Farming experience at a particular point in time

β_0 = Intercept

$\beta_1, \beta_2, \beta_3$ and β_4 = Coefficients of the regression

ε_i = Error term

4. RESULTS

4.1 DEMOGRAPHIC DESCRIPTION OF THE RESPONDENTS

From the study area where data was collected, two hundred and eighteen (218) beneficiaries and non-beneficiary respondents were issued a questionnaire in which one hundred and ninety-six (196) were retrieved. This section summarizes the general frequency distribution of respondents on different demographic items.

In terms of gender, Table 1 revealed that 175 of the subjects (89%) are males while only 21 (10.7%) are females. The larger male sample is due to religion and cultural norms and values of the target respondents of the study. From Table 1, 15 (7.7%) of the respondents fall within the 21-30 age group, while 61 (31.1%) of the respondents are in the 31-40 age bracket; and 120 (61.2%) within the age group of 41-above. The preceding Table 1 also reveals that 33 (16.8%) of the respondents obtained the minimum of non formal education (i.e., *Islamiyah* schools) and 48 (24.5%) of them obtained primary certificate, while 45 (23%) held secondary certificate, and 70 (35.7%) obtained tertiary certificate; this signifies that majority of the subjects attended formal schools in which 70 (35.7%) were able to obtain tertiary certificate. The analysis of household size in Table 1 reveals that 48 (24.5%) of the respondents had 1-5 number of children, while 58 (29.6%) of them had 6-10 children; 61 (31.1%) had from 11-15 children and only 29 (14.8%) of the respondent's children range from 16-above. Table 1 indicates that 9 (4.6%) of the respondents spend 1-10 years in farming, while 50 (25.5%) of them had experienced 11-20 years in farming, also 83 (42.3%) of the farmers spend 21-30 years in

farming and lastly 54 (27.6%) have acquired 31-above years' experience in farming. This signifies that greater percentage of the sample have a lot of farming experience.

TABLE 1
Respondent Profile

	Frequency	Percent	Cumulative Percent
Gender			
Male	175	89.3	89.3
Female	21	10.7	100.0
Total	196	100.0	
Age			
21-30	15	7.7	7.7
31-40	61	31.1	38.8
41-Above	120	61.2	100.0
Total	196	100.0	
Marital Status			
Married	175	89.3	89.3
Single	4	2.0	91.3
Divorce/Widow	17	8.7	100.0
Total	196	100.0	
Education			
Non-Formal	33	16.8	16.8
Primary	48	24.5	41.3
Secondary	45	23.0	64.3
Tertiary	70	35.7	100.0
Total	196	100.0	
Household Size			
1-5	48	24.5	24.5
6-10	58	29.6	54.1
11-15	61	31.1	85.2
16-Above	29	14.8	100.0
Total	196	100.0	
Farming Experience			
1-10	9	4.6	4.6
11-20	50	25.5	30.1
21-30	83	42.3	72.4
31-Above	54	27.6	100.0
Total	196	100.0	

Source: From field Survey Data (2019) computed using STATA 14.0

4.3 PRE-ESTIMATION TEST

4.3.1 VALIDITY

Validity is defined as “whether an instrument measures what it was designed to measure” (Jamaludin, 2012). There are three types of validity test namely content, criterion and related construct validity (Ahmad, 2011).

This study used content validity because it measures the degree to which the sample of the items or scale represents the content that it is designed to measure. A few experts were asked to examine the questionnaire and provide feedback for revision. The panel of experts included active researchers in the area of economic and Fadama development project staff. After they have reviewed the questionnaire, changes are made to clarify and eliminate ambiguous statements according to their recommendations.

4.3.2 RELIABILITY TEST

The results indicate that the Cronbach’s alpha reliability coefficients for the two variables are all above 0.6. Generally, Creswell (2012) stated that reliabilities of less than 0.6 are considered to be poor, those above 0.7 are deemed acceptable, those above 0.8 are good, while the closer the reliability coefficient to 1.0, the better. Table 2 indicates that the internal consistency reliability of the variables used in this study is considered good and excellent.

TABLE 2
Result of the Reliability Statistics of the Variable of the Study

Variable	Number of items in construct	Cronbach’s Alpha
Agricultural productivity	41	0.949
Farmer’s income	8	0.638

Source: From field Survey Data (2019) computed using STATA 14.0

4.3.3 THE COMMON SUPPORT ASSUMPTION TEST

Common support assumption in difference in difference score matching analysis signifies that for all the estimated propensity score the value should not be greater than one, in this study the common support option has been from the acceptable range of (0.2624 to 0.6829), hence the region of common support assumption is fulfilled.

TABLE 3
Description of the Estimated Propensity Score in Region of
Common Support

Estimated Propensity score				
Percentiles		Smallest		
1%	0.2624	0.2624		
5%	0.3365	0.2624		
10%	0.3885	0.2624	Obs	196
25%	0.4427	0.2624	Sum of Wgt.	196
50%	0.4682		Mean	0.5006
		Largest	Std. Dev.	0.0995
75%	0.5784	0.6829	Variance	0.0099
90%	0.6318	0.6829	Skewness	0.1479
95%	0.6829	0.6829	Kurtosis	2.6738
99%	0.6829	0.6829		

Source: From field Survey Data (2019) Computed Using STATA 14.0

Table 3 it can be seen that the estimated propensity score in region of common support result is presented in percentiles in which at 1% is 0.2624 up to the largest score of 0.6829 at 99%, also the Table 3 revealed that skewness level of the data is -0.148 and the kurtosis is 2.6738; therefore, these do not exceed the value of +3 to -3, hence the data are normally distributed and can undergo an inferential test.

4.2 DISCUSSION OF RESULTS

Propensity score model (Probit model) results on socioeconomic factors that influence participation in Fadama III development project in Danbatta local Government are displayed in Table 4.

Table 4 presents results of logistic regression analysis with demographical features (i.e., Marital status, Education level, Household size and farming experience) as independent variable while treatment (participation) which is a dummy variable is the dependent variable.

The results show that marital status significantly influenced treatment (participation) in Fadama III project and regression coefficient was found ($\beta = 0.219, p = 0.015$), this signifies that married people participate in the project by 21%. This finding supported the findings of Solomon (2020), Madu (2020), Ominikari et al. (2017) and Tsauni and Danlami (2016).

TABLE 4
Probit Linear Regression

Treatment	Coef.	St.Err.	t- value	p- value	(95% Conf Interval)	Sig
Marital status	0.219	0.015	0.25	0.025	-0.130 0.167	**
Education	0.378	0.037	2.13	0.034	0.006 0.151	**
Household size	-0.060	0.045	1.33	0.184	-0.029 0.149	**
Farming Experience	0.652	0.057	0.22	0.003	-0.100 0.124	***
Constant	-0.451	0.338	-1.33	0.184	-1.119 0.216	
Mean dependent var		0.5		SD dependent var		0.501
R-squared		0.719		Number of Obs		196
F-test		2.7		Prob > F		0.015
Akaike crit. (AIC)		282.392		Bayesian crit. (BIC)		305.339

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Source: From field Survey Data (2019) computed using STATA 14.0

And the results also show that education level has significantly influenced treatment (participation) in Fadama III project and regression coefficient was found ($\beta = 0.378$, $p = 0.034$); this signifies that farmers that are educationally wise participate more in the program by contributing 37% to treatment. This finding aligned with the findings of Solomon (2020), Madu (2020), Ominikari et al. (2017) and Tsauni and Danlami (2016). Household size in this study did not have significant influence on treatment (participation) in Fadama III project and regression coefficient was found ($\beta = -0.06$, $p = 0.184$), this signifies that household size is not a determinant of participation in the Fadama III project. This finding is inconsistent with the finding of Solomon (2020), Madu (2020), Ominikari et al. (2017) and Tsauni and Danlami (2016).

The result also shows that farming experience has significantly positive influence on treatment (participation) in Fadama III project and regression coefficient was found ($\beta = 0.652$, $p = 0.003$), this signifies that 65% of household farmers participating in Fadama III project have farming experience. This finding is similar with the finding of Solomon (2020), Madu (2020), Ominikari et al. (2017) and Tsauni and Danlami (2016). Our results show that the independent

variables or the observed heterogeneity (i.e., marital status, education level, household size and farming experience) were able to predict the dependent variable treatment (participation) at 71%.

4.2.1 THE IMPACT OF FADAMA III DEVELOPMENT PROJECT ON HOUSEHOLD FARMERS' AGRICULTURAL PRODUCTIVITY IN DANBATTA LOCAL GOVERNMENT AREA OF KANO STATE.

The propensity score matching using difference in difference estimation computed the average treatment effect on treated (ATET) in order to evaluate the Fadama III project on farmer productivity by considering observable heterogeneity between the treated group and control group when conducting matching algorithms. Table 5 displays the Matching Estimation Result for Household Farmer's Agricultural Productivity (i.e., Sorghum and Rice)

Table 5 reveals that after matching using two period data i.e. the outcome variable for beneficiaries and non-beneficiaries of before and after period, all the matchings above in Table 5 yield to similar result ranging from 20.100 to 20.933, hence, the farmers participating in the Fadama III project have experienced increase in productivity by averagely 20.1*50kg of output (i.e., production of sorghum and rice) and this is an economically significant achievement secured by the farmer project participants. This finding is consistent with the finding of Ovharhe (2020), Adetomiwa et al. (2020), Solomon (2020), Ominikari et al. (2017) and Tsauni and Danlami (2016).

TABLE 5
Matching Estimation Result for Household Farmer's Agricultural Productivity (i.e., Sorghum and Rice)

Estimation method	Difference in difference result	Std.Error	T-value
ATET Nearest Neighbour Matching	20.933 (50kg sack)	1.672	12.519
ATET Kernel Matching	20.100 (50kg sack)	1.292	15.560
ATET Radius Matching	20.338 (50kg sack)	1.292	15.736
ATET Stratification Matching	20.072 (50kg sack)	1.582	12.685
ATET Local Linear Matching	20.302 (50kg sack)	1.324	13.322

Source: From field Survey Data (2019) computed using STATA 14.0

4.2.2 THE IMPACT OF FADAMA III DEVELOPMENT PROJECT ON HOUSEHOLD FARMERS INCOME IN DANBATTAL LOCAL GOVERNMENT AREA OF KANO STATE

The propensity score matching using difference in difference estimation computed by Average treatment effect on treated (ATET) in order to evaluate the Fadama III project effect on farmer's income was done by considering observable heterogeneity between the treated group and control group when conducting matching algorithms.

TABLE 6
Matching Estimation Result for Household Farmer's Income

Estimation method	Difference in difference result	Std.Error	t-value
ATET Nearest Neighbour Matching	75865.232	8291.763	9.149
ATET Kernel Matching	67393.563	6968.787	9.671
ATET Radius Matching	74853.917	5983.170	12.511
ATET Stratification Matching	67393.563	6824.066	9.876
ATET Local Linear Matching	73261.736	5238.054	8.734

Source: from field Survey Data (2019) computed using STATA 14.0

Results in Table 6 revealed that after matching using two period data i.e., the outcome variable of before and after period and the all the matchings above in the Table 6 yield result ranging from ₦67,393.563 to ₦75,865.232. Hence the farmers participating in Fadama III project have experienced income increase by ₦67,393.563 to ₦75,865.232 and this is an economically significant achievement secured by the farmers participating in the project. This finding aligns with the finding of Ovharhe (2020), Adetomiwa et al. (2020), Solomon (2020), Ominikari et al. (2017) and Tsauni and Danlami (2016).

4.2.3 ROBUSTNESS OF MODEL ESTIMATE

In order to ensure that the distribution of the demographical characteristic in the control group reincarnate with the treated group, the set characteristic was subjected to balancing test in order to check the violation of covariates common support assumption, Table 7 reports the result of this test on the five propensity score matching used

in the study. The following Table 7 shows the inferior bound, the number of treated and the number of controls for each block.

TABLE 7
Balancing Test Result

Inferior of Block of Pscore	Treatment		
	Control	Treated	Total
0.2	19	10	29
0.4	73	67	140
0.6	6	21	27
Total	98	98	196

Source: From field Survey Data (2019) computed using STATA 14.0

From Table 7 the balancing test was divided into four inferior blocks of propensity score matching and the blocks were automatically generated by STATA 14 software across the treated and control groups and both the groups share similar demographical characteristic (i.e., gender, age, marital status, education level, household size and farming experience), hence, covariate common support assumption property is satisfied among the 196 respondents of the study.

5. DISCUSSION OF FINDINGS AND CONCLUSION

The primary aim of this study was to assess the impact of Fadama III project in Danbatta local government of Kano state, Nigeria. The specific objectives of the study are to evaluate the impact of Fadama III project on income and productivity of household farmer and lastly the influence of socio demographical features on participation in Fadama III development project; to achieve the mentioned objectives, relevant data were collected and analyzed.

From the results of the study, the following conclusions were made: 21% of the respondents are married and 37% of household farmers possess a minimum qualification of primary education; it was concluded that household size is not statistically a determinant of participation in Fadama III project. Some 65% of household farmers participating in Fadama III project have farming experience. It was further concluded that independent variables or observed heterogeneity (i.e., marital status, Education level, Household size and farming experience) predict dependent variable treatment

(participation) at 71%. The household farmers who participate in Fadama III project have experienced increase in productivity (i.e., production of sorghum and rice) and finally, the household farmers participating in Fadama III project have experienced increase in their income level.

6. RECOMMENDATION

After the conclusion, the following recommendations are made in order to provide adequate procedures to complement the impact of Fadama III project in Danbatta local government of Kano state, Nigeria.

Regular farmers training sessions must be conducted to employ strategies to reflect best management practices to ensure sustainability in agricultural productivity, timely delivery of advisory support and increased capacity building programs, adequate counterpart fund provision, satisfactory support of storage facilities, create awareness of insurance policies in agricultural productivity, community developmental program should be designed in the future such that it will accommodate a large number of potential farmers to improve their well-being. The government needs to invest more on some infrastructural facilities as well as human resources development for maintaining food supply stability and to secure increase in income. Considerable improvement in agricultural technology is required for enhancing crop yields, and a better organized farmers market will ensure stable price for their products.

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