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Full Length Research Paper

Impact of Fadama II project on income of tomato farmers in Niger State, Nigeria

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This study was designed to quantitatively determine the impact of Fadama II Project on the farm income of tomato producers by utilizing primary data from tomato farmers in Bosso and Mokwa Local Government Areas of Niger State for the year 2009. Production function analysis and Chow's analysis of covariance confirmed significant differences in production functions, heterogeneity in slopes and intercepts and factor bias was observed on the production functions of participating and non-participating farmers respectively. The project exerted a positive significant impact on the incomes of the farmers. The study recommends improvement in irrigation performance, introduction of improved varieties of tomato, strengthening relevant research and extension as well as formation of organized farmer associations.

Key words: Fadama II Project, tomato, participating farmers, non-participating farmers.

INTRODUCTION

Tomato is one of the most widely grown vegetables in the world. The popularity of tomato among consumers has made it an important source of vitamins A and C in diets (Tukru, 2007). Tomato grows well in irrigated conditions which makes it one of the principal crops cultivated on Fadama lands. Fadama is a Hausa language word which means wetland. Fadama is a land which is flooded in the wet season. Water dominates this environment probably because water is near the earth surface land or because the land is covered by shallow waters. World Bank (2001) defined Fadama as river valley areas which are seasonally flooded or have high water tables for all, or a large part of the year. Fadama are flood plains and low lying areas underlined by shallow aquifers found along Nigeria's river system. The National Fadama Development Programme (NFDP) was designed to assist some States of the Federation through the World Bank supported Agricultural Development Programme (ADP) network to, among others: finance the provision of shallow tube wells in Fadama lands for small scale irrigation, simplifying drilling technologies for shallow tube wells, constructing Fadama infrastructure, organizing Fadama farmers for irrigation management, cost recovery and better access to credit, marketing and other services as well as provision of vehicles, pumps and other equipment (Ayanwale and Alimi, 2004).

Irrigation is widely perceived as a key element in the promotion of agricultural production in sub-Saharan Africa. Large scale irrigation is capital intensive and the small-scale farmer often lacks the ability to operate and manage irrigation systems. Because of these reasons, production of tomato under the Fadama system has been receiving increased attention following the introduction of the First National Fadama Development Project (NFDP) in the early 1990s. One of the goals of the Fadama project is to enable farmers to produce food throughout the year. Fadama farming does not require large investment in capital input or specific management skills and these makes it more adaptable by small-scale farmers (Babatunde et al., 2008).

The Fadama II project operated in eleven (11) Local Government Areas (LGAs) out of the 25 LGAs in Niger state. Local Fadama desks were established and were operational in the 11 participating LGAs in the state. About 186 Fadama Associations and 186 local development plans have been formed. The Fadama Community Associations (FCAs) have a total of 2,058 Fadama user

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groups under them with membership strength of 26,068 composed of 17,462 males (67%) and 8,606 female 33%. Nwachukwu et al. (2008) stated that the second National Fadama Development Project was borne out of the need to ensure all year round agricultural production using available Fadama resources in Nigeria and also as a follow up to Fadama I that was Community Driven Development (CDD) with emphasis on social inclusiveness and empowerment of the rural people to take charge of their development agenda. The project focused on increasing sustainable incomes of Fadama users though empowerment in terms of capacity building, advisory services, acquisition of productive assets and rural infrastructural development.

Despite noticeable development, Fadama irrigation practice is still characterized by sub optimal irrigation schedules. Water application is done at intervals based on the farmers' judgments, not necessarily backed by scientific principle (Mofoke et al., 2002). According to the 2006 census, the population of Nigeria was about 140,000,542 persons (Tukru, 2007). For the fact that agriculture in the country is mainly rain fed, there is the need to exploit the dry season so as to make food production surpass average population growth rate and guarantee national food security. This is the primary reason why the National Fadama Projects were initiated with financial assistance from the World Bank. The Bank has committed about $1.2 billion for Agricultural Development Project (ADP) to increase farm production and welfare among small holders in Nigeria since 1974 (World Bank, 2001). World Bank (2001) further reported that several studies have shown that as at mid-term, beneficiaries have increased their incomes by about 25%. So far, an estimated 2.3 million Fadama II Project participating households have benefited from the expansion in income and wealth derived from the previously unavailable services provided by the project. The project had created about 126,000 permanent jobs and an additional savings of more than $40.8 million have been realized by the majority of the participating states. Similarly, in a study conducted by Ayanwale and Alimi (2004) regarding the impact of National Fadama in alleviating poverty reported that the major crops cultivated in Fadama fields remained the same as leafy vegetables, okra (*Abelmoschus esculentus*), maize and tomato. The farm income obtained from Fadama fields cultivation increased by about three times from ₦13,368.00 in 1997 when the first National Fadama Development Project started to ₦38,918.00 in 2004. Also, the households who owned one form of transport increased from 48 to 72%. Furthermore, the range of technical efficiency was 0.059 - 0.994 suggesting that the participants are relatively efficient. Ayanwale and Alimi (2004) suggested that the project exerted a positive impact on the participants and has a great potential of alleviating rural poverty in the study area.It was against this backdrop that this study seeks to ascertain the impact the project had exerted on the incomes and livelihoods to form the fulcrum for policy evaluation and formulation given that the Fadama II Project had been phased out in 2009 to midwife the commencement of the Fadama III Projects in the country. Evaluating the impact of Fadama II (on tomato producers in particular) to know its level of success or failure in Niger state has become imperative because, the success of Fadama II in one part of the country does not mean automatic success in another part. More so, the findings of this study will be useful to policy makers sharpen policy thrust and focus. This study therefore was undertaken to ascertain the impact of Fadama II Project on the incomes of farmers who participated in the scheme.

METHODOLOGY

Study area

The study was conducted in Niger State of Nigeria. The State is located between Latitudes 8°20´N and 11°30´ N and Longitudes 3°30´E and 7°20´E with a total land area of 76,363 km^2 and a population of 4,082,558 people (Wikipedia, 2008). The state is agrarian and well suited for production of a wide variety of crops such as yam, cassava, maize, millet, rice, cowpea and tomato etc because of favourable climatic conditions. The annual rainfall is between 1100 – 1600 mm with average monthly temperature ranges from 23 and 37°C (NSADP, 1994). The vegetation consists mainly of short grasses, shrubs and scattered trees.

Sampling technique

The data used for this study were mainly from primary sources collected from two Local Government Areas (LGAs), one of the LGAs is a Fadama II Project participating LGA (Bosso) while the second is a non-Fadama II participating LGA (Mokwa) which were purposively selected because of their status as participating and non-participating LGAs in the Fadama II Project respectively. There was also the prevalence of tomato production activities in these LGAs. The second stage involved a simple random selection of five villages from each LGA. From each of these villages, a total of 16 (sixteen) farmers were randomly selected giving a total of 160 farmers comprising 80 from Fadama II participating LGA and 80 from non-Fadama II participating LGA respectively. The data were collected using structured questionnaire. Data requirements for this study include input information such as farm size in hectares, labour input in man days, quantity of fertilizers in kilograms and agrochemicals in Naira, depreciation on farm tools and equipment etc., prices, socio-economic characteristics of farmers such as years of schooling, farming experience, age, household size, etc as well as output information. Data were collected between August 2008 and January, 2009.

The empirical model

Production function estimation

A production function stipulates the technical relationship between inputs and output in a production process. Four different functional forms of the tomato production function were specified as follows:

$$LnY_p = Lna_o + a_1LnX_1 + a_2LnX_2 + a_3LnX_3 + a_4LnX_4 + a_5LnX_5 + e_1 \quad (1)$$

$$LnY_n = Lnb_o + b_1LnX_1 + b_2LnX_2 + b_3LnX_3 + b_4LnX_4 + b_5LnX_5 + e_2 \quad (2)$$

$$LnY_q = Lnc_o + c_1LnX_1 + c_2LnX_2 + c_3LnX_3 + c_4LnX_4 + c_5LnX_5 + e_3 \text{ - - - -} \quad (3)$$

$$LnY_r = Lnd_o + d_1LnX_1 + d_2LnX_2 + d_3LnX_3 + d_4LnX_4 + d_5LnX_5 + d_6D + e_4 \text{ - - -} \quad (4)$$

Where Y_p in equation (1) is the income of farmers participating in Fadama II, Y_n in equation (2) is the income of non-participating farmers in Fadama II, Y_q in equation (3) is the pooled data without dummy, Y_r in equation (4) is the pooled data with a dummy variable, X_1 is farm size in hectares, X_2 is labour input in man days, X_3 is quantity of fertilizer in kg, X_4 is other inputs such as cost of seeds, agrochemicals etc in Naira, X_5 is capital inputs (depreciation on fixed factors such as tools, equipment, hoes, cutlasses, axes, machinery, rent on land, interest payments on borrowed capital, cost of machine hire, irrigation, etc.), D is the participation dummy variable which takes the value of unity for farmers who participated in Fadama II Project and zero for non-participating farmers respectively, a_i, b_i, c_i and d_i are the regression parameters to be estimated, e_i is the stochastic term while subscripts p, n, q and r stand for participating farmers, non-participating farmers, pooled without dummy and pooled with dummy farmer groupings respectively.

Test for structural shift in production function and the nature of impact

Chow's analysis of covariance was used in data analysis. One of the ways of comparing two regressions with a view of checking the slope and intercept differentials in both time-series and horizontal data is through the use of Chow test. In order to determine if there is any structural shift in production function between participating and non-participating farmers, the statistical tests performed using Onyenweaku (1997), Koutsoyiannis (2001), Gujarati (2006) and Onoja et al. (2009) are as follows.

Test for technical change

The Chow's F-statistic is calculated as follows:

$$F = \{[(\Sigma e_3^2 - \Sigma e_1^2 - \Sigma e_2^2) / (k_3 - k_1 - k_2)] \ / [(\Sigma e_1^2 + \Sigma e_2^2) / (k_1 + k_2)]\} \text{ ----------} \quad (5)$$

Where Σe_1^2 and k_1 are the error sum of square and degree of freedom respectively for a participating farmer, Σe_2^2 and k_2 are the error sum of square and degree of freedom for a non-participating farmer and Σe_3^2 and k_3 are the error sum of square and degree of freedom respectively for the pooled data without dummy.

Test for homogeneity of slopes

The F-statistic is calculated as follows:

$$F = \{[(\Sigma e_4^2 - \Sigma e_1^2 - \Sigma e_2^2) / (k_4 - k_1 - k_2)] \ / [(\Sigma e_1^2 + \Sigma e_2^2) / (k_1 + k_2)]\} \text{ ----------} \quad (6)$$

Where Σe_4^2 and k_4 are the error sum of square and degree of freedom respectively for the pooled data with a dummy variable with a value of unity for a participating farmer and zero otherwise; while other variables are as previously defined.

Test for differences in intercept (impact of Fadama II on the income of participating farmers)

The F-statistic is calculated as follows:

$$F = \{[(\Sigma e_3^2 - \Sigma e_4^2) / (k_3 - k_4)] / (\Sigma e_4^2 / k_4)\} \text{ ---------} \quad (7)$$

Where the variables are as previously defined. If the calculated Chow's F exceeds the critical F-value, then the intercepts are assumed to be different between participating and non-participating farmers which is attributed to impact of the project. This test is conditional on a common slope, so the test for differences in slopes is performed first before testing for differences in intercept.

RESULTS AND DISCUSSION

The socioeconomic characteristics of the respondents indicated that a typical farmer participating in the project is male, 34 years old, married with an average of 10 household members and with experience of about 15 years in the business, have at least adult level of education and cultivated 0.85 ha of tomato on the one hand. A typical non- participating farmer in the project on the other hand is male, 37 years old, married with an average of 9 household members and with experience of 18 years in the business, has at least quranic level of education and cultivated 0.51 ha of tomato.

Estimated production equations

The production equations for different categories of tomato producers were estimated. In each case, four functional forms were experimented with and the lead equation chosen based on the normal economic, econometric and statistical criteria. The error sum of square for the lead equation in each case was chosen and used in the computation of Chow's F-statistic. The ordinary least squares regression analysis indicated that the lead equations for Fadama II participating, non-Fadama II participating, pooled sample without dummy and pooled sample with dummy are the exponential, double-log, double-log and exponential forms of the equations respectively. The results are presented in Tables 1 - 4.

Testing for structural shift in production function and the nature of impact

The results of the tests for technical change, homogeneity of slopes and differences in intercepts are presented in Tables 5 - 7.

Test for technical change

Tests for technical change are shown in Table 5. The calculated Chow's F is 70.289 which is statistically significant at 1%. This result confirms that there is a significant difference between the production functions of Fadama II participating and non-participating farmers respectively.

Test for homogeneity of slopes

The results of the tests for homogeneity of slopes in the

Table 1. Regression estimates of the factors affecting tomato production by Fadama II participating farmers in Niger State, 2009.

Variable	Linear	Double log	Semi log	Exponential
Constant	140003.03 (2.529)**	0.353 (0.048)	-393294.5 (-0.263)	11.457 (32.420)***
Farm size	-179333.00 (-1.893)*	-2.260 (-1.318)	-1443833.9 (-0.411)	-1.100 (-2.662)**
Labour	-6840.652 (-2.482)**	-0.931 (-3.152)***	-226266.5 (-3.749)***	-0.033 (-2.844)**
Fertilizer	2407.196 (2.796)**	3.041 (1.791)*	234717.38 (0.677)	0.015 (2.802)**
Seed	-6.099 (-0.221)	0.112 (0.767)	30965.337 (1.040)	-423E-005 (-1.986)*
Capital	-8.765 (-1.549)	-0.209 (-0.729)	-34739.648 (-1.405)	-4.91E-005 (-1.616)
Ext. contact	2371.832 (0.368)	0.221 (0.802)	68630.506 (1.221)	0.019 (0.559)
R^2	0.534	0.789	0.682	0.741
R^2 adjusted	0.450	0.715	0.570	0.576
F-ratio	6.313***	10.619***	6.083***	9.833***

Source: Completed from survey data, 2009. *** implies statistically significant at 1%; ** implies statistically significant at 5% and * implies statistically significant at 10%. Figures in parenthesis are the respective t-ratios.

Table 2. Regression estimates of the factors affecting tomato production activities of non-Fadama II participating farmers, Niger State, 2009.

Variable	Linear	Double log	Semi log	Exponential
Constant	-161.873 (-0.008)	8.232 (4.358)***	-129809.8 (-1.182)	10.062 (31.194)***
Farm size	-216.562 (-0.063)	0.519 (-2.604)**	5114.653 (0.521)	-0.028 (0.632)
Labour	1268.712 (1.496)	0.644 (1.488)	59201.833 (2.352)	0.018 (0.220)
Fertilizer	-171.339 (-0.667)	0.783 (3.492)***	-25811.404 (-1.094)	0.070 (0.955)
Seed	13461.984 (1.600)*	0.600 (1.363)	51730.721 (2.021)*	0.161 (0.261)
Capital	4.159 (1.248)	0.087 (0.707)	10609.428 (1.490)	3.97E-005 (0.482)
Ext. contact	-1115-178 (-0.659)	-0.146 (-0.588)	-8162.596 (-0.565)	-0.027 (-0.350)
R^2	0.660	0.745	0.719	0.680
R^2 adjusted	0.598	0.656	0.620	0.622
F-ratio	10.665***	8.295***	7.262***	9.130***

Source: Completed from survey data, 2009. Other notations are as previously defined.

Table 3. Regression estimates of the factors affecting tomato production in Niger State, 2009, (pooled data without dummy).

Variable	Linear	Double log	Semi log	Exponential
Constant	76071.888 (2.097)**	9.593 (9.392)***	223982.31 (1.376)	10.920 (4.448)***
Farm size	-1655.600 (-0.229)	0.086 (0.504)	34388.634 (1.683)*	-0.140 (-3.854)***
Labour	-3395.565 (-2.096)**	-0.349 (-1.362)	-111179.1 (-1.722)	-0.013 (-1.194)
Fertilizer	516.078 (4.12)***	0.603 (5.561)***	48437.583 (2.801)**	0.006 (7.194)***
Seed	4.046 (0.673)	0.041 (3.777)***	4945.034 (1.759)*	-1.29E-006 (-0.20)
Capital	7.257 (0.064)	-0.074 (0.421)	-14828.409 (-1.022)	-4.10E-005 (-1.569)
Ext. contact	2445.844 (0.064)	0.025 (1.909)**	12449.739 (0.388)	0.008 (1.739)*
R^2	0.687	0.839	0.677	0.816
R^2 adjusted	0.662	0.816	0.630	0.801
F-ratio	26.762***	55.736***	14.350***	53.871***

Source: Completed from survey data, 2009. Other notations are as previously defined.

production functions for the two groups of farmers are presented in Table 6. The calculated Chow's F-statistic of 73.480 is greater than the critical F value (3.12) and thus significant. This implies that the slopes of the production functions are heterogenous. Heterogeneity of slopes indicates that the production functions are factor-biased.

Table 4. Regression estimates of the factors affecting tomato production in Niger State, 2009, (pooled with dummy).

Variable	Linear	Double log	Semi log	Exponential
Constant	76077.888 (2.097)**	10.121 (8.566)***	327756.26 (1.749)*	10.751 (40.142)***
Farm size	-1655.600 (-0.229)	0.058 (0.439)	28830.386 (1.374)	0.096 (1.712)*
Labour	-3395.565 (2.096)**	-0.393 (-1.504)	-119858.4 (-2.890)***	-0.011 (-2.703)**
Fertilizer	516.078 (4.765)***	0.496 (3.060)**	27323.076 (1.064)	0.006 (7.336)***
Seed	4.046 (0.673)	0.169 (1.165)	30117.016 (1.311)	0.129 (1.803)*
Capital	-7.257 (-1.864)*	-0.080 (-0.871)	-1592.016 (-1.098)	-3.47E-005 (-1.326)
Ext. contact	2445.844 (1.764)*	-0.005 (0.022)	16389.949 (0.509)	0.005 (0.229)
R^2	0.687	0.843	0.687	0.821
R^2 adjusted	0.662	0.815	0.632	0.804
F-ratio	26.762***	30.599***	12.545***	47.331***

Source: Completed from survey data, 2009. Other notations are as previously defined.

Table 5. Test for technical change.

Category of farmer	Error sum of square	Degrees of freedom	F cal
Fadama famers	2.281	73	
Non Fadama farmers	$3x10^9$	64	70.289***
Pooled data	$1x10^{11}$	153	

Source: Completed from survey data, 2009. *** implies statistically significant at 1%.

Table 6. Test for homogeneity of slopes.

Category of farmer	Error sum of square	Degrees of freedom	F cal
Fadama famers	2.281	73	
Non Fadama farmers	$3x10^9$	64	73.480***
Pooled data	$1.2x10^{11}$	151	

Source: Completed from survey data, 2009.
*** implies statistically significant at 1%.

Table 7. Test for shifts in the intercept.

Category of farmer	Error sum of square	Degrees of freedom	F cal
Fadama famers	2.281	73	
Pooled data without dummy	$1x10^{11}$	153	-5.917***
Pooled data with dummy	$1.2x10^{11}$	151	

Source: Completed from survey data, 2009.
*** implies statistically significant at 1%.

Test for differences in intercept

Table 7 shows the results of the statistical tests for the differences in intercepts of the production functions. The results show that the calculated Chow's F-statistic of -5.917 is statistically significant. This result indicates heterogeneity of intercepts or that the incomes realized by the two groups of farmers are not the same. It implies that Fadama II Project brought about structural shifts in the intercept of the income equation. In other words Fadama II Project brought about significant increases in the level of income of the participating as compared to

non-participating farmers.

CONCLUSION AND RECOMMENDATIONS

Significant production effects were confirmed to be brought about by the Fadama II Project. Heterogeneity in intercepts and factor bias was observed on the production functions of participating and non-participating farmers respectively. This suggests that the project positively impacted on the incomes of tomato producers and consequently improved their livelihoods. The following policy recommendations are hereby deemed appropriate. Tomato production should be encouraged to remain an all-year-round activity. Now that the Fadama III Project had commenced, smallholder irrigation should be expanded through the establishment of new schemes and the rehabilitation of existing ones. Irrigation provides a means of overcoming the limitations imposed on agricultural production by unreliable, erratic and unpredictable rainfall.

Improved tomato varieties well suited and adapted with high and stable yields should be developed for the different ecosystems in the country. Research should be aimed at targeting varieties to specific niches in a systems approach. The development of improved soil fertility practices will also be necessary.

Production inputs such as improved tomato seeds, fertilizers, agrochemicals and irrigation machines should be made readily available to the farmers. This should necessitate the formation and strengthening of existing farmer groups which will facilitate close monitoring of input utilization by Fadama user groups. Also, given that agricultural products by nature are highly perishable, storage and processing facilities should be made available to tomato farmers to forestall the incidences of spoilage and deterioration as a means of further supporting acquisition of productive assets and developing rural infrastructure. This will ensure that producers realize maximum benefit from their production activities, empower local communities, and improve the way government reach the poor and vulnerable groups, such as women, the elderly, disabled and people living with HIV/AIDS.

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