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Increasing Crop Output through Improved Technology Adoption: The Fadama III Approach in Delta State, Nigeria

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Abstract

The study focused on increasing crop output through improved technology adoption: the Fadama III approach in Delta State, Nigeria. The study which took place between June 2012 and February, 2013 used stratified random sampling technique to select 340 respondents (made up of 279 Fadama users and 61 non-users). Data which came from primary source was generated through structured questionnaire and analysis was achieved by both descriptive and inferential statistics. It was shown that the rates of adoption of these technologies vary but they generally range from about 11% for Irrigation practices to about 51% for use of improved crop cultivars. The mean rate of adoption of all arable crops technologies was about 43%. Results also show that Fadama users significantly had higher mean percentage increase in yield of about 21% than non-Fadama users who recorded only a mean of about 15% increase. The variables that significantly affected rate of adoption were, Farming experience, Farm size Non-farm incomes, access to advisory services and cost of technology adoption, all of which except the last positively influenced rate of adoption. Among the constraints to adoption of technologies, cost of adoption, lack of knowledge of improved technologies, complexity of available technologies and late delivery of required improved technologies were most serious. Among other recommendations it was suggested that governments should intensify efforts to the promotion of the more adoption of proven technologies through the provision of credits in order to increase productivity.

Keywords: Technology adoption, Fadama III, Crop output, Delta State, Nigeria

Introduction

Nigeria is predominantly still an agricultural economy. Approximately 70% of the population engages in agricultural production at a subsistence level, with holdings being generally small and scattered (NBS, 2007). Agriculture provides about 41% of Nigeria's total gross domestic product (GDP). The agricultural sector is not only the most important non-oil economic activity in Nigeria; it is also the single largest employer of labour forces. Thus the agricultural sector is often seen as important for reducing poverty and providing food security (Agenor *et al*., 2004).

In the past years, governments at all levels had introduced several food security programmes to this end, all targeted at the numerous smallholder farmers. The primary purpose of such programmes had been to increase the output and productivity of the farms and by extension, incomes of the farming households. However, as each programme is phased out and replaced by another, it had been difficult to say

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if they made the desired impact on the lives of Nigerians in terms of food availability because of the persistent rise in food scarcity and demand in the country.

Among the earlier poverty alleviation and farm/farmer targeted programmes were National Accelerated Food Production Project (NAFPP) in 1973, Operation Feed the Nation (OFN) in 1976, River Basin and Rural Development Authorities (RBRDA) in 1976, Green Revolution Programme (GRP) in 1980, Agricultural Development Programme (ADP) in 1975 among others.

Although governments at various levels and donor agencies had made deliberate efforts to transform the agricultural sector, the literature is replete with evidence of disappointing effects of these well-conceived programmes. The fact is that none of them had been able to increase the mean size of farm holdings, productivity of the farms and incomes of the farming households, with the net effect of the rural farm households remaining abysmally poorer than urban non-farm households.

According to (Ozowa, 2005), about 94% of all farm holdings in Nigeria, judging by the international standard are small scale. The small holder farmers however, are the main producers of 98 percent of the food consumed in Nigeria. Available evidences show that small scale farmers depend on their efficiency in the utilization of basic production technology available to them (Nweka *et al.*, 2002; Tsegai and Kormawa, 2002).

The basic technologies available to the farmers had in many ways limited either growth in agricultural output or productivity of in Nigeria. By agricultural productivity is meant general output per unit of input, farm yield by crop or total output per hectare, and output per worker. Regardless of which measure is used, empirical findings point to the fact that any measure aimed at its improvements are important for poverty reduction (Mellor, 1999).

Increasing agricultural production has multiple benefits to the economy. First, it brings about increased incomes for poor farmers who then increase demand for the goods and services produced by the non-farming rural poor. Secondly, it stimulates employment in the rural and urban non-farm sectors through both forward and backward linkages. Thirdly, it decreases urban poverty by slowing migration to urban areas and lowering food prices (Mellor, 1999; Hanmer and Naschold, 2000).

In her endless efforts at enabling the farming poor to increase their agricultural output, improve their income and thereby be lifted above the subsistence level, the Nigerian government introduced the National Fadama Development Project under a World Bank financing 1990's. Over the years, Fadama has grown to include the active participation of farmers as counterpart funders of the programme which has been replicated because of its level of success among rural. Since introduction, the Fadama Programme has passed through different phases, the current one being Fadama III.

Fadama III Project is a follow on to the Fadama-Il which was implemented in 18 States (with World Bank support in 12 states and the African Development Bank (ADB) in 6 States). The project is a $450M intervention credit shared amongst the World Bank (55.6%) and the Federal, State and Local Governments in the ratio of 5.1 %, 17.1% and 8.9% respectively while the participating communities are contributing about 13.3%. The project became disbursement effective on March 23, 2009 and currently in the fourth year of the proposed five years, and has demonstrated a boost in small-scale farming and increased productivity across the participating States through the adoption of proven technologies. The emphasis on adoption of proven technologies is premised on the fact that among the multiple pathways through which agricultural productivity can be increased, availability, affordability, applicability and adoption of improved farm technologies are the core.

Increasing agricultural productivity and hence output of the farm sector using improved technologies is a necessary step towards achieving food security in Nigeria. As noted by Langyintuo *et al.* (2001) productivity will remain low as long as farmers continue to use low yielding inputs and technologies.

Adoption of innovations refers to the decision to apply an innovation and to continue to use it (Oladele, 2005). Intensity of adoption implies the number of technologies practiced or the extent of adoption of a specified technology by the same farmer. Saha *et al.* (1994) observed that producers' adoption intensity is conditional on their knowledge on the new technology and on their decision to adopt.

It has been noted that people do not just adopt a technology because it is available to them. Even when the technology is available and appropriate, some personal and socio-cultural factors bear on the decision to adopt or not (Berdegue and Escobar, 2001; Daniel *et al.*, 2001; Garforth *et al.*, 2003; Perkin & Rehman, 1994).

Empirically, researchers including: Onyenwaku (1988); Iwueke (1989); Mijinadadi and Njoku (1985) have investigated factors related to the adoption of improved technology and they found that technology adoption was related to (1) farmers personal characteristics, characteristics of the farm, Characteristics of innovation itself in terms of relative advantage.

The Fadama III Project has been implemented over a four years of its five-year period from 2008 to 2012 and will terminate in December 2013. The questions that need to be answered in order to assess the project in terms of achievement of its set goals are; what were those proven technologies that the project promoted among the farmers; how many of them were adopted by the farmers; how many of the farmers adopted the technologies; has the adopted technologies made any impact of the output of the farmers and were there constraints to adoption of the technologies?

To these ends, the study sought specifically to;

i. ascertain the types of technologies introduced to the Fadama users and thence establish the rates of their adoption.
ii. assess the impact of the adopted technologies on the output of the Fadama users in comparison to those of Non-Fadama users.
iii. identify constraints to adoption and continued use of technologies among the farmers.

Methodology

This study was carried out in Delta State, Nigeria, from December 2012 to February, 2013. The state was created in 1991 and has 25 local government areas (LGAs) divided into three Agricultural Zones of Delta North, Delta South and Delta Central.

The state covers a landmass of about 18,050 km^2 of which more than 60% is land. The state has a population of about 4,098,391 composed of about 2,074,306 males and 2,024,085 females (National Population Commission, 2006). Delta State lies roughly between longitude 5°00 and 6°45 East and Latitude 5°00 and 6°30 North.

The state is currently the highest producer of petroleum products in the country. However, as with most parts of the country, agriculture is the dominant aspect of the rural economy of the state. Agriculturally, the state is divided into three zones, namely, North, Central and the South Zones. Generally, the major food crops grown include: cassava, yams, cocoyams, maize, and rice, assorted vegetable and other crops. Also of importance is livestock production and fisheries, besides forest and wildlife products.

To analyse the impact of the Fadama III project on technology adoption, the food crop farmers in the state were divided into two strata, Fadama users and Non-Fadama users. The stratification was designed to allow for estimation of the direct effects of Fadama III project by comparing Fadama III project beneficiaries to similar households in similar communities not included in the project.

Delta State has 25 LGAs, out of which 20 are participating in Fadama III. Out of the 20 LGAs participating in Fadama III project in the state, and considering those who have paid their counterpart funds and have had their Fadama User Groups (FUGs) funded, 9 LGAs were randomly selected to represent areas of direct project intervention. From the selected LGAs, a random sample of 279 Fadama User Households was drawn.

Selection of Non-Fadama III participants from the 5 Non-Fadama III LGAs involved a

systematic random selection of 61 Households was drawn to serve as the control group. In all therefore, a total of 340 households were selected for this study.

Data for the study came from primary source. The data were obtained through the use of copies of a well-structured questionnaire were administered by a team of well-trained enumerators who speak English and local Languages of the respondents very well.

Information sought for were those relating to the socioeconomic characteristics of the respondents, the nature of their food crop farming enterprises, their inputs, output and income data. Also sought for were information relating to the technologies provided by FADAMA III Project to the participants and their rates of adoption.

Data were analysed by means of both descriptive and inferential statistics. The descriptive tools used were mean, percentages, pie and bar charts. The inferential statistical tools employed were student t- statistic and regression analysis. The ***t***- statistics was used to compare the mean values of relevant technology adoption and crop output parameters between the specified Fadama user and non-user respondents. The regression analysis was employed to ascertain the socioeconomic factors of the respondents that influenced the rates of technology adoption.

The simplest approach to make an impact evaluation is to compare the value of the indicator of interest before and after the intervention. However, this only tells us what happened, not why. It is a description of the factual. To capture the counterfactual, a comparison of the treatment group with a specified control group under the scenario of before and after an event with respect to the parameters of interest is required. This can be done using single difference, double difference of regression analysis in which project participation is an explanatory dummy variable (Ravallion, 2005; Banerjee *et al.*, 2006). This study used the double difference method specified as follows.

$$DD = \frac{\left[\sum_{i=1}^{b}(Q_{pi1} - Q_{pi0})\right]}{b} - \frac{\left[\sum_{j=1}^{a}(Q_{nj1} - Q_{nj0})\right]}{a}$$

Where
DD = Differences in yield of the i^{th} food crop between the respondents
b = Number of Fadama III participants
a = Number of Non –Fadama III participant (control group)
Qpi1 = Mean yield of i^{th} crop for beneficiaries of Fadama III Project since the project was launched
Qpi0 = Mean yield of i^{th} crop for beneficiaries of Fadama III Project before the project was launched
Qnj1 = Mean yield of i^{th} crop for Non-beneficiaries of Fadama III Project since the project was launched
Qnj0 = Mean yield of i^{th} crop for Non-beneficiaries of Fadama III Project before the project was launched
The level of significant difference in the yield/hectare was tested using paired-wise-t-test analysis.
The use of double difference method became plausible because baseline data were available in the case of participants and was sourced via memory recall in the case of Non-participants in Fadama III Project.

The regression model was specified as follows.

$$T_r = f(LED, NFI, FSZ, FEX, ADS, CRD, COT)$$

Where,
Tr = Rate of technology adoption
LED = Level of formal education
NFI = Annual non-farm income (N)
FSZ = Farm size in hectares
FEX = Number of years of farming experience
ADS = Benefited from Fadama III Advisory services (yes = 1 and 0 otherwise)
CRD = Volume of credit accessed (N)
COT = Monetary cost of technology adoption (N)

Three functional forms of the regression equation were tried and were specified as follows.

Linear function: $T_r = \beta_0 + \beta_i X_i + e$

Semi-log function: $T_r = log\ \beta_0 + \beta_i\ log\ X_i + e$
Double log function: $log\ T_r = log\ \beta_0 + \beta_i\ log\ X_i + e$

Where,

T_r is the rate of technology adoption (explained variable).
X_i is the ***i***th explanatory variable.
B_0 and **β_i** are the intercept and ***i***th slope parameters that were estimated respectively.
e is the stochastic error term.

The output of these functional forms were subjected to statistical, economics and econometric tests and the one which outperformed the others with respect to *apriori* expectations was adopted as the led equation and then use for discussion.

Results and Discussion

The demographic characteristics of the respondents are presented in Table 1. The variable described were gender, age, level of formal education and types of primary occupation.

Table 1: Demographic Characteristics of Respondents

Variable	Variable categories	Fadama Users (n = 279)		Non-Fadama Users (n = 61)		All Respondents (N = 340)	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Gender	Male	162	58.1	28	45.9	190	55.9
	Female	117	41.9	33	54.1	150	44.1
Age group	Less than 20 years	2	0.7	1	1.6	3	0.9
	20 - 29 years	13	4.7	4	6.6	17	5.0
	30 - 39 years	37	13.3	9	14.8	46	13.5
	40 - 49 years	96	34.4	14	23.0	110	32.4
	50 - 59 years	63	22.6	25	41.0	88	25.9
	60 years and above	68	24.4	8	13.1	76	22.4
Educational status	No formal education	49	17.6	9	14.8	58	17.1
	Primary education	121	43.4	19	31.1	140	41.2
	Secondary education	57	20.4	15	24.6	72	21.2
	NCE/OND	25	9.0	11	18.0	36	10.6
	First degree/HND	22	7.9	6	9.8	28	8.2
	Postgraduate degree	5	1.8	1	1.6	6	1.8
Primary occupation	Food crop production	182	65.2	38	62.3	220	64.7
	Civil/public servant	11	3.9	3	4.9	14	4.1
	Artisan	29	10.4	7	11.5	36	10.6
	Trading	17	6.1	5	8.2	22	6.5
	General business	38	13.6	4	6.6	42	12.4
	Others	2	0.7	4	6.6	6	1.8

With respect to gender, about 56% of all respondents were male, while about 44% were female. This implies a fairly balanced male to female ratio participation in the sample, although male dominated the female marginally. The same pattern was observed for both Fadama user and Non-Fadama users, although it appeared that more male than female participated in Fadama III than female.

The sample was populated by respondents who were relatively advanced in age. This is because only 19% of the respondents were below 40 years of age. At the upper age group, as many as 81% were 40 years of age or more. This pattern is more with Fadama III users than the non-users. With Fadama III Project being targeted at the low income group of the rural population, majority of who are farmers, the seemingly advanced age nature of the respondents is a reflection of the fact that farming population in Delta State is aging. To checkmate this undesirable trend and therefore attract younger ones into farming, more farm modernisation and rural infrastructure upgrades as currently being pursued through Fadama III Project are further advocated.

The educational level of the farmers presents a picture of relatively not well educated group of people, with as many as 17 % having no formal education at all. Also, 41% of them had primary while about 21% were educated up to secondary levels. Those who had post-secondary educations were only about 20%. Good formal education is a necessary condition required for profitable participation in modern day farming and farm related enterprises. So any complimenting programme that would increase the educational levels of the farmers would improve the farming practices of the people.

The respondents were engaged in food crop production enterprises either as a primary or secondary occupations. Those who engaged in food crop production enterprises as their primary occupation accounted for 65% of the respondents, implying that only 35% were into other farm and non-farm enterprises as their primary occupations. These findings show that food crop farming was the main livelihood of the respondents. Engagement in other farm/non-farm enterprises was secondary and they serve to augment incomes from the primary sources.

Table 2: Respondents' Farm Characteristics

Variable	Variable categories	Fadama Users (n = 279)		Non-Fadama Users (n = 61)		All Respondents (N = 340)	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Types of enterprises	Cassava	121	43.4	13	21.3	134	39.4
	Yam	76	27.2	16	26.2	92	27.1
	Maize	41	14.7	13	21.3	54	15.9
	Cowpea	12	4.3	4	6.6	16	4.7
	Groundnut	21	7.5	9	14.8	30	8.8
	Rice	8	2.9	6	9.8	14	4.1
Farm size (ha)	Less than 0.5	65	23.3	17	27.9	82	24.1
	0.5 - 1.49	98	35.1	24	39.3	122	35.9
	1.5 - 2.49	68	24.4	10	16.4	78	22.9
	2.5 - 3.49	34	12.2	8	13.1	42	12.4
	3.5 - 4.49	5	1.8	1	1.6	6	1.8
	4.5 or more	9	3.2	1	1.6	10	2.9

The types of food crop enterprises engaged in and the farm sizes of the respondents are shown in Table 2. It could be seen from the table that majority of the respondents (39.4%) produced cassava as their main crop followed by those who were into yam (27.1%) and maize (15.9%). Only few of them produced groundnut, cowpea and rice as their main crops. These show the

suitability and acceptability of cassava, yam and maize in the farming system of Delta State. There appear to be greater comparative advantages in growing these crops in the state than there is for other crops.

Irrespective of the crop enterprises the farmers were into, they were generally smallholders as Table 2 indicates. On the whole, about 60% of the respondents had farm holdings of less than 1.5 hectares in size. On comparative basis however, Fadama users appeared to have had relatively larger hectarage than Non-Fadama users. The most plausible reason for this differential size in farm holdings is support extended to some of the respondents by Fadama III Project.

The types of food crops production technologies identified and their rates of adoption (in terms of number of farmers using each as a percentage of all Fadama user respondents) are given in Table 3.

There were 12 known technologies that were provided as could be seen in the table. The rates of adoption of these technologies vary but they generally range from about 11% for Irrigation practices to about 51% for use of improved crop cultivars. The mean rate of adoption of all arable crops technologies was about 43%. Other arable crops technologies that had fairly high rate adoption were product marketing technique (48.57%), Controlled use of herbicides/pesticides (47.14%), Dry season farming(18%), Improved land preparation (47.14%) and Optimum planting distances/densities (45.71%).

Table 3: **Types and Rates of Adoption of Food Crops Production Technologies**

Identified food crop production technologies	Fadama users (n = 279)	
	Number of participants adopting technologies	Percentage level of adoption
Inorganic fertilizer application	30	42.86
Organic fertilizer application	26	37.14
Controlled use of herbicides/pesticides	33	47.14
Dry season farming	13	18.11
Inclusion of legumes in crop mixture	25	35.71
Irrigation practices	8	11.43
Crop rotation practices	28	40.00
Optimum planting distances/densities	32	45.71
Use of improved crop cultivars	36	51.43
Yam mini-sett technology	12	17.14
Improved land preparation	33	47.14
product marketing technique	34	48.57
All technologies	28	43.08

The result indicates that an irrigation practice which promotes dry season farming was not popularly adopted by the respondents. Affordability issues were the constraints to adoption of this practice.

To enable the assessment of the impact of adoption of proven technologies on productivity (output/hectare), a double difference method was adopted. This was to establish the counterfactual impact of the technologies on output of the farms. The result is as presented in Table 4.

Table 4: Difference in Yield /ha of Selected Crop Enterprises within and between Groups

Enterprise	Yield/ha (tons) for Fadama users			Yield/ha (tons) for Non-Fadama users			Inter-group differences (Double Difference)
	After	Before	Intra-group Differences	After	Before	Intra-group Differences	
Yam	14.89	12.117	2.774	13.885	12.410	1.475	1.300*
Cassava	15.32	11.871	3.452	14.479	12.193	2.286	1.166*
Maize	2.297	1.840	0.457	2.152	1.887	0.265	0.192*
Cowpea	0.627	0.541	0.086	0.602	0.546	0.056	0.031*
Groundnut	1.309	1.118	0.191	1.288	1.123	0.165	0.027
Rice	1.366	1.153	0.213	1.389	1.146	0.243	-0.031

Note: * Indicates a significant difference between Fadama users and non-users ($P \leq 0.05$)

The table shows that with the exception Groundnut and Rice production enterprises, there were significant differences between Fadama users and non-users in terms of output per hectare for the period before and during Fadama III Project. In all cases except for Rice production, Fadama farmers recorded higher yield than non-Fadama farmers. In the case of rice enterprise, non-Fadama farmers appeared to have recorded higher yield than Fadama farmers, though the difference was not statistically significant. The improved technologies adopted by Fadama users could have enabled them to increase their output per unit of land area than non- users over the Fadama period.

Expressing the changes in yield since Fadama III Project was introduced as percentage of the baseline (before the project) yield, shows that all respondents recorded increases in their farm output (see Table 5). However to corroborate the result presented by the double difference analysis, it could be seen from Table 5 that Fadama users had higher mean percentage increase in yield of about 21% than non-Fadama users who recorded only a mean of about 15% increase.

Table 5: Percentage Changes in Output/ha of Selected Crops for Fadama users and Non-users

Enterprises	Fadama users			Non-Fadama users		
	Yield/hectare after	Yield/hectare before	Percentage change over the period	Yield/hectare after	Yield/hectare before	Percentage change over the period
Yam	14.891	12.117	22.90	13.885	12.410	11.88
Cassava	15.323	11.871	29.08	14.479	12.193	18.75
Maize	2.297	1.840	24.83	2.152	1.887	14.05
Cowpea	0.627	0.541	16.00	0.602	0.546	10.20
Groundnut	1.309	1.118	17.12	1.288	1.123	14.65
Rice	1.366	1.153	18.44	1.389	1.146	21.23
Mean			**21.39**			**15.13**

The result of the regression analysis which was carried out to establish the socioeconomic factors that affect the rate of technology adoption by the respondents is presented in Table 6. The three functional forms showed very high coefficients of multiple determinations (R^2), high F-values and comparable model standard errors. However, the linear model outperformed the others in most of the evaluation criteria except in the model standard

error. It had the highest R^2, more number of significant coefficients and highest F-calculated value than the other two models and so, was adopted as the lead equation for further analysis. The significant variables were Farming experience, Farm size Non-farm incomes, access to advisory services and cost of technology adoption.

Table 6: Determinants of Rates of Technology Adoption

Variables	*Coefficients*		
	Linear	**Semi log**	**Double log**
Intercept	12.337* (7.593)	1.256* (33.435)	-0.427 (-1.988)
Farming experience (years)	0.045* (2.011)	0.001 (1.396)	0.019* (2.034)
Farmsize (hectares)	10.834* (10.892)	0.275* (11.945)	0.385* (7.885)
Non-farm income(₦)	0.000* (5.400)	0.000* (5.661)	0.347* (8.312)
Formal education (years)	0.003 (0.230)	0.000 (0.021)	0.003 (1.094)
Advisory services (Dummy)	1.364* (2.459)	0.009 (0.732)	0.004 (1.445)
Volume of Credit(₦)	0.000 (0.181)	0.000 (-0.897)	0.000 (0.339)
Cost of technology adoption(₦)	0.000* (-3.554)	-3.1E-06* (5.89798)	-0.001 (-0.481)
R^2	0.9669	0.8970	0.9619
Adjusted R^2	0.9657	0.8933	0.9605
F - Calculated	800.98*	238.94*	692.73*
Model Standard error	0.091777	0.07002	0.04258

Note: Figures in parentheses are ***t*** – values and * indicates coefficients that are significant at ($P \leq 0.05$)

Farming experience had positive effect on the rate of technology adoption by the Fadama users, implying that more experience farmers had higher rates of adoption than the less experienced ones. Experience is the cumulative effect of learning processes. As such, farmers who have spent some years in farming have learnt by observation and training better and enduring ways of managing their resources, thus enabling them adopt more technologies than those with little or no experience in the art of farming.

Farm size also had positive effect on technology adoption, such that farmers with larger farms appeared to have adopted more technologies than those with smaller farms. Although the number of small scale enterprise holders significantly outweighs those of the large scale operators, the smallholders' rate of technology adoption was the lower. The reason for this could be the uneconomic scale of operation which makes the adoption of improved technologies to be unprofitable. This is so because most improved technologies require that size of enterprise holding should be reasonably large to justify investment in them. This then suggest that the Fadama users and indeed all rural entrepreneurs should be more financially empowered to enable them increase the size of their holdings and therefore net enterprise incomes.

Availability of off-farm incomes seems to support technology adoption. The probable reason for this is disposable income augmenting synergy between farm and off-farm incomes. O'Neill and Matthew (2000) had noted that off–farm incomes have the direct effect on the use of improved farming technics and therefore technical efficiency of farmers.

Participation in the advisory services provided by Fadama III Project to farmers had positive effect on the rate of adoption of proven technologies and farm output. This agree with Agbebi (2012), who noted that there is a relationship between access to extension services and profitability of farmers, that is, the more the farmers had access to extension and other advisory services the higher the farmers output will be. This implied that participants adopted more technologies than non-participants and therefore had higher farm output than non-participants. It is therefore obvious that for positive change of attitude by farmers towards their perception of modern farming techniques, reaching them through well designed advisory services will bring desired results.

Lastly among the significant variables, monetary cost implications for adopting new technologies had an opposite effect on rate of adoption. This meant that the higher the monetary requirements, the lower the rate of adoption. This is obviously so, considering the poor financial status of the farmers.

Education had positive effect on the level of technology adoption. However, contrary to expectation the is variable was not significant. This could be due to the general low level of educational attainments among the respondents.

Although a number of improved technologies were provided by Fadama III Project to users of its less than 50% on the average of the respondents in each enterprise category adopted the technologies. The constraints to adoption of technologies are presented in Table 7.

Among the constraints to adoption of technologies, cost of adoption, followed distantly by lack of knowledge of improved technologies, complexity of available technologies and late delivery of required improved technologies were the most serious. These factors were indicated by about 36%, 14%, 14% and 13% of the respondents as the most serious factors limiting their ability to adopt or continue to use adopted improved technologies. Other constraints were Non-availability of improved inputs (9.7%), discouragement from earlier users (7.5%) and preference to older technologies currently in use (5.4%).

Table 7: Constraints to Adoption of Improved Technologies

Constraints to adoption	Frequency	Percent
Not aware of the technology	40	14.3
Too expensive to adopt	101	36.2
Too complex to apply	39	14.0
Non-availability of improved inputs	27	9.7
Late delivery of required improved inputs	36	12.9
Discouraged by earlier users	21	7.5
Prefer to old technology currently in use	15	5.4
Total	279	100

Conclusion

The study had shown that Fadama III Project introduced a number of food crops production technologies to the Fadama user households. It also showed that though the rate of adoption of these technologies was less than 50%, the user households who adopted some or all of these technologies, significantly had higher output per hectare than those who did not adopt them. The variables that made significant effect on the rate of adoption of these technologies were, Farming experience, Farm size Non-farm incomes, access to advisory services and cost of technology adoption, all of which except the last positively influenced rate of adoption.

Among the constraints to adoption of technologies, cost of adoption, followed distantly by lack of knowledge of improved technologies, complexity of available technologies and late delivery of required improved technologies were the most serious.

It is therefore recommended that governments should intensify efforts to the promotion of the

more adoption of proven technologies through the provision of credits in order to increase productivity. In addition, measures to intensify extension contacts with farmers and other advisory services to make optimum utilization of available technologies and to further reap the benefits therefrom should be put in place. Also, rural infrastructure should be improved upon to encourage rural off-farm economic activities and therefore total income the farming households.

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