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Impacts of Community-driven Development Programs on Income and Asset Acquisition in Africa: The Case of Nigeria

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Summary. — This study evaluates the impacts of a community-driven development (CDD) project on household income and acquisition of productive assets in Nigeria. Using recall data, difference-in-differences, and propensity score matching approaches, the study finds that the project succeeded in targeting the poor and women farmers in its productive asset acquisition component. Participation in the project also increased the mean income of beneficiaries by about 40–60% but the impact of the project on income of the poorest beneficiaries was not statistically significant. Additionally, sustainability of this achievement is uncertain since the project did not involve rural credit services. The large cash transfer through its productive asset acquisition component is also unsustainable. Future studies should be undertaken using longer-term panel data to capture the pattern and trend of the impact of this project.

Key words — Nigeria, Africa, community-driven development, impact evaluation, poverty, targeting, income, assets

1. INTRODUCTION

The community-driven development (CDD) approach has become a key strategy used by both government and development assistance programs (Gillespie, 2004; Mansuri & Rao, 2004; Platteau, 2004). The popularity of the CDD approach has been propelled by its potential to develop projects and programs that are sustainable and responsive to local priorities, empower local communities to manage and govern their own development programs, and more effectively target poor and vulnerable groups (Dongier *et al.*, 2001; Gillespie, 2004). Empirical evidence of the effectiveness of CDD in achieving these objectives is mixed (Mansuri & Rao, 2004). Among the interesting questions capturing the attention of scholars is the sustainability of donor-supported CDD and its effectiveness in targeting the poor and vulnerable. Khwaja (2001) observed that projects managed by communities were more sustainable than those managed by local governments because of better maintenance of the assets and infrastructure created by the project. Arcand and Bassole (2007) observed that access to clean water and health services and consumption increased for poor families in a CDD project area. Labonne and Chase (2008) also observed an increase in social capital for communities benefiting from a CDD project.

However, Cleaver (1999), Kleimeer (2000), and Mosse (1997) found that CDD projects that lacked continuous external institutional, financial, and technical support were not sustainable.

Targeting the poor has been one of the challenges of development and emergency response programs (Farrington & Slater, 2006). One argument in favor of CDD asserts that it can improve targeting because CDD projects make better use of local knowledge to define and identify the targeted groups (Mansuri & Rao, 2004). However, empirical evidence is mixed concerning the effectiveness of targeting using the

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CDD approach. One review concluded that in heterogeneous communities with high social inequality, the performance of CDD projects in targeting has been worse than that of externally managed programs (Conning & Kevane, 2002). However, the review also revealed that in egalitarian communities with open and transparent systems of decision making, targeting was better with CDD than with development approaches using external project management.

This study was conducted to assess the impact of a CDD project called Fadama II, which is the largest agricultural project in Nigeria covering 12 of the 37 states. The Fadama II project aims to reduce poverty by supporting communities to acquire infrastructure and productive assets, providing demand-driven advisory services, increasing the capacity of communities to manage economic activities, and reducing conflicts among resource users. We evaluate the impact of the project on income poverty [1] and productive assets, and also examine whether the project succeeded in targeting the poor and the vulnerable through its poverty reduction efforts and productive asset acquisitions. Results show that the project succeeded in targeting the poor and women farmers in its productive asset acquisition component. Participation in the project also increased the income of beneficiaries by about 40–60%. However, the impact of the project on income of the poorest asset tercile was nonsignificant. This could be due to the failure of the poor to effectively use the new productive asset in the first year lagged impact of assets on income of the poor. The large cash transfer through its productive asset acquisition component is also unsustainable. We explore this apparent large impact, which in the first year seems to have missed the targeted poor groups.

The study uses counterfactual nonproject communities and households as well as project beneficiaries, allowing better attribution of the outcomes to the project. This approach contributes to evaluating impacts of CDD projects, most of which are evaluated without using comparison groups (Mansuri & Rao, 2004). Since efforts to empower local communities to actively participate in managing their development programs have increasingly been using the CDD approach (Dasgupta & Beard, 2007; Mansuri & Rao, 2004), results of this study will be useful for planning public investment in CDD in developing countries. The evaluation is conducted in Nigeria, a country that serves as a good case study given its high incidence of poverty (55%) and since it has the largest population in sub-Saharan Africa—a region with the highest incidence of poverty (Ojowu, Bulus, & Omonona, 2007; World Bank, 2007).

2. STRUCTURE OF THE FADAMA II PROJECT

Fadama II is a follow-up to Fadama I (phase I of the National Fadama Development Project), which was implemented during the period 1993–1999. [2] Fadama I focused mainly on crop production and largely neglected support of post-production activities such as commodity processing, storage, and marketing. The design of Fadama I did not support rural infrastructure development and did not consider other resource users such as livestock producers, fisherfolk, pastoralists, and hunters, among others. This focus on crop producers contributed to increased conflicts among the users of *fadama* [3] resources. Fadama I project increased crop production, but the neglect of post-harvest technology contributed to reduced crop prices and increased storage losses (Babatunde, Fakayode, & Obafemi, 2008).

Fadama II was first implemented in 2005 and operated in 12 states, eight of which were Fadama I states (Bauchi, the Federal Capital Territory [FCT], Kebbi, Lagos, Niger, Ogun, Oyo, and Taraba), and four of which were only Fadama II states (Adamawa, Gombe, Imo, Kaduna). [4, 5] Fadama II sought to address the shortcomings of Fadama I by shifting from a top-down and supply-driven public sector development program to the community-driven development approach. Fadama II also included other *fadama* resource users that the first project had ignored, and supported activities and services other than agricultural production. Fadama II was designed to operate for 6 years (2004–2010), but actual implementation did not begin until September 2005. However, due to its significant progress in the first 2 years, Fadama II project was elevated to the third phase—Fadama III, which covers all 37 states (World Bank, 2008).

Consistent with the CDD approach, project activities are centered on farmer groups, i.e., Fadama User Groups (FUGs) and Fadama Community Associations (FCAs). An FUG comprises *fadama* users with a common economic interest and is therefore a type of economic interest group. An FCA is the association of multiple FUGs operating in a given area. Each FCA designs and oversees the implementation of a local development plan, which is the blueprint of the Fadama II development project in that FCA. As part of its targeting strategy, the project provides special preferences to FUGs consisting of youth, women (especially widows), physically challenged persons, the elderly, and people with HIV/AIDS. Targeted groups can engage in any of the productive or service sectors supported by the project. Participation of other project beneficiaries was conditioned on being in a local government area (LGA) which was selected to participate in Fadama II. Selection of LGA was done by the state agricultural development program using criteria that ensured strong commitment of the LGA to engage in economic activities and to pay matching funds. Beneficiaries were also required to belong to economic interest groups, in which 20% of the members are women. The CDD approach means that beneficiaries are given the chance to choose the kind of activities they want to pursue, and all users of *fadama* resources are encouraged to develop participatory and socially inclusive local development plans. However, there are some activities that the project does not support, such as activities that could lead to degradation of natural resources or large-scale changes in land use (NFDO, 2005).

The project set a target of 50% of male and female *fadama* resource users who benefit from the project-supported activities achieving an increase in average real income by at least 20% compared with the baseline. For the productive asset acquisition component, the project supports FUG members to acquire productive assets such as processing equipment (e.g. grain milling machines), fishing and irrigation equipment, buildings, etc.

Under this component, *fadama* resource paid 30% of the cost of the productive assets acquired. The project gave matching funds equivalent to 70% of the value of productive assets. However, the project supports acquisition of group-owned assets only, i.e., it does not support FUG members to acquire productive assets individually.

Because we evaluated the progress of the project and its income impacts after only one full year of implementation, this study should not be considered a final impact assessment of Fadama II. Rather, it is a quantitative assessment of initial progress and impacts after 1 year of implementation, and a potentially useful baseline against which to measure future progress and impacts.

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3. DATA AND METHODOLOGICAL FRAMEWORK

This study was conducted in all 12 states benefiting from the project. The 12 states lie in three major agro-ecological zones (Maziya-Dixon *et al.,* 2004): the humid forest (Lagos, Ogun, and Imo); moist savannah (Adamawa, FCT, Oyo, and Taraba); and dry savannah (Bauchi, Gombe, Kaduna, Kebbi, and Niger). In each benefiting state, the project was implemented in 10 selected local government areas.

We used a household survey to analyze the impact of the Fadama II project on beneficiaries and the spillover of benefits to nonparticipants living in Fadama II LGAs. To capture the spillover of impact to project nonbeneficiaries, we divided the sampling frame into three strata: (1) direct project participants, (2) respondents living in Fadama II LGAs but not directly participating in the project (although they might benefit indirectly), and (3) respondents living in communities in *fadama* resource areas outside the Fadama II local government areas (LGAs) but with socioeconomic and biophysical characteristics comparable to the Fadama II LGAs and in the same state. We expected nonbeneficiaries living in LGAs with a Fadama II project to be affected by spillover from some project benefits, such as construction of rural infrastructure and provision of advisory services. For example, project participants living in a Fadama II community that built a culvert could use the same road to transport their produce, and information about new technologies provided by the Fadama II advisory services might be shared with nonparticipants.

This stratification was designed to allow for estimation of the direct and indirect effects of Fadama II. By comparing project outcomes for direct beneficiaries with outcomes for similar (in terms of initial productive asset endowments, education, etc.) nonparticipating households in the same LGAs, we obtained an estimate of the direct impacts of Fadama II participation. Because nonparticipating households in the Fadama II LGAs may have benefited from spillover effects, this comparison does not provide an estimate of the full impact of the project. Comparing Fadama II beneficiaries to similar households in similar LGAs not included in the project provides a better estimate of the total impact of the project on beneficiaries (assuming that spillovers are not affecting households in the LGAs outside the project), while comparing nonparticipants in Fadama II LGAs with similar households in LGAs outside the project provides an estimate of the impact of spillover effects on nonparticipants in project LGAs.

As with Fadama I, selection of states to participate in Fadama II was not random. The 12 Fadama II states and the local *fadama* resource areas where the project operated were purposively selected by the government of Nigeria in collaboration with the World Bank. [6] In each of the selected state, 10 LGAs were purposively selected using the following criteria: (i) show interest in participating in the project and ability to contribute to project monthly costs; (ii) must have an LGA level association (Fadama Community Association, FCA) with at least 20% of members of FCA administration being women and (iii) FCA should be well-qualified staff to manage economic activities. These criteria form additional bias in which less organized LGAs were less likely to be selected. Purposive placement of projects is common with many government-funded programs in developing countries (Duflo, Glennerster, & Kremer, 2006). This introduces a selection bias and weakens the external validity of our results. Most of the states selected were in the humid and dry savannah zones. As previously stated, eight of the 12 states also participated in the Fadama I project. Fadama II did not give special preference to or bias against Fadama I beneficiaries. However, former Fadama I beneficiaries might have derived an advantage because of their membership in Fadama User Associations (FUAs), which are groups formed under Fadama I. Each Fadama II beneficiary is required to be a member of an FUG, which can be based on an FUA, where one existed earlier. This could have introduced some selection bias in sampling Fadama II beneficiaries in the sense that FUA members in the eight Fadama I states were more likely to be Fadama II beneficiaries and thus more likely to be sampled than were non-FUA members. [7] The purposive selection of the participating LGAs by the government—as discussed above—influenced our sampling and analytical methods discussed below.

We treated the LGAs purposively selected by the government as the sampling frame and randomly selected four LGAs from among the 10 in each participating state. In the selected treatment LGAs, one FCA was randomly selected from each of the four LGAs, and then approximately 25 households were randomly selected from each FCA. This approach was designed to result in a sample size of 100 households for each household type (direct project beneficiaries, nonbeneficiaries living within Fadama II LGAs, and households outside Fadama II LGAs) in each state, for a total sample of 3,750 households. The number of households sampled in each of the three categories was: 1,281 Fadama II beneficiaries, 1,281 nonbeneficiaries within Fadama II LGA, and 1,229 nonbeneficiaries outside Fadama II LGAs.

Selection of nonbeneficiaries living within and outside Fadama II LGAs followed the same procedure as just described. However, the FUG listed depended on the availability of economic interest groups comparable to those in Fadama II.

The difference-in-differences analysis used in this study (explained further in the next section) requires baseline data of good quality. Because the baseline survey for Fadama II, collected by the project, had some deficiencies (Faye & Sutherland, 2006), the research team, under supervision of the authors, collected baseline data for Fadama II using recall information. The serious problems with the baseline data were: (i) only beneficiaries were included in the sample; (ii) random sampling of respondents was questionable; (iii) data, required for assessing income—a key outcome of fadama II—were not collected. As discussed in this section, the methods used to collect data for the present study addressed these and other data issues.

The project was implemented in September 2005, only slightly more than a year before the survey was conducted; therefore, we expected respondents to be able to remember the baseline data required for two years before the survey—that is, for the crop years October 2004 to September 2005 (2004–05) and October 2005 to September 2006 (2005–06). This recall information included data on household composition and size, major productive assets, and major components of household income. Household respondents had no difficulty recalling changes in household composition, size, or major productive assets since October 2004, while recall of income components posed some difficulties. However, because income was not used as an explanatory variable in the analysis (unlike prior household composition and assets) but only as a dependent variable, the potential for measurement error in that variable was of less concern, although it increased uncertainty and reduced the statistical power of the estimates. [8]

If a project's outcome indicator is household income, the average impact of the project on its beneficiaries (referred to as the "average effect of the treatment on the treated") is defined as the difference between the expected income earned

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by project beneficiaries while participating in the project and the expected income they would have received if they had not participated in the project:

$$\text{ATT} = E(Y_i|P = 1) - E(Y_0|P = 1) \quad (1)$$

where ATT = average impact of treatment on the treated; p = participation in the project ($p = 1$ if participated in the project, and $p = 0$ if did not participate in the project); Y_1 = outcome (household income, in this example) of the project beneficiary after participation in project; Y_0 = outcome of the same beneficiary if he or she had not participated in the project.

But $E(Y_0 = 1|p = 1)$ is unobservable. Adding and subtracting $E(Y_0 = 0|p = 0)$ on the right side of Eqn. (1) results in

$$\text{ATT} = [E(Y_1|p = 1) - (E(Y_0|p = 0)] - [E(Y_0|p = 1) - (E(Y_0|p = 0)] \quad (2)$$

The first expression (within the first set of square brackets) is observable because it is the difference between the incomes of the beneficiaries and nonbeneficiaries. The second expression ($Y_{0=1|p=1)}$ is unobservable and thus represents the bias resulting from estimating ATT as the first expression $E(Y_0|p = 1)$ may not equal $E(Y_0|p = 0)$.

Two common sources of bias are (1) project placement or targeting bias, in which the location or target population of the project is not random (e.g., some subprojects of Fadama II are targeted to the poor and vulnerable so that wealthier groups do not have an equal chance of participating), and (2) self-selection bias, in which households choose whether or not to participate and thus may be different in their experiences, endowments, and abilities.[9] Randomized controlled (RCT) design is the ideal method to address these biases. But RCT is not feasible in the present study because project placement and participation decisions were already made before the design of the survey and were not random, as discussed in Section 2. The notion of random assignment also usually conflicts with the nature of CDD interventions, in which LGAs and households make their own decisions about whether to participate and what activities they will pursue, thus limiting the ability to use this approach even from the outset.

Various quasi-experimental and nonexperimental methods have been used to address the bias problem (for details, see Heckman, Ichimura, Smith, and Todd, 1998, Heckman, Ichimura, and Todd, 1998, Rosenbaum and Rubin, 1983, and Smith and Todd, 2001). One of the most commonly used quasi-experimental methods is propensity score matching (PSM), which selects project beneficiaries and nonbeneficiaries who are as similar as possible in terms of observable characteristics expected to affect project participation as well as outcomes.[10] The difference in outcomes between the two matched groups can be interpreted as the impact of the project on the beneficiaries (Smith & Todd, 2001). We used this method to estimate the ATT for impacts of the Fadama II project on household productive assets, incomes, and indicators of access to rural infrastructure.

PSM is subject to the problem of "selection on unobservables," meaning that the beneficiary and comparison groups may differ in unobservable characteristics, even though they are matched in terms of observable characteristics. Econometric regression methods devised to address this problem suffer from the problems previously noted. The bias resulting from comparing noncomparable observations in some cases may be much larger than the bias resulting from selection on unobservables (Heckman, Ichimura, Smith, *et al.*, 1998).

In this study, we address the problem of selection on unobservables by combining PSM with the use of the double-difference (DD) estimator (also referred to as the difference-in-differences estimator; see Duflo, Mullainathan, & Bertrand, 2004 for detailed discussion of this method). The double-difference estimator compares changes in outcome measures (i.e., change from before to after the project) between project participants and nonparticipants, rather than simply comparing outcome levels at one point in time.

$$\text{DD} = (Y_{p1} - Y_{p0}) - (Y_{np1} - Y_{np0}) \quad (3)$$

where Y_{p1} = outcome of beneficiaries after the project started; Y_{p0} = outcome of beneficiaries before the project started; Y_{np1} = outcome of nonbeneficiaries after the project started; and Y_{np0} = outcome of nonbeneficiaries before the project started.

The advantage of the double-difference estimator is that it nets out the effects of any additive factors (whether observable or unobservable) that have fixed (time-invariant) impacts on the outcome indicator (such as the innate abilities of farmers or the inherent quality of natural resources), or that reflect common trends affecting project participants and nonparticipants equally (such as changes in prices or weather; Ravallion, 2005).

In principle, the double-difference approach can be used to assess project impacts without using PSM and will produce unbiased estimates of impact as long as these assumptions hold. However, if the project has differential impacts on people with different levels of wealth or other observable characteristics, the simple double-difference estimator will produce biased estimates if participant and nonparticipant households differ in those characteristics (Ravallion, 2005). By combining PSM with the double-difference estimator, controls for differences in pre-project observable characteristics can be established. A bias could still result from the heterogeneous or time-variant impacts of the unobservable differences between participants and nonparticipants. For example, communities and households that participated in Fadama I may have different responses to Fadama II than those that did not because of the cumulative effects of social capital developed under Fadama I, favorable or adverse experiences under Fadama I, or other factors.[11] Such shortcomings are unfortunately inherent in all nonexperimental methods of impact assessment (Duflo *et al.*, 2006). To verify the robustness of our results, we also used econometric methods to estimate ATT. We include participation in Fadama II as one of the explanatory variables and use its estimated coefficient as the ATT. Since participation in Fadama II is endogenous and likely to be correlated with other determinants of outcomes, conventional methods (such as fixed-effect methods with panel data and instrumental variables methods) will still produce biased estimates. Combining the matching and regression methods addresses this problem in a two-stage procedure addresses this problem, in which the estimated PSM are used as weights in the regression model (Imbens & Wooldridge, 2009). The weighting removes the bias due to any correlation between covariates ($\mathbf{x}$) and Fadama II (Imbens & Wooldridge, 2009). This is a two-stage weighted regression (2SWR), which is specified as follows:

$$\Delta Y_i = \beta_0 Y_0 + \beta_{i\Delta}\mathbf{X} + \tau\text{FII} + e_i \quad (4)$$

where Y_i is outcome i (income or value of assets), $i = 1, 2$, Y_0 is the initial value of outcome of interest, $\mathbf{X}$ = vector of covariates that determine outcome Y_i. $\mathbf{X}$ includes the same variables used for estimating PSM since PSM is estimated using covariates that simultaneously affect both participation in the

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Fadama II program and the outcomes of the program, e_i = error term of outcome i.

The standard errors estimated by the double-difference method may be inconsistent because of serial correlation or other causes of a lack of independence among the errors. In ordinary regression models, serial correlation can result from unobserved fixed effects, but by taking first differences, the double-difference method eliminates that source of serial correlation. While serial correlation may lead to inconsistency in the estimates if more than 2 years of panel data are used (Duflo *et al.*, 2004), this concern does not arise in this analysis, since it is based only on two periods, before and after the project.

The propensity scores were computed using binary probit regression models. We estimated three probit models for three comparisons: (1) Fadama II beneficiaries compared with all nonbeneficiaries, (2) Fadama II beneficiaries compared with nonbeneficiaries within Fadama II LGAs, and (3) Fadama II beneficiaries compared with nonbeneficiaries outside Fadama II LGAs. The dependent variable in each model is a binary variable indicating whether the household was a beneficiary of the Fadama II project. We observe that female-headed households and households with larger family size affected favorably the propensity to participate in the project (Table 1).

The explanatory variables used in computing the propensity scores are those expected to jointly determine the probability to participate in the project and the outcome. The probit model results were used to compute the propensity scores that were used in the PSM estimation of ATT and as weights for the econometric method used to compute impact of the program.

Several methods are possible for selecting matching observations. We used the kernel matching method (using the normal density kernel), which uses a weighted average of "neighbors" (within a given range in terms of the propensity score) of a particular observation to compute matching observations. Unlike the nearest-neighbor method, using a weighted average improves the efficiency of the estimator (Smith & Todd, 2001). Observations outside the common range of propensity scores for both groups (i.e., lacking "common support") were dropped from the analysis. This requirement of common support eliminated about half of the total number of observations, indicating that many of the observations from the various strata were not comparable. We used the default bandwidth of 0.06 for Kernel matching. To test robustness, we tried different Kernel matching procedures (Epanechnikov, Biweight and Normal) with the same bandwidth of 0.06. All the point estimates of ATT from the three matching methods remained the same with only slight changes in the standard errors in some cases. Since the results appeared robust and very similar in all the three procedures and since we are constrained by the page length of the paper, we only reported the results of the Kernel matching using the Epanechnikov procedure T.

Further testing of the comparability of the selected groups was done using a "balancing test", which tests for statistically significant differences in the means of the explanatory variables used in the probit models between the matched groups of Fadama II participants and nonparticipants (Dehejia & Wahba, 2002). [12] As shown in Table 1, all covariates showed statistically insignificant differences between the matched groups (but not between the unmatched samples), supporting the contention that PSM ensures the comparability of the comparison groups (at least in terms of observable characteristics). The bootstrapping method produced robust standard errors of the estimated ATT, because the matching procedure matched control households to treatment households "with replacement" (see Abadie and Imbens (2002, 2006), on the use of bootstrapping for inference in matching estimators).

Table 1. *Balancing test of covariates and probit regression of participation in Fadama II*

	Balancing test of covariates results						Probit results
	Sample	Treated	Control	% Bias	% Reduction in bias	*P*-Value	Maximum likelihood Coefficients
Household size	Unmatched	10.792	9.024	24.7		0.000***	0.021***
	Matched	9.794	9.398	5.5	77.6	0.388	
Female headed household (1 = female, 0 = Male)	Unmatched	0.370	0.228	31.5		0.000***	0.531***
	Matched	0.373	0.383	−2.4	92.4	0.782	
Age of household head	Unmatched	42.775	42.389	3.3		0.513	−0.001
	Matched	43.33	43.312	0.2	95.2	0.985	
Years of education of household head	Unmatched	9.671	9.390	6.3		0.221	0.001
	Matched	10.02	9.828	4.3	31.8	0.594	
Rainfed land value 2005 (0 0 0 Naira)	Unmatched	3,400	340	6.7		0.164	0.0001*
Agroecological zones (cf humid forest)							
– Moist Savannah	Unmatched	0.224	0.269	−10.5		0.038**	−0.067
	Matched	0.167	0.156	2.5	76.1	0.717	
– Dry Savannah	Unmatched	0.395	0.373	4.5		0.368	−0.039
	Matched	0.431	0.416	3.1	31.2	0.707	
Distance to road in 2005 (km)	Unmatched	28.429	27.121	−4.2		0.459	0.0004
	Matched	11.22	10.832	0	100	0.92	
Productive asset value (0 0 0 N), 2005	Unmatched	140	100	6.2		0.204	−0.432
	Matched	100	100	0.4	93.1	0.911	
Value of livestock 2005 (0 0 0 N)	Unmatched	38,488	76,261	−3.5		0.535	0.026
	Matched	42,739	28,153	1.4	61.4	0.206	
R^2							0.037
Prob > χ^2							0.000***
Log likelihood							0.000***

*, **, & *** respectively mean, the corresponding statistic is significant at $p = 0.10$, 0.05 & 0.01.

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Table 2. *Sources of income for Fadama II beneficiaries and nonbeneficiaries*

Source	% Contribution to total income before project (Oct. 2004 to Sept. 2005)			% Contribution to total income after project started (Oct. 2005 to Sept. 2006)		
	FII beneficiaries	Nonbeneficiaries		FII beneficiaries	Nonbeneficiaries	
		Within FII LGAs	Outside FII LGAs		Within FII LGAs	Outside FII LGAs
Average income (000 Naira)	79.99	62.35	38.43	108.63	70.91	43.30
Income sources						
Crop production	46.60	53.80	46.90	56.80	56.50.	60.20
Nonfarm activities	48.50	38.70	43.30	41.10	39.90	39.30
Livestock production	4.90	7.43	9.70	2.10	3.50	0.05
Other activities	0.00	0.13	0.19	0.00	0.14	0.54

Note: FII, Fadama II; LGA, local government area.

4. EMPIRICAL RESULTS

(a) *Major sources of income*

Table 2 shows that crop production was a major source of income for all types of respondents before and after the Fadama II project started. This activity contributed more than 46% to the incomes of both beneficiaries and nonbeneficiaries before and after the Fadama II project. The contribution of crop production to household income had increased 1 year after the project for all types of respondents, but the change was especially large (more than 10%) for the Fadama II beneficiaries and nonbeneficiaries outside Fadama II LGAs. For the beneficiaries, the increase in the contribution of crops to household income could have resulted from the acquisition of productive assets that helped to add value (e.g., agroprocessing equipment) or increase productivity (e.g. irrigation). This is a reflection of the project's focus on agriculture-based subprojects. Because Fadama II is a CDD project, the change also reflects the beneficiaries' demand for agricultural equipment and advisory services that led to increases in crop production. The factors contributing to the change in the contribution of crops to the household incomes of respondents outside Fadama II LGAs could be due to the overall agricultural gross domestic product (GDP) growth, which increased from 4.2% in 1999–2000 to 7.2% in 2006–2008 (WDI, 2008) Nigeria. This could explain the increased contribution of agricultural income even for non-Fadama II beneficiaries.

Nonfarm activities contributed the second-largest share of household income before and after the project. Although the Fadama II project supported both agricultural and nonfarm activities, however, the contribution of nonfarm activities to household income decreased for both the beneficiaries and the nonbeneficiaries living in LGAs not participating in the project. What is interesting is the low contribution of some activities that the project was willing to support. Beekeeping, hunting, gathering wild products, fish farming, and pastoral livelihoods are among the activities the project supported but did not contribute significantly to household income. Because the project is a CDD, the limited contribution of those activities suggests that few beneficiaries demanded them.

(b) *Impact of Fadama II on asset acquisition*

Asset acquisition is the second largest investment in the Fadama II project, after rural infrastructure investments (World Bank, 2003). Because Fadama II supported productive asset acquisition by FUGs rather than assets owned by individual households, we divided the productive assets into those owned by individual farmers and those owned jointly by economic interest groups. It was not easy to determine the share of value that each member of a group held in jointly owned productive assets. The intensity of use of the productive assets also differed across households within groups. For example, members of an economic interest group owning a borehole for watering animals used the equipment not according to how much they contributed but according to their needs as determined by the number of animals they owned. For agricultural processing equipment and other group-owned productive assets, group members processed their own products and hired the equipment to nongroup members. The group then divided the profit obtained from hiring out the asset to ensure its full use. Our study captured only household level benefits and not the group income or other benefits. As it will be discussed below, benefits from group assets likely increased the farmers' financial ability to acquire individual assets. Our data collection did not capture the group-level management of productive assets.

Table 3 shows that the Fadama II project had a large and statistically significant impact on the value of productive assets owned by groups. In all comparisons reported in Table 3, Fadama II beneficiaries saw the value of group-owned productive assets increase significantly across all agro-ecological zones, asset terciles, and gender. The initially poorest tercile of beneficiaries experienced the largest growth of group-owned productive assets (both in absolute and percentage terms): an average increase of 91,780% (from only Naira 482 to Naira 470,865). [13] The reason for this massive increase is that ownership of group productive assets was relatively small for those beneficiaries before the project. [14] The large increase in the value of jointly owned productive assets is not surprising since it includes the value of the cash transfer (70% of the total productive asset value) from the project to the beneficiaries.

Privately owned water and irrigation assets more than doubled in value over the same period. Likewise, total values of processing equipment, livestock, and building structures owned by FUGs more than doubled, again reflecting the large cash transfer by the project to FUGs. The large increases for individual productive asset types add up to a large increase in the total value of productive assets, especially for beneficiaries in the poorest asset tercile, who had few productive assets before the project.

The increase in value of productive assets among the upper asset tercile was 63%—a substantial increase, but substantially dwarfed by the growth in assets of the lower two wealth groups. The value of productive assets owned by women's economic interest groups participating in the project also increased significantly compared with the value of productive assets belonging to women's groups not participating in the

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Table 3. *Value of productive assets before and after Fadama II across agro-ecological zones, gender, and asset terciles*

Treatment type	Value of individually owned assets (000 Naira)[a]				Value of group-owned assets (000 Naira)[a]			
	Before project[1]	After project[1]	ATT[2]	2%	Before project[1]	After project[1]	ATT[2]	2%
Fadama II beneficiaries ($n = 621$)	47.37 (114.55)	62.42 (97.88)			52.09 (274.48)	350.80 (907.38)		
Nonbeneficiaries ($n = 1{,}119$)	46.83 (116.10)	53.45 (54.77)	22.96***	48.5	5.96 (62.93)	4.69	307.5	590.3
						−57.7		
Nonbeneficiaries within FII LGAs ($n = 574$)	45.82 (113.72)	40.15 (45.57)	26.16***	55.2	9.29 (84.16)	4.62 (62.30)	303.65***	582.9
Nonbeneficiaries outside FII LGAs ($n = 545$)	47.91 (118.61)	67.83 (62.86)	30.09***	63.5	2.46 (27.00)	4.77 (52.60)	271.08***	520.4
Agroecological zones								
Humid forest zone								
FII beneficiaries ($n = 237$)	72.63	86.55 (206.85)	7.63	10.5	83.47	619.89 (1,287.49)	577.72*** (155.68)	692
	−160.06		−14.34		−408.78			
All nonbeneficiaries ($n = 401$)	75.99	74.96 (130.11)			7,724	3,087 (61.75)		
	−148.46				−60.7			
Moist savannah zone								
FII beneficiaries ($n = 139$)	74.64	103.90 (193.37)	61.34*,S (36.42)	82.2	9.81	397.86 (631.55)	446.23*** (103.04)	4,549
	−133.83				−34,924			
All nonbeneficiaries ($n = 301$)	47.91	43.83 (122.10)			5.96	11.94		
	−96.83				−86.65	−82.4		
Dry savannah zone								
FII beneficiaries ($n = 245$)	37.06	43.58	19.97***,S (5.64)	53.9	46.07	68.38 (353.12)	44.31* (25.33)	96
	−41.6	−51.84			−168.35			
All nonbeneficiaries ($n = 417$)	40.37	36.72			4.25	0.96		
	−46.05	−69.74			−40.72	−17.36		
Sex of household head								
Women only								
FII beneficiaries ($n = 230$)	51.57	74.20 (160.24)	16.7	32.4	28.65	505.38 (1,125.39)	448.25***,b	1,565
	−125.76		−22.73		−229.78		−124.701	
All nonbeneficiaries ($n = 255$)	63,531 (151,330)	55,318 (158,418)			6,826 (65,012)	6,526 (82,256)		
Men only								
FII beneficiaries ($n = 391$)	55.06	62.26 (137.67)	41.50**	75.4	65.77	260.60 (738.38)	217.44***	331
	−75.06		−19.29		−296.92		−49.5	
All nonbeneficiaries ($n = 864$)	49.81	53.05			5.72	4.18		
	−67	−97.86			−62.38	−48.74		
Asset terciles								
Tercile 1 (the poorest)								
FII beneficiaries ($n = 370$)	5.23	52.94 (121.36)	6.68	127.8	0.48	470.87 (1,072.01)	442.47*** (76.89)	91,780
	−4.71		−6.92		−2.37			
All nonbeneficiaries ($n = 666$)	7.64	47.47 (111.18)			0.12	3.69		
	−18.75				−1.23	−46.91		
Tercile 2								
FII beneficiaries ($n = 118$)	44.55	44.7	27.84*** (6.38)	62.5	3.57	213.48 (629.13)	104.92*** (39.11)	2,937
	−23.11	−45.66			−13.62			
All nonbeneficiaries ($n = 248$)	51.05	42.4			1.46	1.92		
	−24.78	−61.51			−8.46	−18.8		

Table 3 (*continued*).

Treatment type	Value of individually owned assets (0 0 0 Naira)[a]				Value of group-owned assets (0 0 0 Naira)[a]			
	Before project[1]	After project[1]	ATT[2]	2%	Before project[1]	After project[1]	ATT[2]	2%
Tercile 3								
FII beneficiaries ($n = 136$)	99.58 −52.97	124.72 (237.44)	80.174*** (21.58)	80.5	236.79 (554.08)	130.16 (436.40)	149.80*** −60.73	63
All nonbeneficiaries ($n = 202$)	114.51 −49.93	95.85 (148.60)			31.45 (146.97)	11.76 (104.82)		

*, **, & *** respectively mean, the corresponding statistic is significant at $p = 0.10$, 0.05 & 0.01.
[a] Individually owned assets are those owned by a household while group owned assets are those owned by a group of farmers.
[1] "Before project" is one year before Fadama II started, October 2004 to September 2005, and "After project" is one year after the project started, October 2005 to September 2006.
[2] ATT = Average impact of the treatment on the treated.

project. This increase was substantially higher than the corresponding increase for men.

These results demonstrate that the pilot asset acquisition component succeeded in its efforts to target poor and vulnerable groups.

Compared with all nonbeneficiaries and with nonbeneficiaries within and outside project LGAs, beneficiaries experienced greater increases in the value of privately owned productive assets as a result of participating in the project. Comparisons between the dry savannah and the moist savannah agroecological zones, and between male beneficiaries and male nonbeneficiaries also showed significantly greater increases in the value of private productive assets for beneficiaries. However, the increase in the value of productive assets was generally less for privately owned assets than for those owned by economic interest groups. That is because Fadama II supports asset acquisition through economic interest groups rather than individual Fadama users (NFDO, 2005). Nevertheless, FUG members were able to acquire such privately held productive assets through their groups. The individual acquiring the private asset would pay the entire beneficiary contribution in the name of the FUG. Fadama II did not interfere with this practice, which could explain the significant increase in the value of privately owned productive assets for beneficiaries. Another possible explanation is that FUG members had to buy complementary inputs to support the jointly owned productive assets. For example, FUG members owning irrigation equipment may have needed to buy pesticide sprayers to grow irrigated vegetables. The statistically insignificant impact of participation in the project on privately owned productive assets for beneficiaries in the poorest asset tercile and for female beneficiaries suggests that the poor and vulnerable were not able to finance both the privately owned productive assets and the beneficiary contribution of group productive assets.

An interesting question to explore is the sustainability of the Fadama II success story beyond the project period and how it can be replicated to other communities. The major constraint faced by poor households is their inability to finance acquisition of high-value assets—even though the project contributed a significant amount of asset costs in matching grant form—without some form of support from projects or credit services. Fadama II did not involve credit service providers because of the high interest they charge and their limited availability. Thus, alternative sources of credit were used by the 14% of respondents who had access to credit services (Table 4). Relatives, social clubs, and friends were reported to be the major sources of credit for Fadama II beneficiaries. Both beneficiaries and nonbeneficiaries in tercile 1 borrowed more from this source than respondents in tercile 2 and 3. This finding underscores the limited options that poor beneficiaries faced to pay for their 30% contribution to productive assets.

It is not clear how the poor were able to pay their contributions and if they were able to manage assets efficiently.[15] Those who could not secure the necessary funds may have used other forms of financing through wealthier friends or relatives (see Table 4). For example, a woman in one FUG reported that she entered into a rental agreement with a wealthy man who paid her beneficiary contribution for a milling machine. Such arrangements could affect the targeting of the poorest. Even though we find that the project successfully targeted the poor, this example shows elite capture affected some beneficiaries.

The project supervision mission of February 2007 noted that most of the subprojects for women and vulnerable groups had not been implemented because women and vulnerable groups could not pay their contributions. The mission also noted that

most of the processing equipment acquired by women was operated by hired hands who benefited more than the project beneficiaries who hired them, and thus recommended the beneficiary contribution for women and vulnerable groups be reduced to 10%. Initially, the project set the contribution of beneficiaries of the pilot asset acquisition project at 40% of the value of the productive asset (NFDO, 2005) but reduced it to 30% because of overwhelming evidence of the failure of the poor to pay their share. Even the 30% contribution might have been high for expensive productive assets and might have forced FUG members who are unable to pay their contribution to turn to more wealthy individuals for credit support. Planning for the next phase of the project (Fadama III) needs to consider the use of sustainable financing for targeted groups—for example, through microfinancing institutions. Existing local rotating savings and credit schemes such as *esusu*, *dashi*, and *adashi* could help to increase credit access (Bascom, 1952; Bouman, 1995; Okonjo, 1979).

(c) *Impact of Fadama II on household income*

The average annual household income after Fadama II started (2005–06) for the sample households ranged from Naira 43,298 to Naira 108,625 (in year 2003 real value) (Table 5).[16] This is above the average rural household income of Naira 42,644 reported by the 2003–04 living standard survey (FOS, 2004) but within the same order of magnitude. On average, the real incomes of Fadama II beneficiaries increased to 58.5% as a result of participation in the project, based on the PSM and double-difference estimation; that is well above the target of a 20% increase that Fadama II set to achieve for 50% of beneficiaries after 6 years of operation (Table 5). By contrast, average real incomes of all nonbeneficiaries increased only 15.5% and even less (12.7%) among nonbeneficiaries outside Fadama II LGAs (12.7%).[17] The high increase in income for nonbeneficiaries is consistent with the increasing agricultural income in Nigeria. As noted above, the agricultural GDP increased from 4.2% in 1997–2000 to 7.2% in 2006–2008. The mean increase in income for beneficiaries was significantly different from that for nonbeneficiaries at $p = 0.05$. The two-stage weighted regression results also show a Naira 31,579 or 40% increase in household income of Fadama II beneficiaries (Table 6). This further shows the robust increase in income due to participation in Fadama II.

Considering the income of beneficiaries before and after the project (without controlling for other reasons for income to change), about 42% of beneficiaries increased their incomes by at least 20% in the first year of Fadama II operation (Table 7). By contrast, the share of nonbeneficiaries who increased their incomes by at least 20% was only 34%.

The large increase in income in a short time could be well-understood by the following example of a group of 20 women beneficiaries from Adamawa state, who acquired a milling machine through the project. The daily profit that each group member gets was Naira 50 or Naira 11,250 per year if the milling machine operates for five days per week and 45 weeks per year. Thus household income for each group member increased by 35% since the household income of women beneficiaries was Naira 35,000 per year during the baseline year. Other anecdotal evidence provides comparable or higher incomes, especially for groups involving men.

We also examined the spillover effects of the Fadama II project by comparing the changes in income of Fadama II beneficiaries with those of nonbeneficiaries living within and outside LGAs with Fadama II projects. The results show no significant difference between the income changes of Fadama II beneficiaries and nonbeneficiaries living in the same community. These results suggest that nonbeneficiaries in Fadama II LGAs may have benefited substantially from spillover of the project. For example, nonbeneficiaries used roads, culverts, and other public facilities funded by Fadama II. Nonbeneficiaries could also benefit from services offered by beneficiaries. Similarly, beneficiaries who acquired milling machines could offer milling services and employment to nonbeneficiaries.

It is likely that the impact of the project on incomes will be larger in the future because of lagged effects of investments in productive assets, infrastructure, and other project investments. Even without longer-term lags, the impacts on incomes in 2005–06 could be expected to be less than proportionate to the increase in productive assets from September 2005 (at the beginning of project implementation) to September 2006 (the date for measuring changes in productive assets after implementation of the project), because many of the investments in productive assets occurring between September 2005 and September 2006 may not have come soon enough to affect agricultural production and income during the 2005–06 production year. We would expect the full effects of productive

Table 4. *Access to credit in 2005–2006 across poverty terciles*

	All	Tercile 1 (poorest)		Tercile 2		Tercile 3		*T*-test
	$n = 1{,}728$	FII[e] ($n = 364$)	Non-FII[e] ($n = 660$)	FII[e] ($n = 118$)	Non-FII[e] ($n = 248$)	FII[e] ($n = 136$)	Non-FII[e] ($n = 202$)	
% Reporting								
Borrowed? % yes	13.7	17	11	19	9	17	16	[a,b,c]
Source of credit (using only those who received credit)% reporting								
– Bank	9.7	2	4	13	17	17	26	
– Relatives and friends	24.9	26	30	17	26	13	19	
Cooperative	21.0	17	21	4	21	22	23	[b]
Farmers association	3.0	5	1	9	4	0	0	
NACRDB[d]	12.1	5	8	17	13	9	3	
Nongovernmental organization	2.1	5	1	0.0	0.0	4	0	
Fadama II	5.5	8	0.0	9	4	17	0.0	[a,c]

[a] Significant difference between Fadama II and non-Fadama II within tercile 1.
[b] Significant difference between Fadama II and non-Fadama II within tercile 2.
[c] Significant difference between Fadama II and non-Fadama II within tercile 3.
[d] NACRDB = Nigerian Agricultural Cooperative and Rural Development Bank.
[e] FII = Fadama II.

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Table 5. *Impact of Fadama II on household income*

Treatment type	Net real annual income (000 Naira/household)		ATT[b,c]	% Net change due to participation[d]
	Before project[a,b]	After project[b]		
FII beneficiaries (n=621)	79.99 (257.77)	108.63 −265.97		
All nonbeneficiaries (n=1,119)	75.99 (256.13)	87.7 −267.56	46.77**	58.5
Nonbeneficiaries within FII LGAs (n=574)	62.35 (260.51)	70.91 −263.28	32.35	40.5
Nonbeneficiaries outside FII LGAs (n=545)	95.00 (249.76)	113.1 −270.16	35.35*	40.5
Agroecological zones				
Humid forest zone				
FII beneficiaries ($n = 237$)	87.43 (292.10)	112.63 −299.1	14.96	17.1
All nonbeneficiaries ($n = 401$)	12.31 (257.17)	31.34 −276.53		
Moist savannah zone				
FII beneficiaries ($n = 139$)	70.58 (203.34)	74.30 −280.6	33.52	47.5
All nonbeneficiaries ($n = 301$)	96.50 (258.14)	77.38 −271.8		
Dry savannah zone				
FII beneficiaries ($n = 245$)	79.11 −255.97	124.46 −225.34	62.66*	79.2
All nonbeneficiaries ($n = 417$)	106.07 (255.20)	142.71 −254.17		
Gender of household head				
Only FII beneficiaries				
Male ($n = 391$)	83.69 (281.00)	107.45 −282.1	−749	−0.9
Female ($n = 230$)	74.28 (217.81)	110.45 −239.43		
Women only				
FII beneficiaries ($n = 230$)	74.33 (217.82)	110.38 −239.4	51.30**	69.1
Nonbeneficiaries ($n = 255$)	35.41 (210.01)	48.35 −219.47		
Men only				
FII beneficiaries ($n = 621$)	83.7 −281.08	107.5 −282.13	84.83***	101.3
Nonbeneficiaries ($n = 1,119$)	86.26 (269.01)	98.25 −281.31		
Asset terciles				
Tercile 1 (the poorest)				
FII beneficiaries ($n = 364$)	70.85 (154.44)	82.75 −153.92	31.78	*44.9*
Nonbeneficiaries ($n = 660$)	76.83 (153.00)	77.51 −154		
Tercile 2				
FII beneficiaries ($n = 118$)	93.85 (161.25)	119.01 −175.28	94.75**	101
Nonbeneficiaries ($n = 248$)	74.71 (163.65)	104.99 −180.71		

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Table 5 (*continued*).

Treatment type	Net real annual income (000 Naira/household)		ATT[b,c]	% Net change due to participation[d]
	Before project[a,b]	After project[b]		
Tercile 3				
FII beneficiaries ($n = 136$)	122.07 (239.04)	154,892 −267.24	1.18	1
Nonbeneficiaries ($n = 202$)	126.47 (207.49)	128.27 −223.23		

Notes: FII = Fadama II.
[a] Numbers in brackets are standard deviations of the corresponding statistic.
[b] ATT = $(Y_{p1} - Y_{p0}) - (Y_{np1} - Y_{np0})$. "Before project" is 1 year before Fadama II started, October 2004 to September 2005, and "After project" is 1 year after the project started, October 2005 to September 2006.
[c] "ATT" and the corresponding "%" refer to the change in productive assets resulting from participation in Fadama II compared with the corresponding group of nonbeneficiaries. Thus, they should not be interpreted as referring to the change in the productive assets of the corresponding control group of nonbeneficiaries.
[d] % Net change due to participation in project = $(ATT/Y_{p0}) * 100$.
[*] Significant at the 10% level.
[**] Significant at the 5% level.
[***] Significant at the 1% level.

Table 6. *Determinants of household income (Two-stage weighted regression)*

Variable	2SWR coefficients
Participation on Fadama II	31,579[**] (13,102)
Household size	3,297.2[***] (1,263)
Female household head	404.7 (22,721)
Age of household head	2.5 (821)
Level of education of household head	−2,031.5 (2,299)
Agroecological zone (cf dry Savannah)	
– Moist Savannah	−77,610.7[***] (28,387)
– Humid forest	−26,781.6 (24,223)
Primary activity of household head (cf crops)	
– Livestock production	−46,214.8 (35,230)
– Fishery	−78,625.1[**] (38,574)
– Nonfarm activity	5,309.7 (27,618)
– Other activities	2,797.6 (26,179)
Access to credit	−3,146.3 (25,748)
Change (before Fadama II—after Fadama II)[a]	
– Distance to nearest town (km)	−328.9 (374)
– Distance to nearest all-weather road (km)	165.4 (1,940)
– Value of livestock (Naira)	−0.01[*] (0.0098)
– Land area (ha)	0.0001 (1.45e−06)
– Value of productive assets (Naira)	0.0001 (206)
Constant	35,829.8 (53,523)

[a] "Before project" is 1 year before Fadama II started, October 2004 to September 2005, and "After project" is 1 year after the project started, October 2005 to September 2006.
[*] Significant at the 10% level.
[**] Significant at the 5% level.
[***] Significant at the 1% level.

assets acquired by September 2006 only to begin to be felt during the 2006–07 production year.

The effect of Fadama II varied across the three major agroecological zones of Nigeria (Tables 5 and 6). The project had a significant impact (at $p = 0.10$) in the dry savannah zone, where participation in the project led to an average increase in income of 79%. In the humid forest and moist savannah zones, the changes in net income resulting from participation in the project were positive but smaller than in the dry savannah and not statistically significant. The large net increase in income in the dry savannah zone, where limited rainfall is a major problem, could be explained by the acquisition of irrigation facilities and water equipment, which address a major production constraint in that zone. The weak impact of Fadama II in the moist Savannah and humid forest is also due to the small sample in these zones. The dry savannah zone had the largest sample size of Fadama II beneficiaries and nonbeneficiaries. [18]

A comparison of men versus women beneficiaries showed no significant difference in income before or after the project. This could be due to the special preference that Fadama II gives to women whose incomes are usually lower than those of men. By targeting women, Fadama II may have enabled them to catch up with men in terms of income. As was the case with the value of productive assets, the income change for female beneficiaries was significantly greater than the income change for female nonbeneficiaries. That was expected given the significant change in the value of productive assets for female nonbeneficiaries (see Table 3). We also find that the project significantly increased income for male beneficiaries relative to male nonbeneficiaries, with a higher estimated percentage ATT for men than women. This suggests that even though the program successfully targeted women in its productive asset acquisition, men's income increased probably due to their higher resource endowment that allowed them to take advantage of the Fadama II project in the short-term.

Concerning the effects of Fadama II on the three asset terciles, only the Fadama II beneficiaries in the second tercile increased their incomes significantly more (at $p = 0.05$) than the nonbeneficiaries in that tercile. That finding indicates that the project had a less immediate impact on poverty reduction among the poorest households. However, the magnitude of the estimated impact on incomes of the poorest asset tercile is large (45%), although it is statistically insignificant. The incomes of the poorest asset tercile appear to have been affected less than those of the second tercile possibly because of the initial investments that the poor had to make to participate in the project. Such investments could have crowded out short-term investments for the poorest, most liquidity-constrained households that could have otherwise increased income in the first year of participation. It is possible that beneficiaries in the poorest tercile may see their incomes increase further after starting to benefit from their investments in productive assets, which, as discussed in the previous section, increased significantly.

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Table 7. *Achievement of target increase in income among Fadama II beneficiaries*

Treatment type	% Change in real income before and after the project started[a]		
	20% and below	20–50%	>50%
Fadama II beneficiaries	57.9	11.9	30.1
All nonbeneficiaries	66.2	12.6	21.1
Nonbeneficiaries within FII LGAs	65.1	15.5	19.4
Nonbeneficiaries outside FII LGAs	67.5	9.2	23.2

[a] "Before project" is 1 year before Fadama II started, October 2004 to September 2005, and "After project" is 1 year after the project started, October 2005 to September 2006.

Fadama II targeted the poor and vulnerable groups like women, youth, the elderly, people with HIV/AIDS, and the physically challenged. Holding other factors constant, this targeting is likely to reduce income inequality. In addition to comparing the value of productive assets and income across gender and asset terciles, we further analyzed the achievement of this targeting by examining the change in consumption inequality over the first year of the project. We computed the Gini coefficient using consumption expenditure instead of income, because the coefficient could be greater than one if income was negative (Berrebi & Silber, 1985; Chen, Tsaur, & Rhai, 1982; Stich, 1996). The results show that the Gini coefficient of project beneficiaries decreased by 9%, suggesting that the project contributed to reduction of consumption inequality (Table 8). This is consistent with the results of our productive asset analysis, which showed that the value of productive assets increased more significantly among the poorest asset tercile than among the middle and upper terciles.

5. CONCLUSIONS AND POLICY IMPLICATIONS

In its first year of operation, the Fadama II project, which is the largest agricultural project in Nigeria and which used a community-driven development approach, realized significant positive impacts on household income and productive asset acquisition. Using propensity score matching and double-difference methods to control for project placement and self-selection biases, we find that participation in the Fadama II increased dramatically the value of productive assets, especially for the poorest households, largely because of the subsidy provided to help finance acquisition of such assets. Household incomes improved substantially more for Fadama II beneficiaries than for nonbeneficiaries, with an average increase in real income resulting from participation in Fadama II ranging from about 40% to 60%, well above the target of at least 20% increase in income that Fadama II set to achieve in 6 years for 50% of the beneficiaries. About 42% of beneficiaries increased their incomes by at least 20% within 1 year of Fadama II implementation, indicating that the project nearly succeeded in achieving its income goal within its first year of operation.

Comparison of the income impacts of the project across asset terciles showed that the project did not have a statistically significant impact on income among the poorest tercile (although the estimated coefficient was positive), despite the large and significant impacts on productive assets reportedly available to the poor. However, the project may have a much bigger impact among the poorest beneficiaries in the future because of the lagged effect of productive asset acquisition. Thus, a follow-up study is needed to capture the longer-term effects of productive assets and other changes that farmers experienced as a result of participating in the Fadama II project.

The project also had more-limited impacts on income in the humid forest and moist savannah zones than in the dry savannah zone. That could be a result of the irrigation investments that beneficiaries in the moist savannah zone demanded over other types of productive assets to address the erratic rainfall in the area. Irrigation investments have a larger impact on agricultural productivity in moisture-stressed areas than in more-humid areas.

The large impact of the project on income in 1 year of operation needs to be examined further to understand its long-term trend. Of major concern is the nonsignificant impact of the project on income of the targeted group—the poorest beneficiaries. This will require collection of additional panel data to re-examine its impact.

The impact of the Fadama II project on productive asset acquisition is large and statistically significant across all agro-ecological zones, asset terciles, and genders. However, the change in the value of productive assets caused by participation in Fadama II was larger and more significant for jointly owned productive assets. This reflects the policy that the project used to implement the pilot asset acquisition component. The dramatic increase in the value of productive assets resulting from participation in the project was mainly caused by the cash transfer from the 70% matching funds that the project provides to Fadama User Groups. The large cash transfer used to implement this project raises the important question of whether this success story can be replicated.

Three major issues that need to be addressed in scaling up this success story are better targeting of poor and vulnerable groups, finding sustainable methods of promoting development of rural financial services, and increasing the capacity of *fadama* resource users to manage productive assets efficiently. These three issues are interrelated and therefore need to be considered simultaneously.

Over the first year that the project operated, the Gini coefficient of consumption expenditure for the beneficiaries decreased by about 9% compared with an increase of 2% for nonbeneficiaries. This suggests that the project contributed to reduction of consumption expenditure inequality, probably through targeting poor and vulnerable groups. Consistent with this, Fadama II also succeeded in raising the value of productive assets of the poorest asset tercile more significantly than for the other asset terciles. The weak impact of the project on income of poorer households, despite the large asset increase for this group, could be a result of the low capacity of the poor to use and manage the new productive assets. Results also show that beneficiaries in the poorest tercile borrowed more from relatives and friends than other terciles, suggesting that well-off individuals who provide credit to the poor beneficiaries could ask for high interest rate or required other agreements that lowered the income returns of the poor beneficiaries.

This raises the need to help the poor to access affordable credit services. The medium-term review study recommended

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Table 8. *Impact of Fadama II on consumption distribution*

Treatment type	Gini coefficient before project[a]	Gini coefficient after project[a]	% Gini coefficient change
FII beneficiaries	0.408	0.370	−9.3
All nonbeneficiaries	0.319	0.325	1.9
Nonbeneficiaries within FII LGAs	0.323	0.317	−1.9
Nonbeneficiaries outside FII LGAs	0.316	0.331	4.8

Note: FII = Fadama II; LGA = local government area.
[a] "Before project" is 1 year before Fadama II started, October 2004 to September 2005, and "After project" is 1 year after the project started, October 2005 to September 2006.

further reduction of the beneficiary contribution to 10% for women and the vulnerable (Fadama, 2007). Even though this recommendation addresses the short-term objective, it is not likely that the approach will be sustainable after the project ends. The long-term solution for the failure of the poor to pay for productive assets is affordable rural credit services. Fadama II did not involve credit service providers to help beneficiaries to pay for their contribution. There is need to involve credit service providers by helping them to offer credit at competitive interest rates to the poor using collateral substitutes such as group repayment incentives. For example, the project could help to strengthen the provision of credit services in rural areas by using strong rural associations, as done by the Grameen Bank. The project could also help to foster credit intermediaries or to promote rotating savings and credit associations that can help the poor to access productive assets. Addressing the low capacity of the poor and vulnerable to manage productive assets efficiently also calls for increased training and development of complementary services, such as advisory services.

Overall, the Fadama II project has achieved its goal of increasing the incomes of the beneficiaries in the first year of its operation. The project has also succeeded in targeting the poor and vulnerable in its productive-asset component, even though that did not appear to increase significantly short-term household incomes among the poorest asset tercile. The unique feature that could have contributed to the significant impact of the project in a short time is its broad-based approach, which addresses the major constraints limiting the success of CDD projects that address only one or two constraints. This has implications on planning poverty reduction efforts in low-income countries. Given that the poor face numerous constraints, a CDD project that simultaneously addresses many constraints will likely build synergies that will lead to larger impacts than will a project that addresses only one or two constraints. This suggests the need for the government and donors to pool resources and initiate multipronged CDD projects rather than many isolated projects.

Since this study focused on the quantitative approaches of impact assessment, future research should explore the political, project management, and institutional issues that could shed more light on the impact processes and pathways. This will help better understand the conditions under which CDD's work best.

NOTES

1. Income poverty is the most common measure of poverty. It uses income as the indicator of poverty. For example, people with income of less than US$1 a day per capita are regarded as poor by many studies and reports (e.g., see World Bank, 2007).

2. Fadama I operated in 25 states, of which nine are also covered by Fadama II. The Fadama I states were Bauchi, Jigawa, Kano, Kebbi, and Sokoto in the North; Kogi, Niger, Plateau, Benue, Taraba, and the Federal Capital Territory in the Middle Belt; and Ogun, Oyo, Osun, Ondo, Lagos, Edo, Delta, Anambra, Enugu, Imo, Abia, Rivers, Cross Rivers, and Akwa Ibom in the South.

3. *Fadama* is a Hausa word for low-lying flood plains, usually with easily accessible shallow groundwater. Fadama are typically waterlogged during the rainy season but retain moisture during the dry season. These areas are considered to have high potential for economic development through appropriate investments in infrastructure, household assets, and technical assistance.

4. We discuss the implications of Fadama I and Fadama II sharing the same states in the methods section.

5. These states are supported by the World Bank assisted aspects of Fadama II. An additional six states are benefiting under a version of the project supported by the African Development Bank.

6. The project planners did not take randomization into account when designing the project. This study was initiated about a year after the project started, so had no ability to influence the design of the project.

7. The double-difference estimator that we used in the impact evaluation helps to address the impacts of such differences in initial conditions by differencing out any additive fixed effects of such differences but does not completely solve the potential problem of selection bias because the impacts of Fadama II may interact with participation in Fadama I. These issues are discussed further below.

8. In econometric analysis, measurement error in a dependent variable increases the uncertainty of the estimates but causes no bias as long as the error is not correlated with the explanatory variables, whereas measurement error in an explanatory variable does cause a bias (Greene, 2003). We believe that similar principles apply to the results of propensity score matching, the quasi-experimental approach used in this study, although we have not seen literature explicitly discussing this issue in the relatively recent literature on propensity score matching.

9. For example, a pastoralist in the state of Niger reported that he did not want to participate in Fadama II because similar projects he was involved with in the past had failed.

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10. This method is referred to as "quasi-experimental" because it seeks to mimic the approach of experiments in identifying similar "treatment" and "control" groups. However, because the comparison groups identified in PSM are not selected by random assignment, they may differ in unobserved characteristics, even though they are matched in terms of observable characteristics.

11. Unfortunately, we did not collect information on respondents' participation in Fadama I and thus could not try to test or control directly for such effects.

12. The covariates used in the PSM regression include gender, age and level of education of household head, distance to all-weather road, household size, membership to economic group, agroecological zone, land area and value of livestock and productive assets. We used pre-project values of all covariates.

13. This increment is not a simple difference between the before and after values. Rather, it is an increase that takes into account the changes of the control group, such as ATT/value of assets of beneficiary before the project. These values are all in real (deflated to 2003) values.

14. However, the preproject level of group assets was significantly larger for Fadama II beneficiaries than for nonbeneficiaries. This might reflect actual differences resulting from a greater tendency of Fadama II beneficiaries to have participated in group activities before the Fadama II project, or it might reflect a reporting error concerning when group assets were acquired by Fadama II beneficiaries (i.e., some Fadama II respondents may have mistakenly reported some of the group assets that they acquired under Fadama II as group assets owned before the project). If the latter case is true (overreporting of initial group assets by Fadama II beneficiaries), then the impacts of Fadama II on the acquisition of group assets are underestimated, and the total effects would be even larger than the estimated effects.

15. It is still too early to tell how FUGs managed and benefited from their productive assets. However, the medium-term review report concluded that the capacity to manage some productive assets was low and there was still need for building the capacity of FUGs to manage their assets efficiently (Fadama, 2007).

16. Note, this is the minimum and maximum average income across the different groups used to income in Table 6.

17. The percentage change of the nonbeneficiaries before and after the project are not reported in the table but are calculated using the following simple formula (symbols are as defined in Eqn. (3)):

$$\frac{Y_{np1} - Y_{np0}}{Y_{np0}} * 100$$

18. For example, income of Fadama II beneficiaries in the moist Savannah increased by 48% through participation in the program but this increase was not significant.

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