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LIVELIHOODS IN DEMOCRATIC REPUBLIC OF CONGO

Impact evaluation of the Purchase for Progress (P4P) Project

Effectiveness Review Series 2015/16

Photo: Three women walking on the main road of the Cirhogole Village (Kabare Territory -South Kivu). Credit: Ramon Sanchez Orense/Oxfam.

ANDREW ANGUKO

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EXECUTIVE SUMMARY

Oxfam GB's Global Performance Framework is part of the organization's effort to better understand and communicate its effectiveness, as well as enhance learning across the organization. Under this Framework, a small number of completed or mature projects are selected at random each year for an evaluation of their impact, known as an 'Effectiveness Review'. The project 'Purchase for Progress in DRC' (DRCB45) was one of those selected for an Effectiveness Review in the 2015/16 financial year. One key focus is on the extent to which projects have promoted change in relation to relevant OGB global outcome indicators. The global outcome indicator for the Livelihoods thematic area is defined as 'total household consumption per adult equivalent per day'. This indicator is explained in more detail in Section 5 of this report.

PROJECT DESCRIPTION

The project activities were implemented by Oxfam GB in conjunction with its partners: Food and Agriculture Organization of the United Nations (FAO), United Nations World Food Programme (WFP), Centre Régional d'Appui et de Formation pour le Developpement (CRAFOD) and the Equateur province Department of Agriculture. The project began in April 2012 and completed in October 2014. The project's overall objective was to contribute to improving production, sales and revenues from maize, rice, groundnuts and beans, by providing the necessary inputs and technical advice on modern methods of farming, and forming marketing groups for these commodities for increased sales. The project covered Bikoro and Ingende, two municipalities of of the Equateur province of the Democratic Republic of Congo. Maize, rice, groundnuts and beans were grown mainly for sale to wholesalers and local traders while the surplus was bought by the World Food Programme. The WFP bought some of the produce from farmers, which was later taken to refugee camps in areas affected by conflict.

Particular problems experienced by farmers in the two municipalities led to the choice of interventions. The farmers had poor access to markets, had low crop-production capacity, and lacked the necessary inputs. In addition, the transport network was poor, so farmers had challenges transporting their produce to local markets.

The partners played a key role in trying to solve these problems. For example, FAO and CRAFOD were involved in capacity building and in the construction of warehouses for storage of farm produce. They also constructed a few kilometres of road to open up the area for trade. They provided seeds, empty sacks, agricultural tools and equipment, bicycles, wheelbarrows and carts to the project participants to ease the problem of transportation. The Equateur Province Department of Agriculture educated farmers on modern methods of crop production. The WFP bought the surplus produce from the farmers. Oxfam provided the funds for project implementation and was in charge of coordination of project activities.

The project was intended to benefit up to 3,000 households in Bikoro and 4,000 in Ingende municipalities through increased agricultural productivity, increased value addition and increased sales and revenues. With support from the programme, these beneficiaries were expected to increase their output, produce higher-value goods, and reach more markets. In general, the Purchase for Progress project aimed mainly at ensuring improved quality and quantity of produce, improving the condition of transport and storage, and promoting women's participation through the development of sustainable livelihoods opportunities and increased household income.

EVALUATION APPROACH

This review adopted a quasi-experimental impact evaluation design, which involved comparing households that had been supported by the project with households in neighbouring communities that had not been supported by the project, but had similar livelihood characteristics in 2011, before the project was implemented.

The Effectiveness Review was carried out in 15 randomly selected villages in the two districts where the project activities had been implemented. Households that had participated in the project were selected at random to be interviewed. For comparison purposes, interviews were also carried out with farmer households from four villages that had not participated in the project, but who were eligible and had expressed an interest in doing so. The comparison villages were selected purposively because they were deemed to have had similar characteristics to the implementation villages at baseline. Households in these villages were also randomly selected and interviews conducted.

In total, 284 project participants and 378 non-participants were interviewed. At the analysis stage, the statistical tools of propensity-score matching and multivariate regression were used to control for demographic and baseline differences between the households surveyed in project and comparison areas, to increase confidence when making estimates of the project's impact.

RESULTS

The results from this Effectiveness Review suggest that the project under analysis has had a positive effect on production and sales of maize, rice, groundnuts and beans, but that this has not clearly translated into increases in income for participant households.

One key question for this review was to determine whether household income differed between the intervention and comparison groups. This Effectiveness Review follows common practice in considering household consumption as a proxy measure of household income. Respondents were asked for details about their household's recent consumption of both food and non-food items, and an overall figure for per-day, per-person consumption was calculated. There was no statistically significant difference between the two groups with regard to this indicator, nor in terms of food consumption alone.

We should consider reasons why the positive results for sales of the four specific crops (and on agricultural processing) may not result in increased household income. If the project participants were focusing more on farming (as the project was encouraging them to do), then maybe they were investing less in other livelihood activities. Given that fishing is one of the main livelihood activities for farmers in this region, it is possible that they are now doing it less than they used to before the project. It is also possible that project participants are investing more in inputs for their farms, so that the increases in revenue do not translate fully into increases in profits.

It is important to note that the project seems to have been successful in meeting its intermediate objective of encouraging participants to engage in the production of maize, rice, groundnuts and beans, and in increasing revenue from those crops. Households in the intervention group are estimated to have generated between two and four times as much revenue from sales of those four crops as did households in the comparison group. However, it is not clear from our data whether this translated into an increase in the total revenues generated from sales of all crops.

The Effectiveness Review also sought to find out whether farmers adopted modern agricultural practices acquired through capacity-building training offered by the project. The agricultural practices included the use of improved seedlings, use of a seed nursery, production of compost manure, organic farming, use of improved certified seed/seedlings, integrated diversified

farming system, SALT (Sloping Agricultural Land Technology) and farm planning based on weather forecasts (e.g. rain gauges). Results indicate that, on average, farmers in intervention areas adopted three agricultural practices compared with their comparison counterparts who adopted two practices. Additionally, the Effectiveness Review found that, on average, participant households adopted at least three agricultural technologies compared with non-participants who adopted two technologies. The differences were statistically significant and robust to other estimation models presented in Appendix 3 of this report.

It was also important to investigate whether participant households had more access to markets than non-participant households. The Effectiveness Review revealed that on average there was a 17 percentage point difference in the proportion of participant households selling their produce to community associations, cooperatives, buying stations and the WFP, compared with the comparison group. It is also important to note that 64 percent of the participants and 57 percent of the non-participants sold their produce to middlemen with the potential of reduced revenues.

The project also attempted to increase value addition so that farmers could get better returns from their produce. To this end, respondents were asked to state if they had processed any crop in the previous 12 months. The results from this Effectiveness Review indicate that, on average, participant households processed two products compared with non-participant households, who processed only one product.

It was important to check whether the farmers cultivated more crops in order to diversify their production to cushion them from low production of particular crops and poor sales and revenues. The results indicate that, on average, farmers in intervention areas produced 3.1 crops compared with 2.5 crops for farmers in the comparison group. Part of this difference appears to be the consequence of pre-existing differences between the intervention and comparison households, but part of it appears to be a result of the project activities.

Finally, there is strong evidence to suggest that, on average, the household wealth index of participant households has increased. Wealth increased as a result of the project by between 0.09 and 0.4 standard deviations since 2012 compared with non-participants.

The reasons for the positive results for wealth index are not clear-cut. However, outcomes that are proxy to the wealth index may be responsible. It was observed from the analysis that intervention households received more revenue from the sale of maize, rice and groundnuts. These households could use this income to acquire more household goods and assets, thus contributing to the statistically significant difference observed in the wealth index measured using household assets.

Key results of this Effectiveness Review

Outcome	Evidence of positive impact	Comments
Adoption of agricultural practices and technology	YES	On average, farmers in intervention areas adopted 3 agricultural practices compared with 2 practices adopted by farmers in comparison areas. Intervention households also adopted 3 agricultural technologies, on average, compared with comparison households who adopted 2.
Increased access to markets	YES	On average, there was a 17 percentage-point difference in the number of intervention households selling to community associations, cooperatives, buying stations and/or the WFP.
Increased value addition	YES	On average, intervention households processed 2 products compared with comparison households who processed 1 product.

Crop diversity	YES	Intervention households produced 3 crops, on average, compared with the matched comparison households that produced 2 crops.
Increased cultivation of maize, rice and groundnuts	YES	Significantly more households in the intervention group farmed maize, rice and groundnuts in the year prior to the survey than did households in the comparison group – thought there was no clear effect on the cultivation of beans.
Increased revenue from the sale of maize, rice and groundnuts	YES	On average, intervention households generated between two and four times as much revenue from sales of maize, rice, groundnuts and beans than did comparison households.
Increased total revenue from crop sales	Not clear	The data do not provide clear evidence on whether or not overall revenue from crop sales was any higher among the intervention group than among the comparison group.
Wealth index	YES	There is evidence to show that the wealth index of households in intervention areas has increased. Wealth has increased for the project households by approximately 0.09 of a standard deviation.
Overall household income (Global Indicator)	NO	This indicator represents the Oxfam GB Global Indicator for livelihoods and was not significantly different between the two groups.

PROGRAMME LEARNING CONSIDERATIONS

Consider involving partners with different expertise in the value chain for maximum benefits.

There is evidence from this Effectiveness Review that farmers in project areas adopted more agricultural practices than the non-project participants. It is important to note that the partners involved in this project identified specific roles where they had a comparative advantage in terms of expertise and resource endowment. The capacity-building component was done by the Food and Agriculture Organization of the United Nations, together with staff from the Equateur province Department of Agriculture who had local knowledge of the area. It appears, therefore, that the roles of the partners were clearly defined. This strategy, where partners take up specific roles based on expertise and local knowledge, may be replicated in other contexts where similar projects are implemented.

Consider allocating more resources to the production of groundnuts in this community.

This Effectiveness Review shows a considerable average positive difference in income from the sale of groundnuts between the two groups and has therefore presented a positive impact of this intervention. This crop could be promoted on a large scale since it has the potential of changing the fortunes of farmers in this region. It is the single most important crop where a substantial amount of funding should be channelled. The reasons are that groundnuts mature fast and are not normally affected by entomological and pathological agents and so the cost of production can be much lower. Secondly, and perhaps more importantly, this crop generates

considerable revenue that may have the potential of increasing household incomes and getting communities out of poverty in the long run.

Consider partnering with the relevant government ministries, especially the Ministry of Roads, in order to open up the area for transportation of agricultural goods.

Transport is a major challenge in this community and opening the area by building roads requires huge capital outlay, which short-term projects cannot accomplish. Involvement and advocacy with the relevant government departments may reduce the burden on scarce resources being used for road construction instead of agricultural production, as was witnessed in this project. Infrastructural development is indeed a public sector function that projects may not efficiently and effectively engage in. Despite the efforts by the project to put some resources into road construction, it is evident from this Effectiveness Review that no significant difference was realized in terms of the reduction of transport costs between the two groups. Hence the need to consider formulating transportation strategies by developing a vibrant advocacy at the provincial and national level to establish adequate transport means to connect the producers, consumers and wholesalers in this region.

Consider building a strong monitoring system and Performance-Monitoring Plan (PMP) during programme design.

The programme team is encouraged to consider a monitoring system that collects real time data, which can be used for targeting, project implementation, reflection and shaping or informing implementation strategies and activities. The project team is also encouraged to develop a performance-monitoring plan containing all the key indicators of project performance. These indicators should be monitored on a quarterly basis to check for deviations against set targets and corrective measures taken whenever there are negative deviations.

1 INTRODUCTION

Oxfam GB has put in place a Global Performance Framework (GPF) as part of its effort to better understand and communicate its effectiveness, as well as to enhance learning across the organization. This Framework requires project and programme teams to annually report output data across six thematic indicator areas. In addition, every year, for each thematic indicator area, a modest sample of mature[1] projects are randomly selected to be evaluated through rigorous Effectiveness Reviews. One key focus is on the extent to which they have promoted change in relation to relevant OGB global outcome indicators.

The global outcome indicator for the Livelihoods thematic area is defined as total household consumption per adult equivalent per day. This indicator is explained in more detail in Section 5 of this report.

This Effectiveness Review, which took place in December 2015, was intended to evaluate the success of the project 'Purchase for Progress (P4P) in Equateur province of the Democratic Republic of Congo (DRC)' in promoting food security and strengthened maize, rice, groundnuts and beans production and marketing among the project participants.

This project was implemented in two municipalities in Equateur province – Bikoro and Ingende – between March 2012 and October 2014, by Oxfam in conjunction with the World Food Programme (WFP), Food and Agriculture Organization (FAO) and CRAFOD, a local NGO working with FAO and the Department of Agriculture of Equateur province. It was intended to benefit up to 3,000 households in Bikoro and 4,000 in Ingende through increased agricultural productivity, increased value addition, and increased sales and revenues. With support from the programme, these beneficiaries were expected to increase their output, produce higher-value goods, and reach more markets. In general, the Purchase for Progress project aimed mainly at ensuring improved quality and quantity of produce, improving the condition of transport and storage, and promoting women's participation through the development of sustainable livelihoods opportunities and better income.

This report presents the findings of the Effectiveness Review. Section 2 briefly reviews the project description. Section 3 describes the evaluation design used, and Section 4 describes how this design was implemented. Section 5 presents the results of the data analysis, based on the comparison of outcome measures between the intervention and comparison groups. Section 6 concludes with a summary of the findings and some programme learning considerations. Finally, baseline statistics before matching are provided in Appendix 1, technical and methodological considerations on the propensity-score matching (PSM) approach are given in Appendix 2, and tests of the robustness of the results are examined in Appendix 3.

2 PROJECT DESCRIPTION

2.1 PROJECT ACTIVITIES

Oxfam embarked on an agriculture scale-up programme to contribute to poverty reduction efforts in two municipalities of Equateur province of DRC through reaching smallholder farmers using a market-based value-chain approach. Fishing, logging and agriculture provide livelihoods to the majority of the population of the province. At least 90 percent of the population in this region comprises farmers and fishermen.

The municipalities of Bikoro and Ingende were selected for the implementation of the project. One of the bottlenecks to improved production was the low level of skills and knowledge of modern agricultural practices and markets in indigenous communities, coupled with a poor transport network, thus making progress slower than donors anticipated. Commodities such as cassava are widely grown, but maize, rice and groundnuts are being promoted by international agencies such as WFP, FAO, Oxfam and others, so that the people can attain self-sufficiency in food production and improved revenues to boost household incomes.

Purchase for Progress (P4P) was funded by the Belgian and French governments and implemented by Oxfam together with partners. The programme covered two municipalities in Equateur province, Bikoro and Ingende, with the Belgian government providing funding for the villages in Ingende and the French government providing funding for the villages in Bikoro. The programme was implemented from April 2012 to October 2014.

There were four crops chosen by farmers: maize, rice, beans and groundnuts. The role of FAO was to provide certified seeds for maize, rice, beans and groundnuts for planting, as well as agricultural tools and equipment. They also provided means of transport, such as bicycles, for the transportation of farm produce, and were instrumental in the establishment of grinding mills. The WFP was involved in the coordination of the project, but also bought the surplus produce from the farmers through the partners and community associations. Since WFP is involved in relief programmes, it was envisaged that the UN agency could buy the relief food from the local farmers instead of importing it from elsewhere, hence the name Purchase for Progress (P4P). The provincial department of agriculture and CRAFOD provided training and carried out inspections in the field to see if the training was being implemented. Oxfam provided the funds donated by the French and Belgium governments and also coordinated the implementation of the project activities.

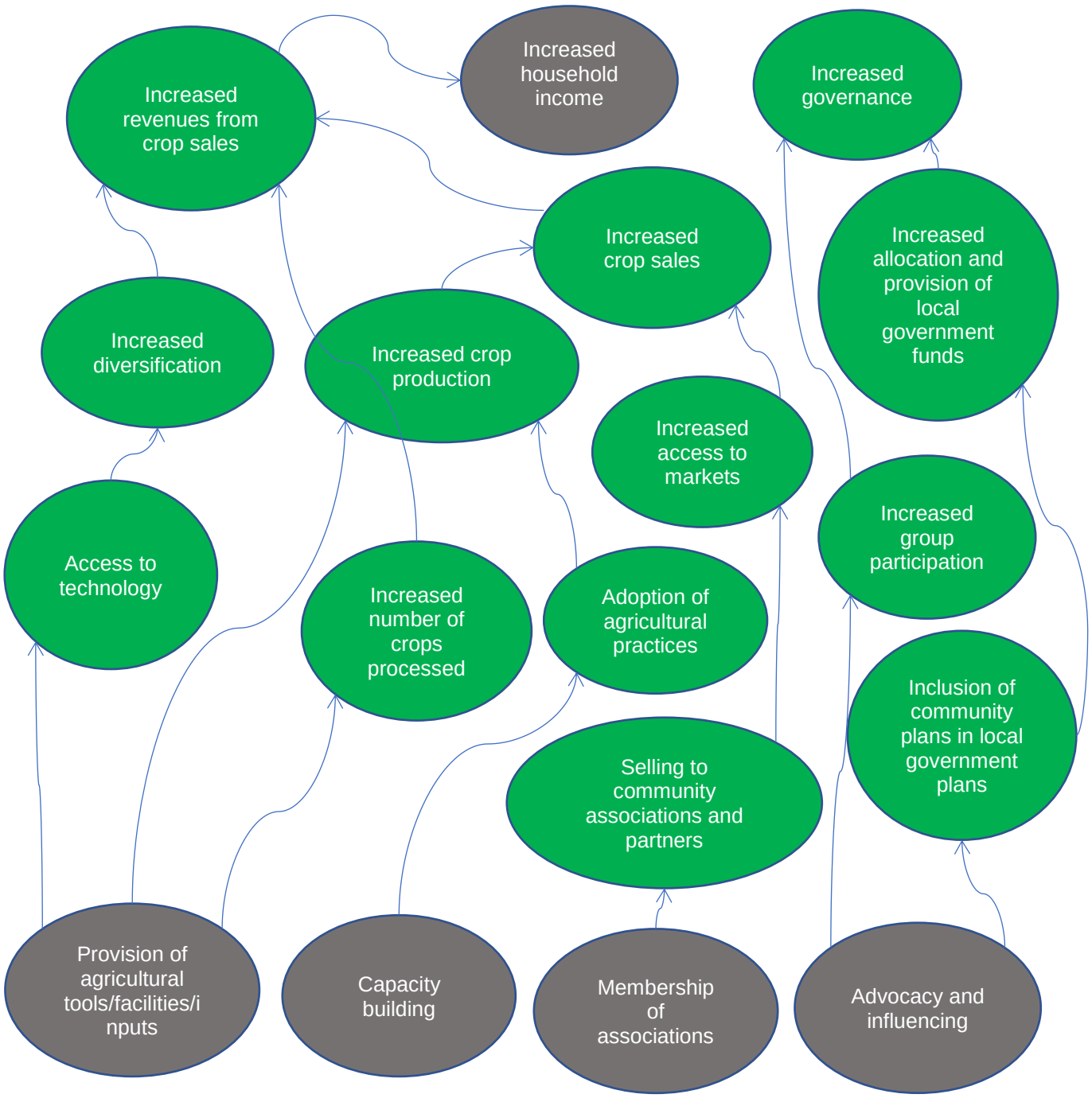
The activities implemented included linkage to markets; provision of cultivation, harvesting and processing tools (such as empty sacks, seeds, and tools); technical assistance regarding farming techniques; provision of market information and provision of credit facilities to the farmers. Transport facilities, such as bicycles and wheelbarrows, were also provided. The produce was sold to wholesalers and retailers and the surplus was sold to the World Food Programme, which in turn distributed it as relief food in areas of need within DRC and beyond. The project also established 134 associations/groups in Bikoro and 160 in Ingende whose members were maize, rice, groundnuts and beans farmers.

Oxfam and partners worked with these groups or associations for effective and efficient management of the project. This programme aimed to improve the livelihoods of over 7,000 households in Bikoro and Ingende through strengthening of production systems of high value crops.

2.2 PROJECT LOGIC AND INTENDED OUTCOMES

In this section, we describe how the project was supposed to achieve its goals. Using existing documentation about the project as well as evidence from discussions with the team implementing it, we can map out the intended hypothetical causal links from project activities, via outputs and intermediate outcomes, to overall household income. Figure 2.1 provides a summary of the results found in the different steps of the project logic.

Figure 2.1: Project's simplified logic model and impact



Project logic is an explicit theory or model of how the project causes the intended or observed outcomes and plays an important role in the design of quantitative evaluations. It identifies project resources, project activities and intended project outcomes, and specifies a chain of

hypothetical causal assumptions linking programme resources, activities and intermediate outcomes with ultimate project goals.

Project logic is important because of the recognition that a project's success or failure can be assessed only with a clear understanding of the problem it was intended to address, the rationale for choosing a particular approach, and how the project was expected to operate.

A central element of many quantitative methodologies is the specification of hypotheses that can be tested through experimental or quasi-experimental designs. Sometimes an evaluation will test a single hypothesis. However, in the project logic presented above, the hypothesized causal chain of interlinked hypotheses is specified and tested.

The project was expected to increase household income and food security by building the capacity of farmers to use modern agricultural practices through improvement in maize, rice, groundnut and bean production and marketing with interventions, such as training; provision of inputs, such as seeds, farming tools and means of transport (e.g. bicycles and wheelbarrows); and marketing of produce through farmers' associations and partners.

According to the project logic, higher production and increased sales were expected to lead to better revenues and hence increased income for the households involved in the project. At the same time, membership of associations aimed to ensure that farmers had access to markets. This was because they could take their produce to the associations, which was expected to enhance sales and revenues and ultimately lead to increased incomes.

The establishment of grinding mills was expected to lead to an increase in the number of products processed and increased prices – and hence increased revenues – leading to an increase in household income.

There were also attempts made to increase community members' participation in the project, especially women. With increased women's membership and participation in groups, they were expected to influence decisions that could lead to the inclusion of community plans in local government plans. They could also use their groups to advocate for budgetary allocation in the prioritized community plans, which could lead to improved local governance.

Based on the project logic, the Effectiveness Review sought to answer the following key evaluation questions:

- Did the farmers adopt modern methods of crop production, agricultural technology and processing of crops for value addition before selling?
- Was there increased access to markets for farmers involved in the project?
- Was there a difference in the quantities of maize, rice, groundnuts and beans produced and sold and the revenues obtained from sales between the participants and non-participants?
- What was the effect of the project on the overall household income of the participants?

It was particularly important to investigate the drivers of the expected changes in outcomes, such as training received and agricultural practices adopted, value addition, access to markets and access to technology.

3 EVALUATION DESIGN

The central problem in evaluating the impact of any project is how to compare the outcomes that result from that project with *what would have been the case* without that project having been carried out. In the case of this Effectiveness Review, information about the lives and livelihoods of project participants was collected through a household questionnaire – but clearly it was not possible to observe what their situation would have been had they not had the opportunity to participate in this project. In any evaluation, that 'counterfactual' situation cannot be directly observed: it can only be estimated.

In the evaluation of programmes that involve a large number of units (whether individuals, households, or communities), common practice is to make a comparison between units that were subject to the programme and those that were not. As long as the two groups can be assumed to be similar in all respects except for the implementation of the specific project, observing the situation of those where the project was not implemented can provide a good estimate of the counterfactual.

An ideal approach to an evaluation such as this is to select at random the areas in which the project will be implemented. Random selection minimizes the probability of there being systematic differences between the project participants and non-participants, and so maximizes the confidence that any differences in outcomes are due to the effects of the project.

In the case of the project examined in this Effectiveness Review, the selection of the villages involved in the project was not made at random; in fact, villages were deliberately chosen based on their being particularly vulnerable in terms of low quantity and quality of agricultural production among the members, lack of agricultural inputs, poor use of modern methods of crop production, low revenues and lack of access to markets. The project worked with farmers that were members of the 160 associations in Ingende and 134 associations in Bikoro.

However, discussions with the implementation staff revealed that there were neighbouring villages with farmers who would have been eligible and had the potential to benefit from participation in the project, but who were not given the opportunity to participate. These farmers, therefore, did not benefit from the project even though they had similar livelihoods characteristics to the project participants at baseline. This allowed a 'quasi-experimental' evaluation approach to be adopted, in which the situation of farmers in non-project villages was assumed to provide a reasonable counterfactual for the situation of farmers who had participated in the project activities.

To improve the confidence in making this comparison, households in the project were 'matched' with households with similar characteristics in the non-project (or 'comparison') villages. Matching was performed on the basis of a variety of characteristics – including household size, education level and indicators of material well-being, such as housing conditions and ownership of assets. Since some of these characteristics may have been affected by the project itself (particularly those relating to wealth indicators), matching was performed on the basis of these indicators *before* the implementation of the project. Baseline data were not available and so survey respondents were asked to recall some basic information about their household's situation from 2011, before the project was implemented. While this recall data is unlikely to be completely accurate, this should not lead to significant bias in the estimates as long as the measurement errors due to the recall data are not significantly different for the project participants and the comparison group.

Recall survey data provided a variety of baseline household characteristics on which matching could be carried out. These characteristics were used to calculate a 'propensity score', which is the conditional probability of the household being a participant, given the set of observable characteristics at baseline. Project households and comparison households were then matched

based on their having propensity scores within certain ranges. Please refer to Appendix 2 for a more extensive explanation of the matching procedure and tests carried out after matching to assess whether baseline characteristics are similar between the two groups.

As a check on the results derived from the propensity-score matching process, results were also estimated using multivariate regression models. Like propensity-score matching, multivariate regression also controls for measured differences between intervention and comparison groups, but it does so by isolating the variation in the outcome variable explained by being a project participant, after the effects of other explanatory variables have been accounted for. The regression models tested are described in Appendix 3.

It should be noted that both propensity-score matching and multivariate regression rely on the assumption that the 'observed' characteristics (those that are collected in the survey and controlled for in the analysis) capture all of the relevant differences between the two groups. If there are 'unobserved' differences between the groups that affect project participation, then estimates of outcomes derived from them may be misleading. Unobserved differences between the groups could potentially include differences in attitudes or motivation (particularly important when individuals have taken the initiative to participate in a project), differences in community leadership, or local-level differences in weather or other contextual conditions faced by households. The choice of which intervention and comparison villages to survey for this Effectiveness Review was made principally to minimize the potential for any such unobservable differences to bias the results.

4 DATA COLLECTION

4.1 SAMPLING APPROACH

The intervention group consisted of farmer households cultivating maize, rice, groundnuts and beans that participated in the project from inception to closure. The intervention group was selected based on its vulnerability, as explained earlier. Since it was not possible to include all villages because of insufficient resources, some villages within the selected municipalities did not take part in the project activities even though they were also vulnerable. This group, therefore, formed the comparison group. It is important to take note of these two terms, *intervention* and *comparison*, since they are used frequently in this report.

The project was implemented in 160 farmer associations/villages in Bikoro and 134 in Ingende. Thirteen farmer associations were randomly selected from the 160 associations in Bikoro and two selected from Ingende. The reason for the selection of fewer villages in Ingende was that fewer activities had been implemented in Ingende compared with Bikoro at the time of the survey and these activities in Ingende were implemented towards the end of the project, so little impact was envisaged at the time of the survey.

Households' lists of participants in the sampled villages of Bikoro and Ingende were obtained from the partners. The number of farmers to be selected from each of the villages was determined by dividing the number of members in each of the villages by the total number of participants in the selected villages and multiplying by the sample size that had been determined for the intervention group. The result provided the number of farmers to be interviewed from each of the 15 villages as indicated in Column 4 of Table 4.1. The sample frame was constructed by identifying those households that received at least one project intervention from the project area. Among the households that benefited directly from the project, 284 were randomly selected to be interviewed.

There were villages in Bikoro municipality that did not participate in the project, but could have participated since they were similar to those that did take part. The project staff and partners identified four such villages, which provided good comparison groups to the best knowledge of the project staff. A total of 378 households were randomly selected to be interviewed.

The comparison villages were selected purposively. Households were, however, randomly selected from the comparison villages using the 'random walk' sampling method. This involves selecting a starting point using a landmark, such as a church, school or road junction or any other identifiable mark from where the interviewer would begin the survey. If a selected starting point did not fulfil one of the above requirements, the next road had to be selected and if this was not suitable, the next had to be chosen, and so on, until an appropriate starting point was identified. Starting points were spread all over the sampling area and were not close to each other. The interviewer/enumerator would begin from a designated starting point and walk along the road sampling at systematic intervals defined by the field supervisor (say, after every five households depending on the distribution of households in the village). No road was 'walked on' for a second time until all the roads of the village had been 'walked on' once. This method was employed because there were no household lists in comparison villages.

It was difficult for the project team to find similar households in comparison communities who were maize, rice, groundnuts and beans farmers, but had never worked with this project or any other NGO in implementing similar activities because of the multi-ethnicity of the people in this region The differences therefore lie in the activities Oxfam and partners implemented with the project participants, which the non-participants did not benefit from.

A household questionnaire was developed by Oxfam staff, in collaboration with partners, to capture data on various outcome measures associated with the project's activities. Demographic data and recalled baseline data were also collected to statistically control for differences between the supported and comparison households that could not plausibly be affected by the project. The questionnaire was tested by local Oxfam staff and then by the enumerators during a practice exercise, and revised accordingly. Data collection involved the use of mobile devices using SurveyCTO software. The full list of villages with numbers of households/farmers interviewed in intervention and comparison villages is shown in Table 4.1.

Table 4.1: Intervention and comparison groups sample sizes

	Project participants			**Sample comparison group**		
Municipality	**Villages/farmer associations randomly selected from Bikoro and Ingende**	**Households/ farmers participating in the project**	**Households/ farmers interviewed**	**Municipality**	**Villages/farmer associations selected in comparison communities**	**Households/ farmers interviewed in comparison communities**
Bikoro	ADC	400	55		Bolongo	77
	AIED	350	41		Bongonde	172
	APM	300	24		Boteke	62
	Abim	100	4		Nzalekenga	67
	Ajame	150	14			
	Alliance	200	10			
	Elikya	220	11			
	Mabele	250	14			
	Mosala	400	21			
	Opaimo	220	10			
	Telema	380	18			
	Tokolalate	200	10			
	Tomibongisa	300	16			
Ingende	Bolingo	1000	17			
	Salongo	1000	19			
TOTAL		**5470**	**284**			**378**

4.2 ANALYSIS

Households of project participants and non-participants were compared in terms of their demographic characteristics, livelihoods activities and economic situation in 2011. These data were based on information either recalled during the questionnaire or reconstructed from the household composition at the time of the survey.

The full comparison is shown in Appendix 1. Some important differences were found between the project participants and non-participants. For example, on average, more of the household heads in project villages than in comparison villages had completed secondary education, and more of the households from project villages than from comparison villages were at the top of the wealth distribution. On the other hand, comparison villages were, on average, located significantly closer to the nearest market than were the project villages. These differences that existed before the project have the potential to bias any comparison between the project and comparison groups. It was therefore important to control for these baseline differences when making such comparisons.

As described in Section 3, the main approach used in this Effectiveness Review was propensity-score matching (PSM). The variables on which respondents were matched were selected from among the full list detailed in Appendix 1, based on two key factors. Firstly, we selected those variables that were thought to be the most significant in influencing respondents' participation in the project. Secondly, we aimed to include variables that could affect potential project outcomes *as well as* the likelihood of participating in the project. The list of matching variables selected and the full details of the matching procedure applied are described in Appendices 1 and 2.

After matching, households in the intervention and comparison groups were well balanced in terms of the recalled baseline. Matches were found for almost all project participants interviewed: only three of the 284 project participant households could not be matched and had to be dropped from the analysis. For the analysis of data from the section of the questionnaire that was addressed only to women household members, a separate PSM model was created: in this case, nine of the 144 women interviewed in project participant households could not be matched to women in comparison households and were therefore dropped from the analysis.

All the results described in Section 5 of this report were also tested for robustness by estimating them with various alternative PSM models and linear or probit regression models. These robustness checks are shown in Appendix 3. The alternative models produced results that are all similar (in size and in statistical significance) to those presented in the tables in Section 5.

It is important to recall, as highlighted in Section 3, that PSM and regression models can control only for the baseline differences between the households in project and comparison communities for which data was collected in the survey. If there are any 'unobserved' pre-existing differences between the two groups – such as individuals' attitudes, motivation, skills or confidence – then these may bias the estimates of outcomes described in Section 5. The evaluation design and the selection of respondents were intended to minimize any potential for unobserved differences, but this possibility cannot be excluded and must be borne in mind when interpreting the results.

5 RESULTS

This report is intended to be free from excessive technical jargon, with more detailed technical information being restricted to the appendices and footnotes. However, there are some statistical concepts that cannot be avoided in discussing the results. In this report, results will usually be stated as the average difference between households living in villages where the project was implemented (referred to as the 'intervention group') and the matched households in villages where the project was not implemented (named the 'comparison group').

In the tables of results on the following pages, statistical significance will be indicated with asterisks, with three asterisks (***) indicating a p-value of less than 1 percent, two asterisks (**) indicating a p-value of less than 5 percent and one asterisk (*) indicating a p-value of less than 10 percent. The higher the p-value, the less confident we are that the measured estimate reflects the true impact. Results with a p-value of more than 10 percent are not considered to be statistically significant.

5.1 INTRODUCTION

This section presents a comparison of the project participants and non-participants in terms of various outcome measures relating to the project under review.

The results are shown after correcting for the baseline and demographic differences found in Section 4.2 using a propensity-score matching procedure. The details of this procedure are described in Appendix 2. All outcomes discussed here have also been tested for robustness using alternative statistical models, as described in Appendix 3. The alternative models produced results that are similar (in size and in statistical significance) to those presented in the tables in this section.

It is important to stress that the results presented in this section are average results across all those who participated in at least one of the interventions that were carried out during the implementation period in the 15 villages/associations selected under the project up to 2014. Clearly, it would be of interest to investigate the effects of the project at a more local level and for specific subgroups – but the small sample sizes limit the potential for detecting any differences between these various subgroups.

5.2 INVOLVEMENT IN PROJECT ACTIVITIES

Before considering outcome-level changes, it is interesting to consider the proportion of respondents who report exposure to project-related interventions. This is an important consideration as, firstly, it represents the analysis of the first step of the project's theory of change – i.e. are project participants being exposed to the intended interventions? Secondly, it is important to assess whether respondents in comparison areas also report receiving such support in their communities as this may have an effect on the differences that might be detected between the intervention and comparison groups in the outcome measures reported subsequently. The following activities were considered for the intervention and comparison households from baseline to end line:

- Provision of maize, rice, groundnut and bean seeds for planting.
- Provision of bicycles and wheelbarrows.
- Technical assistance on farming techniques.

- Provision of market information (price, location, contacts/linkages).
- Support in obtaining access to agricultural credit.
- Provision of empty sacks.
- Provision of agricultural tools and equipment (slashers, sharpening materials, pangas).

Table 5.1: Received support by households from NGOs, government or cooperatives during the four years prior to the survey

	1	2	3	4	5	6	7	8
	Household received maize, rice and groundnut seeds for planting %	**Household received bicycle(s) %**	**Household received wheelbarrows %**	**Household received technical assistance on farming techniques %**	**Household received market information on prices %**	**Household received support in obtaining credit facilities %**	**Household received empty sacs %**	**Household received agricultural tools and equipment %**
Intervention group mean:	74.7	16.4	13.9	69.0	64.1	42.0	71.9	67.6
Comparison group mean:	6.2	2.4	0.9	3.6	1.1	0.7	0.5	1.6
Difference:	68.5*** (3.6)	14.0*** (2.5)	13.0*** (2.2)	65.4*** (3.0)	63.0*** (2.8)	41.3*** (2.9)	71.4*** (2.7)	66.1*** (2.9)
Observations (intervention group):	281	281	281	281	281	281	281	281
Total observations:	650	650	650	650	650	650	650	650

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions

Table 5.1 shows a comparison between those identified as participants (the intervention group) and those identified as non-participants (the comparison group) in terms of their participation in project activities. It should be noted that these figures make a comparison between outcomes after correcting (as far as possible) for the baseline and demographic differences between the intervention and comparison respondents, using the propensity-score matching process described in Appendix 2.

It can be seen from the table that the majority of respondents received maize, rice and groundnut seeds for planting; market information on prices, technical assistance on methods of crop production, and agricultural tools and equipment. Rather smaller proportions of the project participants reported receiving support in obtaining credit, or distributions of a bicycle or wheelbarrow. It is apparent from the table that only very small minorities of the comparison households reported receiving any of these forms of support. It can be argued that the two groups were similar in terms of livelihoods characteristics and therefore these two groups were comparable.

5.3 TRAINING ATTENDED AND AGRICULTURAL PRACTICES ADOPTED

It was important to assess whether farmers attended training sessions and the number of times they attended such sessions. The training topics covered farm technologies, organizational management, marketing and finance management, conflict resolution, women's rights, governance and planning processes, quality of maize and rice that WFP can buy from producers, storage techniques, and how farmers can know if they are making profit. The respondents were asked to state whether they or any member of their household had attended any of the above training during the previous four years. Additionally, they were asked to state how many times they or any of their household members had received such training since 2011 when the project started. The respondents were also asked whether they had practised any of the following agricultural methods in the previous 12 months:

- Seed nursery
- Production of organic fertilizer
- Organic farming
- Use of improved certified seeds/seedlings
- Integrated diversified farming systems
- Sloping agricultural land technology
- Farm planning based on weather forecasts.

Table 5.2 investigates the impact in the intervention and comparison households using kernel propensity-score matching.

Table 5.2: Training received and practices adopted

	1	2	3	4
	Some household members attended training in previous 4 years **%**	**Number of times household members attended training in previous 4 years**	**Use of modern agricultural practices (Any of the practices)** **%**	**Number of agricultural practices adopted**
Intervention group mean:	91.5	14.8	92.5	3.3
Comparison group mean:	24.9	0.7	77.2	1.9
Difference:	66.6*** (3.5)	14.0*** (0.8)	15.3*** (3.1)	1.4*** (0.1)
Observations (intervention group):	281	281	281	281
Total observations:	650	650	650	650

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions, with standard errors. All means are calculated *after* matching.

The estimates in Table 5.2 Column 1 suggest that about 92 percent of the respondents in the intervention group reported attending training sessions since 2011 compared with only 25 percent of the respondents in the comparison group. It appears that respondents in the intervention group reported receiving training, on average, about 15 times during the three years, compared to fewer than one time, on average, for those in the comparison group (Column 2).

The number of agricultural practices adopted by the project participants, on average, was about 1.4 more than the number adopted by the non-project participants (Column 4). In addition, on average, there was also a 15 percentage point increase in the number of households using any of the modern agricultural practices in intervention areas compared to the comparison households (Column 3).

The reasons for the adoption of agricultural practices can be argued based on the roles of the partners that were involved in the implementation of the project. It is important to note that the partners involved in this project identified specific roles where they had comparative advantage in terms of expertise and resource endowment. The capacity-building component was done by the Food and Agriculture Organization of the United Nations, together with staff from the Equateur province Department of Agriculture.

It is therefore possible that the experience of the FAO, coupled with its long experience in agricultural research and knowledge of the local context by the staff from the Department of Agriculture in Equateur province, contributed to the high adoption of agricultural practices in project areas. This strategy, where partners take up specific roles based on expertise and local knowledge, may be replicated in other contexts where similar projects are implemented.

5.4 VALUE ADDITION

The second channel through which the project aimed to increase income and revenues was by increasing the value added and therefore generating higher prices for certain products. The survey investigated value addition by asking for each agricultural product produced and sold in the last 12 months and if the product was processed before being sold. Column 1 of Table 5.3 provides estimates of the probability of a household in the intervention and comparison group having processed any product in the previous 12 months. Column 2 provides estimates for the number of agricultural products processed during the same period.

There was a difference of 10 percentage points, on average, in the number of households in project areas that reported processing any product in the previous 12 months compared with non-participant households (Column 1). Column 2 of the table shows that households in the intervention areas processed, on average, 2.1 agricultural products, compared to 1.6 products among those in the comparison areas.

Table 5.3: Processing agricultural products

	1	2
	Did you process any product? %	**Number of products processed**
Intervention group mean:	90.4	2.1
Comparison group mean:	80.4	1.6
Difference:	10.0*** (3.1)	0.5*** (0.1)
Observations (intervention group):	281	281
Total observations:	650	650

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates bootstrapped 1,000 repetitions

One of the key result areas of this project was to ensure high quality of produce that could be sold at a higher price. It is instructive to note that the Food and Agriculture Organization of the United Nations constructed 20 grinding mills for maize and 20 grinding mills for rice in the project areas, and this gave farmers an opportunity to process their produce. The FAO also constructed 14 warehouses for storage of produce after attaining the right moisture content, which had the potential of ensuring the quality of the produce.

5.5 ACCESS TO MARKETS

The other channel through which the project aimed to increase revenues was reducing costs when selling agricultural produce. This was done by ensuring that farmers took their produce to the associations, which in turn took the produce to the warehouses. It is from these warehouses that WFP and other wholesalers bought the produce.

Conscious that the cost of transporting goods from their farms to the wholesalers and consumers could be significant, respondents were asked to estimate the cost to them of transport of all the products sold during the previous year.

The first column of Table 5.4 reports on the proportion of the revenue generated from crop sales that respondents reported spending on the cost of transportation to market. Respondents reported that the transport cost accounted, on average, for 16 percent of the revenue, and there is no evidence that this differs significantly between the intervention and comparison groups.

Column 2 of the table shows that, on average, there is large (17 percentage point) difference between the intervention and comparison groups in the number of households selling their produce to community associations, cooperatives, buying stations or to WFP. However, Column 3 provides some indication that the proportion selling to local traders or middlemen may also be higher among the project participants, and this has the potential of reducing revenues.

Table 5.4: Transport costs and access to markets

	1	2	3
	Transport costs (% of reported total value of crops sold, among households that made any crop sales)	**Selling to community associations, cooperatives, buying stations or WFP %**	**Selling to local traders or middlemen %**
Intervention group mean:	18.5	24.2	64.4
Comparison group mean:	16.3	7.4	57.0
Difference:	2.2 (4.3)	16.8*** (3.0)	7.4* (4.2)
Observations (intervention group):	258	281	281
Total observations:	568	650	650

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates bootstrapped 1,000 repetitions

Equateur province is largely inaccessible, so the project tried to construct 16 bridges and 30 kilometres of roads in Bikoro and Ingende to mitigate this problem. In addition, the project participants were provided with bicycles and wheelbarrows to ease the transportation of produce. It may be that the activities aimed at reducing transportation costs have not led to a significant reduction in these costs, and this is an area where the project needs to look again at the strategies that have been employed.

Transportation is an important step in the process of production and marketing of agricultural produce. Indeed, it allows both producers and traders to distribute produce to major consumption centres. In the territory under study, transportation is limited and this state of affairs affects the cost of production.

The selling of produce by the farmers in this project employed a unique strategy whereby the focal persons of the farmers' associations were updated on the prices of commodities from time to time using their mobile phones. The farmers could therefore take advantage of this market information to sell their produce when prices were favourable.

5.6 USE OF AGRICULTURAL TECHNOLOGY AND TOOLS

The project also aimed to improve access to and use of technological tools, such as solar dryers, warehousing and storage facilities, sharpening materials, rice threshers/corn huskers, sieves for grains, rice/corn mills, and small hand tools. The use of these tools was expected to increase the volume and quality of production. The questionnaire asked each respondent if they used any of the technological tools during production, processing and selling of agricultural products. Table 5.5 reports estimates on the number of tools and the probability that farmers have accessed at least one technological tool.

An estimate in Column 1 indicates that, on average, intervention households used more than three types of technological tool, compared with fewer than two types by households in the comparison areas.

Table 5.5: Access to technology

	1	2
	Number of agricultural technologies accessed and used by farmers during the previous 12 months	**Proportion of farmers who accessed and used at least one technology during the previous 12 months** **%**
Intervention group mean:	3.5	94.7
Comparison group mean:	1.7	80.2
Difference:	1.9*** (0.1)	14.5*** (3.0)
Observations (intervention group):	281	281
Total observations:	650	650

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates bootstrapped 1,000 repetitions

Column 2 of the table reveals that most of the survey respondents reported using at least one technological tool during the previous 12 months, but that this figure was 15 percentage points higher among the project households than among the comparison households.

Agricultural technology was used at various stages of the value chain from land preparation, planting, weeding, harvesting and drying, to storage and processing. Given that farmers in participant households were provided with the various tools indicated above, they were therefore exposed to more tools compared to their non-project counterparts. They were also provided with training in the use of these tools, as indicated in Table 5.2.

5.7 NUMBER OF AGRICULTURAL CROPS PRODUCED

Alongside encouraging project participants to implement improved agricultural activities, the project also sought to encourage farmers to grow other crops, such as groundnuts, that could mature early and give farmers income and expand into high-value production. One indication of whether farmers have expanded their crop portfolio is to analyse the differences between the intervention and comparison households in the number of crops being cultivated in the year prior to the survey.

Table 5.6 presents the average number of crops cultivated by the sample of households. As is apparent from Column 1 of the table, there is evidence that the project participants cultivated a significantly greater range of crop types than did the comparison respondents.

Table 5.6: Number of crops produced

	1	2
	Number of agricultural crops produced during the previous 12 months	**Number of agricultural crops produced in 2011**
Intervention group mean:	3.12	2.78
Comparison group mean:	2.51	2.40
Difference:	0.61*** (0.15)	0.37** (0.15)
Observations (intervention group):	281	281
Total observations:	650	650

Bootstrap Standard Errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates bootstrapped 1,000 repetitions

In addition, a comparison was made between the number of crops that respondents in intervention and comparison households recalled producing before the launch of the project, in 2011. The results, shown in Column 2 of the table, act as a check on whether the difference in the range of crops cultivated in the year prior to the survey reflects a pre-existing difference between the groups. It can be seen that the project participants did produce a significantly wider range of crops than the comparison households in 2011, but that this difference appears to have increased in size over the project's lifetime. This provides some reassurance that the project has successfully effected an increase in the range of crops being farmed.

5.8 CROP PRODUCTION, SALES AND REVENUES

This Effectiveness Review sought to discover whether there was a change in the quantity of maize, rice, groundnuts and beans produced and sold and the revenues obtained by the farmers who participated in this project. The respondents were asked whether any member of the household had grown these crops in the previous 12 months. If yes, they were asked for the total revenue obtained from sales of that crop. Tables 5.7 to 5.10 present the estimates of differences between the intervention and comparison households in cultivation and sales of these crops.

Table 5.7 shows that, on average, households in the intervention communities were slightly more likely than households in the comparison communities to cultivate maize (a difference that is statistically significant only at the 10 percent level, but which is robust to the alternative statistical models described in Appendix 3). However, they appear to have been either selling much larger volumes or receiving a higher price: sales of maize among the project participant households is estimated to have generated between two and three times as much revenue, on average, as among the comparison households. In Column 3 of the table we calculate this difference specifically among households that reported making some sales. The figures in Column 3 are reported in logarithmic terms, so as to reduce the influence on the analysis of households with particularly large sales. The result implies that sales revenue was approximately 35 percent higher among intervention households that sold some maize than among comparison households that sold some maize.

Table 5.7: Engagement in cultivation of maize, and revenues obtained from sales

	1	2	3
	Proportion of households that cultivated maize in the previous 12 months **%**	**Revenues from maize sales in the previous 12 months, across the whole sample** **Congolese francs**	**Revenues from maize sales in the previous 12 months, among households that made some sales[a]** **Logarithm of Congolese francs**
Intervention group mean:	57.3	73 286	10.976
Comparison group mean:	49.1	30 907	10.673
Difference:	8.2* (4.4)	42 379*** (16 027)	0.303** (0.154)
Observations (intervention group):	281	281	143
Total observations:	650	650	290

[a] This analysis is carried out using a PSM model constructed specifically for the sub-sample of households that reported any maize sales.
Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions. All means are calculated *after* matching.

Maize is one of the most important foodstuffs that the World Food Programme distributes in refugee settings in most African countries. Farmers in the project areas were encouraged to cultivate this crop and take it to the established storage facilities/warehouses via the farmers' associations. The World Food Programme therefore bought the surplus maize from these warehouses ready for distribution to conflict areas. The farmers were provided with certified maize seeds by the FAO and agricultural tools and equipment necessary for land preparation, weeding, harvesting, processing and transportation.

The provision of these tools and certified seeds as outlined above could have led to higher production of maize in project areas than non-project areas. The construction of warehouses in the vicinity, coupled with the construction of grinding mills, ensured that processing of agricultural produce could take place as indicated in Table 5.3. This had the potential of improving the quality of the produce and the World Food Programme could therefore offer better prices, hence the increased sales witnessed in the intervention areas.

Table 5.8 shows the proportions of households engaged in the cultivation of rice, and the revenues obtained from sales of rice. In contrast to maize, only a small proportion of households reported cultivating rice – though this proportion was 10 percentage points higher in the intervention communities than in the comparison communities. This translated into much greater revenues generated from sales of rice among intervention households than among comparison households. (However, the small number of households that made any sales of rice, particularly in the comparison group, prevents us from estimating the difference in sales revenue, specifically among those households.)

Table 5.8: Engagement in cultivation of rice, and revenues obtained from sales

	1	2
	Proportion of households that cultivated rice **%**	**Revenues from rice sales in the previous 12 months, across the whole sample** **Congolese francs**
Intervention group mean:	13.2	26 762
Comparison group mean:	3.1	4 409
Difference:	10.1*** (2.4)	22 353*** (8 542)
Observations (intervention	281	281
Total observations:	650	650

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions. All means are calculated *after* matching.

Rice is the second most common foodstuff that is normally distributed to refugees. The production of this crop was promoted by the partners by carrying out specific capacity-building interventions coupled with the provision of certified planting material to ensure high yields. As mentioned before, modern methods of crop production were adopted by the farmers through information from FAO and CRAFOD and the extension staff from the Equateur Department of Agriculture, and this would ultimately lead to higher production of rice.

The presence of grinding mills established by FAO and warehouses at central locations in the project areas offered an opportunity for the processing of rice, which increased the price being obtained for this produce. Consequently, this led to increased revenues from the sale of rice in project areas compared with the non-project areas.

Table 5.9 shows the proportions of households engaged in farming groundnuts, and the revenues obtained from their sales. In the municipalities of Bikoro and Ingende (that is, the area covered by the Effectiveness Review), the project attempted to diversify crop production to cushion farmers by encouraging the cultivation of groundnuts that could be sold to the local market. There is evidence that these efforts were successful: a much greater proportion of project participants than comparison households was farming groundnuts (38 percent against 12 percent), and they generated revenue from sales that is five or six times larger, on average. However, among those households that sold any groundnuts at all, it is not clear from the figures (in Column 3) whether there is any difference in the revenue generated between the intervention and comparison households.

Table 5.9: Engagement in cultivation of groundnuts, and revenues obtained from sales

	1	2	3
	Proportion of households that cultivated groundnuts **%**	**Revenues from sales of groundnuts in the previous 12 months, across the whole sample** **Congolese francs**	**Revenues from sales of groundnuts in the previous 12 months, among households that made some sales[a]** **Logarithm of Congolese francs**
Intervention group mean:	38.4	30 085	10.493
Comparison group mean:	12.4	5 369	10.460
Difference:	26.0*** (3.8)	24 716*** (5 584)	0.032 (0.271)
Observations (intervention	281	281	70
Total observations:	650	650	106

[a] This analysis is carried out using a PSM model constructed specifically for the sub-sample of households that reported any sales of groundnuts.
Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions. All means are calculated *after* matching.

This result shows a considerable average increase in income from the sale of groundnuts and therefore indicates a positive impact of this intervention.

Table 5.10: Engagement in cultivation of beans, and revenues obtained from sales

	1	2	3
	Proportion of households that cultivated beans **%**	**Revenues from sales of beans in the previous 12 months, across the whole sample** **Congolese francs**	**Revenues from sales of beans in the previous 12 months, among households that made some sales[a]** **Logarithm of Congolese francs**
Intervention group mean:	16.0	3 114	9.902
Comparison group mean:	14.2	4 851	9.933
Difference:	1.8 (3.3)	-1 737 (2 084)	-0.031 (0.365)
Observations (intervention group):	281	281	24
Total observations:	650	650	51

[a] This analysis is carried out using a PSM model constructed specifically for the sub-sample of households that reported any sales of beans.
Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions. All means are calculated *after* matching.

Table 5.10 shows there is no evidence of a difference between the intervention and comparison households in the proportions farming beans, nor in the revenues obtained from their sales. It is likely that the production of beans has not been given particular attention in terms of encouraging the farmers to grow them.

5.9 TOTAL REVENUE FROM CROP SALES

The provision of agricultural inputs, capacity building through training, and the adoption of modern farming methods were just some of the activities performed to increase agricultural production in general.

In the course of the survey, respondents were asked whether or not they had farmed any of ten different crops in the previous 12 months. If they responded positively, they were then asked to estimate the total quantity of each crop produced and sold in the same period, and the revenue generated from those sales. The results for the average total revenues from sales of all crops are presented in Table 5.11.

In the first column of the table, we examine the revenue generated by sales of maize, rice, groundnuts and beans. Since we found in Section 5.9 that the intervention group had considerably greater sales than the comparison group of three of these four crops, it is not surprising that the sales of the four crops added together are also considerably higher among the intervention group. Specifically, the intervention group is estimated to have generated between two and four times the comparison group from sales of those four crop types. Column 2 of Table 5.11 shows the revenue from sales of the other six crop types mentioned in the questionnaire (that is, bananas, vegetables, cassava, sweet potatoes, mangoes, and potatoes). These data provide no evidence of a difference between the intervention and comparison groups in terms of revenue from these six crops: while estimates imply that the intervention group generated less revenue than the comparison group, the difference is not statistically significant.

Columns 3 and 4 of Table 5.11 compare the intervention and comparison groups in terms of the total revenue generated from sales of all ten crop types mentioned in the questionnaire. Column 3 shows the raw averages across the whole sample, while Column 4 shows the figures in logarithmic terms, restricted to those who reported having made some crop sales (89 percent of the households surveyed). This analysis does not provide any evidence that the total sales revenue differs significantly between the intervention and comparison groups.

It should be noted that there is a high level of uncertainty about each of the results presented in Table 5.11, as shown by the large standard errors of the estimated differences.

Table 5.11: Total crop revenues

	1	2	3	4
	Revenue from sales of maize, rice, groundnuts and beans in the previous 12 months, across the whole sample **Congolese francs**	**Revenue from sales of all crops *except* maize, rice, groundnuts and beans in the previous 12 months, across the whole sample** **Congolese francs**	**Total revenue from sales of all crops in the previous 12 months, across the whole sample** **Congolese francs**	**Total revenue from sales of all crops in the previous 12 months, among households that made any crop sales[a]** **Logarithm of Congolese francs**
Intervention group mean:	133 246	201 894	335 140	12.023
Comparison group mean:	45 536	247 831	293 367	11.979
Difference:	87 711*** (20 756)	-45 937 (48 904)	41 773 (58 220)	0.045 (0.115)
Observations (intervention group):	281	281	281	258
Total observations:	650	650	650	568

[a] This analysis is carried out using a PSM model constructed specifically for the sub-sample of households that reported any crop sales.
Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions. All means are calculated *after* matching.

5.10 OVERALL HOUSEHOLD INCOME

Measuring household income directly is problematic: self-reported measures of total income are generally regarded as unreliable, given the wide variety of endeavours such populations engage in to generate income. Most households were engaged in other livelihood activities, so a direct income measure would have had to collect detailed information about the contribution of each of these activities to household income.

For these reasons, the survey did not attempt to collect data on total household income directly. However, there is a widely recognized and strong association between household income and consumption. The Effectiveness Review therefore followed common practice in micro-level socio-economic analysis in considering household consumption and expenditure as an indicator of income.

To that end, respondents were asked to provide detailed information about their recent expenditure on both food and non-food items. Firstly, the respondents were asked from a list of 29 types of food, which had been consumed in their household over the previous seven-day period, and and in what quantities. The quantities of each food item consumed were then converted into a monetary value. This was done by asking the respondent how much was paid for the food item in question or, if the food item was from the household's own production, how much it would be worth if it was purchased from the local market. The respondents were also asked how much they spent on particular regular non-food items and services from a list of 18 items, such as fuel, toothpaste, and transport fares over the previous four weeks. Finally, they were asked to estimate the value of other occasional types of expenditure that they had

incurred over the previous 12 months from a list of 19 items, which included clothes, medical expenses and home repair.

The household expenditure measure was calculated by converting each of the expenditure types into a per-day per-capita figure and adding them together. This figure was then divided by a factor representing household size, to generate a per-day, per-person expenditure figure. As with the measures of agricultural sales, the expenditure variable has been expressed on a logarithmic scale to reduce the influence on the overall result of any households with extreme values for total consumption. The comparison of consumption per adult equivalent per day and total household consumption per adult equivalent per day between supported households and comparison households, after logarithmic transformation, is shown in Table 5.12.

It can be seen in the table that there is no evidence of a significant difference between the consumption of households of project participants and non-participants, either in terms of food consumption (Column 1) or food and non-food consumption added together (Column 2). It is worth noting that, in contrast to the data for agricultural sales, the consumption data allow more precise conclusions to be made. It seems safe to conclude, therefore, that the project has not had a major effect on the overall consumption (and, by implication, on the net income) of participant households.

Table 5.12: Household consumption

	1	**2**
	Food consumption per adult equivalent per day **(Logarithm of CF)**	**Total household consumption per adult equivalent per day** **(Logarithm of CF) – Global Indicator**
Intervention group mean:	6.774	7.127
Comparison group mean:	6.815	7.131
Difference:	-0.042 (0.062)	-0.004 (0.060)
Observations (intervention group):	281	281
Total observations:	650	650

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions. All means are calculated *after* matching.

We may question why the positive results for production and sales of crops (and on agricultural processing) have not resulted in increased household income. There could be several reasons for this. First the cost of production could have increased. Second, if the project participants were focusing more on farming four specific crops (as the project was encouraging them to do), then it is possible that they were investing less in other crops and/or in other livelihoods activities. Given that fishing is one of the main livelihood activities for farmers in this region, it is possible that they are now doing it less than they use to before the project. It is also possible that project participants are investing more in inputs for their farms, so that the increases in revenue do not translate fully into increases in profits.

In summary, the results of Table 5.12 imply that household consumption and total household consumption per adult equivalent per day were not significantly different in the two groups, but the positive average differences indicate that this project has the potential to increase household incomes in future.

5.11 HOUSEHOLD ASSET WEALTH

In this section, we explore the project's impact on households' wealth. During the course of the questionnaire, respondents were asked to provide information about their household's ownership of various assets (including livestock, productive equipment and household goods), as well as about the conditions of the family's house, both in 2011 and at the time of the survey. This information on asset ownership and housing conditions was used to generate an index of overall household wealth.

The wealth index was generated under the assumption that if each of the assets and housing characteristics constituted suitable indicators of household wealth, they should be correlated with each other. That is, a household that scores favourably on one particular wealth indicator should be more likely to do so for other wealth indicators. A small number of items that had low or negative correlations with the others were therefore not considered to be good wealth indicators and so were excluded from the index

A data reduction technique called principal component analysis (PCA) was used to produce two indices of overall wealth, one based on the recalled data from the end of 2011, and one based on the household's situation at the time of the survey. In particular, the wealth index is taken directly from the first principal component. PCA enables us to assign weights to the different assets, to capture as much information as possible from the data. Broadly, PCA assigns more weight to those assets that are *less* correlated with all the other assets, as these carry more information. By contrast, items with *more* intra-correlation are given less weight.

In order to ensure the same weights were applied to assets for both the recalled wealth index and the wealth index for the time of the survey, the two 'waves' of data were first pooled before undertaking the PCA procedure. This means changes in wealth can be more easily compared over time. It should also be noted that the wealth index for 2011 is the measure that has been used throughout this analysis to control for baseline differences in wealth status between intervention and comparison households.

For the analysis in this section, we started by 'normalizing' the wealth index. This means that the impacts of the project that we report can be directly understood as the *number* of standard deviations by which the project improved wealth. This means that results from this Effectiveness Review can be more easily compared to other similar evaluations.

In Table 5.13, we estimate the project's impact on wealth in two ways. In Column 1 we report wealth for the project and non-project households at the time of the survey, using the regular matching procedure that has been used throughout the other tables in this report. In Column 2, however, we take a slightly different approach. We calculate the differences between wealth at the time of the survey and at the start of 2012, and compare these differences between project and non-project households in the matched sample. For the results in Column 2, it is necessary to omit recalled wealth from the matching process.

Table 5.13: Wealth index

	1	2
	Normalized wealth index	**Difference in normalized wealth index**
Intervention group mean	0.311	0.129
Comparison group mean	0.010	-0.011
Difference:	0.301*** (0.095)	0.141** (0.056)
Observations (intervention group)	281	281
Total observations	650	650

Standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates are bootstrapped with 1,000 repetitions.

In both of the specifications reported in Columns 1 and 2, the project had sizeable and statistically significant positive effects on wealth. Wealth increased as a result of the project by between 0.08 and 0.39 standard deviations. This result is particularly striking because impacts on household wealth typically take a number of months or years after the project's end to feed through to the project participants, yet the fieldwork for this evaluation was carried out when the project had just ended. Nevertheless, given the consistency of the results between Columns 1 and 2, and similar results in the robustness checks in Appendix 3, we believe this finding is one of the more robust results in the report.

Based on this finding, it can be seen that, on average, project participants have experienced improvements in their wealth indicators since 2012.

There is an apparent contradiction in the results in that the measure that we normally think of as being most closely related to household income (i.e. consumption) does not clearly show a positive effect from the project, but a measure that we would normally expect to be less directly related to current income and to change only over the longer term (i.e. wealth indicators) seems to show an impact.

The reasons for these positive differences in wealth index are not clear-cut. However, outcomes that are proxy to wealth index may be responsible. Findings from this Effectiveness Review reveal that the project participants received increased revenues from maize, rice and groundnut sales. It is therefore possible that the participants used some of these revenues to acquire more household assets than the non-participants.

5.12 GROUP PARTICIPATION AND DECISION-MAKING BY WOMEN

The project also aimed to improve women's participation in group activities. In order to investigate this objective the questionnaire included a section with questions for a woman living in the household. These questions aimed to investigate household decision-making and group participation in meetings. The groups listed were:

- Women's associations
- Farmers' associations/groups
- Cooperatives
- Credit or microfinance groups

- Disaster management groups
- Social support groups.

Table 5.14 Column 1 provides estimates on the percentage of respondents who regularly attended meetings of any of the groups. On average, 89 percent of respondents in intervention areas reported regular attendance at group meetings, as opposed to only 34 percent in the comparison areas.

Table 5.14: Group participation

	1	2	3
	Regularly attends meetings of any of the groups %	**Number of groups women participate in**	**Number of groups women are involved in decision-making**
Intervention group mean:	88.9	3.8	1.5
Comparison group mean:	33.7	0.7	0.3
Difference:	55.2*** (5.2)	3.1*** (0.2)	1.2*** (0.2)
Observations (intervention group):	135	135	135
Total observations:	299	299	299

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates bootstrapped 1,000 repetitions

Estimates in Table 5.14 Column 2 suggest that, on average, women in the intervention group regularly attended meetings of almost four groups, compared with about one in the comparison group. Column 3 of the table shows that women in the intervention villages are also more likely than women in comparison villages to be involved in decision-making in any group.

The above results suggest that women's participation in groups has improved and women are now able to take part in decision-making in these groups. This is reinforced by data also collected in the survey on the groups in which women recalled participating in 2011, before the project's launch. While the intervention group reported participating in significantly more community groups than the comparison group even before the project, the change in the number of groups in which they participate has been much greater: intervention group women now participate in 1.4 more groups than before, whereas comparison group women participate in only 0.1 more groups than in 2011. This information may be particularly important for project design and planning, since women may take the lead in identifying project activities that they prioritize and those that have the potential of having positive impacts on their livelihoods.

5.13 GOVERNANCE

The final outcome of the project was to influence local and national governance towards pro-poor economic development. The project aimed especially at improving governance over district plans and more particularly at the community level. An example of a community plan could be the provision of clean water to the community members. The questionnaire explored outcomes of leader participation, inclusion of community development plans in government plans, and whether local government allocated budget and provided funds for the implementation of these community plans. The respondents were asked the following questions:

- Are you aware of community plans that have been taking place in your community in the last five years?
- Have you or any household member participated in any of these planning meetings in the last five years?
- Did the leaders of your community/association participate in these meetings in the last five years?
- Do you know who the leaders of your community/association are?

If respondents indicated that they were aware of community plans that had been implemented in the last five years, then they were asked to:

- State whether in the last five years, the community plan has ever been included in the local government plan.
- State if the local government allocated budget for this community plan in the last five years.
- State if, in the last five years, the local government provided funding relative to the proposed activities listed in the plan.

Significant proportions of respondents said that they did not know the answers to each of these questions. In the analysis in this section, ‘don’t know’ responses are treated as equivalent to ‘no’ responses.

Column 1 of Table 5.15 shows that a much larger proportion of the respondents from the intervention group than from the comparison group were aware of community plans. Column 2 of the table indicates that a majority of respondents in the intervention group also stated that leaders of their community or associations participate in meetings, as opposed to only a small minority (9 percent) of the comparison group.

The questionnaire also investigated whether community plans have ever been included in the local government plan and if the local government plan allocated budget for the community plan. Table 5.15 Column 3 shows that only 13 percent of the households in intervention areas reported the inclusion of community plans in government plan in the last four years – but this was significantly greater than the four percent of comparison respondents. Column 4 indicates that six percent of households in project areas reported that local government allocated a budget or provided funds for the community plans, compared with less than one percent in the comparison group.

Table 5.15: Municipal plans and budget

	1	2	3	4	5	6
	Aware of community plans %	**Did the leaders of your community/ association participate in meetings %**	**In the last 5 years has the community plan ever been included in the local government %**	**Did the local government allocate budget for this community plan or provide funding for the activities listed in the plan, in the last 5 years %**	**Do you know who the leaders of your community are?**	**Household member participated in any of the planning meetings in past 5 years**
Intervention group mean:	57.7	58.7	12.8	5.7	80.4	61.6
Comparison group mean:	15.6	9.0	3.6	0.5	23.7	11.8
Difference:	42.1*** (4.1)	49.8*** (3.8)	9.2*** (2.7)	5.2*** (1.4)	56.7*** (4.0)	49.7*** (4.0)
Observations intervention:	281	281	281	281	281	281
Total observations:	650	650	650	650	650	650

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates bootstrapped 1,000 repetitions

There is a significant difference between the two groups. However, it is not clear whether the activities of the project led to increased participation of community leaders or whether the project influenced the government to allocate budget to these community plans as indicated by the project participants. Focus Group Discussions (FGDs) and Most Significant Change (MSC) studies could be conducted to investigate these governance issues.

6 CONCLUSIONS

6.1 CONCLUSIONS

This Effectiveness Review has found evidence that the project has made a positive impact on some outcomes of the project in the theory of change in Equateur province of the Democratic Republic of Congo. There were large differences between project participants and non-participants in terms of their engagement in the cultivation of maize, rice and groundnuts, and in the revenues obtained from sales of those three crops. The intervention group is estimated to have generated between two and four times as much revenue from sales of those four crop types as the comparison group. However, it is not clear from our data whether the project had any effect on the total value of sales of all crop types.

Another key conclusion from this Effectiveness Review is that, on average, there was a 15 percentage point difference between the participant and non-participant households in the proportions reporting use of modern agricultural practices, such as integrated diversified farming systems or the use of weather forecasts for planning. Participant households, on average, adopted three agricultural practices compared with two for the non-participant households. Participant households also adopted the use of agricultural tools that were instrumental in the value chain from land preparation, planting and weeding, to harvesting and processing. On average, three agricultural technologies were adopted by project participants, compared with two technologies adopted by the comparison group. This can be explained by postulating that intervention areas were accessible to expertise and agricultural technologies from the FAO and CRAFOD together with extension staff from the Equateur Department of Agriculture, whereas the comparison group received technical assistance only from the extension staff.

On average, households in the project areas produced 3.1 crops in the year prior to the survey, compared with 2.5 for the comparison group. Part of this difference in crop diversity appears to be due to pre-existing differences between the intervention and comparison groups, but the project seems also to have had a significant effect in this respect. In addition, the number of products processed, on average, was approximately a third higher in intervention households than comparison households. There was also increased crop diversity in intervention areas.

There was increased access to markets by households in intervention areas. There was a 17 percentage point difference in the number of households in intervention areas selling to community associations, cooperatives, buying stations or the WFP, compared with the matched comparison group. There was also a 6.4 percentage point difference in the number of households in project areas selling to partners compared with households in non-project areas.

The Effectiveness Review also found increased participation of women in groups. Women in project areas participated in nearly four groups, on average, compared with less than one group for women in the comparison areas. The numbers of groups where participant-household women were involved in decision-making were, on average, higher than those in the non-project areas.

This analysis failed to identify evidence supporting an increase in overall household income in intervention households. Indicators of total household expenditures (Global Indicator for livelihoods) and daily per capita food consumption are not statistically different for intervention and comparison households.

Finally, there is strong evidence suggesting that, on average, the household wealth index of participant households has increased since 2012 compared with non-participants.

6.2 PROGRAMME LEARNING CONSIDERATIONS

Consider involving partners with different expertise in the value chain for maximum benefits.

There is evidence from this Effectiveness Review that farmers in project areas adopted more agricultural practices than the non-project participants. It is important to note that the partners involved in this project identified specific roles where they had a comparative advantage in terms of expertise and resource endowment. The capacity-building component was done by the Food and Agriculture Organization of the United Nations, together with staff from the Equateur province Department of Agriculture who had local knowledge of the area. It appears, therefore, that the roles of the partners were clearly defined. This strategy, where partners take up specific roles based on expertise and local knowledge, may be replicated in other contexts where similar projects are implemented.

Consider allocating more resources to the production of groundnuts in this community.

This Effectiveness Review shows a considerable average positive difference in income from the sale of groundnuts between the two groups and has therefore presented a positive impact of this intervention. This crop could be promoted on a large scale since it has the potential to change the fortunes of farmers in this region. It is the single most important crop where a substantial amount of funding should be channelled. The reasons are that groundnuts mature fast and are not normally affected by entomological and pathological agents and so the cost of production can be much lower. Secondly, and perhaps more importantly, this crop generates considerable revenue that may have the potential of increasing household incomes and getting communities out of poverty in the long run.

Consider partnering with the relevant government ministries, especially the Ministry of Roads, in order to open up the area for transportation of agricultural goods.

Transport is a major challenge in this community and opening the area by building roads requires huge capital outlay, which short-term projects cannot accomplish. Involvement and advocacy with the relevant government departments may reduce the burden on scarce resources being used for road construction instead of agricultural production, as was witnessed in this project. Infrastructural development is indeed a public sector function that projects may not efficiently and effectively engage in. Despite the efforts by the project to put some resources into road construction, it is evident from this Effectiveness Review that no significant difference was realized in terms of the reduction of transport costs between the two groups. Hence the need to consider formulating transportation strategies by developing a vibrant advocacy at the provincial and national level to establish adequate transport means to connect the producers, consumers and wholesalers in this region.

Consider building a strong monitoring system and Performance-Monitoring Plan (PMP) during programme design.

The programme team is encouraged to consider a monitoring system that collects real time data, which can be used for targeting, project implementation, reflection and shaping or informing implementation strategies and activities. The project team is also encouraged to develop a performance-monitoring plan containing all the key indicators of project performance. These indicators should be monitored on a quarterly basis to check for deviations against set targets and corrective measures taken whenever there are negative deviations.

APPENDIX 1: BASELINE STATISTICS BEFORE MATCHING

Table A1.1: Descriptive statistics: comparison between intervention and comparison households at baseline – variables used for matching

	Intervention mean	Comparison mean	Difference	Standard error
Household size	6.134	5.929	0.205	0.179
Household head is female	0.204	0.180	0.024	0.031
Age of household head (years)	43.761	44.728	-0.967	1.031
Household head completed primary education	0.641	0.651	-0.010	0.038
Household head completed secondary education	0.246	0.138	0.109***	0.030
Household was in the second wealth quintile in 2011	0.092	0.212	-0.120***	0.028
Household was in the third wealth quintile in 2011	0.151	0.212	-0.060**	0.030
Household was in the fourth wealth quintile in 2011	0.218	0.185	0.033	0.031
Household was in the highest wealth quintile in 2011	0.303	0.122	0.181***	0.031
Travelling time from the house to market in 2011 (minutes)	554.521	230.852	323.669***	80.674
Proportion of household members who are adults and able to work	0.567	0.562	0.005	0.018
Household's main livelihood activity in 2011 was farming	0.912	0.907	0.005	0.023
N	284	378	662	

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

APPENDIX 2: METHODOLOGY USED FOR PROPENSITY-SCORE MATCHING

The analysis of outcome variables presented in Section 5 of this report involved group mean comparisons using propensity-score matching (PSM). The basic principle of PSM is to match each participant with a non-participant that was observationally similar at baseline and to obtain the programme treatment effect by averaging the differences in outcomes across the two groups after project completion. Unsurprisingly, there are different approaches to matching, i.e. to determining whether or not a household is observationally 'similar' to another household. For an overview, we refer to Caliendo and Kopeinig (2008).

The following sections describe and test the specific matching procedure followed in this Effectiveness Review.

Estimating propensity scores

Given that it is extremely hard to find two individuals with exactly the same characteristics, Rosenbaum and Rubin (1983) demonstrate that it is possible to match individuals using a prior probability for an individual to be in the intervention group, naming this its *propensity score*. More specifically, propensity scores are obtained by pooling the units from both the intervention and comparison groups and using a statistical probability model (e.g. a *probit* regression) to estimate the probability of participating in the project, conditional on a set of observed characteristics.

Table A2.1 presents the probit regression results used to estimate the propensity scores in our context. To guarantee that none of the matching variables were affected by the intervention, we only considered variables measured at baseline, and only those variables that were unlikely to have been influenced by anticipation of project participation (Caliendo and Kopeinig, 2008).

Table A2.1: Estimating the propensity score on variables used for matching

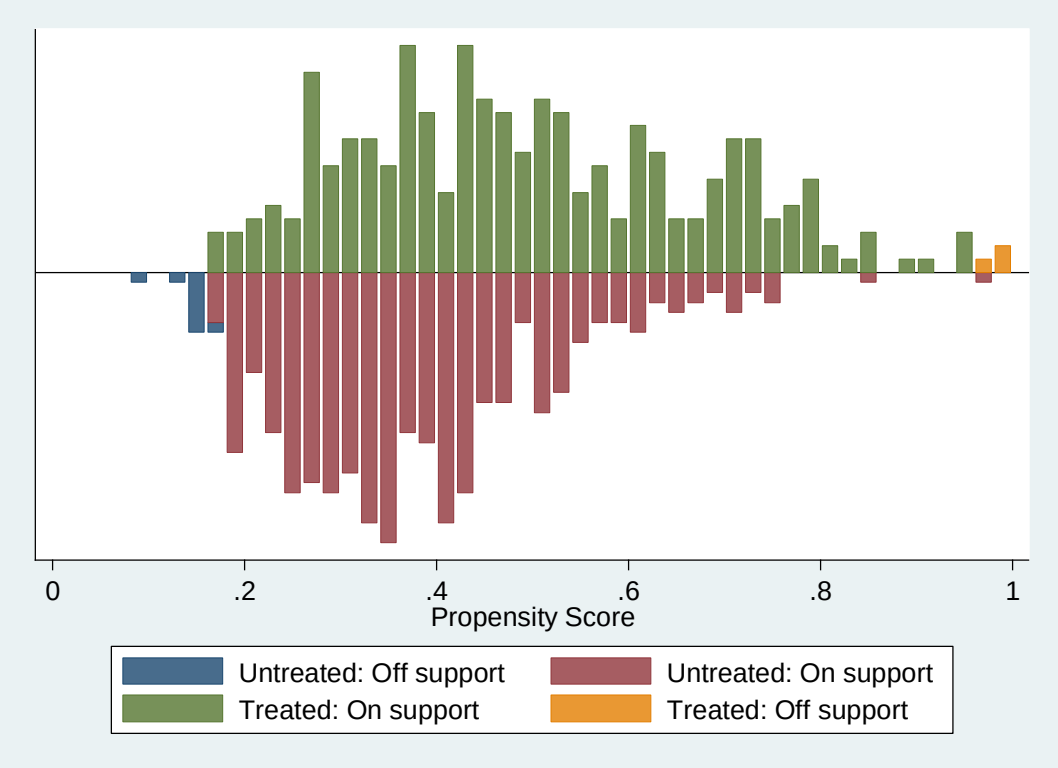
	Coefficient	Standard error	P > |z|
Household size	0.007	0.026	0.791
HH head is female	0.092	0.136	0.499
Age of household head (years)	-0.010	0.004	0.023
HH head completed primary education	-0.319	0.124	0.010
HH head completed secondary education	0.459	0.143	0.001
HH was in second wealth quintile in 2011	-0.292	0.171	0.087
HH was in third wealth quintile in 2011	-0.010	0.161	0.953
HH was in fourth wealth quintile in 2011	0.272	0.159	0.087
HH was in highest wealth quintile in 2011	0.727	0.168	0.000
Travelling time from the house to market in 2011 (minutes)	0.000	0.000	0.000
Proportion of HH members who are adults and able to work	0.264	0.244	0.280
Household's main livelihood activity in 2011 was farming	0.092	0.182	0.613

Defining the region of common support

After estimating the propensity scores, the presence of a good *common support area* needs to be checked. The area of common support is the region where the propensity-score distributions of the treatment and comparison groups overlap. The common support assumption ensures that 'treatment observations have a comparison observation "nearby" in the propensity-score distribution' (Heckman, LaLonde and Smith, 1999). Since some significant differences were found between the intervention and comparison groups in terms of the baseline and demographic characteristics (as detailed in Section 4.2), some of the households in the intervention group are too different from the comparison group to allow for meaningful comparison. We developed a minima and maxima comparison, deleting all observations whose propensity score was smaller than the minimum and larger than the maximum in the opposite group (Caliendo and Kopeinig, 2008). In this particular case, nine of the 378 households surveyed in the comparison villages and three of the 284 households surveyed in the intervention villages were dropped because they lay outside the common support area. The estimates of differences in outcomes between the various treatment groups only apply to those intervention households that were not dropped; that is, they do not represent the surveyed population as a whole.

Figure A2.1 illustrates the area of common support and indicates the proportion of households lying on and off the common support area, by treatment group.

Figure A2.1: Propensity score on and off common support



Matching intervention households to comparison households

Following Rosenbaum and Rubin (1983), after estimating the propensity scores and defining the area of common support, individuals are matched on the basis of their propensity score. The literature has developed a variety of matching procedures. For the main results presented in this Effectiveness Review we chose to employ the method of kernel matching (note that we use alternative matching procedures as a means of robustness checks in Appendix 3). The kernel

matching method weights the contribution of each comparison group member, attaching greater weight to those comparison observations that provide a better match with the treatment observations. One common approach is to use the normal distribution with mean zero as a kernel, and weights given by the distribution of the differences in propensity score. Thus 'good' matches get a larger weight than 'poor' matches.

We used the *psmatch2* module in STATA using 0.07 as a bandwidth and restricted the analysis on the area of common support. When using PSM, standard errors of the estimates were bootstrapped using 1,000 repetitions to account for the additional variation caused by the estimation of the propensity scores and the determination of the common support.[2]

Check balancing

For PSM to be valid, the intervention group and the matched comparison group need to be balanced in that they need to be similar in terms of their observed baseline characteristics. This should be checked. The most straightforward method to do this is to test whether there are any statistically significant differences in baseline covariates between the intervention and comparison groups in the matched sample. The balance of each of the matching variables after kernel matching is shown in Table A2.2. None of the variables implemented for the matching is statistically significant once the matched sample is used.

Table A2.2: Balancing test on the set of covariates used for matching

Treatment assignment	**Psmatch2 Common Support**		
	Off Support	**On Support**	**Total**
Untreated	9	369	378
Treated	3	281	284
Total	**12**	**650**	**662**

Covariates	**Unmatched Matched**	**Mean**		**% bias**	**% reduction bias**	**P-value**
		Treated	**Control**			
Household size	**U**	6.121	5.9322	8.2		0.299
	M	6.121	6.0938	1.2	85.6	0.889
Hhh_female	**U**	0.20641	0.18157	6.3		0.427
	M	0.20641	0.20746	-0.3	95.8	0.975
Age of household head (years)	**U**	43.747	44.415	-5.1		0.519
	M	43.747	43.393	2.7	46.9	0.744
Household head completed primary education	**U**	0.63701	0.64228	-1.1		0.89
	M	0.63701	0.63248	0.9	14	0.911
Household head completed secondary education	**U**	0.24199	0.14092	25.9		0.001
	M	0.24199	0.25712	-3.9	85	0.679
Household was in the second wealth quintile in 2011	**U**	0.09253	0.19512	-29.5		0

	M	0.09253	0.09596	-1	96.6	0.889
Household was in the third wealth quintile in 2011	**U**	0.15302	0.21409	-15.8		0.048
	M	0.15302	0.16087	-2	87.2	0.799
Household was in the fourth wealth quintile in 2011	**U**	0.21708	0.1897	6.8		0.389
	M	0.21708	0.19843	4.6	31.9	0.587
Household was in the highest wealth quintile in 2011	**U**	0.30249	0.12466	44.4		0
	M	0.30249	0.30619	-0.9	97.9	0.924
Travelling time from the house to market in 2011 (minutes)	**U**	451.34	233.74	33.1		0
	M	451.34	398.82	8	75.9	0.485
Proportion of household members who are adults and able to work	**U**	0.56802	0.56481	1.4		0.864
	M	0.56802	0.5637	1.8	-34.8	0.827
Household's main livelihood activity in 2011 was farming	**U**	0.91103	0.90786	1.1		0.889
	M	0.91103	0.92118	-3.5	-220	0.665
Observations		**281**	**369**			

Sample	**Ps R^2**	**LR-chi2**	**p>Chi2**	**Mean bias**	**Median bias**	**B**	**R**	**%concern**	**%bad**
Unmatched	0.081	71.600	0.000	14.9	7.5	68.1*	1.76	33	8
Matched	0.002	1.510	1.000	2.6	1.9	10.3	1.31	8	0

*** If B>25%, R outside (0.5; 2)**

APPENDIX 3: ROBUSTNESS CHECKS

In order to assess the robustness of the results presented in Section 5, a series of checks were carried out to determine whether the main findings of this report are sensitive to the estimation procedure – propensity-score matching with the kernel method – that was used to control for observable differences between the intervention and comparison groups. This appendix presents four types of robustness checks.

1. Multivariate regression (on the area of common support)

The first robustness test we ran was to estimate the impact of project participation using an ordinary least squares (OLS) regression. The main idea behind OLS is to isolate the variation in the outcome variable that is due to the intervention status – the project's impact – by controlling directly for the influence that observable differences between the intervention and comparison groups have on outcomes. To do this, we estimate:[3]

$$Y_i = \alpha + \beta_1 \tau_i + \boldsymbol{X_i'\delta} + \varepsilon_i$$

where Y_i is the dependent variable (the outcome) and $\boldsymbol{X_i}$ is a column vector of the same matching variables listed in Tables A3.1 or A3.2. The intervention status is given by a dummy variable (τ_i), which takes the value one if the household participated in the project and zero otherwise. This estimation is carried out on the area of common support identified through the procedure described in Appendix 3. The key difference between this OLS regression model and the propensity-score matching procedure used in the main report is that the OLS regression estimates a direct parametric relationship between the covariates in $\boldsymbol{X_i}$ and the dependent variable Y_i.

It is also important to note that, as with the PSM methods used in the main body of the report, OLS regressions can only account for observable differences between the intervention and comparison groups. Unobservable differences may still bias the results. In the tables that follow, only the estimate of $\beta_1$will be reported.

2. Multivariate regression on the whole sample

One feature of estimation through OLS is that it is possible to include the observations that were excluded due to being off common support in Section 5 by extrapolating the relationship between $\boldsymbol{X_i}$ and Yi . It should be borne in mind, however, that extrapolating in this way may bias the results if the covariates are distributed very differently between the intervention and comparison group.

3. Propensity-score weighting

Following the example of Hirano and Imbens (2001) we also estimate OLS regressions, using exactly the same model as in Equation 1, but weighting the observations according to the propensity score. Observations are assigned weights equal to one for the intervention households and $\hat{P}(\boldsymbol{X_i})/(1-\hat{P}(\boldsymbol{X_i}))$ for the comparison households. The variable $\hat{P}(\boldsymbol{X_i})$ represents the probability of a household being in the intervention group, given their observable characteristics, measured through the vector of matching variables $\boldsymbol{X_i}$ – this was estimated in the probit regressions in Appendix 3. We report the estimates of β_1 in the same way as the regular OLS regressions.

4. Nearest-neighbour matching

The nearest-neighbour (NN) matching algorithm matches each observation from the intervention group with an observation from the comparison group that is closest in terms of their propensity score.[4] In this robustness check, we apply the NN method 'with replacement', meaning that comparison observations can be matched to intervention observations more than once. In the tables below, we report the estimated differences between the intervention and comparison group.

The tables of robustness checks in the following pages correspond to the tables of results in Section 5 of this report.

Table A3.1: Forms of support received by households since 2003

	1	2	3	4	5	6	7	8
	Household received maize, rice and ground-nut seeds for planting %	**Household received bicycle(s) %**	**Household received wheel-barrows %**	**Household received technical assistance on farming techniques %**	**Household received market information on prices %**	**Household received support in obtaining credit %**	**Household received empty sacs %**	**Household received agricultural tools and equipment %**
OLS regression (common support)	70.0***	11.3***	10.4***	64.7***	63.9***	42.7***	70.2***	67.5***
	(3.0)	(2.3)	(2.1)	(3.1)	(3.1)	(3.2)	(2.9)	(3.0)
N	650	650	650	650	650	650	650	650
OLS regression (whole sample)	69.6***	11.7***	10.9***	63.7***	63.1***	41.9***	69.9***	66.5***
	(3.0)	(2.3)	(2.1)	(3.1)	(3.1)	(3.2)	(2.9)	(3.0)
N	662	662	662	662	662	662	662	662
OLS with propensity-score weighting	69.3***	14.0***	13.2***	64.8***	62.4***	40.9***	71.1***	65.5***
	(3.1)	(2.4)	(2.2)	(2.9)	(2.9)	(3.0)	(2.7)	(2.9)
N	650	650	650	650	650	650	650	650
PSM nearest neighbour	70.5***	12.1***	11.0***	64.8***	60.9***	40.6***	69.4***	66.9***
	(4.3)	(2.9)	(2.5)	(3.5)	(3.2)	(3.2)	(3.0)	(2.9)
N	650	650	650	650	650	650	650	650

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.2: Training received and practices adopted

	1	2	3	4
	Attended training in previous 4 years %	**Number of times participants attended training**	**Use of modern agricultural practices (Any of the practices)** %	**Number of agricultural practices adopted**
OLS regression (common support)	69.9***	14.3***	17.1***	1.5***
	(2.8)	(0.8)	(2.8)	(0.1)
N	650	650	650	650
OLS regression (whole sample)	69.2***	14.1***	17.1***	1.4***
	(2.8)	(0.8)	(2.8)	(0.1)
N	662	662	662	662
OLS with propensity-score weighting	67.7***	14.0***	15.6***	1.4***
	(3.2)	(0.8)	(2.8)	(0.1)
N	650	650	650	650
PSM nearest neighbour	68.3***	14.1***	15.3***	1.5***
	(5.0)	(0.8)	(4.3)	(0.2)
N	650	650	650	650

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.3: Processing agricultural products

	1	2
	Households processing at least one product %	**Number of products processed**
OLS regression (common support)	9.5***	0.43***
	(2.6)	(0.09)
N	650	650
OLS regression (whole sample)	9.1***	0.43***
	(2.6)	(0.09)
N	662	662
OLS with propensity-score weighting	8.8***	0.42***
	(2.9)	(0.10)
N	650	650
PSM nearest neighbour	11.0**	0.46***
	(4.5)	(0.15)
N	650	650

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.4: Transport costs and access to markets

	1	2	3
	Transport costs ***(% of reported total value of crops sold, among households that made any crop sales)***	**Selling to community associations, cooperatives, buying stations or WFP** **%**	**Selling to local traders or middlemen** **%**
OLS regression (common support)	2.8	14.7***	10.6***
	(4.7)	(3.0)	(4.0)
N	568	650	650
OLS regression (whole sample)	2.8	14.7***	10.8***
	(4.7)	(3.0)	(4.0)
N	589	662	662
OLS with propensity-score weighting	2.8	16.3***	10.0**
	(4.1)	(2.9)	(4.2)
N	578	650	650
PSM nearest neighbour	0.6	13.9***	7.8
	(5.2)	(3.6)	(5.5)
N	578	650	650

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.5: Access to technology

	1	2
	Number of agricultural technologies accessed and used by farmers during the previous 12 months	**Proportion of farmers who accessed and used at least one technology during the previous 12 months** **%**
OLS regression (common support)	1.7***	13.5***
	(0.1)	(2.6)
N	650	650
OLS regression (whole sample)	1.7***	13.7***
	(0.1)	(2.6)
N	662	662
OLS with propensity-score weighting	1.8***	13.6***
	(0.1)	(2.8)
N	650	650
PSM nearest neighbour	2.0***	16.7***
	(0.2)	(4.3)
N	650	650

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.6: Number of crops produced

	1	2
	Number of crops produced during the previous 12 months	**Number of crops produced in 2011**
OLS regression (common support)	0.58***	0.28**
	(0.12)	(0.12)
N	650	650
OLS regression (whole sample)	0.60***	0.31**
	(0.12)	(0.12)
N	662	662
OLS with propensity-score weighting	0.63***	0.33**
	(0.13)	(0.13)
N	650	650
PSM nearest neighbour	0.69***	0.55***
	(0.19)	(0.18)
N	650	650

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.7: Engagement in cultivation of maize, and revenues obtained from its sale

	1	2	3
	Proportion of households that cultivated maize in the previous 12 months %	**Revenues from maize sales in the previous 12 months, across the whole sample** **Congolese francs**	**Revenues from maize sales in the previous 12 months, among households that made some sales** **Logarithm of Congolese francs**
OLS regression (common support)	7.1*	35 732*	0.234*
	(4.1)	(18 529)	(0.136)
N	650	650	290
OLS regression (whole sample)	7.3*	35 840*	0.222
	(4.1)	(18 576)	(0.136)
N	662	662	297
OLS with propensity-score weighting	8.6**	39 782***	0.316**
	(4.2)	(15 276)	(0.136)
N	650	650	290
PSM nearest neighbour	10.0*	49 627***	0.422**
	(5.8)	(17 087)	(0.192)
N	650	650	290

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.8: Engagement in cultivation of rice, and revenues obtained from its sale

	1	2
	Proportion of households that cultivated rice in the previous 12 months %	**Revenues from rice sales in the previous 12 months, across the whole sample** **Congolese francs**
OLS regression (common support)	9.1***	15 355**
	(2.0)	(6 942)
N	650	650
OLS regression (whole sample)	9.1***	16 202**
	(2.0)	(7 097)
N	662	662
OLS with propensity-score weighting	10.2***	22 426**
	(2.4)	(8 725)
N	650	650
PSM nearest neighbour	11.4***	26 192***
	(2.7)	(8 496)
N	650	650

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.9: Engagement in cultivation of groundnuts, and revenues obtained from their sale

	1	2	3
	Proportion of households that cultivated groundnuts in the previous 12 months %	**Revenues from sales of groundnuts in the previous 12 months, across the whole sample** **Congolese francs**	**Revenues from sales of groundnuts in the previous 12 months, among households that made some sales** **Logarithm of Congolese francs**
OLS regression (common support)	23.8***	19 085***	-0.015
	(3.5)	(4 035)	(0.250)
N	650	650	106
OLS regression (whole sample)	24.0***	18 934***	0.023
	(3.5)	(3 936)	(0.250)
N	662	662	135
OLS with propensity-score weighting	25.7***	23 792***	-0.082
	(3.6)	(5 486)	(0.277)
N	650	650	106
PSM nearest neighbour	24.6***	21 755***	0.027
	(4.6)	(6 594)	(0.277)
N	650	650	106

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.10: Engagement in cultivation of beans, and revenues obtained from its sale

	1	2	3
	Proportion of households that cultivated beans in the previous 12 months %	**Revenues from sales of beans in the previous 12 months, across the whole sample** **Congolese francs**	**Revenues from sales of beans in the previous 12 months, among households that made some sales** **Logarithm of Congolese francs**
OLS regression (common support)	2.4	-988	-0.022
	(3.0)	(1 192)	(0.311)
N	650	650	51
OLS regression (whole sample)	2.3	-1 019	-0.073
	(3.0)	(1 182)	(0.317)
N	662	662	69
OLS with propensity-score weighting	1.7	-1 281	-0.011
	(3.1)	(1 599)	(0.286)
N	650	650	51
PSM nearest neighbour	2.5	-372	-0.102
	(4.3)	(2 895)	(0.445)
N	650	650	51

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.11: Revenue from crop sales

	1	2	3	4
	Revenue from sales of maize, rice, groundnuts and beans in the previous 12 months, across the whole sample **Congolese francs**	**Revenue from sales of all crops except maize, rice, groundnuts and beans in the previous 12 months, across the whole sample** **Congolese francs**	**Total revenue from sales of all crops in the previous 12 months, across the whole sample** **Congolese francs**	**Total revenue from sales of all crops in the previous 12 months, among households that made any crop sales** **Logarithm of Congolese francs**
OLS regression (common support)	69 183***	-49 101	20 082	0.033
	(20 337)	(31 017)	(39 585)	(0.103)
N	650	650	650	568
OLS regression (whole sample)	69 957***	-47 798	22 159	0.036
	(20 424)	(31 299)	(39 919)	(0.102)
N	662	662	662	589
OLS with propensity-score weighting	84 719***	-33 328	51 391	0.072
	(19 199)	(42 213)	(50 058)	(0.105)
N	650	650	650	568
PSM nearest neighbour	97 202***	14 087	111 289	0.108
	(20 810)	(66 315)	(72 102)	(0.126)
N	650	650	650	568

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.12: Total household consumption

	1	2
	Food consumption per adult equivalent per day (Logarithm of CF)	**Total household consumption per adult equivalent per day (Logarithm of CF) – Global Indicator**
OLS regression (common support)	-0.036	-0.002
	(0.056)	(0.052)
N	650	650
OLS regression (whole sample)	-0.039	-0.008
	(0.056)	(0.053)
N	662	662
OLS with propensity-score weighting	-0.038	0.003
	(0.054)	(0.051)
N	650	650
PSM nearest neighbour	0.013	0.011
	(0.078)	(0.075)
N	650	650

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.13: Wealth index

	1	2
	Normalized wealth index	**Difference in normalized wealth index**
OLS regression (common support)	0.209***	0.123***
	(0.064)	(0.040)
N	650	650
OLS regression (whole sample)	0.210***	0.124***
	(0.065)	(0.040)
N	662	662
OLS with propensity-score weighting	0.280***	0.146***
	(0.082)	(0.051)
N	650	650
PSM nearest neighbour	0.339***	0.130*
	(0.106)	(0.068)
N	650	650

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.14: Women's participation in community groups

	1	2	3
	Regularly attends meetings of any of the groups %	**Number of groups women participate in**	**Number of groups women are involved in decision-making**
OLS regression (common support)	56.6***	3.2***	1.3***
	(4.8)	(0.2)	(0.2)
N	299	299	299
OLS regression (whole sample)	30.2***	3.1***	1.2***
	(3.7)	(0.2)	(0.2)
N	662	315	315
OLS with propensity-score weighting	53.1***	3.0***	1.2***
	(5.2)	(0.2)	(0.2)
N	299	299	299
PSM nearest neighbour	50.4***	3.0***	1.3***
	(6.8)	(0.2)	(0.2)
N	299	299	299

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

Table A3.15: Municipal plans and budget

	1	**2**	**3**	**4**
	Aware of community plans %	**Did the leaders of your community/association participate in meetings? %**	**In the last 5 years has the community plan ever been included in the local government? %**	**Did the local government allocate budget for this community plan or provide funding for the activities listed in the plan, in the last 5 years? %**
OLS regression (common support)	42.1***	50.6***	10.3***	5.1***
	(3.7)	(3.5)	(2.3)	(1.5)
N	650	650	650	650
OLS regression (whole sample)	42.0***	50.2***	10.3***	5.1***
	(3.7)	(3.5)	(2.3)	(1.5)
N	662	662	662	662
OLS with propensity-score weighting	42.6***	50.1***	9.4***	5.2***
	(3.8)	(3.5)	(2.4)	(1.4)
N	650	650	650	650
PSM nearest neighbour	47.3***	53.0***	10.3***	5.3***
	(4.9)	(4.3)	(3.0)	(1.5)
N	650	650	650	650

Robust standard errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01; PSM estimates bootstrapped with 1,000 repetitions

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NOTES

1 A mature project has been running for long enough – typically at least 2.5 years – to have a reasonable expectation of impact, with either an expenditure rate of at least 70% or completion of most project activities.

2 Bootstrapping is a statistical procedure where repeated samples are drawn from the original sample and parameters, such as standard errors, are re-estimated for each draw. The bootstrapped parameter is calculated as the average estimate over the total number of repeated draws.

3 It should be noted that, for all these regression techniques, we report robust standard errors. However, the standard errors are not bootstrapped as in the main results in Section 5.

4 Choosing whether to match with and without replacement involves a trade-off between bias and variance. If we allow replacement, the average quality of matching will increase and the bias will decrease, especially when the distribution of the propensity score is very different in the intervention and comparison groups. However, allowing for replacement increases the variance of the estimates because, in effect, the number of distinct comparison observations is reduced (Caliendo and Kopeinig, 2008).

For more information, or to comment on this report, email policyandpractice@oxfam.org.uk

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Oxfam GB, Oxfam House, John Smith Drive, Cowley, Oxford, OX4 2JY, UK.

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