Food Security and Livelihoods Support among Fishers and Fish Processors in Kasenyi and Tchomia
Project Effectiveness Review – *Full Technical Report*

Livelihoods Support

Oxfam GB
Livelihoods Support Global Outcome Indicator

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Photo: Jane Beesley/Oxfam

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Executive Summary

Under Oxfam Great Britain's (OGB) Global Performance Framework (GPF), mature projects are being selected at random each year to undergo a rigorous assessment of their effectiveness. In the 2011/12 financial year, the food security and livelihoods project (DRCB12) was selected for evaluation against OGB's global indicator for livelihoods support:

- **Proportion of supported producers demonstrating greater income, as measured by per capita daily expenditure.**

During the effectiveness review's data collection phase, the area where the project is currently being implemented was inaccessible for security reasons. Consequently, the effectiveness review was only carried out in the area of Kasenyi and Tchomia, where this project was implemented from December 2008 to November 2009. During these 12 months, the project supported producers in three value chains, with interventions including capacity building, distributions of inputs and equipment, and the construction of productive infrastructure. The effectiveness review focused specifically on the fishing value chain, and it sought to assess whether any sustained impact was derived from these activities. The project's participants were divided into two distinct groups: the fishers themselves (who are all male) and women who were engaged in the processing and marketing of fish.

In March and April 2012, a team of enumerators administered a household survey to 164 male fishers and 230 female fish processors in the area of Kasenyi and Tchomia. The respondents included a random sample of the project participants, as well as comparable non-participants selected from communities where the project was not implemented. The survey was designed to capture data relating to Oxfam's global indicator for livelihoods – *the percentage of supported households demonstrating greater income, as measured by consumption expenditure per capita* – as well as on household food security status, asset wealth, and current fishing and fish processing activities. At the analysis stage, the statistical tools of propensity-score matching and multivariable regression were used to control for measured differences between the intervention and comparison respondents. It is important to note that only around 40 per cent of the fish processors supported in 2008/09 could be identified and located in the communities at the time of the survey; most of the rest were reported to have since left the area. The findings of this effectiveness review apply only to the fish processors who have remained in the area since that time.

The results provide no indication of any sustained effect on the quantity or quality (as measured by price) of the fish being sold by either the fishers or the processors. Among the fish processors, there is also no indication of any positive effect on household income as a whole or on any other measures of household wellbeing such as food security or asset wealth. However, for the fishers, the data do provide some evidence of sustained higher income and increased asset wealth among those who were supported by the project. These results are corroborated by several self-reported measures of household income which were collected during the survey. It appears from these results, therefore, that the project activities of 2008/09 have enabled fishing households to realise some sustained improvements in wellbeing. Unfortunately, however, the same does not apply to the households of fish processors.

Considerations to enable the programme team to learn from this effectiveness review include:

- Ensure that project activities are implemented with sufficient intensity, as well as on a long-enough time-frame, to achieve lasting impact.
- Further investigate the dynamics of change observed among the fishers, to understand how the lack of impact on the level of fishing activities is consistent with the observed increase in household expenditure and asset wealth.

1 Introduction and Purpose

This report documents the findings of the project effectiveness review, focusing on outcomes related to livelihoods support.

Oxfam GB has developed a Global Performance Framework (GPF) as part of its effort to better understand and communicate its effectiveness and enhance learning across the organisation. This framework requires programme/project teams to annually report generic output data across six thematic indicator areas. In addition, modest samples of sufficiently mature projects (e.g. those closing during a given financial year) associated with each thematic indicator area are being randomly selected each year and rigorously evaluated. One key focus is on the extent they have promoted change in relation to relevant OGB global outcome indicators.

The following global outcome indicator was endorsed for the livelihoods support thematic area:

- **Percentage of supported households demonstrating greater income, as measured by daily consumption and expenditure per capita.**

The conceptual underpinnings of this indicator are presented in Section 5 below. The work that took place in the area of Kasenyi and Tchomia, in the Orientale Province of the Democratic Republic of Congo, in March and April 2012 was part of an effort to assess progress against this indicator.

This report presents the effectiveness review's findings. Section 2 provides brief background information on the project and the context in which it was implemented, while Section 3 explains the project's intervention logic. Section 4, Section 5, and Section 6 follow by presenting outcome measures investigated, the impact evaluation design being pursued, and the methods of data collection and analysis, respectively. Section 7 then follows by presenting the results of the effectiveness review , with subsections including those related to basic descriptive statistics, intervention exposure, and finally the differences between the targeted fishers and processors and those selected as comparators on the abovementioned outcome measures. Section 8 concludes.

2 The Project: Food Security and Livelihoods Support in Kasenyi and Tchomia

Oxfam GB's project to improve food security and enhance livelihoods in the area of Kasenyi and Tchomia in Orientale Province (DRCB12) was implemented in 2008–09 by Oxfam GB, in partnership with local staff from the Provincial Inspectorate for Agriculture, Fisheries and Livestock (IPAPEL).

Oxfam GB began working in Kasenyi and Tchomia in 2003, when the area was subjected to large movements of people who had been displaced by the Congo civil war and the Ituri conflict. From 2003 to 2008, Oxfam's work focused on water and sanitation, with dozens of wells being constructed. The project DRCB12 was launched in November 2008 with support from the United Nations DRC Pooled Fund, to improve the food security situation and provide livelihoods support to vulnerable people in the area, largely displaced people and returnees. Under this project, material support and capacity building was provided to producers in three value chains: livestock, fisheries (including both fishers and fish processors), and vegetable farming. A total of 1,916 producers received support from the project, of whom the largest group (1,063 women) were engaged in the processing and marketing of fish.

The project activities implemented in 2008/09 supported producers in three value chains: livestock, fishing, and vegetable farming.

The specific activities of the project varied across the different value chains. The livestock intervention targeted 328 members of three "PRODELs" (groups of people engaged in animal rearing), which were established in the region under a World Bank initiative some years before. The project activities included an animal vaccination campaign, distribution of drugs for treatment of animal disease, construction of three wells, and delimitation and fencing of some breeding grounds. Fishers at three fishing settlements on the lake shore were organised into six groups of 25 members each, who received fishing equipment and technical support. In the same areas, 1063 women, who were engaged in the drying, smoking and marketing of fish, were organised into 21 associations. The project also constructed two "semi-modern" furnaces for smoking fish at each of the three settlements, which were managed by these associations. The members also received training and relevant productive inputs (knives, brushes, plastic basins and salt for drying fish). Finally, the project provided seeds, tools and technical support to 375 farmers to initiate vegetable production in the area; the area was historically known for vegetable production, but the delivery of this activity ceased with the coming of conflict.

After the first 12 months of activities, funding was not available to continue implementing this project in the Kasenyi/Tchomia area. Instead, the food security and livelihoods work was transferred to the Geti area, where it continues to date, still under project DRCB12. The activities carried out in the Kasenyi/Tchomia area are often referred to by the project staff as a pilot for the subsequent activities in the Geti area. Oxfam GB returned to Kasenyi/Tchomia in December 2011 to respond to an outbreak of cholera in the area: this work was continuing at the time of data collection.

Unfortunately, during project effectiveness review, the Geti area was inaccessible due to insecurity. A decision was therefore taken to return to the Kasenyi/Tchomia area to evaluate the impact of the project activities carried out there in 2008–09. It was expected that this would provide valuable learning on the sustainability of this type of programming.

3 Intervention logic of the support provided

Figure 3.1 illustrates a simple 'theory of change' for how the project's main activities were intended to lead to increased food security and reduced household poverty. Most of the project's key activities were intended to increase the efficiency of the production process, improve product quality, or, in some cases (such as the furnaces for smoking fish), both. Whichever effect is intended, success entails bringing greater net income to the household: this may be a result of increased income from the value-chain product itself or it may be that production efficiencies free up time and/or capital for the producer to engage in other productive activities. Greater net income should lead naturally to improvements in food security and (if sustained) to a reduction in household poverty.

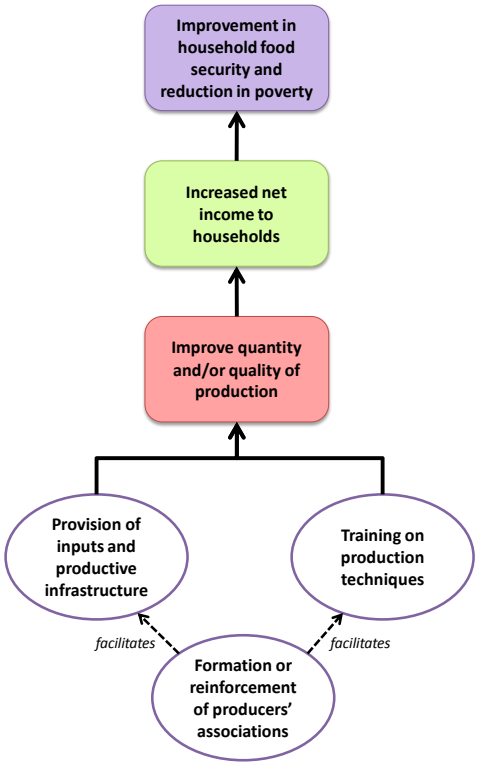
The project involved establishing producer groups and associations to facilitate the implementation of the project activities.

The formation and reinforcement of the producers' groups and associations was undertaken largely in order to facilitate delivery of other project activities. For example, the training and technical support was provided through these groups. The associations were also given the role of managing the productive infrastructure provided under the project, i.e. the furnaces and the wells.

It should be noted also that the project provided training to the participants on themes other than production of the value-chain products, including HIV/AIDS awareness, gender, and protection. The effectiveness of these particular interventions were not assessed under this effectiveness review.

Figure 3.1

Intervention logic



4 Impact Assessment Design

4.1 Limitations in Pursuing the Gold Standard

The core challenge of a social impact evaluation is to credibly estimate the net effect of an intervention or programme on its participants. An intervention's net effect is typically defined as the average gain participants realise in outcome (e.g. income) from their participation. In other words:

Impact = average post-programme outcome of participants – what the average post-programme outcome of these same participants would have been had they never participated

The aim of the review was to estimate the difference that the project made to the supported households.

This formula seems straightforward enough. However, *directly* obtaining data on the latter part of the equation – commonly referred to as the counterfactual – is logically impossible. This is because a person, household, community, etc. cannot *simultaneously* both participate and not participate in a programme. The counterfactual state of a programme's participants can therefore never be observed directly; it can only be estimated.

The randomised experiment is regarded by many as the most credible way of estimating the counterfactual, particularly when the number of units (e.g. people, households, or, in some cases, communities) that are being targeted is large. The random assignment of a sufficiently large number of such units to intervention and control groups should ensure that the statistical attributes of the two resulting groups are similar in terms of a) their pre-programme outcomes (e.g. both groups have the same average incomes); and b) their observed characteristics (e.g. education levels) and unobserved characteristics (e.g. motivation) that affect the outcome variables of interest. In other words, randomisation works to ensure that the *potential outcomes* of both groups are the same. As a result – provided that threats such as differential attrition and intervention spill-over are minimal – any observed outcome differences observed at follow-up between the groups can be attributed to the programme.

However, implementing an ideal evaluation design like this is only possible if it is integrated into the project 's design from the start, since it requires the introduction of some random element that influences participation. To evaluate an ongoing or completed programme – as in this project effectiveness review – or one where randomisation is judged to be impractical, it is therefore necessary to apply alternative techniques to estimate the counterfactual as rigorously as possible.

4.2 Alternative Evaluation Design Pursued

There are several evaluation designs when the comparison group is non-equivalent that can – particularly when certain assumptions are made – identify reasonably precise intervention effect estimates. One solution is offered by matching: find units in an external comparison group that possess the same characteristics, e.g. ethnicity, age, and sex, as those of the intervention group and match them on these characteristics. If matching is done properly, the observed characteristics of the matched comparison group will be identical to those of the intervention group. The problem, however, with conventional matching methods is that with large numbers of characteristics on which to match, it is difficult to find comparators with similar combinations of characteristics for each of the units in the intervention group.

The end result, typically, is that only a few units from the intervention and comparison groups get matched up, thereby, not only significantly reducing the size of the sample but also limiting the extent to which the findings can be generalised to all programme participants. (This is referred to as the "curse of dimensionality" in the literature.)

The evaluation design involved comparing the supported households with non-supported households, while statistically controlling for observed differences between them.

Fortunately, matching on the basis of the propensity score – the conditional probability of being assigned to the programme group, given particular background variables or observed characteristics – offers a solution. The way propensity score matching (PSM) works is a follows: Units from both the intervention and comparison groups are pooled together. A statistical probability model is estimated, typically through logit or probit regression. This is used to estimate programme participation probabilities for all units in the pooled sample. Intervention and comparison units are then matched within certain ranges of their conditional probability scores. Tests are further carried out to assess whether the distributions of characteristics are similar in both groups after matching. If not, the matching bandwidth or calliper is repeatedly narrowed until the observed characteristics of the groups are statistically similar. Provided that a) the dataset in question is rich and of good quality; b) the groups possess many units with common characteristics (i.e. there is a large area of common support); and c) there are no unobserved differences lurking among the groups, particularly those associated with the outcomes of interest, PSM can produce good intervention effect estimates.

Multivariable regression is another approach that is also used to control for measured differences between intervention and comparison groups. It operates differently from PSM in that it seeks to isolate the variation in the outcome variable explained by being in the intervention group *net of other explanatory variables* (key factors that explain variability in outcome) included the model. In this way, multivariable regression controls for measured differences between the intervention and comparison groups. The validity of both PSM and multivariable regression are founded heavily on the "selection on observables" assumption, and therefore treatment effect estimates can be biased if there are unmeasured (or improperly measures) but relevant differences existing between the groups. Both PSM and multivariable regression were employed during data analysis, and efforts were made to capture key explanatory variables believed to be relevant in terms of the assessed outcomes, including details about the composition of the household, and their economic activities at baseline.

4.2 Reconstruction of baseline

For propensity-score matching or multivariate regression to work effectively, individual-level data about on the situation of respondents at baseline is required in order to control for time invariant differences between the groups. In the case of this project's work in the Kasenyi /Tchomia area, no baseline survey had been conducted. Instead, an attempt was made to reconstruct baseline data by asking the respondents to recall their situation before the project was launched in 2008 with the aid of historical markers. This was done only for factors which respondents can reasonably be expected to recall with clarity, such as the condition of the house, the ownership of assets and livestock, and the variety of crops produced.

To maximise the accuracy of baseline data, it is very important that the period which respondents are being asked to recall can be visualised easily. This is

normally accomplished by identifying a landmark event which all respondents will remember clearly, and asking them details of their situation at that time.

4.3 The Comparison Group

A key factor in ensuring the validity of any non-randomised impact evaluation design is to employ an appropriate comparison group. This is particularly true for ex-post, cross-sectional designs. Comparators that differ in relation to the baseline status of the outcome variable(s) of interest and/or who are subjected to different external events and influences will likely result in misleading conclusions about programme impact. Identifying a plausible comparison group is therefore critically important in non-experimental work and is, generally speaking, not an easy task.

The success of the effectiveness review hinged on identifying a plausible comparison group.

One of the complications in selecting a suitable comparison group was that the project had worked with formal groups or associations of producers. The process for selecting membership of these groups was not clear in all cases, but it appears that the members largely self-selected themselves into the groups. It is therefore very likely that those who chose to join a group are systematically different from those who did not – in both observable and unobservable ways – e.g.in terms of the scale of their engagement in the relevant value chain, drive, motivation, and other factors. Consequently, using non-members of the groups as comparators would have likely resulted in biased estimations of the project's effectiveness.

Another complication was that the potential comparison group had to be considered separately for each of the four groups of project participants. In the case of the animal breeders, the project had worked in all three of the PRODELs (the breeders' associations) established in the Kasenyi/Tchomia area. Consideration was given to using members of PRODELs further away as a comparison, but this was rejected because the baseline characteristics of households further away would likely have been different. Moreover, it appeared that those other PRODELs had received comparable levels of assistance to that provided under the Oxfam project. There was some indication that it may have been possible to find less formal groupings of animal breeders in the Kasenyi/Tchomia area, but there was no time available to pursue this possibility. Regardless, it is likely that the types of households who joined the PRODELs would be systematically different from those who joined less formal groups.

Oxfam staff reported that there were groups of vegetable farmers active in the area before the conflict, but that little or no vegetable farming was being done at the time of the project's launch. The project established groups of vegetable farmers, some of whom were involved in similar groups before the conflict, but many of whom were not. Other than those who joined these groups, it is believed that there are few farmers engaged in vegetable production in the Kasenyi/Tchomia area. It would therefore have been very difficult to identify a comparison for this beneficiary group. Ideally, it should be households in comparable locations who would have taken up vegetable farming if offered, but there was no way of identifying such households. A less suitable alternative would have been to identify members of the informal groups that existed before the conflict and use them as comparators. However, there were no known records of membership of the groups that formerly existed. Consequently, it would have required a great deal of effort to recreate them. Moreover, it is suspected that a large proportion of the

membership of the former group is no longer in the area, due to the population movements in the intervening years.

It was only possible to identify a plausible comparison group for the fishers and fish farmers.

Fortunately, identifying a comparison group for the fishers was more straightforward. The membership of these groups was drawn from three fishing settlements or "camps", which themselves have a membership that is reasonably well defined. The groups formed under this project generally included the majority of the members of the related camps, and so it was seen to be appropriate to draw comparison observations from the general membership of other fishing camps. Three comparison camps were selected in the same geographic area as the intervention camps, but which had not participated in the Oxfam project or received comparable support from another source.

In the case of the fish processing women, project staff stated that all or almost all of the women who were engaged in fish processing at each fishing camp were recruited into the local associations, hence the large number of participants in this component of the project. Suitable comparison women could be found, therefore, by interviewing the women involved in processing fish caught at the three fishing camps already selected for comparison purposes for the fishers. Care was taken to draw comparison respondents from camps far enough from the project sites such that they could not have made use of the furnaces constructed under the project.

Since the activities carried out under the project were very different between each of the four types of producers, it was seen as important to analyse the producer groups separately. In order to achieve an adequate sample size in each producer group, combined with the effectiveness review's budget constraint, the number of producer types for which impact could be assessed was at most two. The difficulty of finding suitable comparison groups for the animal breeders and the vegetable producers naturally led the effectiveness review team to take the decision to assess impact of the project on the fishers and the fish processors only.

5 Outcome indicators

5.1 Livelihoods outcome indicator

Measuring household wealth or socioeconomic position in low income countries is not straightforward, particularly in rural areas where respondents tend to be self-employed. Self-reported measures of total income are unreliable, given the wide variety of endeavours such populations engage in to generate income.[1] However, given that there is a widely recognised and strong association between household income and consumption,[2] one popular proxy measure used by the World Bank and other international institutions involves the aggregation of both household consumption and expenditure data.[3] To capture data on this indicator, a household survey is administered that contains a consumption and expenditure module. The respondents are asked what types of food they consumed over the previous seven day period, as well as the particular quantity. The quantity is

[1] Morris, Saul, Calogero Carletto, John Hoddinott, and Luc J. M, Christianensen. (1999) *Validity of Rapid Estimates of Household Wealth and Income for Health Surveys in Rural Africa: FCND Discussion Paper No. 72*. Washington: International Food Policy Research Institute.
[2] See Gujarati, Damodar N. (2003) *Basic Econometrics: Fourth Edition*. New York: McGraw Hill.
[3] Deaton, A and S. Zaidi. 2002. "Guidelines for constructing consumption aggregates for welfare analysis," Working Paper No. 135. The World Bank, Washington, D.C.

transformed into a monetary value, i.e. either how much they paid for the food item in question or, if the food item was from their own production, how much they would have paid if it was bought from the local market. The respondents are also asked how much they spent on particular regular non-food items and services from a list such as soap, toothpaste, and minibus fares over the past four weeks. Finally, they are asked for any household expenditure on non-regular non-food items such as school and hospital fees, clothes, and home repair over the last 12 months. For non-food items that are gender divisible, data are collected in a gender disaggregated fashion, thereby, enabling intra-household consumption inequality to be measured as well. The household expenditure measure is calculated by converting each of the expenditure types into a per-day figure and adding them together.

Respondents were asked to estimate the value of all food consumed in the household during the seven days prior to the survey, as well as other recent expenditures.

While dividing the above equation by household size as the overall denominator is recommended in the literature, using a more nuanced calculation is deemed important to avoid underestimating the wealth status of larger households relative to their smaller counterparts. The formula used for calculating household size is:

where *A* is number of adults in the household; *K* is the number of children; is the consumption of a child relative to an adult; and stands for the extent of economies of scale. This evaluation follows the common practice of setting equal to 0.33 and equal to 0.9,[4] but the findings are not sensitive to reasonable changes in these parameters.

The expenditure variable is normally then out on a logarithmic scale, to improve the model fit in regression analysis and reduce the influence of outliers. The resulting variable can remain continuous, and the average per capita consumption and expenditure can be calculated for the sample in question. Alternatively, this measure can be transformed into a binary variable, so that the proportion of households living above a certain monetary figure can be calculated. The Oxfam GB global indicator for livelihoods uses the median expenditure level of the comparison group as the benchmark for creating the binary variable.

5.2 Other outcome measures

As reviewed in Section 3 above, the support provided to the targeted households is intended to bring about a number of other outcomes, in addition to strengthening livelihoods. Given this, data were collected on a number of additional outcome measures. These include those relating to household ownership of assets and household food security.

Self-reported income change

Respondents were asked to make a judgement whether overall their income had increased, remained the same or decreased since 2008.

Ability to meet basic needs

Respondents were presented with the following four descriptions of household economic situations and asked which matched their own situation most closely:

[4] Ibid.

- Doing well: able to meet household needs by your own efforts, and making some extra for stores, savings, and investment.
- Breaking even: Able to meet household needs but with nothing extra to save or invest.
- Struggling: Managing to meet household needs, but depleting productive assets and/or sometimes receiving support.
- Unable to meet household needs by your own efforts: dependent on support from relatives living outside of your household or the community, government and/or some other organisation – could not survive without this outside support.

Household food security

Household food security was measured using six questions adapted from the Household Food Insecurity Access Scale (HFIAS) developed by USAID's Food and Nutrition Technical Assistance (FANTA) Programme.[5] Respondents were asked whether any of the following were true for them or other members of their household in the four weeks before the date of the survey:

The household expenditure data were complemented by data on food security, asset wealth, and the household's judgement of its ability to meet basic needs.

- Did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?
- Did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?
- Did you or any household member have to eat fewer meals in a day because there was not enough food?
- Was there ever no food to eat of any kind in your house because of lack of resources to get food?
- Did you or any household member go to sleep at night hungry because there was not enough food?
- Did you or any household member go a whole day and night without eating anything because there was not enough food?

For each question which was answered positively, the respondent was then asked how frequently this situation occurred during the four weeks. A score was generated based on the frequency of these events.

Household ownership of assets

Household consumption and food security tend to provide good indications of the household's current economic situation, but in low-income contexts they tend to be influenced strongly by current or very recent income patterns. These measures may not, therefore, fully reflect any long-term economic benefits from the 2008/09 project. In order to provide a better measure of long-term sustainability of wealth, the survey also asked households about their ownership of livestock, household assets, and about the condition of their homes. The full list of assets and other wealth indicators for which data were collected in the survey is shown in Table 5.1.

Respondents were asked about these wealth indicators, both at the time of the survey and with respect to the baseline period, i.e. 2008. Survey piloting confirmed that respondents generally seemed able to recall this information from 2008 with a reasonable level of confidence.

[5] http://www.fantaproject.org/publications/hfias_intro.shtml

Principal component analysis (PCA) was used to create a weighted index of asset ownership for 2008, as well as another index for changes in asset ownership since 2008. PCA is a data reduction technique that narrows in on the variation in household asset ownership, assigning greater weight to those observations better off in those assets associated with this variation. This enables the relative wealth status of the households to be compared.

Table 5.1: List of assets and other wealth indicators used to derive asset index

Livestock	***Agricultural equipment***	***Household goods***	***Vehicles***
Cows	Hoe	Watch	Bicycle
Bulls	Small machete	Table	Motorcycle
Goats	Large machete (*coupe coupe*)	Chairs	Car or motor vehicle
Sheep	Rake	Mattress	
Pigs	Watering can	Bed	
Rabbits	Axe	Lamp (electric or gas)	***Condition of house***
Ducks	Shovel	Iron	Number of rooms
Chickens	Cart	Sewing machine	Material used for walls
	Sprayer	Mobile phone	Material used for roof
		Radio/cassette/CD player	Material used for floor
Agricultural land	**Fishing/processing equipment**	Video/DVD player	Type of water source
Hectares of communal land	Boat	Solar panel	Fuel used for cooking
Hectares of rented land	Outboard motor	Refrigerator/freeze	Type of toilet
Hectares of privately-owned land	Fishing net	Generator	
	Fish knife	Jewellery	
	Brush for drying fish		
	Traditional furnace		
	Drying rack		

Fishing activities

In the theory of change described in Figure 3.1, increasing the quality and/or quantity of production was the first step in leading to increases in household income and wellbeing. Of course, it is possible that the project resulted in short- or medium-term increases in the quantity or quality of production, which may have resulted in benefits to household income even if production has since reverted to its previous level. The indicators described above, particularly asset ownership, are probably the best means to observe this. However, given that the project involved provided durable assets and infrastructure, it seems reasonable to investigate whether increases in quantity and/or quality of production have been sustained.

For that reason, all respondents were asked about the details of the fish they had bought and sold during a seven-day period. For the fishers, it was not thought feasible to evaluate the quantity of fish actually caught; instead, the survey asked them for the quantity of fish they brought to market during the seven-day period and the income earned. This measure excludes any fish caught but consumed in the home or given away to others, but these are assumed to account for only a small minority of the catch of any one fisher.

The fish processors were asked for details of all the fish they had bought and sold during the seven-day period, which should allow an approximate

Details were collected on respondents' sales of fish in the seven days prior to the survey, and also during the final week of 2011.

calculation of the value they added through processing and (in some cases) transporting them to market. It is true that specific stocks of fish may have been purchased during the seven-day period but sold outside that period and vice versa. However, on average, these errors should cancel each other out, so that estimates of value added would be unbiased. In any case, it is believed that the processing normally takes only one or two days and that fish are sold immediately afterwards, so that most fish recorded as having been purchased would have been sold within the same seven-day period and vice versa.

To maximise the accuracy of respondents' recall of detailed transaction information, it was clearly preferable for the seven-day period included in the survey to be the seven days immediately prior to the date of the survey. However, in piloting it became clear that the level of fishing activity was temporarily reduced because of restrictions which the government had placed on fishing in the lake. It was assumed from this that the level of purchases and sales of fish recorded for the seven days prior to the survey would be lower than normal, which would make it more difficult to detect differences between the intervention and comparison producers. It was clearly desirable to ask about the level of fishing activity carried out during a time prior to the imposition of the government restrictions. However, t this could only be done if it was reasonable to assume that the participants could recall details of their transactions from an earlier period in some detail. Discussions with Oxfam and IPAPEL staff suggested that participants would be able to recall the purchases and sales of fish made during the last week of 2011, since the Christmas celebrations make this a time of peak activity in the market. There were nevertheless doubts over respondents' ability accurately to recall their transactions from that period, so it was decided to collect transaction details from the last week of 2011 as well as the week of the survey. If the assumptions which had been made were correct, this would provide a snapshot of respondents' income at a peak time (during the Christmas season), as well as at the time of depressed activity (after the imposition of the restrictions on fishing).

6 Methods of Data Collection and Analysis

6.1 Data Collection

The effectiveness review team designed a household questionnaire to capture data on both the outcome variables presented in Section 5 above, as well as other key characteristics of the targeted and comparison producers. Potential enumerators participated in a two-day training workshop in Bunia city, which included a practical exercise practicing and testing the questionnaire with fish traders in the city. Based on their performance in this exercise, 15 enumerators were selected to carry out the field work. The local IPAPEL extension agent for fisheries assisted the enumerator team to identify respondents, but did not administer any of the questionnaires, given that many of the respondents were known to him personally.

To ensure adequate sample, it was decided to survey around 195 fishers and 305 fish processors, even though the number of processors who participated in the project was seven times larger than the number of fishers. Since the unmatched comparison data are given less weight and/or excluded in PSM, it is important to have larger sample sizes for the comparison group. To that end, around 40 per cent of the samples of both fishers and fish processors

were to come from the intervention sites and 60 per cent from the comparison sites.

The samples of respondents in the intervention sites were drawn from Oxfam's original lists of project participants. The six fisher groups the project supported each had 30 members, so an equal number of respondents were randomly chosen from each list. Given that the processors' associations varied in size, a random sample of respondents was chosen from each proportionate to its size. Randomly-selected reserve respondents were also provided to the survey team for substitution in cases where the designated respondent was not available for interview.

Of the fish processors sampled from the original list of project participants, only 41 per cent could be identified and located at the project site.

In the event, locating the sampled project participants proved more difficult than expected. In particular, a large proportion of the fish processors who participated in the project had left the area since 2008/09 or only visit the area occasionally to make purchases. This was particularly the case at one of the three sites, Muchanga, which is very close to the town of Kasenyi and where the vast majority of sampled project participants were no longer in the area or could not be identified. This problem was less severe, however, at the other two sites. Overall, only 41 per cent of the sampled respondents could be interviewed. The team therefore also interviewed all of those on the reserve list who were available for interview, leading to a total of 103 surveys. The fishers were easier to identify, and most of them were available for interview; in cases where they were on an extended fishing trip away from the community, other household members were often able to respond to the survey on their behalf.

The selection of comparison respondents proceeded as planned and as described in Section 4.3 above. Fishers were identified from among the members of the fishing "camps" selected for comparison and fish processors were identified who were associated with these camps. The survey team interviewed all of the fishers and all of the fish processors who were available for interview at each site, meaning that no random selection of comparison respondents was necessary.

The difficulties of locating the sampled fish processor project participants, as well as other practical difficulties, meant that the target sample sizes had to be revised downwards during the course of the field work. In the end a total of 164 fishers and 230 processors were interviewed, of whom around 45 per cent were project participants.

6.2 Data Analysis

OGB created a data-entry interface in Adobe Acrobat Pro, and temporary staff were employed to enter the data in the Oxfam office in Bunia. The data were then imported into Stata for analysis, the results of which are presented in the following sections.

The analyses involved group mean comparisons using *t*-tests, propensity-score matching (PSM) with Stata's psmatch2 module, and various regression approaches. Kernel and nearest-neighbour matching without replacement were the two methods used in implementing PSM. Variables used in the matching process were selected from among those presented in Table 7.1, using a backwards stepwise regression process to identify those which were correlated with being a member of the intervention group, using a cut-off for

the *p*-value of 0.25. Boot-strapped standard errors enabled the generation of confidence intervals to assess the statistical significance of the effect sizes. Covariate balance was checked following the implementation of each matching procedure. When covariate imbalance at *p*-values of 0.25 or less was identified, the bandwidth or calliper was reduced and the PSM procedure and covariate balance test implemented again. This was continued until all covariates were balanced at *p*-values greater than 0.25.

To complement the PSM analysis, regression models were also constructed for the effects of the project on the various outcome measures. Appropriate covariates for these regression models were selected from among those presented in Table 7.1 below.

Since the fishers and the fish processors have different livelihoods activities and received different forms of support from the project, analysis was carried out separately for the two groups. For the measures where these results could be meaningfully aggregated, an overall figure was calculated by weighting the results of the two groups in proportion to their size in the overall project population.[6]

6.3 Problems and Constraints Encountered

The fact that comparison sites were generally located further from the towns of Kasenyi and Tchomia than the intervention sites created complications in the analysis.

Apart from the practical difficulties encountered above, one particular problem encountered in the course of the field work presents challenges for data analysis:

- *Comparison sites are located systematically further from the towns of Kasenyi and Tchomia (and hence from major markets) than the intervention sites*.
  Since detailed maps of the area were not available, this problem was not clear until the survey work started on the ground. Unfortunately, no other sites more suitable for comparison could be identified. This meant that, at the analysis stage, particular care had to be taken in comparing supported households to intervention households. A binary variable was constructed based on the respondent's estimation of whether their house was located more than or less than two hours' walk from the nearest town (Kasenyi or Tchomia). This variable was used for matching in the PSM models and as a covariate in the regression models. Unfortunately this meant it was not possible to find matches for the whole intervention group. In the case of the fishers, the estimates derived from the no-replacement models apply to only 53 of the 74 intervention households, while those derived from the kernel PSM models apply to 63 of the 74 households. For the processors, the estimates from the no-replacement PSM models apply to 80 of the 100 intervention households, while the kernel PSM estimates apply to 95 of those 100 households. In Section 7.2, therefore, the estimates of the kernel PSM models are applicable to a larger proportion of programme participants than are the no-replacement models. However, it must be remembered (particularly in the case of the fishers) that, even with the kernel matching, part of the supported group has been excluded from the analysis.

[6] This weight was calculated by taking the proportion which the group accounted for in the original population of project participants (12 per cent for the fishers; 88 per cent for the processors), and then, in the case of the fishers, multiplying by the approximate proportion of sampled participants who could be identified and surveyed (41 percent) to reflect that the effect estimates would be valid only for the population who were still present in the area, and then normalizing.

7 Results

7.1 General Characteristics

Table 7.1 presents mean statistics for general household characteristics obtained through the administration of the questionnaire among the sampled fishers and processors from both the intervention and comparison groups. The stars beside the number indicate differences between the two groups that are statistically significant at a 90 percent confidence level or greater.

As is evident, there are several statistically significant differences between the groups:

- *Household size*: Supported fishers on average have slightly larger households than do the comparison fishers. The difference is mostly due to the number of children being greater.
- *Age of household head*: The heads of the supported households are, on average, four years older than the heads of comparison households.
- *Education level of household head*: The heads of the supported households are much more likely to have had some primary education than the heads of comparison households (62 per cent, compared to 41 per cent among the comparison households).
- *Distance of households from local market*: Supported households generally live closer to the centre of their community (represented by the local market). This difference is particularly marked among the fishers; the difference is small and not statistically significant among the processors.
- *Distance of households from nearest town*: As already highlighted in Section 6.3 above, the intervention sites were generally located closer to the towns of Kasenyi and Tchomia (and hence to the major markets) than the comparison sites. This difference is much greater among the fishers than among the processors. This is a consequence of the selection of comparison sites: as noted above, the communities suitable for use as comparison were further from those towns than were the communities of supported households.

The project participants and comparison respondents were found to be different in a number of important respects.

Each of these factors could potentially affect the outcome variables in ways which would confound estimates of the impact of the project. It is therefore important to control for these differences in characteristics when making assessments of impact in Section 7.2. As discussed above (Section 6.3), the difference in the distance of supported and comparison households from the towns of Kasenyi and Tchomia presents a particular difficulty for the analysis. Estimates of effects due to the project have been constructed while controlling whether the household lives closer than two hours' walking distance from the nearest town. (Table 7.1 shows that 94–95 per cent of supported households live closer than two hours' walk to town, compared to only 53 per cent of comparison fishers and 67 per cent of comparison processors.)

Table 7.1 also demonstrates that a larger number of household members are members of a producers' association among the supported households than the comparison households. This is to be expected, since the project involved organising producers into associations, whereas many of the comparison producers were not selected through formal producers' groups or associations.

Table 7.1:
Descriptive statistics for intervention and comparison respondents

	Fishers				Fish processors			
	Intervention mean	Comparison mean	Difference	*t*-statistic	Intervention mean	Comparison mean	Difference	*t*-statistic
Household size	8.689	7.644	1.045**	2.05	7.573	7.197	0.376	0.89
Number of adults	3.851	3.544	0.307	1.08	3.272	2.929	0.343	1.47
Number of children	4.838	4.100	0.738*	1.84	4.301	4.268	0.033	0.11
Number of productive adults	3.459	3.256	0.204	0.72	2.748	2.528	0.220	1.27
Number of unproductive adults	0.378	0.256	0.123	1.28	0.485	0.378	0.107	0.73
Number of male adults	2.000	1.867	0.133	0.61	1.553	1.378	0.175	0.99
Household head female	0.054	0.022	0.032	1.08	0.388	0.394	-0.005	-0.08
Household head greater than 60 years old	0.068	0.067	0.001	0.02	0.039	0.024	0.015	0.67
Household head less than 18 years old	0.000	0.000	0.000	.	0.000	0.008	-0.008	-0.90
Household head is productive	1.000	1.000	0.000	.	0.981	0.969	0.012	0.57
Age of household head	44.730	39.189	5.541***	2.84	39.330	36.079	3.251**	2.05
Only one adult in household	0.000	0.067	-0.067**	-2.29	0.117	0.118	-0.002	-0.04
No male adults in household	0.000	0.011	-0.011	-0.91	0.155	0.189	-0.034	-0.67
All household members > 60 years old	0.000	0.000	0.000	.	0.010	0.008	0.002	0.15
HH head has some primary education	0.622	0.444	0.177**	2.28	0.621	0.386	0.236***	3.64
HH head has some secondary education	0.014	0.022	-0.009	-0.41	0.029	0.024	0.006	0.26
Some HH member has formal employment	0.095	0.044	0.050	1.28	0.107	0.047	0.060*	1.72
Asset index 2008	0.780	0.132	0.648	1.35	0.312	-0.802	1.114***	2.87
Asset poorest third in 2008	0.230	0.289	-0.059	-0.85	0.311	0.449	-0.138**	-2.15
Asset middle third in 2008	0.311	0.333	-0.023	-0.31	0.369	0.315	0.054	0.86
Asset wealthiest third in 2008	0.459	0.378	0.082	1.05	0.320	0.236	0.084	1.42
Distance to the local market †	16.123	28.449	-12.326**	-2.31	14.214	15.717	-1.503	-0.57
Distance to the nearest town (Kasenyi or Tchomia) †	53.122	149.933	-96.811***	-9.25	55.320	101.976	-46.656***	-4.06
Nearest town within two hours on foot	0.946	0.528	0.418***	6.61	0.940	0.675	0.265***	5.14
Proportion of HH income derived from sale of fish in 2008	0.712	0.672	0.040	1.37	0.651	0.654	-0.003	-0.11
Some HH member is a member of an association of fishers or processors	0.851	0.356	0.496***	7.34	0.786	0.386	0.401***	6.63
Number of members of the association	1.351	0.422	0.929***	7.58	1.233	0.480	0.753***	5.75
Observations	**74**	**90**	**164**		**103**	**127**	**230**	

* $p<0.1$, ** $p<0.05$, *** $p<0.01$
HH: household
† minutes on foot

7.2 Comparison of intervention and comparison groups on outcome measures

7.2.1 Fish sales – fishers

As described in Section 3, the project interventions were intended to enable producers to increase the quantity and/or the quality of their fish sales, resulting in greater net income. The survey asked all respondents to describe the details of their sales of their fish during the seven days prior to the survey, as well as during the last seven days of 2011, allowing the comparison of both the level of activity and the income derived from it during those two periods.

We start by analysing this data for the fishers. Table 7.2 presents the results of the various statistical models used to assess the difference between the supported and comparison fishers in terms of their reported sales activity during the seven days prior to the survey. The upper section of the table shows the raw unadjusted differences in the values. The second section uses two different forms of propensity score matching (PSM), and the third section uses three different regression models to provide various estimates of the outcome measure. The various statistical procedures were implemented as a robustness check.

Overall, there is no sign that the level of market activity, the quantity of fish sold, or the revenue generated is any different between the supported fishers and the comparison fishers.

There are no significant differences between the supported and comparison fishers in their sales during the week leading up to the survey.

Table 7.2: Sales of fish during the 7 days prior to the survey (fishers)

	Number of days made sales	**Total quantity sold (kg)**	**Total value sold (natural logarithm of 1 + value in Congolese *francs*)**
Unadjusted:			
Sample mean	3.128	116.976	9.775
Intervention mean	2.886	105.054	9.230
Comparison mean	3.326	126.778	10.237
Unadjusted difference	-0.440	-21.724	-1.006
	(-1.20)	(-0.89)	(-1.38)
Observations:	**156**	**164**	**157**
PSM (ATT)			
Post-matching difference (kernel)	-0.564	-10.522	-0.744
	(-1.05)	(-0.32)	(-0.91)
Observations:	**138**	**146**	**139**
Post-matching difference (no replacement)	-0.612	-58.160**	-0.834
	(-1.33)	(-2.02)	(-0.96)
Observations:	**128**	**136**	**130**
Multivariable Regression:			
MVR coefficient (fixed effects; robust standard errors)	-0.393	-39.432	-0.823
	(-0.82)	(-1.40)	(-1.07)
Observations:	**153**	**161**	**154**
MVR coefficient (robust regression)	-0.360	6.764	-0.014
	(-0.70)	(0.50)	(-0.06)
Observations:	**153**	**161**	**154**
MVR coefficient with control functions (robust SE)	-0.482	-42.671	-0.848
	(-0.86)	(-1.55)	(-1.06)
Observations:	**147**	**155**	**148**

t statistics in parentheses
* $p < 0.01$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

As described in Section 5.2, the level of fishing activity was said to be particularly low at the time of the survey, due to the government's recent restrictions on fishing. It was therefore assumed that the market activity during the last week of 2011 (the peak season for sales) may illustrate differences between the supported and comparison producers more clearly. Table 7.3 presents the results of the same analysis as Table 7.2 but this time relating to sales during the last week of 2011. Even in this case, there are no indications of differences between the supported and comparison producers in their volume of sales or the revenue generated.

Fishers reported selling a higher volume of fish during Christmas week than during the week of the survey, but generated less revenue.

Table 7.3: Sales of fish during the last week of 2011 (fishers)

	Number of days made sales	Total quantity sold (kg)	Total value sold (natural logarithm of 1 + value in Congolese *francs*)
Unadjusted:			
Sample mean	2.732	148.335	9.097
Intervention mean	2.776	141.068	9.032
Comparison mean	2.698	154.311	9.150
Unadjusted difference	0.078	-13.244	-0.118
	(0.21)	(-0.27)	(-0.14)
Observations:	**153**	**164**	**154**
PSM (ATT)			
Post-matching difference	-0.003	33.315	-0.716
(kernel)	(-0.01)	(0.57)	(-0.66)
Observations:	**136**	**146**	**136**
Post-matching difference (no	-0.128	-67.038*	-1.409
replacement)	(-0.28)	(-1.69)	(-1.30)
Observations:	**126**	**136**	**128**
Multivariable Regression:			
MVR coefficient (fixed effects;	0.105	-4.328	-0.998
robust standard errors)	(0.24)	(-0.10)	(-0.96)
Observations:	**150**	**161**	**151**
MVR coefficient (robust	0.077	4.819	0.209
regression)	(0.15)	(0.25)	(0.87)
Observations:	**150**	**161**	**151**
MVR coefficient with control	0.123	-4.549	-0.977
functions (robust SE)	(0.27)	(-0.11)	(-0.93)
Observations:	**144**	**155**	**145**

t statistics in parentheses
* $p < 0.01$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

It is interesting to note that fishers do, on average, appear to have sold a greater volume of fish during the last week of 2011 than during the seven day prior to the survey (though this difference is not quite statistically significant at the 10 per cent level), but the income they reported for those sales was lower. In particular, the median price per kilogram of fish sold was 1500 francs in the last week of 2011, but 1538 francs in the week prior to the survey. It is likely that this discrepancy reflects some error in recalling figures for transactions from the end of 2011.

7.2.1 Sales of fish – processors

The survey data allows the same analysis to be performed with the data on sales made by the processors as by the fishers. Tables 7.4 and 7.5 show the results for the sales made by the processors during the seven days prior to

the survey and during the last week of 2011, respectively. As in the case of the fishers, there are no significant differences between the supported and comparison producers in sales or revenue generated in other of the seven-day periods considered.

Among the fish processors, sales during the seven days prior to the survey were no higher among the project participants than among the comparison group.

Table 7.4: Sales of fish during the 7 days prior to the survey (processors)

	Number of days made sales	Total quantity sold (kg)	Total value sold (natural logarithm of 1 + value in Congolese francs)
Unadjusted:			
Sample mean	2.548	83.240	9.186
Intervention mean	2.711	102.245	9.068
Comparison mean	2.433	68.575	9.271
Unadjusted difference	0.278	33.670**	-0.203
	(0.94)	(2.46)	(-0.29)
Observations:	217	225	207
PSM (ATT)			
Post-matching difference	0.229	21.667	0.663
(kernel)	(0.60)	(1.07)	(0.68)
Observations:	209	217	199
Post-matching difference (no	0.186	25.816	0.512
replacement)	(0.49)	(1.60)	(0.58)
Observations:	196	202	185
Multivariable Regression:			
MVR coefficient (fixed	0.215	20.458	0.507
effects; robust standard	(0.65)	(1.31)	(0.61)
errors)			
Observations:	214	221	203
MVR coefficient (robust	0.251	10.639	0.151
regression)	(0.71)	(1.06)	(0.76)
Observations:	213	220	203
MVR coefficient with control	0.208	19.191	0.551
functions (robust SE)	(0.63)	(1.21)	(0.66)
Observations:	212	219	201

t statistics in parentheses
* $p < 0.01$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

The major difference between the activities of the fishers and the processors is that the processors are generally purchasing fish to process and sell on. In the case of the fishers, the total value of sales may be a reasonable approximation for the value added (given that variable costs of production are probably low). However, in the case of the processors, an estimate of their net income must also account for the value of the fish they purchased. Processors were asked in the survey to detail their purchases of fish during the seven days prior to the survey and during the last week of 2011 at the same level of detail as their sales. For the last week of 2011 only, they were also asked to estimate their expenses on salt, fuel for smoking, and any fee for using a furnace. The total value of purchases and other expenses was deducted from the total value of sales to generate a figure for net revenue from fish for the two seven day periods in question. This figure is not an ideal measure of value added for three reasons: First, it does not account for fish which were purchased and consumed within the household. Second, many costs of production are missing (notably transportation costs and the opportunity cost of the processors' time). Finally, fish may have been purchased before the seven-day period but sold during that period or purchased during that period but sold after it, so that only one side of this

transaction would appear in the calculation. However, these factors can be assumed to apply across all respondents in the sample. Thus, while they reduce the precision of estimates of differences between supported and comparison producers, they are unlikely to bias those estimates.

There is also no significant difference in the market activity of the supported and comparison processors during the last week of 2011.

Table 7.5: Sales of fish during the last week of 2011 (processors)

	Number of days made sales	Total quantity sold (kg)	Total value sold (natural logarithm of 1 + value in Congolese francs)
Unadjusted:			
Sample mean	2.358	83.035	8.343
Intervention mean	2.256	85.310	7.401
Comparison mean	2.429	81.230	9.068
Unadjusted difference	-0.173	4.080	-1.666**
	(-0.58)	(0.31)	(-2.18)
Observations:	**212**	**226**	**214**
PSM (ATT)			
Post-matching difference	-0.044	8.587	-0.850
(kernel)	(-0.12)	(0.55)	(-0.87)
Observations:	**204**	**217**	**205**
Post-matching difference (no	-0.224	7.564	-1.628*
replacement)	(-0.61)	(0.50)	(-1.75)
Observations:	**192**	**203**	**193**
Multivariable Regression:			
MVR coefficient (fixed effects;	-0.116	4.277	-1.257
robust standard errors)	(-0.32)	(0.29)	(-1.39)
Observations:	**209**	**222**	**210**
MVR coefficient (robust	-0.149	-3.819	-1.578
regression)	(-0.42)	(-0.34)	(-1.49)
Observations:	**209**	**221**	**210**
MVR coefficient with control	-0.202	3.717	-1.344
functions (robust SE)	(-0.56)	(0.25)	(-1.46)
Observations:	**207**	**220**	**208**

t statistics in parentheses
* $p < 0.01$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

Table 7.6 shows that there is no difference between the supported and comparison producers in their estimated net income from fish sales during either of the seven day periods.

Table 7.6: Net income from purchases and sales of fish (processors; natural logarithm of 1+ value in Congolese francs)

	During the seven days prior to the survey	During the last week of 2011†
Unadjusted:		
Sample mean	8.534	6.449
Intervention mean	6.981	5.907
Comparison mean	7.493	6.916
Unadjusted difference	-0.512	-1.009
	(-0.67)	(-1.28)
Observations:	**157**	**160**
PSM (ATT)		
Post-matching difference	0.169	-0.173
(kernel)	(0.16)	(-0.16)
Observations:	**150**	**153**
Post-matching difference (no	0.531	-0.796
replacement)	(0.54)	(-0.82)
Observations:	**142**	**143**
Multivariable Regression:		
MVR coefficient (fixed effects;	0.190	-0.506
robust standard errors)	(0.20)	(-0.53)
Observations:	**154**	**157**
MVR coefficient (robust	0.397	-0.576
regression)	(0.57)	(-0.51)
Observations:	**153**	**157**
MVR coefficient with control	0.144	-0.512
functions (robust SE)	(0.15)	(-0.53)
Observations:	**152**	**155**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.
† Includes an estimate of variable costs of production (salt, fuel, and any fee paid for use of a furnace).

There were, again, no clear differences between supported and comparison processors in terms of their net income.

7.3.3 Change in household's revenue from fish since 2008

It was considered unrealistic to ask producers to recall the details of their income from fish before the project began in 2008, so difference-in-difference analysis of the measures considered in the previous sections was not possible. However, respondents were asked for their impression of whether the income they derive from fish had increased or decreased since 2008. Table 7.7 shows that around half of the fishers and 60 per cent of the processors reported that their revenue from fish had increased since 2008. However, once again, there are no significant differences between the supported and comparison households in this respect once baseline differences between the groups were controlled for.

There were no differences between the project participants and comparison groups in terms of their self-reported income.

Table 7.7: Proportion of respondents reporting that their income from fish had increased since 2008

	Overall	Fishers	Processors
Unadjusted:			
Sample mean	0.573	0.494	0.601
Intervention mean	0.615	0.568	0.631
Comparison mean	0.539	0.433	0.576
Unadjusted difference	0.076	0.134*	0.055
	(1.44)	(1.72)	(0.84)
Observations:	**392**	**164**	**228**
PSM (ATT)			
Post-matching difference	0.037	0.084	0.015
(kernel)	(0.90)	(0.76)	(0.18)
Observations:	**365**	**146**	**219**
Post-matching difference (no	0.041	0.000	0.013
replacement)	(0.68)	(0.00)	(0.16)
Observations:	**340**	**136**	**204**
Multivariable Regression:			
Probit (fixed effects; robust	0.024	0.050	-0.001
standard errors)	(0.39)	(0.49)	(-0.01)
Observations:	**383**	**152**	**222**
Probit with control functions	0.020	0.031	-0.005
(robust SE)	(0.32)	(0.29)	(-0.07)
Observations:	**383**	**147**	**222**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

Respondents were also asked to estimate what proportion of their household income comes from fish, both in 2008 and at the time of the survey. This was done by handing respondents 10 stones to represent their overall household income, and asking them to estimate the number of stones which represents the contribution of fish. As seen in Table 7.1, approximately two thirds of household income was derived from fish before the project was launched in 2008. Table 7.8 shows that, for the population overall, the proportion of revenue from fish had decreased to around 60 per cent at the time of the survey. Again, there is no clear evidence of any difference in the size of this fall between supported and comparison households. Among the fishers, the estimates of the difference between the supported and comparison fishers are quite large: supported fishers experienced a six and nine percentage points decline in the proportion of their income derived from fish ,which a smaller drop than that experienced by the comparison fishers. However, these estimates are only marginally statistically significant, so it cannot be stated with any confidence that this difference is a result of the project.

On average, the proportion of household income from sales of fish was reported to have declined among all groups between 2008 and 2012.

Table 7.8: Change in the proportion of household income deriving from fish between 2008 and time of the survey

	Overall	Fishers	Processors
Unadjusted:			
Sample mean	-0.065	-0.107	-0.051
Intervention mean	-0.050	-0.076	-0.042
Comparison mean	-0.077	-0.132	-0.058
Unadjusted difference	0.027	0.057	0.017
	(0.99)	(1.43)	(0.50)
Observations:	**394**	**164**	**230**
PSM (ATT)			
Post-matching difference	0.044*	0.064	0.038
(kernel)	(1.74)	(1.18)	(0.85)
Observations:	**367**	**146**	**221**
Post-matching difference (no	0.016	0.030	0.009
replacement)	(0.54)	(0.59)	(0.22)
Observations:	**342**	**136**	**206**
Multivariable Regression:			
MVR coefficient (fixed effects;	0.026	0.080	0.018
robust standard errors)	(0.87)	(1.52)	(0.49)
Observations:	**387**	**161**	**226**
MVR coefficient (robust		0.086*	0.018
regression)	–	(1.94)	(0.74)
Observations:		**161**	**224**
MVR coefficient with control	0.025	0.076	0.017
functions (robust SE)	(0.84)	(1.33)	(0.46)
Observations:	**385**	**155**	**224**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

7.3.4 Household income and expenditure

Data for several measures of household income were collected in the survey. Te simplest measure involved directly asking whether the respondent's household income had increased, decreased, or stayed roughly the same since 2008. Table 7.9 shows that, for the processors, there is no difference between the supported and comparison households in whether they experienced an increase in income. Among the fishers, estimates of the effect due to the project are positive, but these estimates fall short of being statistically significant.

The survey also asked respondents about whether their household is able to meet its basic needs, without resorting to selling assets or relying on external support. The results, shown in Table 7.10, are consistent with those from the income change question analysed in Table 7.9. There are no indications that more of the supported processors are able to meet their basic needs than are the comparison processors. However, in the case of the fishers, there are indications of a positive result, but this cannot be stated unequivocally.

Table 7.9: Proportion of respondents reporting that their overall household income had increased since 2008

	Overall	Fishers	Processors
Unadjusted:			
Sample mean	0.469	0.405	0.491
Intervention mean	0.465	0.534	0.440
Comparison mean	0.472	0.300	0.532
Unadjusted difference	-0.008	0.234***	-0.092
	(0.15)	(3.10)	(-1.37)
Observations:	**389**	**163**	**226**
PSM (ATT)			
Post-matching difference (kernel)	-0.064	0.178	-0.132*
	(-1.50)	(1.58)	(-1.68)
Observations:	**363**	**145**	**218**
Post-matching difference (no replacement)	-0.046	0.115	-0.103
	(-0.74)	(1.18)	(-1.21)
Observations:	**338**	**135**	**203**
Multivariable Regression:			
Probit (fixed effects; robust standard errors)	-0.061	0.173*	-0.135*
	(-0.98)	(1.69)	(-1.72)
Observations:	**380**	**156**	**220**
Probit with control functions (robust SE)	-0.068	0.169	-0.138*
	(-1.08)	(1.59)	(-1.73)
Observations:	**380**	**151**	**220**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

There are no consistent differences between the intervention and comparison groups on the self-reported measures of household income.

Table 7.10: Proportion of respondents reporting that their household is able to meet its basic needs from household income

	Overall	Fishers	Processors
Unadjusted:			
Sample mean	0.777	0.728	0.794
Intervention mean	0.794	0.822	0.784
Comparison mean	0.763	0.652	0.802
Unadjusted difference	0.031	0.170**	-0.017
	(0.69)	(2.45)	(-0.32)
Observations:	**390**	**162**	**228**
PSM (ATT)			
Post-matching difference (kernel)	-0.003	0.137	-0.045
	(-0.08)	(1.39)	(-0.70)
Observations:	**363**	**144**	**219**
Post-matching difference (no replacement)	-0.017	0.135	-0.076
	(-0.34)	(1.44)	(-1.20)
Observations:	**338**	**134**	**204**
Multivariable Regression:			
Probit (fixed effects; robust standard errors)	-0.016	0.151*	-0.084
	(-0.33)	(1.65)	(-1.41)
Observations:	**381**	**150**	**222**
Probit with control functions (robust SE)	-0.015	0.108	-0.080
	(-0.30)	(1.16)	(-1.34)
Observations:	**381**	**145**	**222**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

A more sophisticated measure of household wellbeing than the above self-reported indicators involves estimating the actual level of household consumption. As described in Section 5.1, the survey asked the respondents to estimate the value of all the food items which members of their household

consumed in the past seven days, as well as other expenditures that members of the household made over the past month (for types of expenditure which are usually made regularly) and over the past 12 months (for types of expenditure which are normally made infrequently). These expenditure details were aggregated and converted into a per-person per-day figure. The results, after logarithmic transformation, are shown in Table 7.11.

Consistent with the previous results, there are no indications in Table 7.11 that processors who were supported by the project have household consumption greater than the comparison processors. For the fishers, the results are again not consistently clear, despite the positive PSM kernel estimate.

Table 7.11: Value of household expenditure (natural logarithm of Congolese francs per person per day)

Household expenditure does appear to be greater among the supported fishers than comparison fishers, but the same does not apply among the fish

	Overall	Fishers	Processors
Unadjusted:			
Sample mean	8.274	8.300	8.264
Intervention mean	8.334	8.374	8.320
Comparison mean	8.225	8.239	8.219
Unadjusted difference	0.109	0.135	0.100
	(1.67)	(1.30)	(1.26)
Observations:	**394**	**164**	**230**
PSM (ATT)			
Post-matching difference	0.191***	0.373***	0.121
(kernel)	(3.54)	(2.65)	(1.23)
Observations:	**367**	**146**	**221**
Post-matching difference (no	-0.182	0.169	0.107
replacement)	(2.42)	(1.28)	(1.11)
Observations:	**342**	**136**	**206**
Multivariable Regression:			
MVR coefficient (fixed effects;	0.104	0.183	0.089
robust standard errors)	(1.60)	(1.55)	(1.12)
Observations:	**387**	**161**	**226**
MVR coefficient (robust		0.177	0.099
regression)	–	(1.58)	(1.24)
Observations:		**161**	**225**
MVR coefficient with control	0.110*	0.178	0.099
functions (robust SE)	(1.68)	(1.44)	(1.24)
Observations:	**385**	**155**	**224**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

There are reasons to believe that the data for food expenditure may be more accurate than the other data collected in this survey. First, expenditure on food over the past week is easier to estimate than other expenditures over the past month or year. A second reason is that the details of food expenditure involve smaller figures, and so are likely to be affected less by recording and data-entry errors than are other types of expenditure. For these reasons, considering food expenditure alone may improve the accuracy of results.

Table 7.12 shows the differences between the intervention and comparison groups in terms of food expenditure only, again transformed onto logarithmic scale. The pattern of results is the same as in Table 7.11, but the precision has indeed increased slightly, such that the two of the regression models produce an estimate of results which are significant at the 10 per cent level. While this would not be treated as an unequivocally positive result if found in isolation, the fact that it is corroborated by the marginally positive results for the subjective measures of household income (Tables 7.9 and 7.10 above) does give added weight to the conclusion that there is a modest effect from the project. The sizes of the estimates in Table 7.12 imply that being supported by the project may have added between 19 per cent and 38 per cent to household food expenditure at the time of the survey.

Table 7.12: Value of household food consumption (natural logarithm of Congolese francs per person per day)

	Overall	Fishers	Processors
Unadjusted:			
Sample mean	7.828	7.799	7.837
Intervention mean	7.847	7.873	7.838
Comparison mean	7.812	7.738	7.837
Unadjusted difference	0.035	0.135	0.001
	(0.56)	(1.31)	(0.01)
Observations:	**394**	**164**	**230**
PSM (ATT)			
Post-matching difference	0.124**	0.379***	0.047
(kernel)	(2.36)	(2.86)	(0.48)
Observations:	**367**	**146**	**221**
Post-matching difference (no	-0.08	0.191	-0.003
replacement)	(1.09)	(1.51)	(-0.03)
Observations:	**342**	**136**	**206**
Multivariable Regression:			
MVR coefficient (fixed effects;	0.045	0.192	0.012
robust standard errors)	(0.64)	(1.57)	(0.13)
Observations:	**387**	**161**	**226**
MVR coefficient (robust		0.194*	0.023
regression)	–	(1.69)	(0.28)
Observations:		**160**	**225**
MVR coefficient with control	0.052	0.225*	0.016
functions (robust SE)	(0.73)	(1.80)	(0.18)
Observations:	**385**	**155**	**224**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

The apparent positive effect on household expenditure among fishing households is clearer when food expenditure is considered in isolation.

In Table 7.13, the results for overall household expenditure are shown in terms of the Oxfam GB global indicator: The proportion of households with per-person per-day consumption expenditure greater than the median of the comparison group. The global indicator is derived directly from the data in Table 7.11, so the pattern of results is similar: There is no evidence that supported processors have higher household expenditure than do comparison processors, but there are indications of a very modest effect among the fishers.

The results for Oxfam's global livelihoods indicator are not positive.

Table 7.13: Proportion of households with per capita per day consumption greater than the median of the comparison group

	Overall	Fishers	Processors
Unadjusted:			
Sample mean	0.511	0.530	0.504
Intervention mean	0.521	0.568	0.505
Comparison mean	0.503	0.500	0.504
Unadjusted difference	0.018	0.068	0.001
	(0.34)	(0.86)	(0.01)
Observations:	**394**	**164**	**230**
PSM (ATT)			
Post-matching difference (kernel)	0.061	0.205**	0.005
	(1.44)	(1.99)	(0.06)
Observations:	**367**	**146**	**221**
Post-matching difference (no replacement)	0.070	0.075	0.013
	(1.14)	(0.74)	(0.16)
Observations:	**342**	**136**	**206**
Multivariable Regression:			
Probit (fixed effects; robust standard errors)	0.009	0.105	-0.014
	(0.14)	(0.99)	(-0.16)
Observations:	**385**	**155**	**224**
Probit with control functions (robust SE)	0.016	0.110	-0.003
	(0.24)	(1.02)	(-0.03)
Observations:	**385**	**155**	**224**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

7.3.4 Food security

To complement the household expenditure data, the survey also included questions about the household's food security situation. As would be expected among this population, respondents reported severe problems with food security. Specifically, the majority of respondents reported that members of their household had missed meals in the four weeks prior to the survey, and more than 40 per cent reported household members spending the whole day without food on at least one occasion.

Table 7.14 presents the difference between supported and comparison households in terms of food security in relation to an index score which was created for each household from the survey results. In this table, higher numbers represent greater food *in*security, so a negative difference represents *improved* food security. As found from the expenditure data and other income measures, there is no difference that the supported processors differ from the comparison processors in their level of food security. Among the fishers, there are again indications of a positive effect from the PSM kernel model, but this is less clear than in the case of household expenditure. In particular, the low *t*-statistic for the regression with control functions suggests that there may be some residual bias in the results of the other regression models. Interestingly, in the other two regression models, the coefficient of the binary variable for whether the household lives within two hours' walk of town is large and highly significant, implying that those living closer to a town have considerably lower food security scores; this does cast some doubt over whether a significant effect on food security can be detected in these results.

There is no consistent evidence that the project has improved household food security.

Table 7.14: Food security score (first principal component – higher numbers represent lower food security)

	Overall	Fishers	Processors
Unadjusted:			
Sample mean	0.000	0.000	0.000
Intervention mean	-0.0362	-0.320	0.060
Comparison mean	0.0315	0.290	-0.051
Unadjusted difference	-0.068	-0.610**	0.111
	(0.34)	(-2.07)	(0.45)
Observations:	**353**	**143**	**210**
PSM (ATT)			
Post-matching difference (kernel)	0.084	-0.676*	0.405
	(0.51)	(-1.70)	(1.43)
Observations:	**327**	**126**	**201**
Post-matching difference (no replacement)	0.048	-0.599	0.277
	(-0.21)	(-1.54)	(0.99)
Observations:	**304**	**117**	**187**
Multivariable Regression:			
MVR coefficient (fixed effects; robust standard errors)	0.210	-0.228	0.406
	(0.98)	(-0.65)	(1.52)
Observations:	**347**	**141**	**206**
MVR coefficient (robust regression)	–	-0.309	0.443
		(-0.82)	(1.58)
Observations:		141	205
MVR coefficient with control functions (robust SE)	0.228	-0.043	0.424
	(1.06)	(-0.12)	(1.56)
Observations:	**345**	**135**	**204**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

7.3.5 Asset wealth

The measures of household wellbeing examined so far – household income and food security – are likely to be significantly associated with the current income position of households. Since the project activities ended more than two years prior to the time of the survey, it is of interest to know if any long-term improvements in household wellbeing can be observed since that time. Household asset ownership is considered to be good measure of a household's established wealth status. As described in Section 5.2, data were collected on ownership of a series of assets and other wealth indicators, both in 2008 and on the date of the survey. The results were used to create an index of the change in the ownership of each asset. A comparison of the treatment groups in relation to this differenced index are presented in Table 7.15. In this table, positive numbers represent an increase in assets and other wealth indicators in comparison to the rest of the sample, while negative numbers represent a decrease relative to the rest of the sample.

Once again on this measure, there is no evidence that the project bolstered asset wealth among the supported processors. However, there are indications of increased asset wealth among the fishers. The estimate is not statistically significant for the no-replacement PSM model, but (as noted in Section 6.3) this model is derived from a more restricted sample of the supported households. More seriously, the estimate of the coefficient from the regression with control functions is smaller than those of the other models and not statistically significant at the 10 per cent level. This may imply some uncontrolled bias which has overstated the results of the other models.

It should be noted that, although the project distributed productive equipment included as "assets" in the index used here (fishing nets to the fishers and knifes and brushes to the processors), the acquisition of these assets are not the direct cause of the results generated in Table 7.15. Specifically, the estimates and their significance change little when these items are excluded from the asset index. The balance of evidence does, therefore, suggest that supported fishers were able to increase their household assets since 2008 to a greater extent than the comparison fishers.

Table 7.15: Change in asset index between 2008 and date of survey

	Overall	Fishers	Processors
Unadjusted:			
Sample mean	0.000	0.000	0.000
Intervention mean	0.119	0.586	-0.043
Comparison mean	-0.0966	-0.482	0.035
Unadjusted difference	0.215	1.068**	-0.079
	(0.76)	(2.35)	(-0.24)
Observations:	**394**	**164**	**230**
PSM (ATT)			
Post-matching difference	0.247	1.155**	-0.078
(kernel)	(0.97)	(2.07)	(-0.21)
Observations:	**370**	**146**	**224**
Post-matching difference (no	0.169	0.671	0.217
replacement)	(0.55)	(1.23)	(0.66)
Observations:	**347**	**136**	**211**
Multivariable Regression:			
MVR coefficient (fixed effects;	0.246	0.833*	0.005
robust standard errors)	(0.85)	(1.68)	(0.01)
Observations:	**387**	**161**	**226**
MVR coefficient (robust		0.879**	-0.083
regression)	–	(2.59)	(-0.30)
Observations:		**161**	**225**
MVR coefficient with control	0.232	0.635	0.014
functions (robust SE)	(0.80)	(1.30)	(0.04)
Observations:	**385**	**155**	**224**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

Several positive effect estimates on the asset measure for the fishers were identified, but these are not consistently statistically significant.

7.3.6 Gender balance in household expenditure

For items of household expenditure that can be gender divisible (including expenditure on health, education, transport, and leisure activities), respondents were asked to specify the amounts spent separately on males and females in the household. The ratios, converted onto a logarithmic scale, are shown in Table 7.16. Positive values represent a bias in favour of males and negative values a bias in favour of females. Not surprisingly, the ratio among the fisher households (almost all of which are headed by a male) is in favour of spending on males, whereas in the processors' households (many of which are headed by females), there is more spending on females. The results may be seen to provide an indication that the ratio has shifted even more in favour of females in the supported processors' households than in the comparison processors' households. However, stronger evidence would be required to state this result with confidence.

Table 7.16: Ratio of household expenditure on goods and services for males to females (natural logarithm)

	Overall	Fishers	Processors
Unadjusted:			
Sample mean	0.156	0.918	-0.134
Intervention mean	-0.005	0.900	-0.348
Comparison mean	0.290	0.933	0.045
Unadjusted difference	-0.295	-0.033	-0.393*
	(1.71)	(-0.14)	(-1.88)
Observations:	**329**	**145**	**184**
PSM (ATT)			
Post-matching difference (kernel)	-0.054	0.445	-0.215
	(-0.37)	(1.46)	(-0.74)
Observations:	**306**	**129**	**177**
Post-matching difference (no replacement)	-0.063	0.441	-0.318
	(-0.32)	(1.61)	(-1.16)
Observations:	**282**	**119**	**163**
Multivariable Regression:			
MVR coefficient (fixed effects; robust standard errors)	-0.280	0.196	-0.421
	(-1.41)	(0.71)	(-1.65)
Observations:	**324**	**142**	**182**
MVR coefficient (robust regression)	–	0.391	-0.188
		(1.42)	(-0.92)
Observations:		**141**	**182**
MVR coefficient with control functions (robust SE)	-0.284	0.059	-0.429*
	(-1.42)	(0.21)	(-1.67)
Observations:	**323**	**136**	**181**

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
PSM estimates bootstrapped 1000 repetitions.
Coefficients for covariates used are not presented.

Household expenditure is slightly biased towards males in fishing households, but towards females in processing households.

8 Conclusion and Programme Learning Considerations

8.1 Conclusions

The analysis above provides some useful information on what effects the project activities carried out in 2008/09 were observable among the beneficiary population two and half years later.

First, although the interventions focussed on increasing beneficiaries' productive capacity – through capacity building, the distribution of inputs, and (in the case of the furnaces) providing productive infrastructure – by early 2012 there was no clear difference between the supported and comparison populations in terms of their current productivity or income from fishing and fish processing.

Among the women fish processors who were supported in 2008/09, the effectiveness review failed to find any lasting effects on the various indicators of household income or wellbeing. As a whole, the supported women are essentially indistinguishable from the comparison women in terms of their subjective description of their wealth status, their household's consumption expenditure, their food security situation, and their ownership of assets. It was clear from visits to the project sites that the associations of processors which were established during the project are still active and that at least some of the furnaces which were constructed are still in frequent use.

However, it seems likely that only a minority of the original project participants are still involved in these associations and making regular use of the facilities. Even among the approximately 40 per cent of the original beneficiaries who were still resident at the project sites, many of them were not well-known to the association leaders and could be identified by the survey team only with difficulty. It is possible that the minority who have maintained the association structure and their use of the furnaces have continued to benefit, but that the average effects across all of the project participants who are still living in the area are negligible. Of course, no conclusions can be drawn about the effects of the project on the approximately 60 per cent of the processors who participated in the original project but have since moved away from the area.

Among the fishers, the analysis provides some indications of sustained positive effects from the project on household expenditure, ownership of assets, and (less clearly) on the household's food security situation. While the sample size limits the ability to make precise judgements, several of the effect sizes identified are reasonably significant. For instance, estimates of the difference in food consumption per person range between 19 per cent and 38 per cent.

8.2 Programme Learning Considerations

- **Ensure that project activities are implemented with sufficient intensity and on a long enough time-frame to achieve lasting impact.**

The main finding from this effectiveness review is essentially a positive one: Even a limited duration livelihoods project like this can result in a sustained improvement in the living conditions of beneficiaries. However, the positive effects were found only among the fishers, not among the fish processors. It seems likely that this difference between the two groups, at least partly, reflects the intensity with which the activities were implemented. The number of fishers who were supported by this project was limited to 150, while the number of processors supported was 1,063. The inputs were provided to all of these participants, but the smaller number of fishers meant that they probably had a more intense capacity building experience than did the processors. Project design should ensure that potential impacts can be substantively realised by all project participants.

The findings of the effectiveness review may also be seen as a confirmation of the project team's belief that the project activities should ideally have been sustained for a longer period. The decision to end the project activities in Kasenyi/Tchomia in December 2009 and to shift the area of operations to the Geti area was driven by the availability of funding. These results – which show that achieving sustained impact on household wellbeing is possible but that it is not guaranteed from a short-term project – could perhaps assist in encouraging donors to make longer-term commitments to supporting particular populations.

- **Further investigate the dynamics of change observed among the fishers, to understand how the lack of impact on the level of fishing activities is consistent with the observed increase in household expenditure and asset wealth.**

It is interesting to consider why the supported fishers, on average, have higher household expenditure than the comparison fishers, even though there are no differences between these two groups in the quantity or value of fish

they appear to be selling. A possible explanation for this is that the project helped fishers to generate higher income in the short term and that they subsequently diversified away from fishing into other activities, which are now generating higher returns. Detailed data on time use or other income sources were not collected in the survey, so this question cannot be tested. A more detailed survey or a rigorous qualitative study would be required to investigate this. While further research on this project may not fit within Oxfam's current priorities in the region, it would be valuable to look into what can be learned from this experience when planning future interventions of this kind.