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RESILIENCE IN NIGER

Evaluation of improving livelihoods through integrated water resource management

Effectiveness Review Series 2013/14

Photo credit: Fatoumata Diabate

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EXECUTIVE SUMMARY

Oxfam GB's Global Performance Framework is part of the organisation's effort to better understand and communicate its effectiveness, as well as enhance learning across the organisation. Under this Framework, a small number of completed or mature projects are selected at random each year for an evaluation of their impact, known as an 'Effectiveness Review'. One key focus is on the extent they have promoted change in relation to relevant Oxfam GB global outcome indicators.

This Effectiveness Review, which took place in western Niger in March 2014, was aimed at evaluating the success of the project 'Improving Livelihoods through Integrated Water Resource Management' in enabling participants to strengthen their livelihoods, minimise risk from shocks and adapt to emerging trends and uncertainty. This project was carried out in four communities in the commune of Banibangou between 2008 and 2013 by Oxfam and Karkara, a Nigerien non-governmental organisation. The specific objectives of the project were to:

- improve the management of surface and sub-soil water resources
- increase and diversify crop production
- support livestock production through better management of pastureland and water resources.

Evaluation approach

This Effectiveness Review used a quasi-experimental evaluation design to assess the impact of the activities among the population of the two communities where the project had been implemented through its whole duration: Banibangou town and Soumatt. A random sample of 179 households living in the two communities were interviewed, as well as 70 women who had been specifically supported by the project in kitchen gardening. For comparison purposes, 450 households were interviewed from three communities in the neighbouring commune of Tondikwindi. At the analysis stage, the statistical tools of propensity-score matching and multivariate regression were used to control for apparent baseline differences between the households in the project and comparison communities, to increase confidence when making estimates of the project's impact.

Results

The comparison made in this Effectiveness Review between project communities in the commune of Banibangou and comparison communities in the commune of Tondikwindi, is not ideal in some respects. It appears that there were differences between the two sets of communities (which either existed at baseline or have arisen since) that are unrelated to the project activities. This complicates the process of drawing conclusions from the comparison between them.

Nevertheless, some results have been identified that correspond to key expected impacts of the project – particularly those relating to water access and management. Nearly all of those interviewed in the project communities were aware of the existence of a local water-management committee (compared to only around 80 per cent of matched households in comparison communities), and a large proportion reported participating directly in the committees. A quarter of those in the project communities said that they had used information from the water committees to take decisions about water consumption, against only 15 per cent in the comparison communities.

The effect of the project's work to provide improved water sources was also clear in the results of the survey. Nearly 40 per cent of respondents in the project communities said

that they have access to piped running water, against only 10 per cent in the comparison communities. Under half of those in project communities said that they rely on an open well, compared to more than 80 per cent in the comparison communities. There were also large differences between the households in the project and comparison communities in terms of their access to improved sources of water for kitchen gardening and for livestock. However, no differences could be observed between project and comparison communities in terms of the time spent collecting water, nor in the number of months of the year during which water is available from the main source.

Key results of this Effectiveness Review

Outcome area	Evidence of positive impact	Comments
Access to and use of information on water management	Yes	A significantly higher proportion of residents in the project communities said that they had used information from the local water committee in taking a decision to reduce water consumption.
Access to improved water sources	Yes	Large proportions in the project communities have access to improved sources of water for household consumption, for livestock, and for agriculture.
Engagement in kitchen gardening	Yes	A larger proportion of households in the project communities are engaged in kitchen gardening, and using a much larger area of land than those in the comparison communities.
Increased sales of agricultural products	Yes	Households in the project communities sold products worth more than twice as much, on average, as those in the comparison communities during the 12 months prior to the survey.
Livestock ownership	No	No indication of any effect of the project on livestock ownership, sales or milk production.
Improved food security	Not clear	Some evidence that fewer food security problems were experienced in project communities, although the average value of food consumption was higher in the comparison communities.
Indicators of resilience	Yes	There is evidence of an impact from the project on several of the specific indicators of resilience (see the full list on page 6). However, the impact on the overall index of resilience is small.

Results apply across all households residing in Banibangou town and Soumatt. The impacts of the project across the population of the commune as a whole were not assessed, nor were the impacts in Tiloa, the third community where activities were implemented directly.

As expected, the data provide evidence that the project has had a significant effect on the take-up of kitchen gardening. Households in the project communities were producing a wider range of crop types than those in comparison communities, and were more likely to have taken some of their production to market. On average, the revenue generated from sales of crops during the year prior to the survey was more than twice as high among households in the project communities as in the comparison communities. The adoption of some of the improved agricultural techniques encouraged under the project – the use of improved seeds, fungicide, and sowing in lines – was also found to be higher in the project communities than in the comparison communities. Unexpectedly, the use of composting was more widespread in the comparison communities.

There was little evidence of impact from the project on households' livestock-rearing activities: herd sizes and milk production were similar in the project and comparison communities. Although the number of animals sold over the past year did not differ between the two groups of communities, the revenue generated from sales appears to have been higher in the comparison communities – although it is not completely clear that this is a statistically significant difference.

There was some evidence that the project had a positive effect on standard indicators of food security, but the actual value of food being consumed at the time of the survey was *higher* in the comparison communities. This may reflect higher food prices in the comparison communities, or may simply be a result of underlying differences between the two sets of communities. An index of wealth indicators – ownership of livestock and assets, and housing conditions – provides no evidence of any difference between the project and comparison communities in changes in material wellbeing over the lifetime of the project.

The project activities were intended not only to provide short-term support to vulnerable households, but also to build their resilience to shocks and stresses. Twenty-two characteristics that are thought to be indicators of resilience in the project area were identified, including aspects of livelihood viability, access to and use of water and pastureland, and support available from social structures and other resources in times of crisis. Overall the households interviewed scored positively in 44 per cent of these characteristics. This overall index of resilience was only marginally higher in the project communities than in the comparison communities. However, positive effects of the project can be seen on several of the underlying indicators. The full list of indicators, and a summary of the results for each, is shown in the table below. Respondents were also asked about the extent to which their household had to rely on negative coping strategies during the several months prior to the survey (that is, during the dry season), but there was no clear evidence of impact from the project in this respect.

Characteristics of resilience considered in this Effectiveness Review

Dimension	Characteristic	Connected to project logic?	Evidence of positive impact?
Livelihood viability	Crop diversification	Yes	Yes
	Use of improved seeds	Yes	Yes
	Ownership of livestock	Yes	No
	Ownership of productive assets	No	No
	Livelihood diversification	No	No
Innovation potential	Adoption of innovative practices	No	No
	Access to credit	No	No
Access to contingency resources and support	Access to remittances or formal earnings	No	No
	Savings	No	No
	Access to wild plants for foraging	Yes	Yes
	Social support networks	No	No
	Access to a grain bank	No	No
Integrity of the natural and built environment	Access to drinking water	Yes	Yes
	Access to water for farming	Yes	No
	Access to water for livestock[a]	Yes	Yes
	Access to pasture[a]	Yes	No
	Frequency of bush fires[a]	Yes	No
Social and institutional capability	Contact with extension services	Yes	No
	Use of information from government or local water committees	Yes	Yes
	Participation in community groups	No	No
	Social cohesion in the community	No	No
	Confidence in local government structures to deal with crises	No	No

[a] Omitted for households that do not currently own livestock.

The survey data provide some indication that the households that were specifically supported by the project in kitchen gardening saw a larger increase in wealth indicators, scored better on the index of resilience, and relied less on negative coping strategies than did households in the comparison communities. Unfortunately the statistical basis for this comparison is not strong, so it cannot be claimed with confidence that these results represent an impact of the project activities.

Programme learning considerations

Ensure that systems to monitor the impact of interventions on the livelihoods and risk-management behaviour of participants is integrated into project design.

While this Effectiveness Review provides a snapshot of the situation of those in the communities served by the project, it does not substitute for an understanding of the dynamics of change that they have experienced. Particularly in an area with livelihoods so vulnerable to seasonal weather patterns, a deep understanding of people's resilience could only be gained by regularly monitoring the actions they take to manage risk and respond to crises. This could be done by means of periodic visits to a panel of households across the intervention area, and could involve data collection on standard quantitative indicators as well as (perhaps more importantly) qualitative interviews to understand the reasons for any changes they have experienced and how they see the project activities as having affected their decisions. A clear and robust assessment of the extent to which a project has been responsible for any such changes would still depend on some sort of comparison between communities, as in this Effectiveness Review. However, strengthening and increasing the frequency of monitoring work would probably generate useful understanding and learning even when carried out only in the project communities.

In particular, seek to monitor changes in the food security situation, as well as indicators of nutrition and health more broadly.

The survey data provided some evidence that households in the project communities were experiencing fewer food security difficulties than those in the comparison communities, according to the standard indicators employed (including missed meals, going to sleep hungry, and spending a whole day and night without eating). On the other hand, there was no indication of a difference in the diversity of food types eaten (despite the greater adoption of kitchen gardening in the project communities), and the total *value* of food consumed was greater in the comparison communities. More frequent monitoring may help to clarify these results and the reasons for the apparent contradiction. For understanding the long-term impact of any change in diet – particularly if there has been greater consumption of vegetables – it would also be important to track indicators of health and nutrition at a community level.

1 INTRODUCTION

Oxfam GB's Global Performance Framework is part of the organisation's effort to better understand and communicate its effectiveness, as well as enhance learning across the organisation. Under this Framework, a small number of completed or mature projects are selected at random each year for an evaluation of their impact, known as an 'Effectiveness Review'. One key focus is on the extent they have promoted change in relation to relevant Oxfam GB global outcome indicators.

This Effectiveness Review, which took place in western Niger in March 2014, was intended to evaluate the success of the project 'Improving Livelihoods through Integrated Water Resource Management' in enabling households to strengthen their livelihoods, minimise risk from shocks and adapt to emerging trends and uncertainty. This project was carried out in four communities in the commune of Banibangou between 2008 and 2013 by Oxfam and Karkara, a Nigerien non-governmental organisation. It was decided that the Effectiveness Review should focus on evaluating the impact of the activities in the two communities where the project had been implemented through its whole duration: Banibangou town and Soumatt.

This report presents the findings of the Effectiveness Review. Section 2 briefly reviews the activities and the intervention logic of the project. Section 3 describes the evaluation design used, and Section 4 describes how this design was implemented. Section 5 presents the results of the data analysis, based on the comparison of outcome measures between the intervention and comparison groups. Section 6 concludes with a summary of the findings and some considerations for future learning.

Figure 1.1: Map of Niger, with the project area (the commune of Banibangou) circled.

2 PROJECT DESCRIPTION

The project 'Improving Livelihoods through Integrated Water Resource Management' was implemented in four communities in the commune of Banibangou between 2008 and 2013 by Oxfam in partnership with Karkara. The project had three specific objectives, all of which sought to contribute to an improvement in livelihoods and living conditions:

- Improve the management of surface and sub-soil water resources.
- Increase and diversify crop production.
- Support livestock production through better management of pastureland and water resources.

The first strand of the project involved making investments in the water-supply infrastructure in the project communities and in the wider commune, while at the same time building the capacity of local water-management committees to monitor and manage the water level. A borehole was rehabilitated and improvements made to the distribution system in Banibangou town, a water tank was installed in Soumatt, and in both locations dry wells were sealed in order to be used for water storage. Rain gauges and equipment to monitor groundwater levels were installed. Local water-management committees were set up and were provided with training and technical support to enable them to monitor rainfall, groundwater, and the level of water available in the wells. These committees were trained to provide the community with regular feedback on rainfall and the water level, so that community members could deliberate and agree on taking action to conserve water supplies if necessary. In addition, their monitoring data are reported to the hydrological extension service and the meteorological office for use in forecasting and planning for provision of support.

The second component of the project involved working directly with groups of women to support them in kitchen gardening (*maraichage*). There is a history of kitchen gardening in the Banibangou area, but the activity had become less common in recent years as a result of water scarcity. The project encouraged women producers who were interested in re-engaging in kitchen gardening to form groups, and then supported them in developing communal plots. (An exception was in Tiloa, where production was instead carried out in private plots.) A priority was to supply these plots with water to allow for the production of vegetables during the dry season: in some cases existing wells were converted into cisterns, while in other cases dams were constructed. Group members also received training and technical support in vegetable production. These activities were intended to provide participants and their households with both a food source and a source of income during the dry season, while benefiting the wider community by increasing the availability of a range of food types at that time of the year.

The final component of the project involved rehabilitating water sources across the local grazing lands, to provide more reliable and better-quality sources of water for livestock. Other activities involved protecting pasturelands, especially by creating fire breaks. These activities were intended to protect the health of livestock and to reduce losses, as well as to reduce the risk of conflict by preventing pastoralists from needing to migrate from their own habitual grazing lands. Importantly, these activities would naturally have benefited pastoralists across the local area (roughly, across the commune of Banibangou), rather than being specifically aimed at those based in the specific target communities.

Other activities carried out under the project included:

- Cash for work activities to conserve rainwater (especially through the construction of *demi-lunes*) and to guard against erosion.
- Conserving trees and forests, including the promotion of agroforestry products and by providing grants directly to households to protect trees. These activities were aimed not only at improving the environment, but also at increasing the availability of wild fruits, which are important as a food source in times of crisis.
- Setting up a grain bank in Tiloa.
- Organising visits to exchange experiences with producers from other areas of Niger and from Burkina Faso.
- Organising a peace forum and other meetings aimed at building solidarity and reducing conflict between communities in the commune.

The project was launched in Banibangou town in 2008, and was expanded to cover the villages of Soumatt and Tiloa, both of which are within Banibangou commune, in 2009. Insecurity meant that Tiloa could not be accessed for implementation of the full range of project activities. Although the project formally closed in March 2013, some activities (distribution of seeds and other agricultural inputs, promotion of agroforestry, and continued capacity building at community and commune level) have continued in Banibangou and Soumatt, as well as in a fourth community, Kolukta.

3 EVALUATION DESIGN

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

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

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

In the case of the project examined in this Effectiveness Review, the implementation sites were not selected at random. Instead, the partners targeted specific communities that were seen to be particularly vulnerable, and where there was potential for the project activities to contribute to reduce vulnerability. However, it is clear that levels of vulnerability throughout the region are high, and that there are many more communities where the project activities could have been implemented. This allowed a 'quasi-experimental' evaluation approach to be adopted, in which the situation of people living in communities outside the implementation area was assumed to provide a reasonable counterfactual for the situation of people living in the communities where the project had been implemented.

It is important to note that some of the project activities focused on providing benefits for the population in three specific communities, while other activities were intended to benefit the population of the commune of Banibangou as a whole. For example, the rehabilitation of wells in pasturelands and the planting of pasture and construction of fire breaks are likely to have had a positive impact for households across the commune, since these pasturelands are not used specifically by the residents of any one village. In addition, some capacity-building in water-management practices that was carried out at a commune level, and the establishment of local water committees, were not restricted to the four project communities. For this reason, if comparison households were interviewed from within the commune of Banibangou, this would likely have under-estimated the effects of the project.

Instead, the team working on the Effectiveness Review identified communities in a neighbouring commune that had similar characteristics to the project communities, in terms of their balance of livelihoods activities, approximate size, access to water, availability of infrastructure (particularly roads and electricity) and distance from urban areas. The communities identified for comparison purposes are located in the commune of Tondikwindi, and are, in fact, included in a newer Oxfam project, which was in the initial stages of implementation at the time of the Effectiveness Review. It was thought that the outcomes for households in these communities had not yet been

significantly affected by the newer project activities. An additional advantage of selecting a comparison group from these communities was that the group could also function as an additional baseline survey for the new project, potentially useful both for informing programme staff on the characteristics of the population of these communities, and for testing the relationship between the characteristics of resilience (discussed in Section 5.9 of this report) and eventual outcomes over the coming years.

Making a comparison of outcomes between project communities in one commune (Banibangou) and non-project communities in another commune (Tondikwindi) is not ideal, since it is possible that there are differences between the two communes unrelated to the project activities that may have an effect on the outcome measures. For example, the quality of services or leadership provided by commune-level authorities may have significantly different effects on the ability of the people and communities in those communes to deal with shocks and stresses. While there were not thought to be any major differences between the two communes, this possibility cannot be ignored when comparing outcomes between the project and non-project communities.

To improve confidence in making this comparison, households in the project communities were 'matched' with households with similar characteristics in the non-project (or 'comparison') communities. Matching was performed on the basis of a variety of characteristics – including household size, ethnicity, education level, productive activities, and indicators of material wellbeing, such as housing conditions and ownership of assets. Since some of these characteristics may have been affected by the project itself (particularly those relating to productive activities and wealth indicators), matching should be performed on the basis of these indicators *before* the implementation of the project. Although baseline data were not available in this case, survey respondents were asked to recall some basic information about their household's situation during the dry season of 2006/07, before the project was implemented. Although these recall data are unlikely to be completely accurate, they are thought to enhance the reliability of the comparison used to make conclusions in this report.

The survey data provided a large number of baseline household characteristics on which matching could be carried out. (The characteristics that were in fact used are listed in Appendix 2.) One practical problem is that it would be very difficult to find households in the comparison communities that correspond exactly in all these characteristics to households in the project communities. Instead, these characteristics were used to calculate a 'propensity score', the conditional probability of the household being in an intervention community, given particular background variables or observable characteristics. Households in the project and comparison communities were then matched based on their having propensity scores within certain ranges. Tests were carried out after matching to assess whether the distributions of each baseline characteristic were similar between the two groups. Technical details on this approach are described in Appendix 3.

As a check on the results derived from the propensity-score matching process, results were also estimated using multivariate regression models. Like propensity-score matching, multivariate regression also controls for measured differences between intervention and comparison groups, but it does so by isolating the variation in the outcome variable explained by being in the intervention group after the effects of other explanatory variables have been accounted for. It should be noted that both propensity-score matching and multivariate regression rely on the assumption that the 'observed' characteristics (those that are collected in the survey and controlled for in the analysis) capture all of the relevant differences between the two groups. If there are 'unobserved' differences between the groups, then estimates of outcomes derived from them may be misleading. This point is further discussed in interpreting the statistical results in Sections 5 and 6.

4 DATA

4.1 SAMPLING

As discussed in Section 3, the survey was conducted with a random sample of all the households living in the four project communities and three comparison communities. In addition, a random sample of those households that were specifically supported by the project in kitchen gardening was interviewed.

The number of households targeted for interview among the general population in each of the project communities was proportionate to the number of households estimated to reside in that community. The numbers to interview in the comparison communities were selected so that the proportions of respondents from smaller and larger communities would be approximately the same as in the project communities. On arriving in each community, the survey team made contact with a key informant, and proceeded to make a list of all the households in the communities. Households were selected at random from this list by systematic random sampling.

In the project communities, the survey team worked with project informants to draw up lists of those households specifically supported by the project in kitchen gardening. Households were then selected at random from this list by systematic random sampling. In cases where a household had already been selected for interview on the list of the general population, an alternative household was selected instead.

Table 4.1: Intervention and comparison communities sample sizes

Commune	Community	Number of households interviewed at random	Number of additional kitchen garden participants interviewed
Banibangou (project sites)	Banibangou Zerma	79	36
	Banibangou Hausa	29	24
	Soumatt I	40	4
	Soumatt II	31	6
	Total	**179**	**70**
Tondikwindi (comparison sites)	Mangaizé ville	309	
	Mangaizé Ko and Kromobara	141	
	Total	**450**	

It was expected that approximately 20 per cent of those households that were selected at random from among the general population would have been specifically supported in kitchen gardening. The intention was to estimate the specific impact of the kitchen gardening intervention by comparing those participant households that were randomly selected from the general population to the 70 additional households that were selected from the list of kitchen garden participants. Unfortunately it did not prove possible from the survey data to identify which of those among the general population had been participants in the kitchen garden intervention: two thirds of the households selected from the general population in the project communities reported that they had received training in kitchen gardening since 2006/07, as did nearly 40 per cent in the comparison communities. The consequence of this is that the estimates of the impact of the specific kitchen garden intervention could be made among only the 70 respondents who are directly known to have participated in that intervention. As is

discussed in Section 4.2 (and in more detail in Appendix 3), adequate matches could not be found in the comparison communities for most of these 70 households, meaning that our ability to draw conclusions about the impact of the kitchen garden component of the project is severely limited.

4.2 ANALYSIS

Households in project and comparison communities were compared in terms of their demographic characteristics, livelihoods activities and economic situation in the dry season of 2006/07. These data were based on information recalled during the questionnaire or reconstructed from the household's composition at the time of the survey.

The full comparison is shown in Appendix 2. Some important differences were found between the households in project and comparison communities. For example, a much higher proportion of survey respondents in the project communities reported that they were engaged in kitchen gardening in 2006/07 (68 per cent) than in comparison communities (28 per cent). There were also significant differences between the project and comparison communities in the mix of ethnic groups, the livelihoods activities in 2006/07, whether the household had electricity, and the geographic location (distance to the nearest market). In addition, significantly more of the respondents in the project communities were heads of household (77 per cent) than in the comparison communities (62 per cent), and correspondingly fewer of the respondents in the project communities were female.

Clearly these differences, which existed before the project, have the potential to bias any comparison that is made of the project's outcomes in the project and comparison communities. It was therefore important to control for these baseline differences when making such comparisons. As described in Section 3, the main approach used in this Effectiveness Review to control for the baseline differences was propensity-score matching (PSM). The full details of the matching procedure applied are described in Appendix 3. After matching, households in the project and comparison communities were reasonably well-balanced in terms of the recalled baseline data. Some statistically significant differences remain between the two groups, but the sizes of these differences are small. The most significant difference is in the proportion of adult household members (in 2006/07) who had ever attended school: in the project communities this proportion was 39 per cent on average, and in the comparison communities it was 47 per cent.

Unfortunately, approximately a quarter of the households interviewed in the project communities (47 of the 179) could not be matched with households in the comparison communities, and had to be dropped from the analysis. The consequence of this is that the estimates of the project's impact presented in Section 5 are not based on a fully representative sample of households in the project communities, but exclude a non-random minority. However, all the results described in Section 5 of the report were tested for robustness by estimating them with several alternative statistical models, including alternative PSM models and linear or probit regression models. Some of these alternative models were constructed using a less restricted subset of households, and some using the full set of households interviewed. Where the alternative statistical models produce markedly different results from those shown in the tables in this section, this is discussed in Section 5, in the text or in footnotes.

It is important to recall, as highlighted in Section 3, that PSM and regression models can control only for the baseline differences between the households in project and comparison communities for which data were collected in the survey. If there are any

‘unobserved’ differences between the two groups – such as individuals’ attitudes or motivation, differences in local leadership, or weather or other contextual conditions – then these may bias the estimates of outcomes described in Section 5. This must particularly be borne in mind given that the project and comparison communities were located in different communes, and that the number of communities in which the survey was carried out was relatively small.

As discussed in Section 4.1, an additional sample of households was interviewed from among the households that had been directly supported in kitchen gardening. The intention was to find matches for these households from among the random sample of households in the comparison communities, and therefore to estimate the impact of the project specifically among the kitchen garden participants. Unfortunately the households that participated in kitchen gardening were found to have many characteristics that were different from the comparison communities, and suitable matches could not be found for a large number of them. This meant that it was not possible to construct a PSM model for the kitchen garden participants. (Details are discussed in Appendix 3.) Instead, regression models were constructed to investigate correlations between the various outcome measures and participation in the kitchen garden activities, after controlling for the various baseline characteristics. The evidence provided by these regression models about the impact of the project is less strong than the evidence provided by the PSM models – but in any case, the results are discussed in Section 5 where they differ markedly from the results among the population in the project communities as a whole.

5 RESULTS

Statistics primer

The main body of this report is intended to be free from excessive technical jargon, with more detailed technical information being restricted to the footnotes and appendices. However, there are some statistical concepts that cannot be avoided in discussing the results.

Effect size

The size or magnitude of an effect when evaluating outcomes refers to the size of the difference between groups. In this report, results will usually be stated as the average difference between the households in the communities where the project activities were implemented (that is, the 'intervention group') and the matched households in the communities where the project was not implemented (the 'comparison group').

Statistical significance

When we use the word 'impact' in this report, we are referring to differences between the households supported by the project activities and the corresponding households in the comparison communities that are *statistically significant*. Imagine that we find that the average household in the project communities owns four goats at the time of the survey. Given that the average comparison household owns only two goats, this would appear to be a large difference between the project and comparison households . However, it is important to remember that this estimated average impact is derived from data on a *sample* of households, rather than data on the whole population. It is possible that, by chance, we happen to have interviewed households in the project communities that own unusually large numbers of goats, but that the ownership among households in the overall population of those communities is similar to that found among households in the comparison communities.

For this reason, it is necessary to take into consideration the statistical probability of finding a difference in ownership of two goats, if there were in reality no difference between the project and comparison communities and in the average number of goats owned. This probability is usually referred to as the *p*-value. *p*-values help to evaluate study hypotheses. The default hypothesis is always that there are no differences between the intervention and comparison groups. When a difference is detected, the *p*-value is used to evaluate whether the default hypothesis (that there is no difference between the intervention and comparison groups) should be rejected – that is, to conclude that the project had an impact. If the *p*-value is small, for instance one per cent, this means that there is a probability of only one per cent that our sample would show project households owning an average of two additional goats compared to comparison households when the true difference were zero. This is a small probability, and so we would have confidence in rejecting the default hypothesis that the project had no impact on the ownership of goats. We would then say that the result is 'statistically significant'. Note that the larger the sample size and the smaller the variation in the outcome measures among the sampled households, the smaller the *p*-value will be, and hence the more likely we are to be able to conclude that a result is statistically significant.

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

5.1 INTRODUCTION

This section presents a comparison of the households interviewed in project and comparison communities in terms of various outcome measures relating to the project under review. In the tables of results, asterisks are used to indicate where the differences are statistically significant at at least the 10 per cent significance level.

The results are shown after correcting for apparent baseline differences between the households interviewed in the project communities (the 'intervention group') and those in the comparison communities using a propensity-score matching (PSM) procedure. More information about the procedure applied is found in Appendix 3. All outcomes discussed here have also been tested for robustness with alternative statistical models; where those alternative models produce markedly different results from those shown in the tables in this section, this is discussed in the text or the footnotes.

It is important to stress that the results presented in this section are average results across *all* the households in the communities where the project was carried out. The results for the project communities include households that directly participated in the project activities, as well as those that did not. A separate sample of households who had been supported directly in kitchen gardening was also interviewed, and regression models constructed to test for a correlation between participating in this intervention and the outcome measures. These regression models provide evidence that is less strong than do the PSM models for impact among the community members as a whole, but the results are nevertheless discussed in this section where appropriate.

Two further points should be remembered when interpreting the results presented in this section. Firstly, around a quarter of the households surveyed in the project communities (47 of the 179 interviewed) were excluded from the analysis during the matching process. This means that the results shown in the tables in this section are not based on a fully representative sample of households in the project communities. However, some of the alternative statistical models used (and discussed in the text or footnotes where appropriate) do include the full set of households interviewed in the project communities. Secondly, if there are any 'non-observable' differences between the households surveyed in project and comparison communities – such as individuals' attitudes or motivation, differences in local leadership, weather or other contextual conditions – then these may affect the estimates of outcomes. This must particularly be borne in mind given that the project and comparison communities were located in different communes, and that number of communities in which the survey was carried out was relatively small.

5.2 INVOLVEMENT IN PROJECT ACTIVITIES

The first step in understanding what impact this project has had is to examine the extent to which respondents reported that they have received the types of support and participated in the various activities implemented under the project.

Table 5.1 shows the differences between the proportions of respondents interviewed in the project and comparison communities in terms of support received by their households since the dry season of 2006/07. It can be seen in column 1 of the table that just over half of the households reported having received training on agricultural

production techniques, a number which seems to be significantly higher than among households in the comparison communities.[1] Nearly two-thirds reported having received training on kitchen gardening – again, a higher proportion than in the comparison communities. Just under one in ten had participated in an exchange or study visit.

One of the project's objectives was to improve connections between people in the project communities and the extension services. Columns 4 to 6 of Table 5.1 show the proportions of households that reported having had any contact (in the form of a visit, or support or advice) with agents of the three extension services since 2006/07. Surprisingly, there is little or no difference between the project and comparison communities in the proportions having had contact with the hydrological or agricultural extension services. Considerably *fewer* households in the project communities than in the comparison communities had had contact with the livestock extension service (24 per cent, against 42 per cent in the comparison communities). Of course these results do not provide any information about the number of times people had received support from the extension services, nor about the quality of the interaction.

Table 5.1: Proportion of households having received support since 2006/07

	1	2	3	4	5	6
	Received training on agricultural production %	Received training on kitchen gardening %	Participated in an exchange or study visit %	Received advice or support from the hydrological extension service %	Received advice or support from the livestock extension service %	Received advice or support from the agricultural extension service %
Intervention group mean:	51.5	64.4	9.1	31.8	23.5	36.4
Comparison group mean:	40.6	55.1	3.1	35.3	42.1	44.8
Difference:	10.9* (6.4)	9.3 (6.3)	6.0* (3.1)	-3.5 (6.9)	-18.7*** (5.5)	-8.5 (6.3)
Observations (intervention group):	148	148	148	148	148	148
Observations (total):	582	582	582	582	582	582

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

Survey respondents were also asked about whether their households had received any of various forms of tangible support from any organisation during the 12 months prior to the survey. Table 5.2 compares households in the project and comparison communities in terms of their responses. As described in Section 2, a number of households received distribution of agricultural inputs during 2013 under this project. However, it can be seen from columns 1 and 2 of the table that the proportions who reported having received seeds or other agricultural inputs were lower in the project communities than in comparison communities.

Columns 3 to 5 of Table 5.2 show that more households in the comparison communities than the project communities had also received various forms of support not connected with the project. In general, then, it appears that larger numbers of people in the comparison communities were receiving support from NGOs and from the extension services than in the project communities. This seems to imply that those

organisations were more active in the comparison communities (and with some project activities similar to those carried out in the project communities) than had been thought prior to carrying out the survey.

For this reason, additional statistical models were constructed to control for the level of support received during the 12 months prior to the survey. That is, these models take account of whether households had received the five types of support listed in Table 5.2 when making comparisons between the project and comparison communities.[2] The results obtained from these models differed from those presented in this report in a few cases: where this occurs, it is noted in the text.

Table 5.2: Proportion of households having received support during the 12 months prior to the survey

	1	2	3	4	5
	Distribution of seeds %	Distribution of other agricultural inputs %	Participation in Cash for Work %	Food distribution %	Cash transfers %
Intervention group mean:	51.5	25.0	41.7	26.5	31.8
Comparison group mean:	66.0	36.8	50.4	39.6	44.3
Difference:	-14.5** (5.9)	-11.8** (5.9)	-8.7 (6.8)	-13.1** (6.6)	-12.5* (6.8)
Observations (intervention group):	148	148	148	148	148
Observations (total):	582	582	582	582	582

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

5.3 WATER MANAGEMENT

We now turn to examining the evidence that the project produced the various changes in outcomes it was trying to affect, starting with water management in the project communities.

As discussed in Section 2, a key activity of the project has been to support and build capacity of the local water management committees. The first column of Table 5.3 shows that almost all respondents in the project communities were aware of the existence of the water management committee, whereas around one in five in the comparison communities were not. The proportion of respondents who said they have at least some awareness of the committee's activities was also significantly higher in the project communities. (On the other hand, the 40 per cent who said that they had quite a good understanding did not differ between the project and comparison communities.) It can be seen in column 3 that nearly 20 per cent of the respondents in the project communities said that at least one member of their household was a member of the committee – a figure which is unrealistically high, but perhaps includes many of those who have been trained as water-level monitors.

Columns 4 and 5 of Table 5.3 show the proportions of respondents who confirmed that the committee regularly provides them with information on the level and the quality of water available locally. Interestingly, these proportions did not differ much between the project and comparison communities.[3] However, there is stronger evidence of a difference in the proportions who reported that the committee *sometimes* provides this information (though figures are not shown in this table).

The indicators provided in Table 5.3 are clearly able to provide only some basic information about awareness of the water committee's activities in the project communities. From interviewing members of the community at large, it was not possible to evaluate the effectiveness of the training and support provided by the project on the capacity of committee members or on the type and quality of the information they provide to the community. Evaluation of these aspects of the project would require a more in-depth evaluation focusing specifically on the committee members.

Table 5.3: Respondents' awareness of activities of water committee

	1	2	3	4	5
	Respondent is aware of the existence of the local water management committee %	Respondent has at least some knowledge of what the committee does to project water supplies %	Some household member is a member of the local water management committee %	Committee regularly provides information on the local availability of water %	Committee regularly provides information on the quality of water available %
Intervention group mean:	95.5	63.6	18.9	43.9	40.9
Comparison group mean:	78.1	54.2	5.3	43.0	44.5
Difference:	17.4*** (4.75)	9.4 (6.9)	13.7*** (4.3)	1.0 (6.7)	-3.6 (6.6)
Observations (intervention group):	148	148	148	148	148
Observations (total):	582	582	582	582	582

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

However, one outcome that could be examined in the households survey was the use to which the information provided by the water committees has been put. Survey respondents were asked specifically whether they had made a decision to limit their use of water at any point during the past 12 months. As can be seen in column 1 of Table 5.4, just over half of the people interviewed responded positively to this question, and this proportion did not differ significantly between the project and comparison communities. When asked in a follow-up question to specify what prompted them to take this decision, those in the project communities were much more likely to attribute this decision to advice from the water management committee. This provides at least some indication of an effect from the project activities on the behaviour of community members. There were also indications that more of those in the project communities attributed their decision to limit water use to advice from the extension service or other government officers.[4]

Table 5.4: Households' use of water

	1	2	3
	Household has taken decision to limit use of water at least once during past 12 months %	Household has taken decision to limit use of water at least once during past 12 months, based on advice of water management committee %	Household has taken decision to limit use of water at least once during past 12 months, based on advice of government officials %
Intervention group mean:	56.1	25.0	5.3
Comparison group mean:	55.0	15.1	2.6
Difference:	1.1 (7.0)	9.9* (5.9)	2.7 (2.3)
Observations (intervention	148	148	148
Observations (total):	582	582	582

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

Another important aspect of the project was in improving people's access to water – for their households, for farming, and for livestock. The project's effects on access to water for farming and livestock will be considered in subsequent sections, but Table 5.5 includes some measures of households' access to improved sources of drinking water. Firstly, it can be seen that there are large differences between the project and comparison communities in the types of water sources being used: less than half of those in the project communities were using an open well as their main source of water, and 39 per cent said that they have access to piped water.[5] Column 3 of the table provides some evidence of a corresponding decrease in the time household members spend collecting water.[6] Column 4 of the table implies that there is no significant difference between the project and comparison communities in the number of months for which water is available from the main source – but those in the project communities reported an improvement in the number of months of availability of water from their main source since 2006/07, whereas those in the comparison communities reported a decrease.

Column 5 of Table 5.5 shows, as expected, that it is much more common in the project communities than the comparison communities to pay for access to water. However, most of these said that the fee is small or symbolic; only seven per cent of those in the project communities (and two per cent in the comparison communities) reported that they are expected to pay a substantial fee to access drinking water.

Table 5.5: Respondents' awareness of activities of water committee

	1	2	3	4	5
	Household's main source of drinking water is an open well %	Household's main source of drinking water is piped running water %	Average time required to collect water from this source (minutes, round trip)	Average number of months during the year for which water is available from the main source	Household pays for access to water %
Intervention group mean:	47.7	38.6	13.3	10.7	47.7
Comparison group mean:	81.2	9.6	14.7	11.0	14.6
Difference:	-33.5*** (5.7)	29.0*** (5.5)	-1.4 (1.8)	-0.3 (0.4)	33.1*** (5.6)
Observations (intervention group):	148	148	148	139	148
Observations (total):	582	582	582	542	582

Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1000 repetitions.

5.4 AGRICULTURAL ACTIVITIES

Survey respondents were asked various questions about their households' farming activities during the year before the survey. Some of key results are shown in Table 5.6. As can be seen in column 1, there was no significant difference between households in the project and comparison communities in terms of the average area of land on which they were cultivating staple crops. Most households (78 per cent overall) were also cultivating a kitchen garden; as shown in column 2 of the table, this proportion was significantly higher in the project than in the comparison communities. (Comparison with the recalled baseline data confirms that this change appears to be the result of greater take-up of kitchen gardening in the project communities since 2006/07.[7]) There is a large difference between the project and comparison communities in terms of the area devoted to kitchen gardening, as shown in column 3. However, the majority of respondents (even those specifically supported in kitchen gardening) reported that the area they cultivate had not changed since 2006/07, which would imply that the difference shown in column 3 of Table 5.6 was present even before the project began.

Outcomes relating to this greater engagement in kitchen gardening in the project communities are shown in columns 4 to 6 of Table 5.6. Column 4 shows that households in the project communities produced an average of 10 crop types during 2013, compared to an average of eight crop types among matched households in the comparison communities. Comparison with the recalled baseline data implies that this difference has arisen since 2006/07. It should again be recalled that these are average figures for the sample of all households residing in the communities: the project's impact on the diversity of crop types produced by those households that were specifically supported in kitchen gardening may be higher.[8]

Column 5 of Table 5.6 shows that nearly half of households in the project communities brought some crops to market during 2013, against only a third among the corresponding households in the comparison communities. Again, this appears to represent a significant change in the project communities since 2006/07. The right-hand column of the table shows that households in the project communities were

generating more than twice as much revenue on average from crop sales than were matched households in the comparison communities.[9] Of course this does not necessarily imply that total net household income is correspondingly higher in the project communities. One reason is that there were probably additional costs involved in producing the extra crops sold by those in the project communities. Perhaps even more important, there were almost certainly opportunity costs involved: if those in the project communities were spending more of their time and energy in cultivating and marketing crops, they are likely to have devoted less time to alternative livelihoods activities. For this reason, sections 5.6 and 5.7 of this report will investigate the project's impact on indicators of overall household wellbeing.

Table 5.6: Households' agricultural activities in 2013/14

	1	2	3	4	5	6
	Area of land on which household cultivated staple crops (hectares)	Household engaged in kitchen gardening %	Area of land used by household for kitchen gardening (square metres)	Number of crop types produced since January 2013	Household sold any crops during 2013 %	Value of crops sold during 2013 (francs CFA)
Intervention group mean:	3.91	82.6	2291	10.1	49.2	18 056
Comparison group mean:	4.25	73.3	526	8.3	33.0	7 985
Difference:	-0.34 (0.65)	9.3* (4.9)	1765*** (536)	1.8*** (0.5)	16.2** (7.1)	10 045** (4 482)
Observations (intervention group):	148	148	148	148	148	148
Observations (total):	582	582	582	582	582	581

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

One of the project's objectives was to promote the use of improved agricultural practices. Table 5.7 shows the figures reported in the survey for use of various improved techniques by households in the project and comparison communities. It can be seen that the proportion of households using improved seeds and fungicide was considerably higher in the project communities. The practices of sowing in lines and using a watering can were also found to be more common in the project communities, though it is not clear that these differences are statistically significant. Surprisingly, a much higher proportion of households in the comparison communities reported using compost than those in the project communities – though this difference apparently existed at baseline.[10] The use of improved ploughing techniques may also be more common in the comparison communities, but the evidence for this is not clear.[11]

Table 5.7: Proportion of households using improved agricultural techniques during the past farming season

	1	2	3	4	5	6
	Use of any improved seeds[a] %	Use of composting %	Use of fungicide %	Use of a watering can %	Use of improved ploughing techniques %	Sowing in lines %
Intervention group mean:	60.6	39.4	57.6	56.8	30.3	81.8
Comparison group mean:	46.8	69.1	32.6	46.8	42.8	72.3
Difference:	13.8** (6.8)	-29.7*** (6.6)	25.0*** (6.7)	10.1 (6.3)	-12.5* (6.4)	9.5* (5.6)
Observations (intervention group):	148	148	148	148	148	148
Observations (total):	582	582	582	582	582	582

[a] Households having specifically purchased any improved seeds or having used seeds that were donated by government services or NGOs
Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions.

Table 5.8 presents some indicators of households' access to water for use in kitchen gardening. These figures are restricted to those households that were actually engaged in kitchen gardening. Column 1 confirms that the use of *bassins* for water supply was restricted to the project communities. Although only 13 per cent of those in the project communities reported using a *bassin* as their main water source, this figure was 29 per cent among those specifically supported in kitchen gardening.

Most of those engaged in kitchen gardening reported that they have access to water at the site itself. The average time taken to fetch water – shown in column 2 of Table 5.8 – was therefore quite small. There is some indication that this time may be smaller in the project communities than in the comparison communities, though the differences are not statistically significant. It is notable that, among the direct participants in the project's kitchen-gardening activities, only 16 per cent said that they have to spend any time fetching water.

On the other hand, as shown in column 3 of the table, respondents in the project communities reported having water available for kitchen gardening for only eight months of the year on average, significantly less than did those in the comparison communities. (Even among the households specifically supported in kitchen gardening, the average was only 8.5 months.)

When asked to evaluate the quality of the water they use for kitchen gardening, most of those in the comparison communities described the water quality as 'good' (as shown in column 4 of the table), but only just over half of those in the project communities did so. Among those supported in kitchen gardening, 76 per cent responded positively, which is a similar proportion to the comparison communities. Of course such a subjective indicator does not prevent a very clear assessment of whether there are real differences in the quality of water between the project and comparison communities: it could equally indicate that those with exposure to the project activities have higher expectations about water quality.

Finally, column 5 of Table 5.8 shows that just over one in five households in the project communities reported paying a fee to access water for agriculture. Among those supported by the project in kitchen gardening, two thirds said that they had to pay for

water. However, consistent with the results on payment for household water supply discussed in Section 5.3, most of these respondents said that the fee is small: only seven per cent of those supported in kitchen gardening said that they had to pay a substantial fee to access water.

Table 5.8: Access to water for kitchen gardening, among those households engaged in kitchen gardening

	1	2	3	4	5
	Main source of water for irrigation is a *bassin* %	Average time required to collect water (minutes, round trip)	Number of months water was available during the past 12 months	Respondent describes the quality of water available as 'good' %	Household pays for access to water %
Intervention group mean:	12.8	3.3	8.2	54.1	22.0
Comparison group mean:	0.6	5.2	9.8	86.3	1.1
Difference:	11.7*** (3.6)	-1.9 (1.2)	-1.5** (0.6)	-29.8*** (6.9)	20.6*** (4.2)
Observations (intervention group):	124	124	124	124	124
Observations (total):	372	371	372	372	372

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

5.5 LIVESTOCK REARING

As discussed in Section 2, another aspect of the project provided support to livestock rearing, through the provision of training, the rehabilitation of water sources, and the protection of pastureland from erosion and fire. Table 5.9 examines some outcomes relating to livestock rearing activities in the project and comparison communities.

It can be seen in column 1 of Table 5.9 that more than half of households owned some livestock (excluding poultry) at the time of the survey, but that this proportion did not differ between the project and comparison communities. Although the number of livestock is estimated (in column 2 of the table) to be smaller on average in the project communities, this difference is not statistically significant.[12] Approximately a third of respondents reported that their household had sold some livestock during the past 12 months: as observed in column 3, the average number of animals sold again did not differ between the project and comparison communities. Surprisingly, the revenue generated from livestock sales – shown in column 4 – was on average much smaller in the project communities than in the comparison communities. However, even this large difference is not consistently found to be statistically significant under the various statistical models tested, so it is not clear that this represents a real difference between households in the project and comparison communities.[13]

The right-hand column of Table 5.9 shows that there was no indication of a difference between the project and comparison communities in terms of the quantity of milk produced during the two weeks prior to the survey. Only eight per cent of survey respondents reported that their household had produced any milk during that two-week period, and only one per cent reported having *sold* any milk during that time.

Table 5.9: Households' livestock-rearing activities (excluding poultry)

	1	2	3	4	5
	Household has any livestock %	Number of livestock owned by household	Number of livestock sold in the past 12 months	Total value of sales of livestock in the past 12 months (francs CFA)	Milk production during the past two weeks (litres)
Intervention group mean:	56.1	4.39	1.23	25 150	1.04
Comparison group mean:	61.2	6.40	1.63	68 706	1.07
Difference:	-5.2 (6.5)	-2.01 (1.44)	-0.40 (0.59)	-43 556** (21 927)	-0.03 (0.60)
Observations (intervention group):	148	148	148	148	148
Observations (total):	582	582	582	582	582

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

A particular challenge encountered in this survey was how to evaluate changes in access to and quality of pastureland. Since no clear objective measure was available that could be asked in the course of a household survey, respondents were instead asked for their subjective impression of whether the households' access to pastureland had increased or decreased since 2006/07, and whether the quality of that land had improved or deteriorated over the same period. As can be seen in the first two columns of Table 5.10, around a third of respondents gave positive answers to each of those two questions, and there was no indication of any difference between the intervention and comparison groups.

One aspect in which the project's impact on pastureland was clear was that the majority of livestock-owning households in the project communities (63 per cent) reported that there are fire breaks in their grazing land, against only a small proportion (24 per cent) of those in the comparison communities. However, when asked to estimate whether the frequency of bush fires had increased or decreased since 2006/07, there was again no detectable difference between those in the project and comparison communities. (Data relating to this measure are not shown in the table.) No data were collected about changes in the *damage* caused by bush fires.

More objective measures were available to evaluate the project's impact on access to water. Column 3 shows the proportions of households that had access to an improved water source (an *abreuvoir* or *borne fontaine*). As would be expected from the project's activities, a much larger proportion of the households in the project communities responded positively than did those in the comparison communities. (It is also worth noting that these improved water sources are thought to have benefited the population across the Commune of Banibangou, so that the results in the two project communities included in this survey do not represent the full impact of the project.) On the other hand, column 4 of the table shows that those in the project communities reported that the number of months of the year during which water was available in the household's normal grazing lands was no greater than among those interviewed in the comparison communities.[14]

The subjective questions about changes in access to and quality of pastureland were repeated in terms of access to, and quality of, water available for livestock: the results are shown in columns 5 and 6 of Table 5.10. The majority of respondents gave positive answers to these questions on water access and quality (whereas the majority had reported a deterioration in access to and quality of pastureland). There is again no indication of a difference between the project and comparison communities in terms of

their evaluation of a change in access to water. However, there is some evidence suggesting that respondents in the project communities were significantly more likely to say that the quality of the water used by their livestock had improved 'a lot' since 2006/07: 57 per cent of those in the project communities gave this response, against 48 per cent of those in the comparison communities.[15] In particular, most of those who said they had access to an improved water source reported that the quality of water had improved 'a lot'.

Table 5.10: Access to and quality of pastureland and water for livestock, among households owning some livestock (other than poultry) at the time of the survey

	1	2	3	4	5	6
	Respondent reports improvement in access to pastureland since 2006/07 %	Respondent reports improvement in quality of pastureland since 2006/07 %	Main water source for livestock is an improved source[a] %	Number of months water was available during the past 12 months	Respondent reports improvement in access to water since 2006/07 %	Respondent reports improvement in quality of water since 2006/07 %
Intervention group mean:	28.0	31.7	17.1	9.1	59.8	72.0
Comparison group mean:	34.5	27.0	3.9	9.8	61.5	68.3
Difference:	-8.7 (7.7)	0.6 (7.5)	14.2*** (5.0)	-0.7 (0.6)	-1.9 (8.8)	4.8 (8.9)
Observations (intervention group):	89	89	89	89	89	89
Observations (total):	368	368	367	367	365	366

[a] An *abreuvoir* or *borne fontaine*
Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions.

5.6 FOOD SECURITY AND DIETARY DIVERSITY

As evidenced by the title of this report, the primary aim of the project was to promote food security among vulnerable households. Two separate sections of the survey allow assessment of the project's impact on food security, food consumption and dietary diversity.

Firstly, survey respondents were asked a series of questions intended to identify whether their household has secure access to food throughout the year. These questions were based on common indicators of food security, adapted from the Household Food Insecurity Access Scale.[16] Respondents were asked on how many days out of the past seven days they and other household members had experienced the following:

- Having to reduce the number of meals eaten in a day because there was not enough food.
- Having to go to sleep at night hungry because there was not enough food.
- Having to spend a whole day and night without eating because there was not enough food.

Respondents were asked about the food security problems experienced by women and men in their households. Only a minority of respondents reported any of these food security difficulties as having occurred at all: 29 per cent of respondents reported that men in their households experienced any of these situations during the past seven days, and only 26 per cent of respondents reported that women in their households experienced any of these situations.

In most cases (more than 90 per cent), the survey responses showed no difference in the incidence of these food security problems between women and men in the household. However, one interesting distinction depended on the gender of the respondent: male and female respondents were equally likely to say that female household members had experienced food security problems – but female respondents were less likely to report that *male* household members had experienced any of these difficulties.

The responses to these questions were analysed in two ways. Firstly, a food insecurity score was created (for women and men separately) by adding together the number of days on which each of these three problems was encountered. The resulting scores range from zero to 21, with higher scores representing food security difficulties experienced on a greater number of days (i.e. a worse food security situation). The differences between project and comparison communities in terms of these scores are shown in columns 1 and 2 of Table 5.11. It can be seen that those in the project communities generally had lower scores – that is, fewer food security problems – than those in the comparison communities. This difference is statistically significant among women.[17]

Table 5.11: Indicators of food security

	1	2	3	4
	Food security score[a] (female household members)	Food security score[a] (male household members)	Severe food insecurity (female household members) %	Severe food insecurity (male household members) %
Intervention group mean:	1.07	1.29	1.8	3.6
Comparison group mean:	1.82	1.81	2.3	2.4
Difference:	-0.71* (0.40)	-0.52 (0.37)	-0.3 (1.9)	0.7 (2.3)
Observations (intervention group):	146	144	128	124
Observations (total):	573	564	485	473

[a] On a scale from zero to 21. Higher values represent more food security problems.
Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions.

The survey questions were also used to generate an indicator of severe food insecurity – defined as having to go to for a whole day and night without eating on any occasion during the past seven days, or having to reduce the number of meals or go to sleep hungry on three or more days. The results for this indicator are shown in columns 3 and 4 of Table 5.11. Only two to three per cent of households were reported to have experienced severe food insecurity according to this definition, with no indication of a difference between the project and comparison communities. (The difference in incidence of severe food insecurity between women and men was also not statistically significant.)

As well as applying these indicators of food security, respondents were asked to provide detailed information about all the food consumed in their household during the seven days prior to the survey. This involved asking, firstly, what types of food the household had consumed – from a list of 24 items – during those seven days. The

results for the range of food types eaten during that period are shown in column 1 of Table 5.12. There is no indication of a difference in the number of food types eaten between households in the project and comparison communities. Nor is there any indication of a difference between the project and comparison communities in the number of types of fruit and vegetables consumed during the seven-day period, despite the greater engagement in kitchen gardening and the correspondingly greater variety of crop types produced by households in the project communities (as discussed in Section 5.4).[18]

Table 5.12: Households' food consumption in the seven days prior to the survey

	1	2	3
	Number of food types consumed	Food consumption per adult equivalent per day (francs CFA)	Food consumption per adult equivalent per day (logarithm of francs CFA)
Intervention group mean:	8.69	452	5.92
Comparison group mean:	9.19	704	6.31
Difference:	-0.50 (0.40)	-249*** (63)	-0.39*** (0.08)
Observations (intervention group):	147	147	147
Observations (total):	579	579	579

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

For each food type that had been consumed during the seven days, respondents were then asked to specify the *quantity* consumed over that period. This quantity was then converted into an approximate monetary value, by asking the respondent how much was paid for the food item in question, or – if the food item was from the household's own production – how much it would have been worth if it had been purchased from the local market.

An overall food consumption measure was calculated by adding together the value of all the food consumed within the household. This total was converted into a per-day, per-person figure, by dividing by seven and then dividing by a factor representing household size.[19] This expenditure variable was then expressed on a logarithmic scale, to reduce the influence on the overall result of any households with extreme values for total consumption. The comparison of expenditure between supported households and comparison households, both before and after logarithmic transformation, is shown in columns 2 and 3 of Table 5.12.

Surprisingly, the level of food consumption was found to be significantly higher in the comparison communities than in the project communities. This is the case even when controlling for whether households had received food aid or other forms of support during the year prior to the survey (as discussed in Section 5.2). It should be recalled that – as discussed in sections 4.2 and 5.1 – these are differences between households in project and comparison communities that appear to be similar in terms of their baseline characteristics. In spite of this, the food consumption of households in the comparison communities seemed to be considerably higher at the time of the survey than did that of households in the project communities.

It does not seem possible that the project activities could have resulted in a large decrease in food consumption. Two alternative explanations are possible: one is that food prices may be generally higher in the comparison communities than the project communities. Since the measures examined in columns 2 and 3 of Table 5.12 are based on the monetary value of food consumption, any such price difference would show a greater value of consumption in the comparison communities even if the volume of food consumed were the same. (The actual volume of food consumption was not collected in standard units, so cannot be analysed.) Alternatively, it may be

that the differences in food consumption observed in Table 5.12 are the result of baseline differences that were not fully accounted for in the matching process, or of differences experienced by the two sets of communities since that time that are unrelated to the project activities.

5.7 INDICATORS OF MATERIAL WEALTH

Apart from food consumption, several additional indicators of a household's economic level were included in the questionnaire. Respondents were asked to provide information about their household's ownership of various assets (including livestock, productive equipment and household goods), as well as about the conditions of the family's house, both in 2006/07 and at the time of the survey. To provide an overall indication of each household's economic situation, this information on asset ownership and housing conditions was used to generate an index of household wealth index.

If each of those assets and housing characteristics are indicators of household wealth, they should be correlated with each other. That is, a household that scores favourably on one particular wealth indicator should be more likely to do so for other wealth indicators. A small number of items that had low correlations with the others were therefore not considered to be good wealth indicators and so were excluded from the index.[20]

A data reduction technique called principal component analysis (PCA) was used to produce two indices of overall wealth, one based on the recalled data from 2006/07, and one based on the household's situation at the time of the survey. PCA produces a measure that maximises the variation in asset types by assigning more weight to those assets that are most highly correlated with the inter-item variation. Hence, each household's weighted index score is determined by both the number of assets it owns, and by the weight assigned to each asset type. The resulting index enables the relative wealth status of the households to be compared. The wealth index for 2006/07 is the measure that has been used throughout this analysis to control (to the greatest extent possible) for baseline differences in wealth status between households in the project and comparison communities.

After calculating the wealth index for both 2006/07 and the date of the survey, households were categorised according to the quintile in which they lie – that is, the top 20 per cent of households according to wealth indicators were categorised together, as were those in the next 20 per cent, and so on. The measure reported in Table 5.13 is based on households moving between quintiles. For example, a household that changed from being among the bottom 20 per cent of the sample in 2006/07 to being in the 20–40 per cent quintile at the time of the survey would be given a score of +1. A household that moved from the middle quintile to the bottom quintile would have a score of –2.

Table 5.13: Change in index of wealth indicators

	Number of quintiles of wealth index in which household increased
Intervention group mean:	0.11
Comparison group mean:	-0.03
Difference:	0.14 (0.13)
Observations (intervention group):	148
Observations (total):	581

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

The results in Table 5.13 show little difference between the project and comparison communities in terms of the change in wealth indicators since 2006/07.[21] This adds weight to the conclusion from Section 5.6 that, despite the higher value of food consumption recorded in the comparison communities than the project communities, it does not seem that households in the comparison communities have improved since 2006/07 in terms of material wellbeing relative to those in the project communities. However, neither do these results provide evidence that those in the project communities have experienced an improvement.

There is some tentative evidence that those supported specifically by the project in kitchen gardening may have experienced a greater increase in the wealth index than did comparison households.[22] However, it cannot be stated with a high degree of confidence that this difference represents an effect of the project activities.

5.8 COPING STRATEGIES ADOPTED

We will now investigate to what extent the project has built the resilience of the 'very poor' and 'poor' households – that is, the extent to which the project has enabled participants to manage risks and deal with shocks, stresses and uncertainty. This section examines households' actual experience of dealing with shocks and stresses, while the next section will construct an estimate of households' ability to cope with shocks and stresses in the future.

One section of the survey asked respondents whether their household had adopted any specific strategies to cope, at any time since the last harvest. The coping strategies mentioned were:

- Receiving money transfers from relatives outside the community
- Engaging in seasonal migration
- Borrowing money or food at a high interest rate
- Selling livestock in order to buy food
- Selling productive assets or household goods in order to buy food
- Cutting or selling wood
- Removing one or more children from school.

If respondents reported that they had engaged in any of these strategies, they were then asked whether it is normal for them to engage in that strategy, or whether it was an unusual strategy specifically adopted in the current year. It was considered that those households that had to adopt unusual coping strategies could be assumed to have particular difficulty in coping with the lean season that year.

The first column of Table 5.14 shows that the majority of households interviewed reported adopting some of the coping strategies during 2013. The proportion of households that had adopted any coping strategies did not differ significantly between the project and comparison communities, and neither did the number of coping strategies adopted. As can be seen in columns 3 and 4 of the table, there is some evidence that those in the project communities were more likely to report adopting unusual coping strategies. However, these results are not clearly statistically significant. In particular, the results do not hold after controlling for whether households had received food aid or other forms of support during the year prior to the survey (which, as discussed in Section 5.2, is arguably a better comparison than that used to produce the figures shown in the table).

Again there is some tentative evidence that those households supported by the project in kitchen gardening may have adopted fewer coping strategies than households in comparison communities.[23] Unfortunately, as always with the results among the kitchen

garden participants, this difference cannot be considered as strong evidence of an effect due to the project.

Table 5.14: Coping strategies adopted since the previous harvest

	1	2	3	4
	Households adopting any of the coping strategies listed %	Number of the coping strategies listed adopted by the household	Households adopting any coping strategy that is not normally used by the household %	Number of coping strategies adopted that are not normally used by the household
Intervention group mean:	68.9	1.30	26.5	0.41
Comparison group mean:	74.1	1.36	17.6	0.26
Difference:	-5.2 (5.5)	-0.07 (0.14)	8.9* (5.15)	0.15 (0.09)
Observations (intervention group):	148	148	148	148
Observations (total):	582	582	582	582

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

5.9 INDICATORS OF RESILIENCE

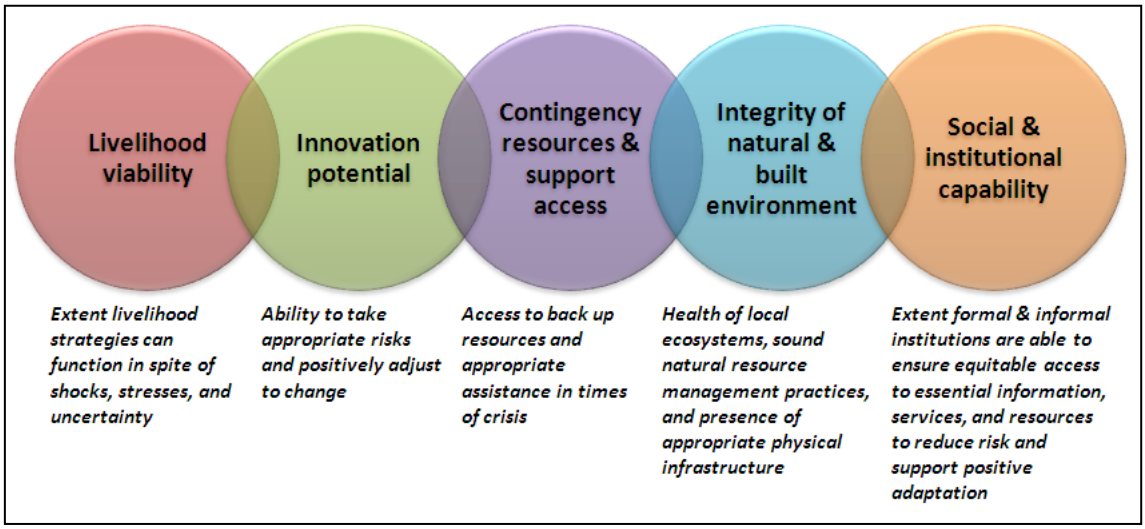
The project under review was specifically aimed at increasing households' resilience to crises. As part of Oxfam GB's Global Performance Framework, an innovative approach has been developed to measuring the resilience of households to shocks and stresses and their ability to adapt to change.[24] This approach involves capturing data on various household and community characteristics falling under the five interrelated dimensions presented in Figure 5.1.

One reason why measuring concepts such as resilience and adaptive capacity is challenging is that we can only really assess whether a system has successfully coped or adapted after the fact. In other words, we would have to wait until after a crisis has struck in order to assess the effectiveness of the intervention in question. Section 5.8 provided some indication of how households were about to cope with the lean season of 2013, but that cannot provide a full assessment of the impact of the project on households' resilience. One reason is that these events occurred while people were being directly supported by the project: the agricultural support and other activities may have assisted households in dealing with those crises in a way that does not reflect a sustained improvement in their capabilities. In that sense, a full assessment of the resilience created at the household and community level through this project could only be made based on households' response to crises and stresses that occur after implementation ends.

The characteristic approach to resilience measurement is based on the assumption that there are particular characteristics of households and communities that affect how well they are able to cope with shocks and positively adapt to change. A limitation, of course, is that we do not know for certain how relevant these characteristics actually are; rather, we assume they are important based on common sense, theory, and an understanding of the local context.

The characteristics that inform the overall measure of resilience fall under the five dimensions presented in Figure 5.1. First, if we think about what a household would need in order to cope with current and future shocks, stresses, and uncertainty, a **viable livelihood** is likely to be one of them. Thus, if a shock happens, a household dependent on just one precarious livelihood activity is likely to be more negatively affected than another that has one or more less sensitive alternatives to fall back on, *all other things being equal*. In addition, households that are on the margins of survival are less likely to be resilient than their relatively more wealthy counterparts. Where longer-term climatic trend prediction information exists, it is also important to assess how viable current livelihood strategies would be given the range of likely future climatic scenarios.

Figure 5.1: Dimensions affecting the ability of households and communities to minimise risks from shocks and adapt to emerging trends and uncertainty



Innovation potential focuses on a household's ability to positively adjust to change, whether anticipated or not. We can hypothesise that such potential is dependent on factors such as the knowledge and attitudes of relevant household members themselves, their ability to take risks, and their access to weather prediction, market information and relevant technology and resources.

Moreover, there will likely be times when even households with the most 'resilient' and adaptive livelihood strategies will find it tough to get by. **Access to contingency resources and external support** – e.g. savings, food and seed reserves, social protection, kin and non-kin support networks, and emergency services – are, therefore, likely to be critical in supporting households in coping with shocks and positively adjusting to change.

It is further recognised that **healthy ecosystems** are better able to cope and adjust to climatic shocks/change than those that are relatively more degraded. We may reasonably assume – again, with all other things being equal – that households whose livelihoods are dependent on healthier ecosystems will be in a better position to adjust to climatic shocks/change than those that are not. The presence of appropriate infrastructure (e.g. pit latrines and roads) that is resilient to shocks and stresses (e.g. flooding) is equally important; if critical infrastructure no longer functions or collapses in times of shocks and stresses, the livelihoods and/or health of community members can be negatively affected.

In most, if not all cases, it is necessary to look beyond the household level when examining resilience and adaptive capacity. Indeed, it is reasonable to assume that

households are likely better able to successfully adjust to climatic shocks/change when they are part of larger coordinated efforts at the community level and beyond. The **social and institutional capability** dimension, in particular, is concerned with the effectiveness of informal and formal institutions in reducing risk, supporting positive adaptation, and ensuring equitable access to essential services in times of shock/stress. In the absence of this capability, we can assume that community-level duty-bearers will be less effective in fulfilling their responsibilities in supporting community members to reduce risk and/or successfully adapt.

There is no one generic set of 'resilience' characteristics that is applicable to all contexts. Given this, efforts were made to specify characteristics relevant to the specific risks faced in the area where the survey was carried out. The characteristics identified are listed in Table 5.15. It is important to note at this stage that while not all characteristics considered in this Effectiveness Review may be directly linked to the project activities, all are deemed to be important to a household's overall resilience in this particular context. The middle column of Table 5.15 shows those characteristics on which the project activities may be expected to have an impact.

Table 5.15: Characteristics of resilience examined in this Effectiveness Review

Dimension	Characteristic	Connected to project logic?
Livelihood viability	Crop diversification	Yes
	Use of improved seeds	Yes
	Ownership of livestock	Yes
	Ownership of productive assets	Yes
	Livelihood diversification	No
Innovation potential	Adoption of innovative practices	No
	Access to credit	No
Access to contingency resources and support	Access to remittances or formal earnings	No
	Savings	No
	Access to wild plants for foraging	Yes
	Social support networks	No
	Access to a grain bank	No
Integrity of the natural and built environment	Access to drinking water	Yes
	Access to water for farming	Yes
	Access to water for livestock[a]	Yes
	Access to pasture[a]	Yes
	Frequency of bush fires[a]	Yes
Social and institutional capability	Contact with extension services	Yes
	Use of information from government or local water committees	Yes
	Participation in community groups	No
	Social cohesion in the community	No
	Confidence in local government structures to deal with crises	No

[a] Omitted for households that do not currently own livestock.

Indices of resilience were constructed using an approach known as the *Alkire-Foster method*, adapted from that used by the Oxford Poverty and Human Development Institute for measuring multidimensional constructs such as poverty and women's empowerment.

The questionnaire used in the Effectiveness Review included questions relating to each of the characteristics listed in Table 5.15. Indeed, several of these indicators have already been discussed in earlier sections of this report. For each characteristic, a benchmark was defined, based on what it means for a household to be faring reasonably well in relation to the characteristic in question. The particular benchmarks used for each characteristic are detailed in Appendix 1. For example, each household was defined as scoring positively in terms of crop diversification if the household farmed at least three different types of staple crops in 2013, as well as at least three other types of crops. There is inevitably a degree of arbitrariness in defining such cut-offs. In many cases, alternative cut-offs and alternative formulations of the indicators were tested, as a check on the robustness of the results obtained from applying the cut-offs.

A measure of overall resilience was then derived by counting the proportion of characteristics in which the household scored positively. We refer to this measure as the *base resilience index*. A household was then defined as having positive resilience overall if it scored positively in at least two thirds of the characteristics. A second resilience index was then created, which takes a value of 1 if the household reaches that benchmark for overall resilience and otherwise is equal to the proportion of characteristics in which the household scored positively. This modified index is known as the *Alkire-Foster resilience index*.[25]

The Oxfam GB global indicator for resilience is based on whether each household is doing better in terms of overall resilience than a 'typical' household in the area. This is defined by comparing each household's resilience index with the median of the comparison group. In particular, the global indicator takes the value of 1 if the resilience index is greater than the median of the comparison group, and zero otherwise.

Table 5.16 presents the differences between the households surveyed in the project and comparison communities in terms of each of these three measures of overall resilience. These figures provide little indication of a difference between households in the project and comparison communities. However, the alternative statistical models tested do provide some evidence that the resilience indices are higher among households in project communities than in comparison communities, with a difference of between 0.03 and 0.05 in the base resilience index (which is scaled from zero to one).[26] The resilience index scores of those supported by the project in kitchen gardening appear to be around 0.06 points higher than comparison households – but again this cannot be taken as strong evidence for a positive impact of the project among these households.

Overall 64 per cent of those in the project communities meet the threshold for the Oxfam GB global indicator for resilience, against 59 per cent in the comparison communities. This difference is not statistically significant, but again the alternative statistical models provide some evidence in favour of such a difference.

For interpreting these results on the indices of resilience, it is clearly important to examine the effects of the project on the underlying indicators. Figure 5.2 shows a graphical comparison of the households in project and comparison communities for each of the indicators of resilience. Tables 5.17 and 5.18 present the same results with the statistically significant differences identified. (The particular definitions used to derive each indicator are detailed in Appendix 1.)

The results for several of the indicators – or related measures – have already been discussed in earlier sections of the report. For example, it has already been found in Section 5.4 that the use of improved seeds was significantly higher in the project communities than the comparison communities: this is included as an indicator of resilience in column 2 of Table 5.17. Also in Section 5.4, households in project communities were found to be growing a greater variety of crop types than those in the

comparison communities. While the corresponding indicator (in column 1 of Table 5.17) is not shown to be statistically significant, some of the alternative statistical models tested do find a significant difference in terms of this indicator.[27]

Table 5.16: Aggregate measures of resilience

	1	2	3
	Base resilience index	Alkire-Foster resilience index	Oxfam GB global indicator for adaptation and risk reduction %
Intervention group mean:	0.44	0.66	63.6
Comparison group mean:	0.43	0.64	59.1
Difference:	0.02 (0.02)	0.02 (0.03)	4.6 (6.5)
Observations (intervention group):	148	148	148
Observations (total):	582	582	582

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

In Section 5.5 it was not clear whether the number of livestock owned by households in the project communities was smaller at the time of the survey than that owned by households in the comparison communities. Applying the threshold used for the indicator of resilience (shown in column 3 of Table 5.17), there is again some evidence of a negative difference between the project and comparison communities, though again the statistical evidence is not conclusive. There is no indication of a difference between households in the project and comparison communities in terms of diversification of livelihoods activities, nor (consistent with the results of Section 5.7) in terms of ownership of productive assets.

Most of the characteristics of innovation potential and access to contingency resources and support (for which results are shown in columns 6 to 12 of Table 5.17) show no differences between the project and comparison communities – but most of these are not closely connected to the expected outcomes of the project, so this is not a surprise. On the other hand, the proportion of respondents who said that their access to wild plants for foraging had increased since 2006/07 was considerably higher in the project communities, presumably as a result of the forest conservation activities implemented under the project.

Columns 1 and 3 of Table 5.18 show that more of those in the project communities than the comparison communities have access to an improved source for drinking water and for livestock (respectively), consistent with the results discussed in earlier sections. The indicator of access to water for agriculture (shown in column 2 of Table 5.18) was based on the number of months during which water was available and the time taken to collect water, among those engaged in market gardening; there is no difference in the proportions of households scoring positively in this indicator between the project and comparison communities. Similarly, as discussed in Section 5.5, there were no differences found between the project and comparison communities in the proportions reporting that their access to (and quality of) pastureland had improved since 2006/07, or that the frequency of bush fires had reduced since that time. However, it is recognised that the measures of these indicators used in the survey are far from ideal.

Figure 5.2: Results for indicators of resilience

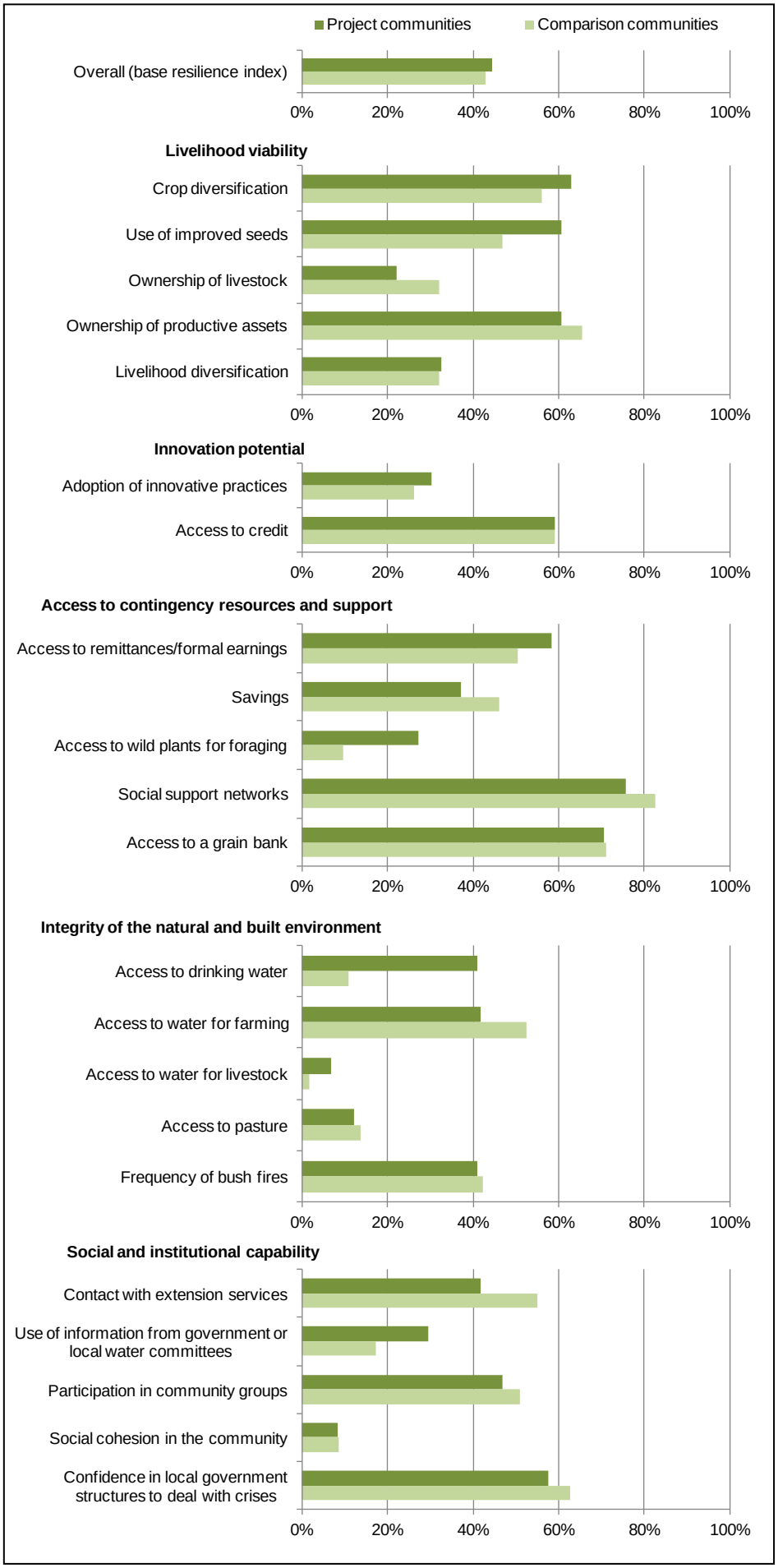


Table 5.17: Proportion of households scoring positively on characteristics of livelihood viability, innovation potential and access to contingency resources and support

	1	2	3	4	5	6	7	8	9	10	11	12
	Crop diversifi-cation %	Use of improved seeds %	Ownership of livestock %	Livelihood diversifi-cation %	Ownership of productive assets %	Adoption of innovative practices %	Access to credit %	Access to remittances or formal earnings %	Savings %	Access to wild plants for foraging %	Social support networks %	Access to a grain bank %
Intervention group mean:	62.9	60.6	22.0	60.6	32.6	30.3	59.1	58.3	37.1	27.3	75.8	70.5
Comparison group mean:	56.0	46.8	32.1	65.6	32.0	26.1	59.1	50.5	46.0	9.5	82.6	71.1
Difference:	6.8 (6.0)	13.8** (6.8)	-10.1* (5.8)	-5.0 (6.3)	0.5 (6.4)	4.2 (6.8)	0.0 (5.9)	7.9 (6.6)	-8.9 (6.6)	17.8*** (5.3)	-6.8 (5.7)	-0.7 (6.5)
Observations (intervention group):	148	148	148	148	148	148	148	148	148	148	148	148
Observations (total):	582	582	582	582	582	582	582	582	582	582	582	582

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

Table 5.18: Proportion of households scoring positively on characteristics of integrity of the natural and built environment and social and institutional capability

	1	2	3	4	5	6	7	8	9	10
	Access to drinking water %	Access to water for farming %	Access to water for livestock %	Access to pasture %	Frequency of bush fires %	Contact with extension services %	Use of information from government or local water committee %	Participation in community groups %	Social cohesion in the community %	Confidence in local government structures to deal with crises %
Intervention group mean:	40.9	41.7	6.8	12.1	40.9	41.7	29.5	47.0	8.3	57.6
Comparison group mean:	10.9	52.4	1.6	13.8	42.2	55.1	17.2	51.0	8.5	62.6
Difference:	30.0*** (5.0)	-10.7 (6.8)	5.2** (2.5)	-1.7 (4.2)	-1.3 (7.0)	-13.4** (6.4)	12.3** (6.1)	-4.0 (7.0)	-0.2 (3.6)	-5.0 (6.6)
Observations (intervention group):	148	148	148	148	148	148	148	148	148	148
Observations (total):	582	582	582	582	582	582	582	582	582	582

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

As discussed in Section 5.2, the proportions of households in the project communities who had had contact with the extension services (at some time since 2006/07) was *smaller* in the project communities than in the comparison communities. Although the difference (shown in column 6 of Table 5.18) appears large, it is not statistically significant under all of the statistical models tested, so it should not be treated as absolutely clear.

One apparent positive impact of the project at the community level was in the use of information from water management committees and technical advisers. As already discussed in Section 5.3 (and shown in column 7 of Table 5.18), nearly a third of those in the project communities said that they had decided to limit their use of water based on information received from the water committees or from government officials, a much larger figure than in the comparison communities. The remaining indicators of institutional and social capability – participation in community groups, social cohesion, and confidence in local government to deal with crises – did not differ between the project and comparison communities.

5.10 INDICATORS OF WOMEN'S EMPOWERMENT

Although not the main focus of the Effectiveness Review, the survey included a section intended to assess the whether the project (and particularly the work with women in promoting kitchen gardening) had had some effect on the empowerment of women in their households and communities.

Table 5.18 shows the comparison of female respondents in the project and comparison communities in terms of various indicators of women's empowerment. Each of these measures was obtained by presenting female survey respondents with one or two statements and asking about the extent to which they agreed or disagreed with the statement. For example, the measure of attitude towards women's rights is the proportion of women who agreed with the statement that 'A woman should never question the decisions taken by her husband.'

As can be seen in the first column of the table, only a third of respondents agreed with this statement, a proportion that did not differ between the project and comparison communities. The figures in Table 5.19 aggregate the responses of men and women, but there is no indication of any difference in the proportions who responded positively among women or among men.[28]

Table 5.19: Indicators of women's empowerment, among both male and female respondents

	1	2	3
	Positive attitude to women's rights %	Positive perception of women's contribution in the household %	Positive perception of women's influence in community affairs %
Intervention group mean:	35.6	40.2	47.0
Comparison group mean:	33.7	59.6	69.5
Difference:	1.9 (6.5)	-19.4*** (6.6)	-22.6*** (6.2)
Observations (intervention group):	148	148	148
Observations (total):	582	582	582

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

Respondents were deemed to have a positive perception of women's contribution in the household if they agreed strongly with both of the following two statements:[29]

- These days, women contribute more to meet households' needs than they used to.
- A woman can contribute just as much as her husband to meet household needs.

In this case, it is clear that respondents in the comparison communities responded more positively than those in the project communities. Again there is little or no difference between the responses given by male and female respondents.

Finally, women's influence in community decisions was assessed by whether respondents agreed strongly with the statement that 'Women are able influence major decisions taken at the community level'. As seen in column 3 of the table, the majority of respondents agreed strongly with this statement. Again a larger proportion in the comparison communities agreed strongly than did those in the project communities. There is even evidence that female respondents in the project communities were less likely to agree strongly than male respondents.[30] Similar results were obtained from an indicator (not shown in the table) of the individual respondents' assessment of the extent to which his or her own opinions are taken into consideration at the community level – although it is not clear in that case that there is was a difference between male and female respondents.

Overall, then, the respondents interviewed in the comparison communities were more likely to express positive views in terms of these perception-based measures of women's empowerment than were those in the project communities. A potential contributing factor – at least as regards the poorer perception of women's involvement in community affairs among women in the project communities – may be that women involved in the project have increased expectations of how much they should be involved in community affairs, and so are more inclined to respond negatively if these expectations are not being met. However, it seems unlikely that this could account for male respondents also having poorer perception of women's involvement in community affairs, or for the lower recognition of women's rights or women's contribution in the household. On the other hand, it also seems unlikely that the project could have resulted in a negative change in women's situation in their households and communities (or at least, much stronger evidence would be needed to draw such a conclusion). It is possible that the project activities have had an effect on women's expectations, causing those in the project communities to respond more negatively about their current situation. Alternatively, the differences in outcomes may simply represent more longstanding, underlying differences in culture between the two sets of communities.

6 CONCLUSIONS

6.1 CONCLUSIONS

In some respects, the comparison made in this Effectiveness Review, between project communities in the commune of Banibangou and comparison communities in the commune of Tondikwindi, is not ideal. It appears that there were differences between the two sets of communities (which either existed at baseline or have arisen since) that are unrelated to the activities of the project under review. For example, larger proportions in the comparison communities reported receiving support from NGO projects than did those in the project communities. This complicates the process of drawing conclusions from the comparison between them.

Nevertheless, some results have been identified that correspond to key expected impacts of the project – particularly those relating to water access and management. Nearly all of those interviewed in the project communities were aware of the existence of a local water-management committee (compared to only around 80 per cent of matched households in comparison communities), and a large proportion reported participating directly in the committees. A quarter of those in the project communities said that they had used information from the water committees to take decisions about water consumption, against only 15 per cent in the comparison communities.

The effect of the project's work to provide improved water sources was also clear in the results of the survey. Nearly 40 per cent of respondents in the project communities said that they have access to piped running water, against only 10 per cent in the comparison communities. Under half of those in the project communities said that they rely on an open well, compared to more than 80 per cent in the comparison communities. There were also large differences between the households in the project and comparison communities in terms of their access to improved sources of water for kitchen gardening and for livestock. However, no differences could be observed between project and comparison communities in terms of the time spent collecting water, nor in the number of months of the year during which water is available from the main source.

As expected, the data provide evidence that the project has had a significant effect on the take-up of kitchen gardening. Households in the project communities were producing a wider range of crop types than those in comparison communities, and were more likely to have brought some of their production to market. On average, the revenue generated from sales of crops during the year prior to the survey was more than twice as high among households in the project communities that in the comparison communities.

The adoption of some of the improved agricultural techniques encouraged under the project – the use of improved seeds, fungicide, and sowing in lines – was also found to be higher in the project communities than in the comparison communities. Unexpectedly, the use of composting was more widespread in the comparison communities.

There was little evidence of impact from the project on households' livestock-rearing activities: herd sizes and milk production were similar in the project and comparison communities. Although the number of animals sold over the past year did not differ between the two groups of communities, the revenue generated from sales unexpectedly appears to have been higher in the comparison communities – although it is not completely clear that this difference is statistically significant.

There was some evidence that the project had a positive effect on standard indicators of food security, but the actual value of food being consumed at the time of the survey was *higher* in the comparison communities. This may reflect higher food prices in the comparison communities, or may simply be a result of underlying differences between the two groups. An index of wealth indicators – ownership of livestock and assets, and housing conditions – provides no evidence of any difference between the project and comparison communities in changes in material wellbeing over the lifetime of the project.

The project activities were intended not only to provide short-term support to vulnerable households, but also to build their resilience to shocks and stresses. Twenty-two characteristics that are thought to be indicators of resilience in the project area were identified, including aspects of livelihood viability, access to and use of water and pastureland, and support available from social structures and other resources in times of crisis. Overall the households interviewed scored positively in 44 per cent of these characteristics. The evidence that the project had a positive effect on the overall index of resilience is not completely clear, but positive effects of the project can be seen on many of the underlying indicators. Respondents were also asked about the extent to which their household had to rely on negative coping strategies during the several months prior to the survey (that is, during the dry season), but there was no clear evidence of impact from the project in this respect.

The survey data provide some indication that the households that were specifically supported by the project in kitchen gardening saw a larger increase in wealth indicators, scored better on the index of resilience, and relied less on negative coping strategies than did households in the comparison communities. Unfortunately the statistical basis for this comparison is not strong, so it cannot be claimed with confidence that these results represent an impact of the project activities.

6.2 PROGRAMME LEARNING CONSIDERATIONS

Ensure that systems to monitor the impact of interventions on the livelihoods and risk-management behaviour of participants is integrated into project design.

While this Effectiveness Review provides a snapshot of the situation of those in the communities served by the project, it does not substitute for an understanding of the dynamics of change that they have experienced. Particularly in an area with livelihoods so vulnerable to seasonal weather patterns, a deep understanding of people's resilience could only be gained by regularly monitoring the actions they take to manage risk and respond to crises. This could be done by means of periodic visits to a panel of households across the intervention area, and could involve data collection on standard quantitative indicators as well as (perhaps more importantly) qualitative interviews to understand the reasons for any changes they have experienced and how they see the project activities as having affected their decisions. A clear and robust assessment of the extent to which a project has been responsible for any such changes would still depend on some sort of comparison between communities, as in this Effectiveness Review. However, strengthening and increasing the frequency of monitoring work would probably generate useful understanding and learning even when carried out only in the project communities.

In particular, seek to monitor changes in the food security situation, as well as indicators of nutrition and health more broadly.

The survey data provided some evidence that households in the project communities were experiencing fewer food security difficulties than those in the comparison communities, according to the standard indicators employed (including missed meals, going to sleep hungry, and spending a whole day and night without eating). On the other hand, there was no indication of a difference in the diversity of food types eaten (despite the greater adoption of kitchen gardening in the project communities), and the total *value* of food consumed was greater in the comparison communities. More frequent monitoring may help to clarify these results and the reasons for the apparent contradiction. For understanding the long-term impact of any change in diet – particularly if there has been greater consumption of vegetables – it would also be important to track indicators of health and nutrition at a community level.

APPENDIX 1: THRESHOLDS FOR CHARACTERISTICS OF RESILIENCE

Dimension	Characteristic	Threshold: a household scores positively if...
Livelihood viability	Crop diversification	Household cultivated at least three types of cereals and three other crops during 2013.
	Use of improved seeds	Household used any improved seeds during 2013.
	Ownership of livestock	Household owns more than five head of livestock (cattle, sheep, goats, camels or donkeys).
	Ownership of productive assets	Household owns at least one significant productive asset: a cart, plough, sewing machine, bicycle, motorcycle, or other vehicle.
	Livelihood diversification	Some household member(s) engage(s) in trading, a service business (such as a mechanic, builder or community animal health worker) or a household business, which would only be 'moderately affected' by a drought.
Innovation potential	Adoption of innovative practices	Household has adopted at least two new agricultural practices since 2006/07: use of compost, fungicide, use of watering can, sowing in lines, or improved ploughing techniques.
	Access to credit	Respondent reports that household members could borrow 50,000 francs from some source other than neighbours or friends in the community, if needed for an investment opportunity.
Access to contingency resources and support	Savings	Respondent reports that, if a household member fell ill, they household could finance the treatment from their own savings or from health insurance.
	Access to remittances or formal earnings	Respondent reports having receipt of transfer money from outside the community and/or someone in the home has a formal job.
	Access to wild plants for foraging	Respondent reports that the availability of wild plants for foraging has improved or stayed the same since 2006/07.
	Social support networks	Respondent agrees with both of the following statements: • If you have a difficulty in your household, other people in your community would always help you. • You help out your neighbours with food, money or other goods when they find themselves in difficult situations.
	Access to a grain bank	Respondent states the household would definitely be able to access grain from a communal grain bank, in case of need.
Integrity of the natural and built environment	Access to drinking water	Household's normal drinking water source was a protected well or better source, water was available throughout the previous 12 months, and it normally takes not more than 30 minutes for household members to collect water.
	Access to water for farming	Household does some market gardening, reports that water was available throughout the previous 12 months, and that it normally takes not more than 30 minutes to collect water.
	Access to water for livestock[a]	Respondent reports that the main source of water for livestock is an improved source (*abreuvoir* or *borne fontaine*) and that their access to water for livestock has improved since 2006/07.
	Access to pasture[a]	Respondent reports that both access to and quality of pastureland has improved since 2006/07.
	Frequency of bush fires[a]	Respondent reports that bush fires have become less frequent since 2006/07.

Dimension	Characteristic	Threshold: a household scores positively if...
Social and institutional capability	Contact with extension services	Household has had some contact with representatives of the hydrological, agricultural or livestock extension service at some time since 2006/07.
	Use of information from government or local water committees	Respondent is aware that a local water committee exists, and his/her household has taken account of information from the committee (or from a government service) in deciding to manage water use.
	Participation in community groups	At least some male and some female household members participate in community groups (producers' groups, savings and loans groups, water management groups or women's groups).
	Social cohesion in the community	Respondent does *not* agree with the following statement: • There are many divisions and disagreements between different groups in your community. and does *not agree strongly* with the following statement: • When there is a dispute in the community, you and your household really have to struggle to have your rights recognised. and *agrees* with *both* of the following statements: • These days, people in the community are able to sit together and resolve their differences peacefully. • People in the community have fewer disputes than they used to.
	Confidence in local government structures to deal with crises	Respondent *agrees* with both of the following statements: • Government services have generally responded well in times of crisis. • If a serious crisis were to strike, you are confident that the local government would support you with whatever assistance is necessary.

[a] Omitted for households that do not currently own livestock.

APPENDIX 2: BASELINE STATISTICS BEFORE MATCHING

		Households in general population				Kitchen garden participants			
		Intervention mean	Comparison mean	Difference	Standard error of difference	Intervention mean	Comparison mean	Difference	Standard error of difference
Number of household members in 2006/07		6.88	6.45	0.43	(0.33)	7.36	6.45	0.91**	(0.46)
Proportion of household members who were children (less than 16 years old) in	%	52.4	51.4	0.95	(1.78)	49.3	51.4	-2.10	(2.64)
Household had only one adult member in 2006/07	%	11.2	12.2	-1.05	(2.87)	10	12.2	-2.22	(4.17)
Household had no male adult members in 2006/07	%	3.91	5.78	-1.87	(1.97)	10	5.78	4.22	(3.13)
All adult household members were elderly (over 60 years old) in 2006/07	%	0	1.56	-1.56*	(0.93)	2.86	1.56	1.30	(1.68)
Household head is female	%	6.15	9.78	-3.63	(2.50)	15.7	9.78	5.94	(3.95)
Age of household head in 2006/07	years	37.6	38.7	-1.03	(1.25)	42.3	38.7	3.64*	(1.89)
Household head was elderly (over 60 years old) in 2006/07	%	4.47	8.67	-4.20*	(2.32)	18.6	8.67	9.90**	(3.84)
Household head has any education	%	45.3	47.3	-2.08	(4.42)	38.6	47.3	-8.76	(6.41)
Household head completed primary education	%	14.0	17.6	-3.59	(3.28)	12.9	17.6	-4.70	(4.82)
Household head completed secondary education	%	0.56	2	-1.44	(1.11)	0	2	-2	(1.68)
Household head is of Zerma ethnicity	%	87.7	74.7	13.0***	(3.61)	92.9	74.7	18.2***	(5.35)
Household head is of Hausa ethnicity	%	7.82	10	-2.18	(2.58)	5.71	10	-4.29	(3.76)
Household head is of Touareg ethnicity	%	3.35	10	-6.65***	(2.40)	1.43	10	-8.57**	(3.64)
Household head is of Fulani ethnicity	%	0.56	3.11	-2.55*	(1.35)	0	3.11	-3.11	(2.08)
Respondent is the head of household	%	77.1	61.8	15.3***	(4.14)	12.9	61.8	-48.9***	(6.03)
Respondent is female	%	26.3	37.1	-10.9***	(4.17)	95.7	37.1	58.6***	(5.86)
Age of respondent in 2006/07	years	35.7	34.7	1.02	(1.30)	43.1	34.7	8.42***	(1.96)
Respondent was elderly (over 60 years old) in 2006/07	%	4.47	7.11	-2.64	(2.16)	15.7	7.11	8.60**	(3.53)
Respondent has any education	%	43.6	40.7	2.91	(4.36)	25.7	40.7	-15.0**	(6.23)
Respondent has completed primary education	%	14.0	14.7	-0.70	(3.11)	4.29	14.7	-10.4**	(4.34)
Respondent has completed secondary education	%	0.56	1.56	-1.00	(0.99)	0	1.56	-1.56	(1.48)
Proportion of adult household members in 2006/07 with any education	%	39.9	37.4	2.56	(3.15)	36.6	37.4	-0.74	(4.52)
Proportion of adult household members in 2006/07 who completed primary education	%	14.0	13.8	0.23	(2.28)	11.3	13.8	-2.50	(3.27)
Proportion of adult household members in 2006/07 who completed secondary education	%	0.95	1.55	-0.60	(0.79)	0	1.55	-1.55	(1.22)
Household cultivated any staple crops in 2006/07	%	94.4	89.3	5.08**	(2.55)	94.3	89.3	4.95	(3.86)
Area of land cultivated with staple crops in 2006/07	hectares	3.72	3.72	-0.0032	(0.38)	3.65	3.72	-0.063	(0.45)

		Households in general population				Kitchen garden participants			
		Intervention mean	**Comparison mean**	**Difference**	**Standard error of difference**	**Intervention mean**	**Comparison mean**	**Difference**	**Standard error of difference**
Household engaged in kitchen gardening in 2006/07	%	68.2	27.6	40.6***	(4.00)	75.7	27.6	48.2***	(5.72)
Area of land dedicated to kitchen gardening in 2006/07	*planches*	1673.8	212.7	1461.1***	(213.3)	475.8	212.7	263.1**	(120.6)
Number of crop types produced by the household in 2006/07		9.70	5.56	4.14***	(0.38)	11.6	5.56	6.08***	(0.52)
Number of crop types sold by the household in 2006/07		2.56	1.22	1.35***	(0.27)	4.19	1.22	2.97***	(0.38)
Household owned any livestock (cattle, sheep, goats or donkeys) in 2006/07	%	50.3	46.9	3.39	(4.42)	47.1	46.9	0.25	(6.42)
Number of livestock (cattle, sheep, goats or donkeys) owned by household in 2006/07		6.40	8.00	-1.59	(1.69)	6.06	8.00	-1.94	(2.53)
Any household member worked as a large-scale trader in 2006/07	%	15.6	13.8	1.86	(3.10)	11.4	13.8	-2.35	(4.39)
Any household member engaged in agricultural labour in 2006/07	%	45.3	30	15.3***	(4.16)	47.1	30	17.1***	(5.97)
Any household member engaged in a skilled trade in 2006/07	%	30.7	29.3	1.39	(4.05)	30	29.3	0.67	(5.87)
Any household member engaged in petty commerce in 2006/07	%	40.2	34	6.22	(4.32)	42.9	34	8.86	(6.29)
Any household member engaged in formal paid employment in 2006/07	%	6.15	5.33	0.81	(2.03)	1.43	5.33	-3.90	(2.75)
Household received remittances during 2006/07	%	51.4	48.2	3.17	(4.42)	57.1	48.2	8.92	(6.42)
Household was in the lowest 20% of the sample according to wealth indicators recalled from 2006/07[a]	%	17.3	21.6	-4.24	(3.56)	17.1	21.6	-4.41	(5.24)
Household was in the second 20% of the sample according to wealth indicators recalled from 2006/07[a]	%	24.0	19.1	4.91	(3.57)	15.7	19.1	-3.40	(5.01)
Household was in the middle 20% of the sample according to wealth indicators recalled from 2006/07[a]	%	21.2	19.3	1.90	(3.53)	21.4	19.3	2.10	(5.11)
Household was in the fourth 20% of the sample according to wealth indicators recalled from 2006/07[a]	%	20.1	19.3	0.78	(3.51)	24.3	19.3	4.95	(5.14)
Household was in the upper 20% of the sample according to wealth indicators recalled from 2006/07[a]	%	17.3	20.7	-3.35	(3.52)	21.4	20.7	0.76	(5.22)
Household had an electricity connection in 2006/07	%	15.6	2.89	12.8***	(2.12)	25.7	2.89	22.8***	(2.88)
Distance of house from nearest market in 2006/07	minutes on foot (estimated by respondent)	44.5	61.1	-16.6**	(7.62)	6.36	61.1	-54.7***	(11.4)
Number of observations		**179**	**450**	**629**		**70**	**450**	**629**	

[a] The construction of the wealth index is described in Section 5.7.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Variables dated 2006/07 are estimates, based on recall data or reconstructed from the composition of the household at the time of the survey.

APPENDIX 3: METHODOLOGY USED FOR PROPENSITY-SCORE MATCHING

The analysis of outcome variables, presented in Section 5 of this report, involved group mean comparisons using propensity-score matching (PSM). The basic principle of PSM is to match each participant with a non-participant that was observationally similar at baseline and to obtain the treatment effect by averaging the differences in outcomes across the two groups after project completion. Unsurprisingly, there are different approaches to matching, i.e. to determining whether or not a household is observationally 'similar' to another household. For an overview, we refer to Caliendo and Kopeinig (2008).[31] This appendix describes and tests the specific matching procedure followed in this Effectiveness Review.

Estimating propensity scores

Given that it is extremely hard to find two individuals with exactly the same characteristics, Rosenbaum and Rubin (1983)[32] demonstrate that it is possible to match individuals using a prior probability for an individual to be in the intervention group, naming it *propensity score*. More specifically, propensity scores are obtained by pooling the units from both the intervention and comparison groups and using a statistical probability model (e.g. a probit regression) to estimate the probability of participating in the project, conditional on a set of observed characteristics.

Tables A3.1 to A3.3 present the probit regression results used to estimate the propensity scores in our context. **Error! Reference source not found.**Table A3.1 shows the probit results for the non-parsimonious models, entering the full set of matching variables considered in this study. These models were constructed for both the general population in the project communities and those households specifically supported by the kitchen garden intervention – both compared to the general population in the comparison communities. To guarantee that none of the matching variables were affected by the intervention, we only considered variables related to baseline, and only those variables that were unlikely to have been influenced by anticipation of project participation (Caliendo and Kopeinig, 2008).

Table A3.1: Estimating the propensity score: non-parsimonious model

	General population			Kitchen garden participants		
	Coefficient	**Standard error**	***p*-value**	**Coefficient**	**Standard error**	***p*-value**
Number of household members in 2006/07 = 1	-0.002	(0.025)	0.944	0.156	(0.072)	0.031
Proportion of household members who were children (less than 16 years old) in 2006/07	0.040	(0.397)	0.919	-0.997	(1.027)	0.332
Household had only one adult member in 2006/07 = 1	-0.026	(0.250)	0.916	0.109	(0.680)	0.873
Household had no male adult members in 2006/07 = 1	-0.180	(0.463)	0.697	0.991	(0.990)	0.317
All adult household members were elderly (over 60 years old) in 2006/07 = 1	a			1.132	(1.566)	0.470
Household head is female = 1	-0.544	(0.384)	0.156	-0.325	(0.830)	0.696
Age of household head in 2006/07 years	-0.006	(0.010)	0.538	-0.019	(0.017)	0.266
Household head was elderly (over 60 years old) in 2006/07 = 1	-0.627	(0.562)	0.265	-0.560	(0.728)	0.441
Household head has any education = 1	-0.372	(0.281)	0.185	-0.796	(0.520)	0.126
Household head completed primary education = 1	-0.392	(0.389)	0.312	1.326	(0.832)	0.111
Household head completed secondary education = 1	-4.327	(175.601)	0.980	a		
Household head is of Zarma ethnicity = 1	0.299	(0.697)	0.668	3.979	(365.834)	0.991
Household head is of Hausa ethnicity = 1	0.180	(0.711)	0.800	3.178	(365.835)	0.993
Household head is of Touareg ethnicity = 1	-0.006	(0.727)	0.993	2.592	(365.836)	0.994
Household head is of Fulani ethnicity = 1	-0.495	(0.947)	0.601	a		
Respondent is the head of household = 1	0.738	(0.338)	0.029	-0.835	(0.859)	0.331
Respondent is female = 1	0.427	(0.339)	0.207	2.190	(0.813)	0.007
Age of respondent in 2006/07 years	-0.003	(0.010)	0.756	0.025	(0.017)	0.140
Respondent was elderly (over 60 years old) in 2006/07 = 1	0.284	(0.570)	0.618	-1.086	(0.854)	0.203
Respondent has any education = 1	0.039	(0.271)	0.884	0.247	(0.522)	0.637
Respondent has completed primary education = 1	0.180	(0.377)	0.633	-1.415	(1.003)	0.158
Respondent has completed secondary education = 1	3.291	(175.597)	0.985	a		
Proportion of adult household members in 2006/07 with any education	0.319	(0.315)	0.310	0.729	(0.881)	0.408
Proportion of adult household members in 2006/07 who completed primary education	0.158	(0.472)	0.738	-0.814	(1.418)	0.566
Proportion of adult household members in 2006/07 who completed secondary education	0.722	(1.518)	0.634	a		
Household cultivated any staple crops in 2006/07 = 1	-0.263	(0.289)	0.362	-2.087	(0.682)	0.002
Area of land cultivated with staple crops in 2006/07 hectares	-0.022	(0.015)	0.141	-0.030	(0.064)	0.644
Household engaged in kitchen	0.793	(0.217)	0.000	1.301	(0.604)	0.031

	General population			Kitchen garden participants		
	Coefficient	**Standard error**	***p*-value**	**Coefficient**	**Standard error**	***p*-value**
gardening in 2006/07 = 1						
Number of crop types produced by the household in 2006/07	0.106	(0.025)	0.000	0.192	(0.064)	0.003
Number of crop types sold by the household in 2006/07	-0.032	(0.026)	0.213	0.016	(0.071)	0.824
Household owned any livestock (cattle, sheep, goats or donkeys) in 2006/07 = 1	0.363	(0.152)	0.017	0.060	(0.395)	0.879
Number of livestock (cattle, sheep, goats or donkeys) owned by household in 2006/07	-0.003	(0.005)	0.537	-0.003	(0.019)	0.858
Any household member worked as a large-scale trader in 2006/07 = 1	0.125	(0.193)	0.517	-0.409	(0.519)	0.430
Any household member engaged in agricultural labour in 2006/07 = 1	0.437	(0.143)	0.002	1.214	(0.372)	0.001
Any household member engaged in a skilled trade in 2006/07 = 1	-0.151	(0.143)	0.293	-0.389	(0.375)	0.299
Any household member engaged in petty commerce in 2006/07 = 1	0.129	(0.135)	0.338	-0.146	(0.400)	0.716
Any household member engaged in formal paid employment in 2006/07 = 1	0.411	(0.309)	0.183	-1.462	(6.039)	0.809
Household received remittances during 2006/07 = 1	-0.162	(0.138)	0.240	0.751	(0.412)	0.068
Household was in the second 20% of the sample according to wealth indicators recalled from 2006/07 = 1	0.152	(0.199)	0.444	0.883	(0.538)	0.101
Household was in the middle 20% of the sample according to wealth indicators recalled from 2006/07 = 1	-0.183	(0.220)	0.405	0.819	(0.568)	0.149
Household was in the fourth 20% of the sample according to wealth indicators recalled from 2006/07 = 1	-0.123	(0.221)	0.577	0.472	(0.517)	0.361
Household was in the upper 20% of the sample according to wealth indicators recalled from 2006/07 = 1	-0.317	(0.270)	0.241	-0.377	(0.795)	0.636
Distance of house from nearest market in 2006/07 minutes on foot (estimated by respondent)	-0.006	(0.001)	0.000	-0.023	(0.005)	0.000
Number of observations	**629**			**520**		

Notes: Probit regression. Variables dated 2006/07 are estimates, based on recall data or reconstructed from the composition of the household at the time of the survey. Explanatory variables expressed as $x = 1$ represent binary variables taking values of either 0 or 1. The dependent variable is 1 if the woman is a member of a self-help group supported by the project, and 0 otherwise. The coefficients represent the contribution of each explanatory variable/characteristic to the probability that a woman participates in the project.
[a] Variable dropped because of estimability or collinearity with other variables.

The final set of variables used in the matching process were identified using a backwards stepwise regression for each of the two groups, to identify those variables correlated with being in an intervention group at *p*-values of 0.20 or less. For the general population, 14 such variables were identified. To improve the balance between the treated and untreated groups, two additional matching variables were manually added to the 14 derived from this process. Both these variables were indicators of household wealth in 2006/07: the number of livestock owned by the household in 2006/07, and the indicator of whether the household was in the top 20 per cent of the sample according to the wealth indicators recalled from 2006/07. Among the horticulture participants, 16 variables were identified that were correlated with being in an intervention group at *p*-values of 0.20 or less. Tables A3.2 and A3.3 show the results of the probit models restricted to these final (restricted) sets of matching variables.

Table A3.2: Estimating the propensity score: parsimonious model for households in the general population

	Coefficient	Standard error	*p*-value
Household head is female = 1	-0.361	(0.253)	0.153
Age of household head in 2006/07 years	-0.011	(0.005)	0.012
Household head has any education = 1	-0.402	(0.185)	0.030
Household head is of Zarma ethnicity = 1	0.262	(0.172)	0.129
Respondent is the head of household = 1	0.336	(0.140)	0.016
Proportion of adult household members in 2006/07 with any education	0.471	(0.255)	0.064
Area of land cultivated with staple crops in 2006/07 hectares	-0.025	(0.013)	0.064
Household engaged in kitchen gardening in 2006/07 = 1	0.820	(0.204)	0.000
Number of crop types produced by the household in 2006/07	0.097	(0.023)	0.000
Number of crop types sold by the household in 2006/07	-0.036	(0.024)	0.141
Household owned any livestock (cattle, sheep, goats or donkeys) in 2006/07 = 1	0.303	(0.142)	0.032
Number of livestock (cattle, sheep, goats or donkeys) owned by household in 2006/07	-0.004	(0.005)	0.461
Any household member engaged in agricultural labour in 2006/07 = 1	0.382	(0.132)	0.004
Household was in the second 20% of the sample according to wealth indicators recalled from 2006/07 = 1	0.268	(0.155)	0.083
Household was in the upper 20% of the sample according to wealth indicators recalled from 2006/07 = 1	-0.115	(0.183)	0.529
Distance of house from nearest market in 2006/07 minutes on foot (estimated by respondent)	-0.006	(0.001)	0.000
Number of observations	**629**		

Notes: Probit regression. Variables dated 2006/07 are estimates, based on recall data or reconstructed from the composition of the household at the time of the survey. Explanatory variables expressed as $x = 1$ represent binary variables taking values of either 0 or 1. The dependent variable is 1 if the woman is a member of a self-help group supported by the project, and 0 otherwise. The coefficients represent the contribution of each explanatory variable/characteristic to the probability that a woman participates in the project.

Table A3.3: Estimating the propensity score: parsimonious model for households supported in kitchen garden production

	Coefficient	Standard error	*p*-value
Number of observations	**406**		

Notes: Probit regression. Variables dated 2006/07 are estimates, based on recall data or reconstructed from the composition of the household at the time of the survey. Explanatory variables expressed as $x = 1$ represent binary variables taking values of either 0 or 1. The dependent variable is 1 if the woman is a member of a self-help group supported by the project, and 0 otherwise. The coefficients represent the contribution of each explanatory variable/characteristic to the probability that a woman participates in the project.

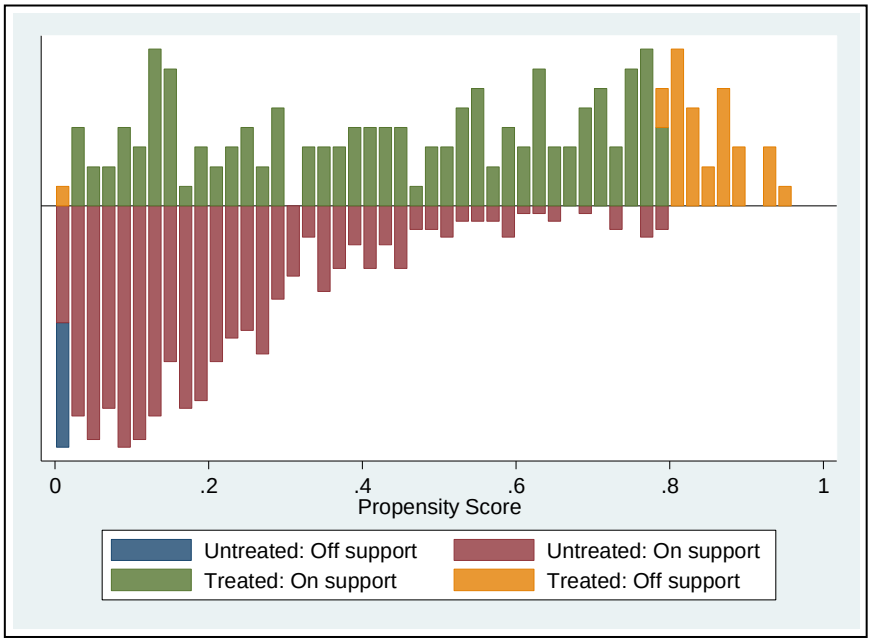
Defining the region of common support

After estimating the propensity scores, the presence of a good *common support area* needs to be checked. The area of common support is the region where the propensity score distributions of the treatment and comparison groups overlap. The common support assumption ensures that 'treatment observations have a comparison observation "nearby" in the propensity score distribution' (Heckman, LaLonde and Smith, 1999[33]). Since some significant differences were found between the intervention and comparison groups in terms of their baseline characteristics (as detailed in Appendix 2), some of the households in the intervention group are too different from the comparison group to allow for meaningful comparison. We used a minima and maxima comparison, deleting all observations whose propensity score is smaller than the minimum and larger than the maximum in the opposite group (Caliendo and Kopeinig, 2008). Among the general population, 31 of the 179 households in the project communities and 16 of the 450 households in the comparison communities

were dropped because they lay outside the area of common support. The consequence of dropping project participant households is that the estimates of differences in outcome characteristics between the various treatment groups only apply to those intervention households that were not dropped; that is, they do not represent the surveyed population as a whole.

Figure A3.1 illustrates the area of common support and indicates the proportion of households lying on and off the common support area for the households among the general population.

Figure A3.1: Propensity score on and off area of common support: households in general population



Among the households in the treatment group for the kitchen garden intervention, despite the large number of potential untreated observations available, adequate matching could not be achieved. When applying the minima and maxima comparison described above with the 16 matching variables listed in Table A3.3, 43 of the 70 treated households were dropped because they lay outside the area of common support. (The majority of the comparison observations, 361 out of 450, were dropped for the same reason.) Clearly any estimates derived from the remaining 27 households who were both in the treatment group and in the area of common support would not provide a good estimate of the effect of the project: they would represent the impact among less than half of the participants. In any case, such a small treatment group would provide very little statistical power with which to detect statistically significant effects. For these reasons, no PSM model was constructed for the households supported by the kitchen garden intervention. Instead, linear regression models were used in some cases to provide estimates of the impact of the project on particular outcome measures among the households supported by the kitchen garden component of the project, as described in the narrative in Section 5.

Matching intervention and comparison households

Following Rosenbaum and Rubin (1983), after estimating the propensity scores and defining the area of common support, individuals are matched on the basis of their propensity score. The literature has developed a variety of matching procedures. For the main results presented in this Effectiveness Review we chose to employ the method of kernel matching. Kernel matching weights the contribution of each comparison group member, attaching greater weight to those comparison observations

that provide a better match with the treatment observations. One common approach is to use the normal distribution with mean zero as a kernel, and weights given by the distribution of the differences in propensity score. Thus 'good' matches are given greater weight than 'poor' matches.

The *psmatch2* module in Stata was used with the default bandwidth of 0.06, and with the analysis restricted to the area of common support. Unfortunately in this process a further 16 of the households that were surveyed in the project communities were dropped from the analysis, in addition to the 31 that were dropped as lying outside the area of common support.

When using PSM, standard errors of the estimates were bootstrapped using 1,000 repetitions (clustered by community), to account for the additional variation caused by the estimation of the propensity scores and the determination of the common support.[34]

Check balancing

For PSM to be valid, the intervention group and the matched comparison group need to be balanced, in that they need to be similar in terms of their observed baseline characteristics. This should be checked. The most straightforward method to do this is to test whether there are any statistically significant differences in baseline covariates between the intervention and comparison group in the matched sample. Efforts were made to ensure that the covariates were balanced across groups at *p*-values greater than 0.20. It can be seen in Table A3.4 that this was not achieved for four of the covariates among the general population – but the magnitudes of the differences between the treated and untreated households in terms of these four covariates, while statistically significant, are reasonably small.

Table A3.4: Balancing test on the restricted set of matching variables, for households in the general population

	Treated	Untreated	*p*-value
Household head is female = 1	0.047	0.036	0.634
Age of household head in 2006/07 years	37.892	37.478	0.793
Household head has any education = 1	0.466	0.550	0.149
Household head is of Zarma ethnicity = 1	0.858	0.885	0.486
Respondent is the head of household = 1	0.750	0.787	0.452
Proportion of adult household members in 2006/07 with any education	0.393	0.473	0.055
Area of land cultivated with staple crops in 2006/07 hectares	3.836	4.559	0.213
Household engaged in kitchen gardening in 2006/07 = 1	0.622	0.630	0.886
Number of crop types produced by the household in 2006/07	8.777	8.439	0.536
Number of crop types sold by the household in 2006/07	2.412	1.813	0.139
Household owned any livestock (cattle, sheep, goats or donkeys) in 2006/07 = 1	0.507	0.508	0.978
Number of livestock (cattle, sheep, goats or donkeys) owned by household in 2006/07	6.628	7.731	0.505
Any household member engaged in agricultural labour in 2006/07 = 1	0.426	0.352	0.195
Household was in the second 20% of the sample according to wealth indicators recalled from 2006/07 = 1	0.223	0.211	0.806
Household was in the upper 20% of the sample according to wealth indicators recalled from 2006/07 = 1	0.182	0.196	0.769
Distance of house from nearest market in 2006/07 minutes on foot (estimated by respondent)	49.649	45.751	0.622
Number of observations	**117**	**582**	

Notes: Variables dated 2006/07 are estimates, based on recall data or reconstructed from the composition of the household at the time of the survey. Explanatory variables expressed as $x = 1$ represent binary variables taking values of either 0 or 1.

Similarly, as shown in Table A3.5, we also pass the balancing tests when using the full (unrestricted) set of matching variables. Only two additional variables in the complete set are unbalanced with *p*-values of less than 0.2 among households in the general population, other than the four mentioned above.

Table A3.5: Balancing tests on the full set of baseline covariates, for households in the general population

	General population		
	Treated	**Untreated**	***p*-value**
Number of household members in 2006/07 = 1	6.926	6.741	0.677
Proportion of household members who were children (less than 16 years old) in 2006/07	0.524	0.529	0.817
Household had only one adult member in 2006/07 = 1	0.115	0.174	0.149
Household had no male adult members in 2006/07 = 1	0.027	0.036	0.662
All adult household members were elderly (over 60 years old) in 2006/07 = 1	0.000	0.007	0.298
Household head is female = 1	0.047	0.036	0.634
Age of household head in 2006/07 years	37.892	37.478	0.793
Household head was elderly (over 60 years old) in 2006/07 = 1	0.047	0.067	0.467
Household head has any education = 1	0.466	0.550	0.149
Household head completed primary education = 1	0.149	0.176	0.518
Household head completed secondary education = 1	0.007	0.009	0.847
Household head is of Zarma ethnicity = 1	0.858	0.885	0.486
Household head is of Hausa ethnicity = 1	0.088	0.047	0.166
Household head is of Touareg ethnicity = 1	0.041	0.053	0.614
Household head is of Fulani ethnicity = 1	0.007	0.009	0.812
Respondent is the head of household = 1	0.750	0.787	0.452
Respondent is female = 1	0.270	0.207	0.202
Age of respondent in 2006/07 years	35.824	35.939	0.944
Respondent was elderly (over 60 years old) in 2006/07 = 1	0.047	0.065	0.515
Respondent has any education = 1	0.446	0.493	0.415
Respondent has completed primary education = 1	0.149	0.158	0.824
Respondent has completed secondary education = 1	0.007	0.007	0.948
Proportion of adult household members in 2006/07 with any education	0.393	0.473	0.055
Proportion of adult household members in 2006/07 who completed primary education	0.136	0.164	0.363
Proportion of adult household members in 2006/07 who completed secondary education	0.010	0.009	0.945
Household cultivated any staple crops in 2006/07 = 1	0.939	0.962	0.363
Area of land cultivated with staple crops in 2006/07 hectares	3.836	4.559	0.213
Household engaged in kitchen gardening in 2006/07 = 1	0.622	0.630	0.886
Number of crop types produced by the household in 2006/07	8.777	8.439	0.536
Number of crop types sold by the household in 2006/07	2.412	1.813	0.139
Household owned any livestock (cattle, sheep, goats or donkeys) in 2006/07 = 1	0.507	0.508	0.978
Number of livestock (cattle, sheep, goats or donkeys) owned by household in 2006/07	6.628	7.731	0.505
Any household member worked as a large-scale trader in 2006/07 = 1	0.162	0.129	0.422
Any household member engaged in agricultural labour in 2006/07 = 1	0.426	0.352	0.195
Any household member engaged in a skilled trade in 2006/07 = 1	0.297	0.322	0.651
Any household member engaged in petty commerce in 2006/07 = 1	0.399	0.422	0.687
Any household member engaged in formal paid employment in 2006/07 = 1	0.047	0.028	0.389
Household received remittances during 2006/07 = 1	0.500	0.540	0.493
Household was in the second 20% of the sample according to wealth indicators recalled from 2006/07 = 1	0.223	0.211	0.806

Household was in the middle 20% of the sample according to wealth indicators recalled from 2006/07 = 1	0.189	0.204	0.753
Household was in the fourth 20% of the sample according to wealth indicators recalled from 2006/07 = 1	0.216	0.242	0.605
Household was in the upper 20% of the sample according to wealth indicators recalled from 2006/07 = 1	0.182	0.196	0.769
Distance of house from nearest market in 2006/07 minutes on foot (estimated by respondent)	49.649	45.751	0.622
Number of observations	**117**	**582**	

NOTES

1 The difference shown in column 2 of Table 5.1 is not statistically significant at conventional levels. However, the estimates derived from the alternative PSM models and regression models tested are statistically significant at at least the 10 per cent level.

2 Specifically, PSM models were constructed using the set of matching variables discussed in Appendix 3, with the addition of the five binary variables for support received during the 12 months prior to the survey, listed in Table 5.2. Two models were created, one using kernel matching and one using nearest-neighbour matching without replacement.

3 The estimates for both variables are consistently positive, and that for information on the level of water available is statistically significant at the 10 or 5 per cent level under some alternative formulations of the PSM model and under the regression models tested.

4 It is less clear whether there is a significant difference between project and comparison communities in the proportions who had limited their water use more often (at least three times during the past 12 months) and attributed this decision to advice from the water committee or from government. However, the estimates of the differences between project and comparison communities in terms of those outcomes are also consistently positive.

5 These differences between the project and comparison communities were present to some extent before the project activities started, according to the baseline data recalled from 2006/07. These recalled data, of course, may be subject to error. However, even taking that baseline data at face value, it is clear that there has been a large reduction in the use of open wells and a large increase in access to piped water in the project communities than in the comparison communities over the lifetime of the project.

6 The estimate shown in column 3 of Table 5.5 is not statistically significant, but the figures derived from most of the alternative statistical models are significant at at least the 10 per cent level. Respondents in project communities recalled having spent considerably more time than those in comparison communities collecting water in 2006/07 (20 minutes on average in the project communities, 16 minutes on average in the comparison communities), so estimates of the change in the time spent collecting water show a positive difference in the project communities that is significant at the 1 per cent level under each of the statistical models tested.

7 Twenty-six per cent of households in the project communities and 18 per cent in the comparison communities reported that they had started doing kitchen gardening since 2006/07. This difference is not quite statistically significant based on the primary PSM model ($p = 0.104$), but it is significant at the 1 per cent level under the parametric PSM models and linear and probit regression models.

8 The coefficients on the variable for participation in the kitchen garden intervention for two different linear regression models constructed with the number of crop types produced in 2013 as the outcome were 2.5 and 2.6, both of which were statistically significant at the 1 per cent level.

9 The implied difference between the two groups is even larger (and still statistically significant at the 1 per cent level) after logarithmic transformation of the sales figures. The coefficient derived from the primary PSM model for the logarithm of sales revenue is 1.7, and those from the alternative PSM and regression models range from 1.1 to 1.6. This implies that sales revenue was between three and five times larger for the average household in the project communities than the average of the matched households in the comparison communities.

10 Only 12 per cent of households reported having adopted the use of compost since 2006/07, and this did not differ significantly between households in project and comparison communities.

11 The estimates derived from the various statistical models of the difference between project and comparison communities in use of improved ploughing techniques are mostly not statistically significant at conventional levels.

12 A difference-in-difference measure was also constructed, using recalled data on livestock ownership in 2006/07. The estimates derived from this model are consistently negative, but most are not statistically significant at conventional levels.

13 In particular, the PSM models that include the variables relating to external support received by the household (as discussed in Section 5.2) produced p-values for the estimated difference in terms of this variable of 0.15 and 0.14. After logarithmic transformation of the outcome variable, all of the various PSM and linear regression models tested produced estimates that were negative and statistically significant at at least the 5 per cent level, with the exception of one of the two PSM models that controlled for external support received by the household, for which the p-value was 0.14.

14 Some of the statistical models tested produced an estimated difference that was negative and statistically significant at the 5 or 10 per cent level.

15 The difference is estimated to be statistically significant at at least the 5 per cent level under most of the PSM and linear regression models tested, though not under the main PSM kernel model used to derive the results presented in this report.

16 Jennifer Coates, Anne Swindale and Paula Bilinksy, Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide, version 3, Food and Nutrition Technical Assistance Project (FANTA), August 2007: http://www.fantaproject.org/monitoring-and-evaluation/household-food-insecurity-access-scale-hfias

17 The estimated difference is negative and statistically significant at at least the 10 per cent level under each of the various PSM and linear regression models tested, with the exception of one of the PSM kernel models, for which the estimated difference is negative and with a p-value of 0.11.

18 The difference between households in the project and comparison communities in the number of types of fruit and vegetables consumed are estimated by each of the various PSM and linear regression models to be negative, but not statistically significant. However, linear regressions of the same variable on the households among households who were specifically supported in kitchen gardening (and among households in comparison communities) produce estimates that are positive, but not statistically significant.

19 To reflect the existence of economies of scale within households, and the lower consumption needs of children, 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 Effectiveness Review follows the common practice of setting equal to 0.33 and equal to 0.9, but the findings are not sensitive to reasonable changes in these parameters.

20 Cronbach's alpha was used to measure this inter-item correlation. The Cronbach's alpha obtained for all the indicators for the recalled 2006/07 data was 0.83. This alpha was increased to 0.85 by removing those items that had a low correlation with the others. The alpha derived for the index of change in wealth indicators was originally 0.86, and was increased to 0.88 by removing those items that had a low correlation with the others.

21 The estimates derived from the various statistical models are uniformly positive, and some of them (including the parametric PSM kernel model and the OLS regression models tested) are statistically significant at the 10 per cent level – but this does not seem strong enough evidence to make a claim of a positive effect due to the project.

22 Two regression models were constructed the outcome measure shown in Table 5.11, including the 70 households known to have been supported by the kitchen garden intervention in the project communities and all households interviewed in the comparison communities. The coefficient on the dummy variable for being supported by the project was positive and statistically significant at the 1 per cent level for the regression models under both of the regression models.

23 Following the same process as that described in note 22, regression models were constructed for the outcomes listed in Table 5.12, including the 70 households known to have been supported by the kitchen garden intervention in the project communities and all households interviewed in the comparison communities. The coefficient on the dummy variable for being supported by the project was negative and statistically significant at the 10 per cent level for the regression models for whether the household adopted any coping strategies (equivalent to column 1 of Table 5.12) or the number of unusual coping strategies adopted (equivalent to column 4 in the table). Coefficients derived from regression models for the other two outcome variables were negative, but not statistically significant.

24 This approach is described in 'A Multidimensional Approach to Measuring Resilience', Oxfam GB working paper, August 2013: http://policy-practice.oxfam.org.uk/publications/a-multidimensional-approach-to-measuring-resilience-302641.

25 It will be noted that in calculating these overall measures of resilience, each of the individual characteristics presented in Table 5.13 was weighted equally. This means that the index is weighted more towards characteristics of livelihood viability, and less so towards the other four dimensions. Alternative weights could be given to the various characteristics and dimensions, which would necessarily result in changes in the overall indices and potentially in the magnitude of differences between the intervention and comparison groups.

26 The parametric PSM models and various linear regression models all produce estimates of a positive difference of 0.03 to 0.05 in magnitude that are statistically significant at least at the 5 per cent level.

27 In particular, the parametric PSM models, the (non-parametric) PSM models that incorporate the variables about support received during the year prior to the survey, and the linear regression models all produce estimates that are positive and statistically significant at at least the 5 per cent level.

28 In the parametric PSM and linear and probit regression models for this outcome, the estimated coefficients on the dummy variable representing the respondent being female are not statistically significant. In interpreting this finding, it should be noted that the enumerators were a mixture of men and women, and that in many cases male enumerators interviewed female respondents and vice versa.

29 Strong agreement was required in this case because large majorities of the respondents agreed (either partially or strongly) with both statements.

30 A variable representing the interaction between residing in a project community and the respondent being female was added to the parametric PSM and linear regression models for this outcome variable. In the four different models tested, the coefficient on this variable was negative; it was statistically significant at the 5 or 10 per cent level in two of the four models. However, even after adding this interaction variable, the coefficient on the overall intervention variable was still negative and statistically significant at the 5 or 10 per cent level, suggesting that male respondents in project communities were also less likely to score positively on this indicator than were male respondents in comparison communities.

31 Marco Caliendo and Sabine Kopeinig 'Some Practical Guidance for the Implementation of Propensity Score Matching', Journal of Economic Surveys, vol. 22(1) (2008), pages 31–72.

32 Paul R. Rosenbaum and Donald B. Rubin, 'The Central Role of the Propensity Score in Observational Studies for Causal Effects', Biometrika, vol. 70(1) (1983), pages 41–55.

33 James J. Heckman, Robert J. LaLonde and Jeffrey A. Smith, 'The Economics and Econometrics of Active Labor Market Programs', Handbook of Labor Economics, vol. 3, part A (1999), pages 1865–2097.

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

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