

# RESILIENCE IN CHAD

Impact evaluation of reinforcing resilience capacity and food security in Bahr el Gazal and Guéra

Effectiveness Review Series

2014/15



A market gardening project set up by villagers provides income and food security for the community in Guéra province, Chad.  
Photo: Andy Hal/Oxfam

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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 to which they have promoted change in relation to relevant Oxfam GB global outcome indicators.

During the 2014/15 financial year, one of the projects that was randomly selected for an Effectiveness Review was the project 'Reinforcing Resilience Capacity in Bahr el Gazal', which was implemented by Oxfam GB in the Bahr el Gazal Region in northern Chad between April 2011 and March 2015. The Effectiveness Review was expanded to include the project 'Improving the Food Security Information System in Guéra Region' (usually known by its French acronym as PASISAT), carried out by Intermón Oxfam and partner organisations Mostagbal and Nagdora between February 2011 and March 2014. The Effectiveness Review, which was carried out in January and February 2015, was aimed at evaluating the success of the community-level activities of these two projects in enabling households to strengthen their livelihoods, minimise risk from shocks and adapt to emerging trends and uncertainty. The Effectiveness Review was carried out in the communities in each region that had received the greatest concentration of activities under each of the projects.

The main activities carried out by the project in Bahr el Gazal included the distribution of seeds and tools, training on agricultural techniques, training of community animal-health workers, restocking of sheep and goats, vaccination of livestock, and training on market gardening. The main objective of the project PASISAT in Guéra was to strengthen the region's Food Security Information System by establishing processes under which data on meteorological conditions and crop production are collected regularly by officials within each canton, and submitted to a central coordinating office. The participants interviewed also benefited directly from support in market gardening; training on seed replication techniques, soil conservation and restoration work; and promotion of improved nutritional practices.

## EVALUATION APPROACH

This Effectiveness Review used a quasi-experimental evaluation design to assess the impact of the described activities among the households who directly participated in the project activities. In Bahr el Gazal, interviews were conducted in 11 of the communities where the project activities were implemented with a sample of households that were assessed as being 'poor' or 'very poor'. In Guéra, interviews were conducted with a sample of those who had participated directly in the market gardening and seed-replication activities across 12 communities. For comparison purposes, households were also interviewed in communities located in the same area as the project communities, but where none of the project activities had been carried out.

In total, 216 households were interviewed in the project communities and 369 households in the comparison communities in Bahr el Gazal, and 219 in the project communities and 340 in the comparison communities in Guéra. To increase confidence when making estimates of the projects' impacts, the statistical tools of propensity-score matching and multivariate regression were used at the analysis stage to control for apparent baseline differences between the households in the project and comparison communities.

In interpreting the results for Bahr el Gazal, it should be noted that most of the households interviewed in both project and comparison communities have received humanitarian support from Oxfam in recent years. This Effectiveness Review attempted to assess the *additional* impact of the 'Reinforcing Resilience Capacity' project, on top of these humanitarian interventions.

# RESULTS

The survey results provide good evidence that the projects have positively affected several outcomes of interest. In terms of agricultural activities, the project PASISAT in Guéra has been successful in increasing the number of crops sold (both staple and vegetable crops) and thus we found higher revenues from their sale among intervention households (150 per cent higher). Moreover, both projects enhanced the use of improved agricultural techniques, such as improved seeds and phytosanitary treatment. In particular, households in intervention communities in Guéra were more likely to employ row planting than their counterparts in comparison communities. Other techniques employed by project households in Bahr el Gazal were biological treatment and soil conservation methods.

Livestock-rearing activities in Bahr el Gazal have improved access to veterinary care and boosted the vaccination of livestock among project communities. However, we did not find that the project activities in the region have had any effect in the number of livestock owned or availability of water for animals.

Both projects aimed at improving dietary diversity and food security among participants. We did not find evidence, however, that any of the projects have had a statistically significant effect on dietary diversity: the average household in our sample (in both intervention and comparison communities) had consumed mainly grains and tubers in the seven days before the survey. There is no evidence either that men, women or children in the intervention households had better access to food during the previous lean season. We found a positive effect of the project in Bahr el Gazal in reducing severe food insecurity, but the results suggest a negative effect of the project for this outcome in Guéra. Perhaps the most interesting result is in terms of expenditure on food consumption: we found that households in project villages from Bahr el Gazal increased their expenditure on food consumed in the seven days prior to the survey by 20 per cent. We did not find an effect on this outcome in households from the intervention group in Guéra.

We created a wealth index, measured in terms of agricultural and household asset ownership. We then estimated the change in wealth index between 2010 and the date of the survey (2014) and scaled it so that a household that saw no changes in wealth indicators has a score of zero, while the household that saw the greatest change in wealth indicators has a score of 1. We found that on average, the change in wealth index in households in project villages was not significantly different from that of the comparison group. Nevertheless, a change in wealth indicators is something expected to happen over the long term rather than be an immediate result of short-term projects, such as the ones being evaluated in this Effectiveness Review.

Another aspect of great interest is the households' ability to cope with change. We looked at three different specifications of resilience indicators, all based on five dimensions: livelihood viability; innovation potential; access to contingency resources and support; natural and built environment; and social and institutional capability. Overall, results showed a positive impact of the projects in improving resilience. However, each project affected results in different ways.

The project 'Reinforcing Resilience Capacity in Bahr el Gazal' contributed positively in promoting the use of improved seeds by 10.4 percentage points; improving access, availability and quality of veterinary care by 9.9 percentage points; and in enhancing the ownership of assets by 15.1 percentage points.<sup>1</sup> There is no evidence to conclude that the project had any effect on improving the innovation potential of households in intervention communities. In terms of access to contingency resources and support, we found that project households in the region were 16.8 percentage points more likely to have access to a grain bank and 8 percentage points more likely to be able to finance an investment of 50,000 francs CFA (approximately 85 USD) or an unexpected medical treatment from savings. Households in project communities were also 22.9 percentage points more likely to access clean drinking water and 8.5 percentage points more likely to have better access to water for market gardening than their counterparts in comparison communities. The project enhanced participation in community groups by 11 percentage points. Finally, households in project communities



are significantly 6.3 percentage points more likely to receive support from state extension services than their counterparts.

On the other hand, there is no evidence that PASISAT's activity had any effect in terms of the resilience dimensions of livelihood viability and innovation potential. However, we found that households in project communities were 8.6 percentage points more likely to receive support from state extension services than those in comparison villages. In the natural and built environment dimension, we found that the project had a positive impact in improving access to drinking water by 9 percentage points and providing access to water for market gardening by 9.1 percentage points, compared to non-project households. We also observed that individuals in project villages were 8.4 percentage points more likely to have access to grain banks and 10.35 percentage points more likely to have access to medical care.

Overall, households in the project communities in Bahr el Gazal were assessed as scoring positively in 50 per cent of the characteristics of resilience, compared to 40 per cent in the comparison communities, while in Guéra, project households scored positively in 45 per cent of the characteristics of resilience, compared to 42 per cent in the comparison group. The work undertaken in both projects appears to have had a positive effect on outcomes that should enable project participants to cope better with shocks, stresses and uncertainty in the future.

**Table 1: Characteristics of resilience examined in this Effectiveness Review**

Dimension	Characteristic	Connected to project logic?	Evidence of positive impact?	
			Bahr el Gazal	Guéra
Livelihood viability	Access to land for cultivation	No	No	No
	Use of improved seeds	Yes	Yes	No
	Ownership of livestock	Yes <sup>1</sup>	No	No
	Access, availability and quality of veterinary care	Yes <sup>1</sup>	Yes	No
	Diversification in sources of income	No	No	No
	Ownership of productive assets	No	Yes	No
Adoption of innovative practices/innovation potential	Understanding of climate change	Yes <sup>1</sup>	No	No
	Attitude to change and innovation	Yes	No	No
	Adoption of innovative practices	Yes	No	No
Access to contingency resources and support	Access to a grain bank	No <sup>2</sup>	Yes	Yes
	Access to medical care	No	No	Yes
	Savings	No	Yes	No
	Access to remittances	No	No	No
Integrity of the natural and built environment	Access to drinking water	Yes	Yes	Yes
	Access to water for market gardening	Yes	Yes	Yes
	Access to water for livestock	Yes <sup>1</sup>	No	-
Social and institutional capability	Social cohesion in the community	No	No	No
	Participation in community groups	Yes	Yes	No
	Support from state extension services	No	Yes	Yes

<sup>1</sup> Bahr el Gazal only.

<sup>2</sup> Although this indicator is connected to the project's logic, none of the communities in our sample benefited directly from this activity.

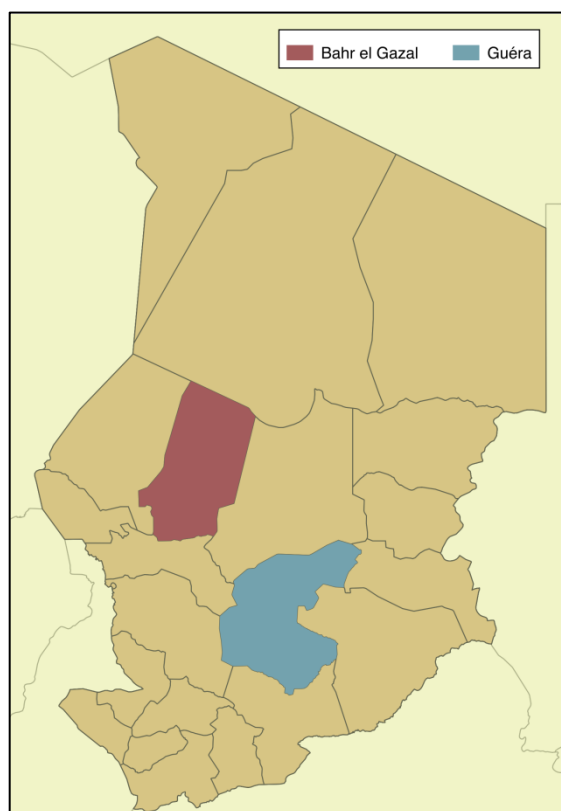
# 1 INTRODUCTION

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 the projects have promoted change in relation to relevant Oxfam GB global outcome indicators.

During the 2014/15 financial year, one of the projects that was randomly selected for an Effectiveness Review was 'Reinforcing Resilience Capacity in Bahr el Gazal', which was implemented by Oxfam GB in the Bahr el Gazal Region in northern Chad between April 2011 and March 2015. The Effectiveness Review was expanded to include the project 'Improving the Food Security Information System in Guéra Region' (usually known by its French acronym, PASISAT), carried out by Intermón Oxfam and partner organisations Mostagbal and Nagdora between February 2011 and March 2014. The Effectiveness Review, which was carried out in January and February 2015, was aimed at evaluating the success of the community-level activities of these two projects in enabling households to strengthen their livelihoods and to minimise risk from shocks and adapt to emerging trends and uncertainty. The Effectiveness Review was carried out in the communities in each region that had received the greatest concentration of activities under each of the projects.

This report is organised as follows. Section 2 briefly reviews the activities implemented under the two projects. 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: Project regions in Chad**



Map made with Natural Earth

# 2 PROJECT DESCRIPTION

## 2.1 PROJECT ACTIVITIES IN BAHR EL GAZAL

Bahr el Gazal is an arid region in the Sahelian zone of Chad, populated mostly by pastoralists and agro-pastoralists. This zone is characterised by a mass exodus of men, leaving household management to women. Three sub areas exist within the intervention zone: 1) a more or less sedentary area with agricultural land and nearby markets, factors that can lead to a variety of income generating activities; 2) a mainly pastoralist area which is in part sedentary with the closest market 75 kilometres away, and where livestock fattening and sale of dairy product are the main income generating activities; and finally, 3) a purely pastoralist area, with small, widely distant villages with the nearest market approximately 200 kilometres away. In this last subarea, income-generating activities are rare.

Oxfam GB has worked in the Bahr el Gazal region since 2010, carrying out humanitarian interventions to support people in coping with and recovering from periods of drought. This work has included large-scale distributions of food and cash transfers, as well as interventions for water, sanitation and hygiene.

The 'Reinforcing Resilience Capacity' project was launched in 2011 with the aim of strengthening adaptive capacity and diversifying livelihoods, so that people in the region would be less vulnerable to future droughts and other shocks. From April 2011 to March 2014 activities were carried out with support from the Swedish International Development Cooperation Agency (SIDA) in three sous-prefectures (districts) in the northern section of Bahr el Gazal. The activities carried out included:

- Distributions of seeds, tools and training on agricultural production methods.
- Vaccination of livestock.
- Training of community animal-health workers.
- Restocking of sheep and goats.
- Rehabilitation of wells for livestock.
- Rehabilitation of motor pumps for wells, and training local people in making future repairs.
- Capacity-building for water-point management committees.
- Breeding of plants intended to improve soil quality and their distribution to communities.
- Training of women on the manufacture and use of improved stoves.
- Providing credit and training to women to enable them to establish small household businesses.

While these activities were carried out over a wide geographic area, there was a particular area of concentration of activities in the sous-prefecture of Mandjoura. In particular, 12 communities in the Mandjoura area (including Mandjoura town itself) received a particularly high concentration of activities under the project. Within those communities, all or almost all of the households that were assessed as 'poor' or 'very poor' were thought to have participated directly in at least one of the project activities.

From April 2013 to March 2015, the project activities were implemented in a different area, in the southern part of Bahr el Gazal. Many of the activities were similar to those implemented earlier in the northern part of the region, including distributions of seeds and tools, training on agricultural techniques, training of community animal-health workers, and the restocking of sheep and goats. In addition, 90 women across eight communities were trained and given practical support to engage in market gardening (maraîchage), and 60 women were supported in sheep-rearing as a household business.



Similarly to the earlier years, the activities in 2013–15 were implemented in various communities across four sous-prefectures. However, there was a particular area of concentration in the sous-prefecture of Chaddra. In particular, the market-gardening and sheep-rearing activities were concentrated in eight communities. Again, in those eight communities, all of those who were assessed by the implementers as 'poor' or 'very poor' were thought to have participated directly in at least one of the project activities.

## 2.2 PROJECT ACTIVITIES IN GUÉRA

The main objective of the PASISAT project, carried out by Intermón Oxfam and local partners in the Guéra Region between 2011 and 2014, was to strengthen the region's Food Security Information System. To that end, Oxfam worked with specialists from AEDES Consulting and with local partners to carry out a detailed survey of climate conditions, livelihoods, socio-economic conditions and vulnerability in each of the 22 cantons (local administrative units) in the region. Processes had been established under which data on meteorological conditions and crop production are collected regularly by officials within each canton, and submitted to a central coordinating office. This coordinating office consolidates and analyses these data and produces reports summarising the food security situation, making projections for the near future, and identifying where vulnerabilities exist and where intervention may be required. These reports are discussed with canton-level officials for validation, and are then used in planning and targeting interventions by regional agencies and other actors.

Since the Food Security Information System covers Guéra Region as a whole, it was not possible to find a group within the region that had not potentially benefited from its existence. This means that the impact of the Information System could not be evaluated using the comparative approach adopted in this Effectiveness Review. However, another aspect of the project involved carrying out various interventions at a community level. These activities were targeted on the three cantons that were identified as having the highest degree of vulnerability, based on the structural profiles compiled at the start of the project. The specific activities included:

- **Support to 30 groups of women (approximately 760 individuals in total) in market gardening:** These groups were trained in market gardening, and provided with seeds and tools to enable them to engage in the activity. In each of the 10 communities where this activity was carried out, a well was constructed to provide a water source during the dry season. Technical support to the group members continued throughout the project's lifetime.
- **Providing access to improved seeds through local seed replication:** In the first year of the project, 25 individuals were provided with first-generation improved seeds, considered more appropriate for the climate in the region than traditional varieties. Seeds were provided for a mixture of staple crops (sorghum, millet and maize) and cash crops (groundnuts and cowpeas). The 25 producers used those seeds to produce a second-generation crop; this crop was purchased by the project partners, who then distributed it to 137 individuals for replication in the second year. The third-generation crop was again purchased by the project partners and was distributed to approximately 800 producers. This activity was intended both to generate revenue among the seed replicators in the first and second years, and to increase agricultural productivity among those who received a seed distribution in the third year. Training in production techniques was also provided to those who received the seed distribution.
- **Engaging in soil conservation and restoration work:** In four communities, small dams (*micro-barrages*) were constructed, with the aim of protecting agricultural land from flooding in case of heavy rain. Community members were trained and equipped in order for them to be able to maintain the dams.
- **Promotion of improved nutrition, hygiene and maternal health practices:** Twelve groups (consisting mostly of women) were trained to be able to carry out awareness-raising within their communities on nutrition – especially infant nutrition – and some aspects of hygiene and maternal health.

This Effectiveness Review focused on assessing the impact of the market gardening and seed-replication activities among those who received direct support from these interventions. Some of the communities where the seed replication was carried out were also included in the soil conservation and restoration activities. Tables 2.1 and 2.2 show the specific activities carried out across the interviewed communities in each region.

**Table 2.1: Project activities in Bahr el Gazal**

Area	Community	Market gardening	Improved seeds	Livestock vaccination	Agricultural inputs	Training on agricultural techniques	Plants	Re-stocking sheep and goats	Training community animal-health workers	Rehabilitation of wells for livestock	Rehabilitation of motor pumps for wells	Credit and training for women on household businesses	Improved stoves	Sheep fattening
Chaddra	Dougoul Micheri	✓	-	-	-	-	-	-	-	-	✓	-	-	-
Chaddra	Herbey	✓	✓	-	✓	✓	-	✓	✓	-	✓	-	-	✓
Chaddra	Mouzrague	✓	✓	-	✓	✓	-	✓	✓	-	✓	-	-	✓
Chaddra	Tororo	✓	-	-	-	-	-	✓	-	-	✓	-	-	-
Chaddra	Touloub	✓	✓	-	✓	✓	-	✓	✓	-	✓	-	-	✓
Mandjoura	Andrabadi	-	✓	✓	✓	✓	-	✓	-	-	-	✓	✓	-
Mandjoura	Andrabate	-	✓	✓	✓	✓	✓	✓	-	-	-	✓	-	-
Mandjoura	Koukoulaye	-	✓	✓	✓	✓	✓	-	-	-	-	-	-	-
Mandjoura	Mandjoura	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	-
Mandjoura	Tourkagore	-	✓	✓	✓	✓	-	-	-	-	-	-	✓	-
Mandjoura	Tourki	-	✓	✓	✓	-	✓	✓	-	-	-	✓	✓	-

**Table 2.2: Project activities in Guéra**

District	Community	Market gardening	Seed replication	Soil conservation techniques
Abtouyour	Djaya Doua	✓	-	-
Abtouyour	Djaya Tayara	✓	-	-
Abtouyour	Koubo Adougoul	-	✓	-
Guéra	Changuil	-	✓	✓
Guéra	Clignata	-	✓	-
Guéra	Golonti	-	✓	✓
Guéra	Kretchou	-	✓	✓
Guéra	Mormo	-	✓	-
Guéra	Sirboudoum	✓	-	-
Mangalmé	Djondjol	✓	-	-
Mangalmé	Hidjelidjé	✓	-	-
Mangalmé	Waga	✓	-	-

# 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 at random the sites in which the programme will be implemented. 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.

However, the communities where the projects examined in this Effectiveness Review were implemented 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 have a positive impact. However, it is clear that producers within the two regions face similar risks, and that there were other communities with equally vulnerable groups 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 not included in any of the projects was assumed to provide a reasonable counterfactual for the situation of people who benefited from them.

It is important to note that those who participated in the projects within the project communities were not selected at random. In Bahr el Gazal, the project activities were targeted at those who were seen as particularly vulnerable. In particular, most of the households classified as ‘poor’ or ‘very poor’ under Household Economy Approach (HEA) surveys were thought to have participated in one or more of the project activities. In Guéra, the project worked mainly with the members of existing producers’ groups or associations. Within each region, it was important to identify and interview people in the comparison communities with similar traits to those who participated in the project. The approaches that were used to make this identification are described in Sections 4.1 and 4.2.

To improve the confidence in making the comparison of outcomes, 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, productive activities, community group participation and indicators of material well-being, such as housing conditions and ownership of assets. Since some of these characteristics may have been affected by the project itself (particularly those relating to 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 in 2010, before either of the two projects was launched. Despite clear shortcomings in the quality of recall data, the use of proxies capturing some measure of pre-intervention state is 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 corresponded 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 various matching algorithms and 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 is a cause for particular caution when interpreting the results of evaluating a project in which participants were to some extent self-selected. The point is further discussed in Sections 5 and 6 alongside the interpretation of the statistical analysis.

# 4 DATA

## 4.1 RESPONDENT SELECTION IN BAHR EL GAZAL

The project activities under review had been conducted in 66 communities across two areas of the Bahr el Gazal region. However, the bulk of the activities had been concentrated in a smaller number of communities. It was decided to include in the Effectiveness Review only communities in which there had been at least one activity other than livestock vaccination, restocking of livestock, distribution of agricultural inputs (seeds or tools), or training on production techniques. There were 20 such communities.

It should be noted that humanitarian interventions – including food distributions and cash transfers – had been carried out by Oxfam across the whole region in recent years. For the purposes of targeting these humanitarian interventions, Oxfam had conducted surveys using the Household Economy Approach (HEA), under which all households in a community are categorised by wealth or poverty status. Humanitarian support targeted households identified through the HEA surveys as being 'poor' or 'very poor'.

The resilience project under review was also targeted mainly at the 'poor' and 'very poor' households in each community. Within the 20 communities that had received the most intense exposure to the project, almost all of the 'poor' or 'very poor' households were thought to have participated in or benefited directly from some of the project activities. This meant that this Effectiveness Review could be carried out with a random sample of all the households that had earlier been identified as 'poor' or 'very poor'. Of the 20 communities that had received the highest concentration of activities under the resilience project, the identification of 'poor' and 'very poor' households was not available for seven communities, and in one case the identification of the community was unclear. Those eight communities were therefore excluded from the Effectiveness Review.

For comparison purposes, 16 communities were identified that were located in the same geographic areas as the project communities and which had similar characteristics to the project communities, but where none of the project activities had been implemented. Importantly, the identification of 'poor' and 'very poor' households was also available for these 16 communities.

Finally, one of the remaining 12 project communities that was eligible to be included in the Effectiveness Review (after excluding the eight for which the identification of 'poor' and 'very poor' households was not available or uncertain) was the town of Chaddra, in the southern part of Bahr el Gazal. This town is a relatively urban area with a large market, and it was not thought that any other community in the region made a suitable comparison. For this reason, Chaddra town was also excluded from the Effectiveness Review.

In summary, then, the survey was carried out in 11 project communities and 16 comparison communities in Bahr el Gazal. Within each of these communities, households were selected at random from among all the 'poor' and 'very poor' households to be targeted for interview. It should be reiterated that all or almost all of these households had received humanitarian support from Oxfam during the years prior to the survey: any differences in outcomes found between the project and comparison communities should therefore be attributable to the additional effect of the specific project under review, assuming there were no differences prior to the project.



## 4.2 RESPONDENT SELECTION IN GUÉRA

### 4.2.1 Market garden intervention

The two activities of the PASISAT project that were included in the Effectiveness Review were the support of market gardening (maraîchage) among groups of women growers, and the support of the replication of improved seeds.

The market gardening activity was carried out in 11 different communities across three departments, with two or three groups being established in each community. Six of these 11 communities were selected at random (using probability proportional to size) to be included in the survey. Within these six communities, members of the market gardening groups were selected at random to be interviewed. The use of random selection at the community and individual level means that those interviewed are a random sample of the overall population of market garden participants.

For comparison purposes, communities were identified within the same three departments that were thought to have similar potential for market gardening to succeed, but where there had been no similar project carried out. The challenge was to identify who within those communities could be interviewed as similar to the market gardening participants. Unlike in Bahr el Gazal (where all or almost all of the 'poor' and 'very poor' households participated in project activities), the women who participated in the market gardening intervention were a minority in their communities. It is likely that these women tended to differ from their neighbours who did not participate in the project activities – for example, in their sense of initiative, willingness to take risks, or in their social connections. It was therefore important to interview people in the comparison communities with similar traits. A reasonable comparison was thought to be with women who were participating in some other type of producers' group or women's group in the comparison communities. For this reason, comparison respondents were selected at random from among the members of women's groups within the comparison communities.

### 4.2.2 Improved-seeds intervention

The improved-seeds intervention was carried out by identifying in the first year of the project (2012), a small number of individuals with the potential for replicating the seeds. Twenty-five such individuals participated, across six communities. In the second year, the second-generation seeds were distributed to a total of 110 producers (including the original 25) across 17 communities. In the following year, a much larger number of producers (632) received third-generation seeds. It was clear that the greatest benefit from the project was realised among those who participated in seed replication in the first or second year – given that they received cash income from selling their seeds back to the project implementers, rather than simply having the benefit of production from the third-generation seeds in the third year. However, it was not seen as possible to carry out the Effectiveness Review only among the first- and second-year participants: there was no way to replicate the process by which these first and second-year participants were selected, so it would not be clear who to interview for comparison with those producers. Instead, the survey was conducted among a sample of those who received the seeds during the final year of the project (which included the first- and second-year producers). To ensure that a reasonable number of those who were interviewed were among the seed replicators in the first and second year of the project, the survey was conducted only in communities where at least eight individuals were involved in seed replication in the second year. There were a total of six such communities. An added advantage of this approach is that the three communities where the soil conservation activities were carried out were included among those six.

Again for comparison purposes, communities were identified from within the same departments, but where nobody received any improved seeds, from this or any similar project. As with the market gardening participants, it was not possible to identify directly which community members would have been selected to receive improved seeds, had there been such an intervention in those communities.

However, most of those who received improved seeds in the third year of the project were participating in existing community-based agricultural producers' groups, so it was thought that members of similar producers' groups in the comparison communities would have similar characteristics. In the comparison communities, survey respondents were therefore selected at random from among the members of existing agricultural producers' groups.

The sample composition at the community level is presented in Table 4.1.

**Table 4.1: Sample frame**

Region/Area/Community	Households interviewed	Region/District/Community	Households interviewed
<b>Bahr El Gazal</b>	<b>585</b>	<b>Guéra</b>	<b>559</b>
<b>Chaddra</b>	<b>403</b>	<b>Abtouyour</b>	<b>137</b>
<b>Comparison</b>	<b>253</b>	<b>Comparison</b>	<b>99</b>
Egre Yhoussa	24	Barama	20
Fourtoulou	52	Barlo Marché	34
Gountour	32	Bérété	24
Koumanga Kochélé	19	Djaya Kossoye	21
Koumanga Kourou	21		
Sougoumar (5 villages)	85	<b>Intervention</b>	<b>38</b>
Toulba	20	Djaya Doua	18
		Djaya Tayara	18
<b>Intervention</b>	<b>150</b>	Koubo Adougoul	2
Dougoul Micheri	12		
Herbey	56	<b>Guéra</b>	<b>276</b>
Mouzrague	43	<b>Comparison</b>	<b>143</b>
Tororo	19	Amkhalbate	15
Touloub	20	Bandaro	16
		Djoukoulkili	25
<b>Mandjoura</b>	<b>182</b>	GGL	26
<b>Comparison</b>	<b>116</b>	Gamé	25
Abal	8	Niergui	18
Djanamari	10	Zoni	18
Gonouga	10		
Herezey	6	<b>Intervention</b>	<b>133</b>
Islet	22	Changuil	44
Iwine	14	Clignata	13
Kedjamounga	28	Golonti	39
Tchougui	11	Kretchou	11
Wolé-Wolé	7	Mormo	8
		Sirboudoum	18
<b>Intervention</b>	<b>66</b>		
Andrabadi	10	<b>Mangalmé</b>	<b>146</b>
Andrabate	10	<b>Comparison</b>	<b>98</b>
Koukoulaye	4	Bakhat	24
Mandjoura	32	Bardé	23
Tourkagore	3	Kouzi Waït	24
Tourki	7	Saraf Doungous	27
		<b>Intervention</b>	<b>48</b>
		Djondjol	15
		Hidjelidjé	18
		Waga	15

## 4.3 ANALYSIS

Households in project and comparison communities were compared in terms of their demographic characteristics in 2014,<sup>2</sup> and livelihoods activities and economic situation using recalled data from 2010 before any of the projects were launched.

The full comparison is shown in Appendix 2. Some characteristics are significantly different across intervention and comparison groups in both regions. For instance, in Bahr el Gazal, the average size of the household in the intervention group is significantly larger and households in the intervention group also owned 4.5 more livestock heads on average in 2010 and were almost 6 percentage points less likely to be engaged in agricultural labour in 2010 than households in the comparison group. On the other hand, in Guéra, household heads in the comparison group are significantly 10.5 percentage points less likely to have received any education compared to the intervention group in the same region. Moreover, the intervention group in Guéra had more land cultivated with vegetable crops, a larger variety of vegetable crops and was more likely to participate in any community group than its counterpart in 2010.

These differences, which existed before the project, have the potential to bias any comparison of the project's outcomes between the members of the project and comparison respondents. 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 well balanced in terms of baseline and demographic characteristics. One important qualification is that six out of the 216 project participants interviewed in Bahr el Gazal, and two out of 219 of those interviewed in Guéra, could not be matched and had to be dropped from the analysis. The estimates of the project's impact presented in Section 5 are not based on the whole population interviewed, but exclude these observations.

All the results described in Section 5 of the report were tested for robustness by estimating them with several alternative statistical models. 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 members of the project and comparison cooperatives for which data was collected in the survey. If there are any 'unobservable' pre-existing differences between the two groups – such as individuals' attitudes, motivation, skills or confidence – then these may bias the estimates of outcomes described in Section 5. Given that the direct project participants were, to some extent, a self-selected group, this possibility cannot be excluded and must be borne in mind when interpreting the results.

# 5 RESULTS

This report is intended to be free from excessive technical jargon, with more detailed technical information being restricted to the appendices and footnotes. However, there are some statistical concepts that cannot be avoided in discussing the results. In this report, results will usually be stated as the average difference between households living in villages where the project was implemented (that is referred to as the 'intervention group') and the matched households in villages where the project was not implemented (named the 'comparison group'). In the tables of results on the following pages, statistical significance will be indicated with asterisks, with three asterisks (\*\*\*) indicating a  $p$ -value of less than 10 per cent, two asterisks (\*\*) indicating a  $p$ -value of less than 5 per cent and one asterisk (\*) indicating a  $p$ -value of less than 1 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 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 projects under review. In the tables of results, asterisks are used to indicate where the differences are statistically significant at least at 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 can be found in Appendix 3. All outcomes discussed here have also been tested for robustness to alternative statistical models;<sup>3</sup> where those alternative models produce markedly different results from those shown in the tables in this section, this is discussed in the text or in footnotes. It is important to stress that the results presented in this section are average results across the project participant and comparison groups in each region.

The statistical procedures used to derive estimates of outcomes are based only on 'observable' baseline characteristics. If there are any 'unobserved' pre-existing differences between the project participants and comparison respondents – such as individuals' attitudes or motivation, differences in local leadership, weather or other contextual conditions – then these may affect the estimates of outcomes. Given that the direct project participants were to some extent a self-selected group, this possibility cannot be excluded and must be borne in mind when interpreting the results.

## 5.2 INVOLVEMENT IN PROJECT ACTIVITIES

The first step in understanding what impact these projects have 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 projects.

As discussed in Section 2, each project carried out different activities in the regions where they were rolled out. There is no single particular intervention in which all surveyed project communities participated, and particularly in Bahr el Gazal, the combination of project activities was different across communities.

Our questionnaire allows us to know whether any household member had received any input or training on different subjects since 2010 and most of the project activities were listed. Tables 5.1 and

5.2 show the differences between the proportions of respondents interviewed in the project and comparison communities in terms of support received by their households since 2010.

In Table 5.1 we notice that households in project communities from Bahr el Gazal were more likely to have reported they received agricultural inputs, such as seeds, plants and tools; and training on agricultural techniques, including market gardening and new farming and pastoral techniques, relative to their counterparts in the comparison communities. There is no evidence however, that the intervention group was more likely than the comparison group to have reported they benefited from restocking of animals after a crisis, even though this intervention was carried out in 8 out of 12 project communities in the region. Another thing to notice is that only 10 per cent of the people interviewed in the intervention communities reported to have benefited from restocking of animals. There is no evidence either that the intervention group was more likely than the comparison group to have reported they received training on the production of staple crops or training on the fabrication of improved stoves.

In the case of Guéra region, project recipients benefited directly from four activities: soil conservation and restoration work, improved nutritional practices, support in market gardening, and training on seed replication. Looking at the results from Table 5.2, we were able to identify those households that reported benefiting from training on market gardening and from training on improved seed production. Household members from the intervention communities are twice as likely to have received training on market gardening, and more than three times as likely to have received training on seed replication. On the other hand, there is no evidence that household members from project communities were more likely than those from the comparison group to have reported they received training on nutrition. However, the sample design was not intended to capture participants of this activity, as explained in Section 4.2.

One should be careful when interpreting these results. It is possible that some of the project recipients did not report they have benefited from any of the projects' activities while in fact they did. Possible explanations are that project recipients simply did not remember they benefited from any of the project interventions, or that project recipients strategically did not report that they benefited from any of the project activities since they thought this statement could lead to more future benefits from the project.



**Table 5.1: Proportion of households in Bahr el Gazal having received support since 2010**

	1	2	3	4	5	6	7	8
	Household has received seeds since 2010 (%)	Household has received tools for agriculture since 2010 (%)	Household has received training on the production of staple crops since 2010 (%)	Household has benefited from restocking of animals after a crisis since 2010 (%)	Household has received plants since 2010 (%)	Household has received training on improved stoves since 2010 (%)	Household has received training on market gardening since 2010 (%)	Household has received training on new farming and pastoral techniques since 2010 (%)
Intervention group mean:	65.7	30.5	38.6	10.0	17.1	40.95	41.9	22.4
Comparison group mean:	56.6	19.9	32.9	9.4	7.6	36.34	23.1	9.2
Difference:	9.1** (4.6)	10.6** (4.2)	5.7 (4.8)	0.6 (2.7)	9.5*** (3.2)	4.61 (4.8)	18.8*** (4.8)	13.2*** (3.5)
Observations (intervention group):	210	210	210	210	210	210	210	210
Observations (total):	578	578	578	578	578	578	578	578

PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

**Table 5.2: Proportion of households in Guéra having received support since 2010**

	1	2	3
	Household has received training on market gardening since 2010 (%)	Household has received training on seed multiplication since 2010 (%)	Household has received training on nutrition since 2010 (%)
Intervention group mean:	37.8	20.3	25.8
Comparison group mean:	17.8	6.3	32.2
Difference:	20.0*** (4.3)	14.0*** (3.2)	-6.4 (4.5)
Observations (intervention group):	217	217	217
Observations (total):	557	557	557

PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

## 5.3 AGRICULTURAL ACTIVITIES

We now examine the evidence on the impact of each project on the outcomes it sought to affect. The first set of outcomes relates to agricultural activities.

Table 5.3a shows that in Bahr el Gazal, the average number of staple crops<sup>4</sup> produced and sold is lower for both groups compared to the figures in Guéra. Nevertheless, matching results suggest that the project ‘Reinforcing Resilience Capacity’ in Bahr el Gazal has had a small but significant positive effect on increasing the diversity of staple crops produced. There is no evidence that the other land and agricultural production outcomes have been affected by the project in Bahr el Gazal, since the difference between the outcomes of the intervention and comparison groups is not significantly different from zero.

On the other hand, the project PASISAT in Guéra has significantly increased the number of vegetable crops<sup>5</sup> produced. The number of vegetable and staple crops sold is also significantly higher for households in the project communities compared to those in comparison communities. This explains why the project has also had a positive impact in increasing the revenue from the sale of crops on average by 150 per cent (columns 4 and 9) when compared to households in comparison villages.

In Guéra as well, households in project communities tend to cultivate a larger area of land with vegetable crops (45 per cent more square metres) than their counterparts in comparison communities. There is no evidence that the project has had any effect on the hectares of land cultivated with staple crops, the number of staple crops produced, or the number of months with water available for vegetable crops.

When we isolate each of the project’s activities under evaluation in Guéra region, we observe that the significance of the results previously discussed holds only for the market gardening intervention (see Table 5.3b), while we do not find a significant effect of the seed replication intervention in any of the land and agricultural production outcomes studied. Particularly, individuals in project villages that were part of the market gardening intervention have higher revenues from the sale of staple and vegetable crops by 170 and 200 per cent, respectively, than individuals in comparison villages.

Table 5.4 presents the effect of each project in promoting the adoption of improved agricultural techniques. Overall, both projects have proven successful in this task. Households from the intervention communities in Bahr el Gazal and Guéra are more likely to use improved seeds for vegetable crops (respectively by 13.6 percentage points and 9.12 percentage points), and more likely to employ phytosanitary treatment (6.54 percentage points and 3.78 percentage points respectively).

In Bahr el Gazal, households in project communities were more likely to use improved seeds for staple crops (13.6 percentage points), and employ biological treatment (10.7 percentage points) and soil conservation techniques (11.7 percentage points) than households in the comparison group. An interesting result is that more households in comparison communities use animal manure as organic fertiliser (11.46 percentage points) than households in the intervention communities. The use of chemical fertiliser, on the contrary, seems to be more frequent among households in the intervention group, although there is no strong evidence to suggest that the latter is significantly different between both groups. Furthermore, in Guéra, households from project communities are 11.2 percentage points more likely to use row planting than households in comparison communities.

**Table 5.3a: Land and agricultural production**

	1	2	3	4	5	6	7	8	9
	Natural logarithm of land cultivated (ha)	Number of staple crops	Number of sold staple crops	Natural logarithm of revenue from sales of staple crops (francs CFA)	Natural logarithm of area under market gardening <sup>1</sup>	Number of months with water for vegetable crops	Number of vegetable crops	Number of sold vegetable crops	Natural logarithm of revenue from sales of vegetable crops (francs CFA)
<b>Bahr el Gazal</b>									
Intervention group mean:	1.24	1.15	0.11	0.58	1.4	7.0	1.7	1.014	4.4
Comparison group mean:	1.19	0.97	0.13	0.97	1.4	6.7	1.4	0.957	4.1
Difference:	0.05 (0.04)	0.18*** (0.06)	0.02 (0.06)	-0.39 (0.26)	0.0 (0.1)	0.3 (0.4)	0.3 (0.2)	0.057 (0.1)	0.3 (0.5)
Observations (intervention group):	210	210	210	210	210	102	210	210	210
Observations (total):	579	579	579	579	579	258	579	579	579
<b>Guéra</b>									
Intervention group mean:	1.0	3.76	1.3	6.9	1.39	7.1	1.724	1.2	4.1
Comparison group mean:	1.1	3.64	1.0	5.4	0.94	6.8	1.266	0.8	2.6
Difference:	-0.1 (0.0)	0.12 (0.1)	0.3*** (0.1)	1.5*** (0.5)	0.45*** (0.2)	0.3 (0.5)	0.458** (0.2)	0.4** (0.2)	1.5*** (0.5)
Observations (intervention group):	217	217	217	217	217	104	217	217	217
Observations (total):	557	557	557	557	557	218	557	557	557

<sup>1</sup> Responses in 'planches' in Bahr el Gazal and square metres in Guéra.  
PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

**Table 5.3b: Land and agricultural production in Guéra, by intervention**

	1	2	3	4	5	6	7	8	9
	Natural logarithm of land cultivated (ha)	Number of staple crops	Number of sold staple crops	Natural logarithm of revenue from sales of staple crops (francs CFA)	Natural logarithm of area under market gardening <sup>1</sup>	Number of months with water for vegetable crops	Number of vegetable crops	Number of sold vegetable crops	Natural logarithm of revenue from sales of vegetable crops (francs CFA)
<b>Market gardening intervention</b>									
Intervention group mean:	1.0	3.8	1.5	7.3	2.5	7.3	3.36	2.3	7.4
Comparison group mean:	1.1	3.7	1.1	5.6	1.6	6.9	2.64	1.9	5.4
Difference:	-0.1 (0.1)	0.1 (0.2)	0.4** (0.2)	1.7** (0.7)	0.9*** (0.2)	0.4 (0.5)	0.72** (0.4)	0.4 (0.3)	2.0*** (0.7)
Observations (intervention group):	97	97	97	97	97	84	97	97	97
Observations (total):	291	291	291	291	291	179	291	291	291
<b>Seed replication intervention</b>									
Intervention group mean:	1.0	3.8	1.1	6.6	0.5	6.83	0.3	0.2	1.4
Comparison group mean:	1.1	3.6	1.0	5.7	0.4	4.87	0.4	0.1	0.8
Difference:	-0.1 (0.1)	0.2 (0.2)	0.1 (0.2)	0.9 (0.7)	0.1 (0.2)	1.96 (1.4)	-0.1 (0.1)	0.1 (0.1)	0.6 (0.4)
Observations (intervention group):	116	116	116	116	116	18	116	116	116
Observations (total):	262	262	262	262	262	37	262	262	262

<sup>1</sup> Responses in square metres in Guéra.  
PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

**Table 5.4: Adoption of improved agricultural techniques**

	1	2	3	4	5	6	7	8	9	10
	Any staple crop with improved seeds (%)	Any vegetable crop with improved seeds (%)	Household used animal manure (organic fertiliser) (%)	Household used chemical fertiliser (%)	Household used compost (%)	Household used phytosanitary treatment (%)	Household used biological treatment (%)	Household used row planting (%)	Household used a plough or a tractor (%)	Household used soil conservation techniques (%)
<b>Bahr el Gazal</b>										
Intervention group mean:	79.5	51.4	72.86	39.05	21.0	18.57	21.4	41.0	15.24	16.2
Comparison group mean:	65.9	37.8	84.32	35.52	17.2	12.03	10.7	40.0	11.28	4.5
Difference:	13.6*** (4.3)	13.6*** (4.7)	-11.46*** (3.8)	3.53 (4.5)	3.8 (3.5)	6.54* (3.4)	10.7*** (3.4)	0.1 (4.9)	3.96 (3.3)	11.7*** (2.8)
Observations (intervention group):	210	210	210	210	210	210	210	210	210	210
Observations (total):	579	579	579	579	579	579	579	579	579	579
<b>Guéra</b>										
Intervention group mean:	37.33	29.95	29.0	3.2	0.46	7.83	2.3	39.6	27.2	18.0
Comparison group mean:	35.07	20.84	24.2	1.7	0.74	4.05	0.9	28.4	22.4	13.0
Difference:	2.26 (5.0)	9.12** (4.5)	4.8 (4.4)	1.5 (1.4)	-0.28 (0.8)	3.78* (2.2)	1.4 (1.2)	11.2** (4.6)	4.8 (3.9)	5.0 (3.6)
Observations (intervention group):	217	217	217	217	217	217	217	217	217	217
Observations (total):	557	557	557	557	557	557	557	557	557	557

PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

## 5.4 LIVESTOCK-REARING ACTIVITIES

In Bahr el Gazal, activities aimed at strengthening the productivity of livestock included restocking of goats and sheep, livestock vaccination campaigns, training of community animal-health workers and sheep fattening. This section examines the impact of these activities on various outcomes and results are presented in Table 5.5.

In the first column of Table 5.5, we analyse the effect of the project on improving access to veterinary care. Respondents were asked if they had access to a veterinary specialist or a community animal-health worker when needed. Some 63.24 per cent of individuals in the project communities reported to have access at least sometimes, compared to 53.88 per cent in comparison communities. The 10.36 percentage point difference between these two groups is significantly different from zero, and thus we can conclude that the project had a positive impact on this outcome.

The second column shows that households in intervention communities were 10.6 percentage points more likely to have at least some proportion of their livestock vaccinated compared to their counterparts in comparison communities. Results from Table 5.5 do not provide any evidence of an effect from the project on increasing the number of livestock owned or in improving access to water for animals.

**Table 5.5: Livestock ownership and health in Bahr el Gazal**

	1	2	3	4	5
	Access to veterinary care (%)	Some or all livestock heads are vaccinated (%)	Total number of livestock <sup>1</sup>	Number of livestock heads (excluding poultry)	Number of months with water for animals
Intervention group mean:	63.24	50.5	25.62	18.2	8.3
Comparison group mean:	52.88	39.9	26.96	19.8	8.0
Difference:	10.36** (5.0)	10.6** (5.0)	-1.34 (2.2)	-1.6 (1.9)	0.3 (0.3)
Observations (intervention group):	204	204	210	210	198
Observations (total):	550	550	579	579	523

<sup>1</sup> Including cows, sheep, goats, donkeys, horses, camels and poultry.  
PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

## 5.5 DIETARY DIVERSITY AND FOOD CONSUMPTION

Both projects carried out activities to improve food security among its project participants. Training on agricultural and pastoral techniques, agricultural inputs or restocking of livestock, intended to provide tools for a better diet in both regions. In this section, we analyse the impact of the projects in improving food security.

The first outcome to look at is the household's food security diversity score. Respondents were asked about their food consumption during the seven days before the survey. Food items were grouped into grains (millet, sorghum, corn, rice, bread and others), tubers, pulses (beans, peas and peanuts),



vegetables (okra and other), fruits, and proteins (meat, fish and chicken). If respondents answered yes to any item then they scored 1 in the corresponding food group and 0 otherwise. The food security diversity score is equal to the sum of the scores in each food group and therefore has a maximum value of 6. Column 1 from Table 5.6 does not show a significant difference in dietary diversity between households in project communities and those in comparison communities in any region. The average diet in households from both regions included two food groups and we found that households consumed mainly grains and tubers.

Columns 2, 3 and 4 present the food security scores for women, men and children in households. Respondents were asked whether children, women or men in the household were forced to reduce the number of meals in a day as a consequence of the lean season during the previous year. They were also asked if during that same period, some household member went to sleep hungry because there was not enough food, and if a household member spent an entire day without eating because there was not enough food. Based on these answers, a score ranging from 0 to 9 was derived, giving more points to those respondents who suffered less during the lean season. Using this measure there is no evidence that any of the projects improved food security; however, we can observe that children tend to have higher scores than men and women in the household. Additionally, households in Bahr el Gazal presented worse scores than Guéra, although these interregional differences are not tested in the study and there may be cultural differences or other systematic differences in how people responded to these questions between the two regions, so they should not be directly compared.

Further, we distinguished between households presenting severe food insecurity and those who did not. Households with any woman or men who skipped a meal, went to bed hungry or did not eat during an entire day, at least four times a week during the lean season, or households with a child who skipped a meal, went to bed hungry or did not eat during an entire day, at least sometime in a week during the lean season, were considered to be households with severe food insecurity. Column 5 in Table 5.6 suggests that in Bahr el Gazal project participants were 14.5 percentage points less likely to present food insecurity than those who were not part of the project. In Guéra matching estimates suggest the opposite effect: households in project communities were 10.9 percentage points more likely to present food insecurity, a result that was confirmed by different estimation methods.

Finally, column 6 shows that households in project communities from Bahr el Gazal consumed food with a value of 20 per cent more in the seven days prior to the survey than households in comparison communities. We did not find a significant effect of the project on this outcome in Guéra.

When analysing the results from this section, one should consider that there was no measurable indicator to control for food insecurity at baseline and thus, it is not possible to rule out completely the possibility that the intervention and comparison groups had different food security profiles prior to the implementation of the project. However, the matching procedure adopted suggested no differences at baseline among the two groups in their wealth indices, which are indicators correlated with food insecurity. Another possible explanation for the findings that project participants appear to be more food insecure in Guéra may be due to differences in perception of food security. Responses to questions about missed meals and going to bed hungry are very subjective, and likely to be affected by (a) how comfortable respondents feel in talking with the enumerator, and particularly whether they feel shame in answering these questions, and (b) respondents' expectations that they might receive future support if they demonstrate that they are in need. This suggestion seems to be supported by the complementary results over reported food expenditure, where project beneficiaries and comparison groups reported indistinguishable expenditure levels (column 6), despite subjective measures of food security presenting differences among groups.

**Table 5.6: Food security and dietary diversity**

	1	2	3	4	5	6
	Food security diversity score	Food security score for women	Food security score for men	Food security score for children	Household presenting severe food insecurity (%)	Natural logarithm of total value of food consumed in the 7 days prior to the survey (francs CFA)
<b>Bahr el Gazal</b>						
Intervention group mean:	2.06	5.1	4.5	6.6	54.8	9.8
Comparison group mean:	2.13	4.7	4.4	6.3	69.3	9.6
Difference:	-0.07 (0.1)	0.4 (0.3)	0.1 (0.3)	0.3 (0.3)	-14.5*** (4.8)	0.2*** (0.05)
Observations (intervention group):	210	168	166	167	210	209
Observations (total):	579	494	490	490	579	573
<b>Guéra</b>						
Intervention group mean:	2.318	7.2	7.05	8.3	45.6	9.0
Comparison group mean:	2.304	7.3	7.22	8.1	34.7	9.0
Difference:	0.014 (0.1)	-0.1 (0.2)	-0.17 (0.2)	0.2 (0.2)	10.9** (4.7)	0.0 (0.1)
Observations (intervention group):	217	216	207	214	217	217
Observations (total):	557	552	535	546	557	554

PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01.

## 5.6 INDICATORS OF MATERIAL WEALTH

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 2010 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 a 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.<sup>6</sup>

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 2010, 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 2010 is the measure that has been used throughout this analysis to control for baseline differences in wealth status between households in the project and comparison communities.

The change in wealth index is scaled so that a household that saw no changes in wealth indicators has a score of zero, while the household that saw the greatest change in wealth indicators has a score of 1. In Bahr el Gazal, the household that experienced the largest negative change in wealth index has a score of -0.18 on this scale, while in Guéra, the household that experienced the largest negative change in wealth index has a score of -0.31. Column 1 in Table 5.7 shows the figures for the change in wealth index for project and comparison households between 2010 and the date of the survey, 2014. There is no evidence that any of the resilience projects had an impact on this outcome. Nevertheless, a change in wealth indicators is something expected to happen over the long term rather than be an immediate result of short-term projects, such as the ones being evaluated in this Effectiveness Review.

The wealth index places individual households on a continuous scale of relative wealth. It is also possible to normalise the index so we have its values ranging between 0 and 100. Column 2 in Table 5.7 shows the average difference in wealth index across intervention and comparison groups. We find no evidence that any of the projects had an impact on this outcome for 2014. This set of results is robust to other algorithms (see Appendix 4).

**Table 5.7: Indicators of material wealth**

	1	2
	Change in wealth index between 2010 and the date of the survey	Normalised wealth index in 2014
<b>Bahr el Gazal</b>		
Intervention group mean:	-0.003	19.516
Comparison group mean:	0.003	19.346
Difference:	-0.006 (0.007)	0.170 (0.691)
Observations (intervention group):	210	210
Observations (total):	579	579
<b>Guéra</b>		
Intervention group mean:	0.113	19.291
Comparison group mean:	0.111	20.291
Difference:	0.002 (0.012)	-1.000 (1.325)
Observations (intervention group):	217	217
Observations (total):	557	557

PSM estimates. Bootstrapped standard errors in parenthesis.

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

## 5.7 INDICATORS OF RESILIENCE

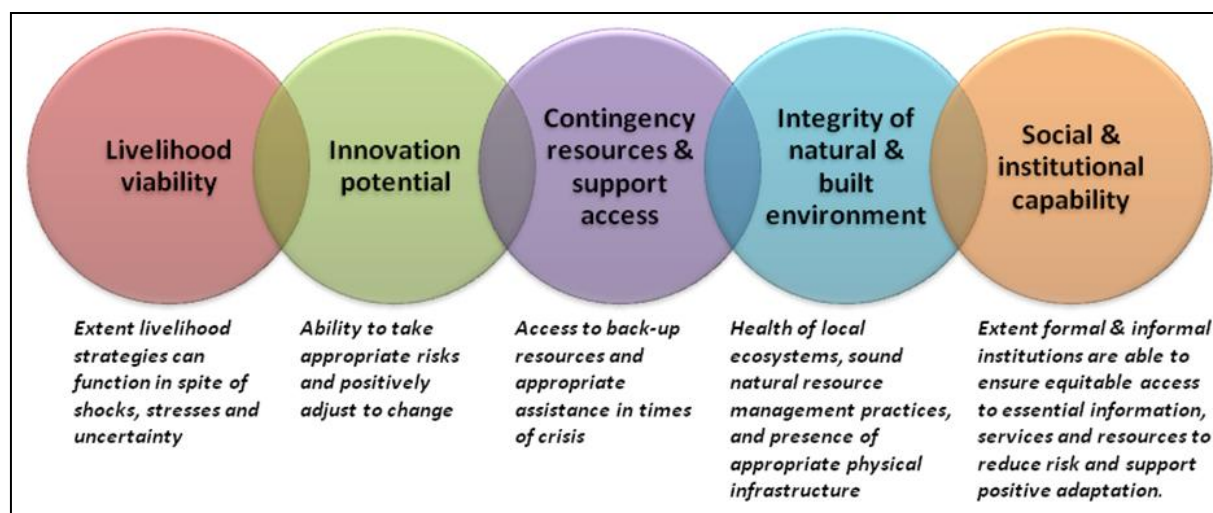
The project under review was specifically aimed at increasing households' resilience to crises. As part of Oxfam GB's Global Performance Framework, an innovative approach has been developed to measure the resilience of households to shocks and stresses and their ability to adapt to change.<sup>7</sup> 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* a shock. 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.

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. If a shock happens, for instance, 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. 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 forecast, market information and relevant technology and resources.

Moreover, there are likely to 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 being able to positively adjust 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 could 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 more likely to adjust successfully 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. For this reason, efforts were made to specify characteristics relevant to the specific risks faced in the regions where the survey was carried out. Discussions were held with Oxfam staff and partners in both of the regions, and three focus groups were conducted in a community in Bahr el Gazal.

The characteristics identified are listed in Table 5.8. 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 right-hand column of Table 5.8 shows those characteristics on which the project activities may be expected to have an impact.

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 5.8. 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 use of improved seeds if the respondent reported to have used improved seeds for at least one crop in 2014. There is inevitably a degree of arbitrariness in defining such cut-offs. Wherever possible, 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.

**Table 5.8: Characteristics of resilience examined in this Effectiveness Review**

Dimension	Characteristic	Connected to project logic?
Livelihood viability	Access to land for cultivation	No
	Use of improved seeds	Yes
	Ownership of livestock	Yes <sup>1</sup>
	Access, availability and quality of veterinary care	Yes <sup>1</sup>
	Diversification in sources of income	No
	Ownership of productive assets	No
Adoption of innovative practices/ Innovation potential	Understanding of climate change	Yes <sup>1</sup>
	Attitude to change and innovation	Yes
	Adoption of innovative practices	Yes
Access to contingency resources and support	Access to a grain bank	No
	Access to medical care	No
	Savings	No
	Access to remittances	No
Integrity of the natural and built environment	Access to drinking water	Yes
	Access to water for market gardening	Yes
	Access to water for livestock	Yes <sup>1</sup>
Social and institutional capability	Social cohesion in the community	No
	Participation in community groups	Yes
	Support from state extension services	No

<sup>1</sup> Bahr el Gazal only.

A measure of overall resilience was then derived by averaging the number of characteristics in which the household scored positively and thus ranged from 0 to 1. We refer to this measure as the *base resilience index* and results are presented in column 1 of Table 5.9. A household was defined as having positive resilience overall if it scored positively in at least two thirds of the characteristics (column 2). 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*<sup>8</sup> (column 3).

Overall, using different resilience measures, we found in Table 5.9 that resilience indicators are higher among the intervention group than the comparison group. Particularly in Bahr el Gazal, we observed that households in project communities scored positively in 50 per cent of the resilience characteristics, contrasting to 40 per cent in comparison communities. In Guéra we found that households in the intervention group scored positively in 45 per cent of the resilience characteristics, while households in the comparison communities scored positively in 42 per cent of the characteristics. These results are significantly different between intervention and comparison groups.

It is clearly important to examine the effects of the project on the underlying indicators to have a better idea in what dimension the project has had a larger impact. Again, the particular definitions used to derive each indicator are detailed in Appendix 1. The following subsections will examine in detail the characteristics of resilience in each dimension.

**Table 5.9: Overall indices of resilience**

	1	2	3
	Base resilience index	Households with positive overall resilience (%)	AF resilience index
<b>Bahr el Gazal</b>			
Intervention group mean:	0.5	2.4	0.7
Comparison group mean:	0.4	0.3	0.6
Difference:	0.1*** (0.01)	2.1** (1.0)	0.1*** (0.01)
Observations (intervention group):	210	210	210
Observations (total):	579	579	579
<b>Guéra</b>			
Intervention group mean:	0.45	16.1	0.7
Comparison group mean:	0.42	11.2	0.6
Difference:	0.03** (0.02)	4.9 (3.3)	0.1** (0.02)
Observations (intervention group):	217	217	217
Observations (total):	557	557	557

PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

## 5.6.1 Dimension 1: Livelihood viability

An index specific to the livelihood viability dimension was created. This index comprised the six characteristics considered in this Effectiveness Review under the livelihood viability dimension: access to land for cultivation; use of improved seeds; livestock ownership; access, availability and quality of veterinary care; diversification in sources of income; and asset ownership. Each characteristic was given equal weight. Consequently, the index simply represents the share of indicators in which the interviewed households scored positively and its values range between 0 and 1. Column 1 in Table 5.10 shows that in Bahr el Gazal, project households scored positively in more livelihood viability characteristics than their counterparts in comparison communities. There is no apparent difference in this measure between intervention and comparison communities in Guéra region.

The first characteristic corresponds to households' access to land for cultivation. Households cultivating more than two hectares of land scored positively in this outcome. The threshold corresponds to the median land size reported by the respondents in both regions, however, one should consider that smallholders are not always able to report accurately the size of their land holdings, which introduces some degree of imprecision around these measures. Column 2 in Table 5.10 does not show any significant difference in access to land for cultivation between subjects in project communities and those in comparison communities. Notice that a large share of the sample in Bahr el Gazal (around 79.5 per cent in the intervention group and 77.2 per cent in the comparison group) scored positively in this characteristic while in Guéra only 53 per cent in the intervention group and 54.5 per cent in the comparison group did.



Column 3 shows the percentage of households scoring positively in the use of improved seeds. Households were given a positive score if they reported to use improved seeds for at least one crop (vegetable or staple crop). Consistent with the results found in Section 5.3, we observed that in Bahr el Gazal the percentage of households with a positive score was considerably higher than in Guéra. The fact of being part of a project community in the former region has had a significant effect in increasing the probability of adopting improved seeds by 10.4 percentage points.

The third characteristic we considered in this dimension is livestock ownership. In Bahr el Gazal, households owning more than 15 livestock heads (excluding poultry) scored positively in this outcome, while in Guéra the cut-off was set at two livestock heads. Thresholds were chosen following the descriptive statistics of the data at the regional level. Differences in the cut-offs can be explained by the fact that Bahr el Gazal is populated mostly by pastoralist and agro-pastoralists, and thus households in the region tend to own more livestock. We do not find that households in project villages were more likely to score positively in this feature, compared to households in comparison villages.

Respondents stating that the household has received access to veterinary care when needed, that the support is at least sometimes available when necessary, and that the quality of the service is of at least 'medium' quality, scored positively in the resilience indicator of access, availability and quality of veterinary care. Column 5 in Table 5.10 shows that households in project villages from Bahr el Gazal were 9.9 percentage points more likely to score positively in the outcome. This confirms that the project has provided better access to veterinary care in the region, but it is also available when needed (at least sometimes) and the service is at least of medium quality. It is important to consider that veterinary centres have been installed in strategic locations where transhumance takes place. Similarly, the management of these centres has been left to state partners and thus, the lack of infrastructure and economic means may prevent individuals getting better availability and quality of the services. On the other hand, in Guéra we did not find that individuals in project villages tend to be more resilient in terms of access, availability and quality of veterinary care, however this outcome is not connected to the region's project logic.

A fifth characteristic looked at is diversification in sources of income. Households received a positive score in this indicator if at least one adult household member engaged in a non-agricultural activity, regular employment, or worked in a small shop, and could maintain this source of income in case of a drought (even with difficulty). Column 6 in Table 5.10 does not provide any evidence that households in intervention communities in either region were more likely to score positively in this outcome compared to their counterparts in comparison communities.

Households owning at least one large asset, such as a cart, plough, motor pump, sheller, sewing machine, motorbike or motor vehicle, or at least three small assets, such as bicycles, lamps or torches, irons, or mobile phones, scored positively in terms of productive asset ownership. We found a positive effect of the project in Bahr el Gazal, where households in intervention communities were 15.1 percentage points more likely to score positively on this indicator than households in the comparison group. By contrast, Guéra's project does not seem to have had an effect on this indicator.

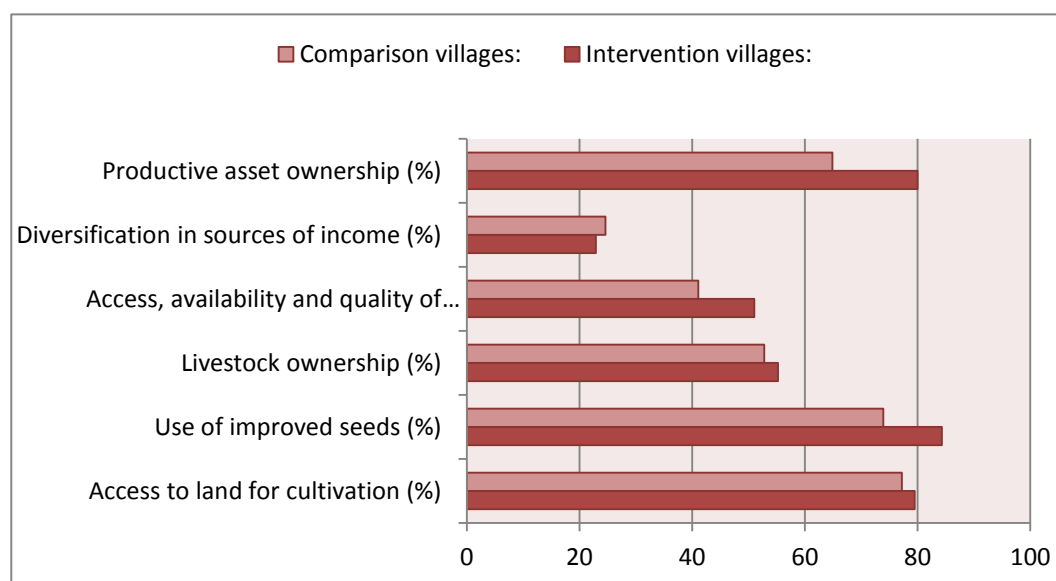
Figures 5.2 and 5.3 show the proportion of households scoring positively in terms of livelihood viability in each region.

**Table 5.10: Households scoring positively in terms of characteristics of livelihood viability**

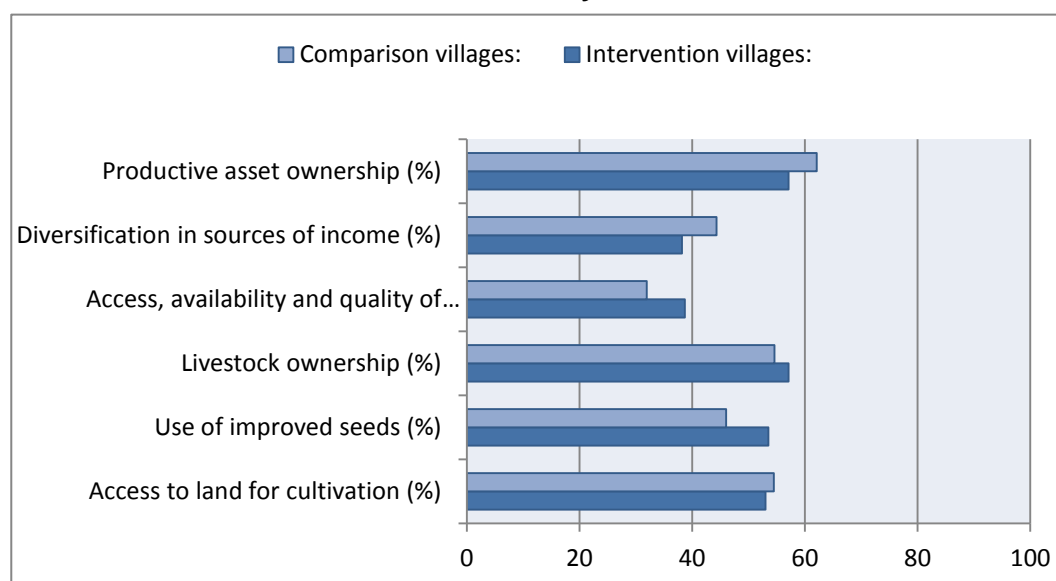
	1	2	3	4	5	6	7
	Index of livelihood viability	Access to land for cultivation (%)	Use of improved seeds (%)	Livestock ownership (%)	Access, availability and quality of veterinary care (%)	Diversification in sources of income (%)	Productive asset ownership (%)
<b>Bahr el Gazal</b>							
Intervention group mean:	0.62	79.5	84.3	55.24	51.0	22.9	80.0
Comparison group mean:	0.56	77.2	73.9	52.78	41.1	24.6	64.9
Difference:	0.06*** (0.02)	2.3 (3.8)	10.4** (4.1)	2.46 (4.7)	9.9** (4.8)	-1.7 (4.2)	15.1*** (4.0)
Observations (intervention group):	210	210	210	210	210	210	210
Observations (total):	579	579	579	579	579	579	579
<b>Guéra</b>							
Intervention group mean:	0.5	53.0	53.46	57.1	38.7	38.2	57.1
Comparison group mean:	0.5	54.5	46.04	54.6	31.9	44.3	62.1
Difference:	0.0 (0.03)	-1.5 (5.0)	7.42 (5.0)	2.5 (4.9)	6.8 (4.6)	-6.1 (4.8)	-5.0 (5.0)
Observations (intervention group):	217	217	217	217	217	217	217
Observations (total):	557	557	557	557	557	557	557

PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

**Figure 5.2: Proportion of households scoring positively in terms of characteristics of livelihood viability in Bahr el Gazal**



**Figure 5.3: Proportion of households scoring positively in terms of characteristics of livelihood viability in Guéra**



## 5.6.2 Dimension 2: Innovation potential

The second resilience dimension we looked at is innovation potential. Three characteristics were considered: understanding of climate change, attitude towards change and innovation, and adoption of new practices or innovations. An index of the proportion of characteristics in which households scored positively was created and is presented in column 1 of Table 5.11. Results in this index suggest that there is no difference in the proportion of characteristics in which households in intervention and comparison communities scored positively in any region.

Respondents scored positively for understanding of climate change if they agreed with the statements: 'It is important that agricultural or pastoral activities take the meteorological conditions into account' and 'The climate changes from year to year, and we have to be prepared to face its negative effects', in preference to opposing statements with which they were presented. Results from Table 5.11 column 2, do not provide any evidence of a difference in terms of understanding of climate change between individuals in the intervention communities and those in the comparison group.

Another characteristic included in this dimension is attitude to change and innovation. Respondents scored positively in this indicator if they agreed with the statements: 'To better succeed in the future, people should experiment more with new methods and innovations' and 'We need to use new methods and innovations to improve our living conditions', rather than with opposing statements they were presented with. As we can observe in column 3 of Table 5.11, there is no evidence to conclude that respondents in project communities tend to have a better attitude towards change and innovation than respondents in comparison communities.

The third characteristic considered is the adoption of new practices or initiatives. Respondents were asked an open question about whether they had experimented with any new practices or behaviours since 2010. Those who reported that the household had tried at least one new practice or behaviour, other than those originating with a project or NGO, scored positively in this indicator. Table 5.11 column 4 shows that the difference in the proportion of individuals adopting new practices or initiatives in intervention communities is not significantly different than the proportion of individuals doing so in comparison communities.

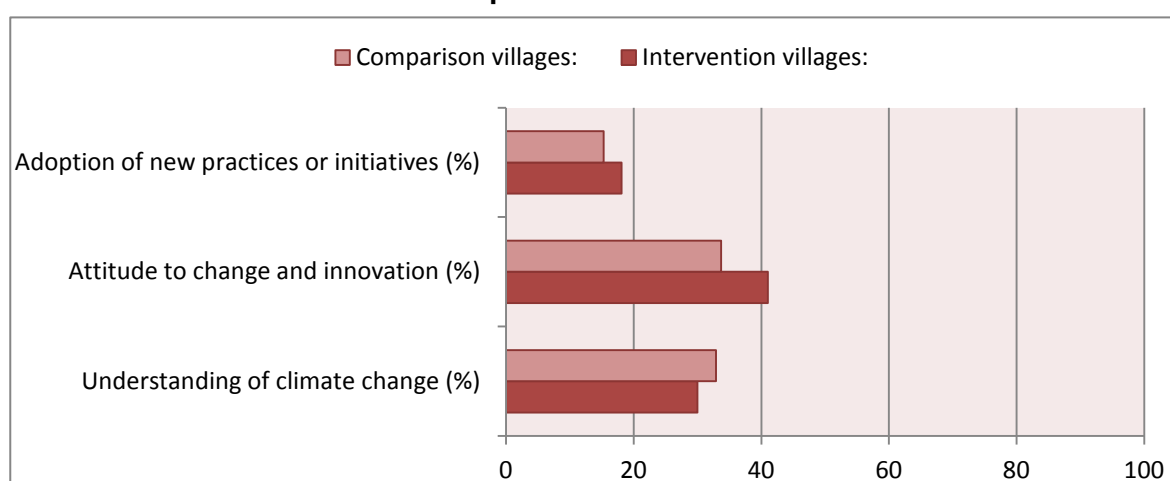
Figures 5.4 and 5.5 show the proportion of households scoring positively in terms of innovation potential in each region.

**Table 5.11: Households scoring positively in terms of characteristics of innovation potential**

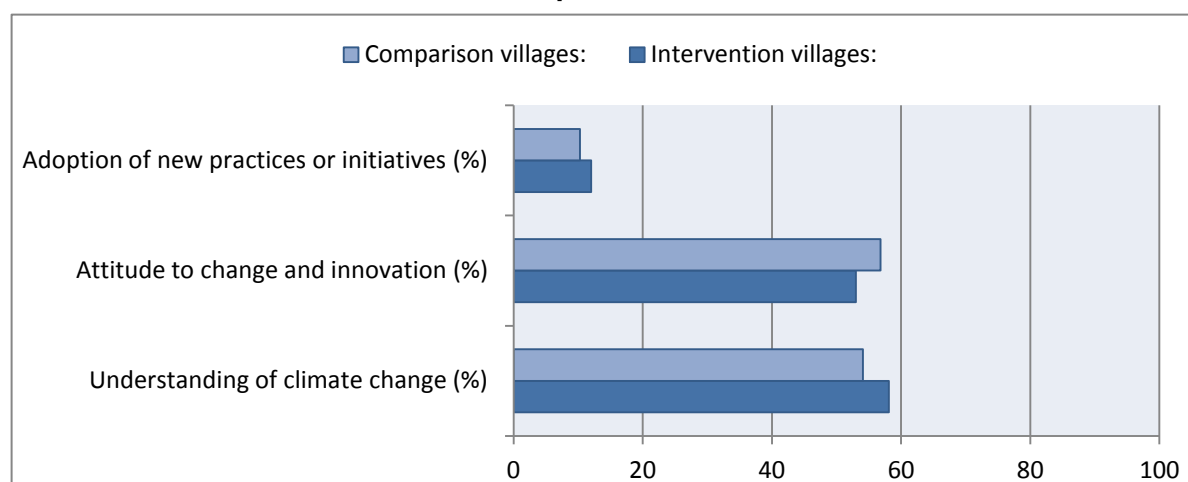
	1	2	3	4
	Index of innovation potential	Understanding of climate change (%)	Attitude to change and innovation (%)	Adoption of new practices or initiatives (%)
<b>Bahr el Gazal</b>				
Intervention group mean:	0.3	30.0	41.0	18.1
Comparison group mean:	0.3	32.9	33.7	15.3
Difference:	0.0 (0.02)	-2.9 (4.6)	7.3 (4.6)	2.8 (3.7)
Observations (intervention group):	210	210	210	210
Observations (total):	579	579	579	579
<b>Guéra</b>				
Intervention group mean:	0.4	58.1	53.0	11.98
Comparison group mean:	0.4	54.1	56.8	10.34
Difference:	0.0 (0.03)	4.0 (4.7)	-3.8 (5.0)	1.64 (3.1)
Observations (intervention group):	217	217	217	217
Observations (total):	557	557	557	557

PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

**Figure 5.4: Proportion of households scoring positively in terms of characteristics of innovation potential in Bahr el Gazal**



**Figure 5.5: Proportion of households scoring positively in terms of characteristics of innovation potential in Guéra**



### 5.6.3 Dimension 3: Access to contingency resources and support

Four characteristics were considered as indicators of access to contingency resources and support: access to a grain bank, access to medical care, savings, and access to remittances or formal earnings. Table 5.12 shows the impact of the project on these various characteristics. Column 1 presents an index of the proportion of characteristics in which households scored positively. There is strong evidence suggesting that, on average, households in project communities in both regions scored positively in more outcomes than households in the comparison group.

The first resilience characteristic is access to a grain bank (column 2). Respondents scored positively for this indicator if they reported that there is a grain bank in the community, and that the household would be able to access grain from the bank during the coming year if necessary. We found significant evidence that the share of households in project communities in both regions having access to a grain bank was 16.8 percentage points and 8.4 percentage points higher in Bahr el Gazal and Guéra, respectively, compared to households in comparison communities.

The next indicator is access to medical care, being positive for those households with access to medical care from a health centre (public or private, or run by an NGO or religious body) if necessary, rather than relying only on home care or traditional healers, and that the treatment could be financed without resorting to asset sales or borrowing. In Bahr el Gazal there was no evidence that the share of households scoring positively in project communities is different from those in the comparison group. In Guéra we found that households in project communities were significantly 10.35 percentage points more likely to score positively in access to medical care than their counterparts in comparison communities.

Households scored positively in the savings resilience indicator if respondents reported that the household could finance an investment of 50,000 francs CFA (approximately 85 USD) from their savings, or would be able to finance unexpected medical treatment from savings, if necessary. Column 4 in Table 5.12 shows that households in project communities from Bahr el Gazal, were significantly 8 percentage points more likely to score positively than those in the comparison communities. We did not find a significant effect of the project in Guéra on this outcome indicator.

Access to remittances is the fourth characteristic included in the access to contingency resources and support dimension. Households scored positively in terms of this indicator if they were receiving some income from remittances during the previous 12 months. Column 5 shows that comparison households in Bahr el Gazal were significantly 8.26 percentage points more likely to score positively in this indicator, compared to households in the project communities. Nevertheless, other matching specifications suggest that the difference is not significantly different from zero. Thus, we cannot

conclude what is the effect of the project in Bahr el Gazal on this outcome. In Guéra, we did not find evidence of a difference in this outcome between intervention and comparison groups.

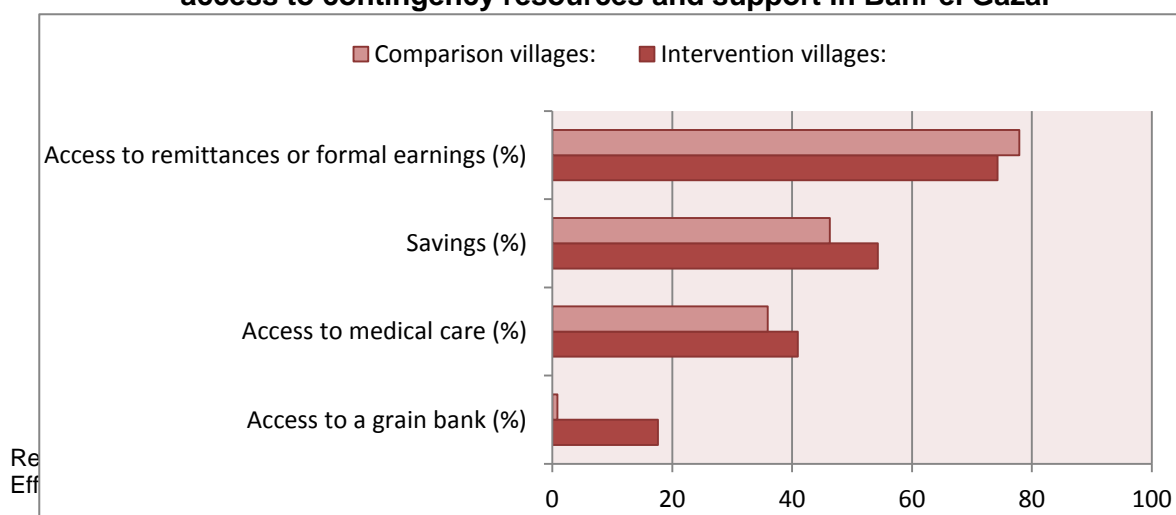
Figures 5.6 and 5.7 show the proportion of households scoring positively in terms of access to contingency resources and support.

**Table 5.12: Households scoring positively in terms of characteristics of access to contingency resources and support**

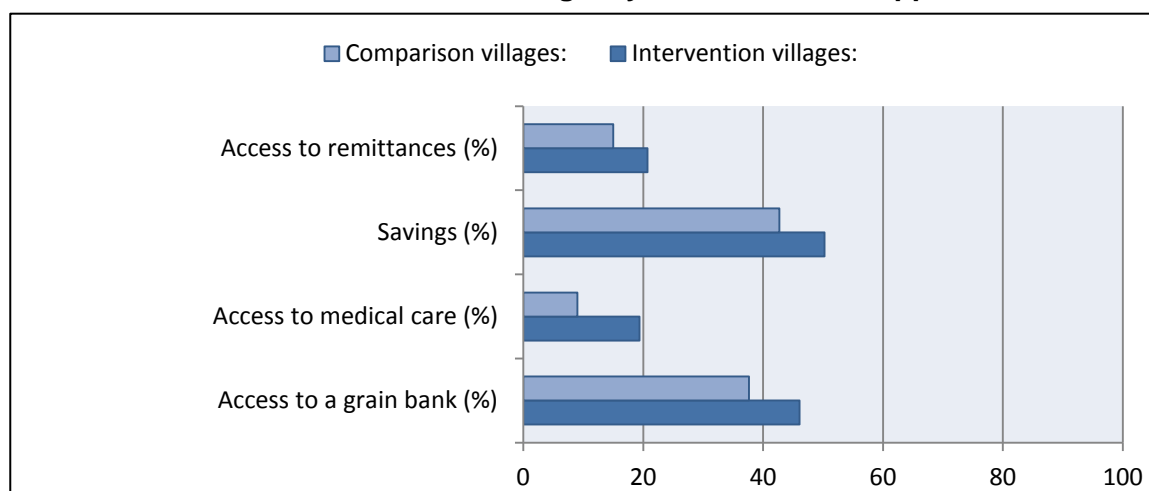
	1	2	3	4	5
	Index of access to contingency resources and support	Access to a grain bank (%)	Access to medical care (%)	Savings (%)	Access to remittances or formal earnings (%)
<b>Bahr el Gazal</b>					
Intervention group mean:	0.34	17.6	41.0	54.3	22.86
Comparison group mean:	0.29	0.8	35.9	46.3	31.12
Difference:	0.05** (0.02)	16.8*** (2.7)	5.1 (4.7)	8.0* (4.7)	-8.26* (4.4)
Observations (intervention group):	210	210	210	210	210
Observations (total):	579	579	579	579	579
<b>Guéra</b>					
Intervention group mean:	0.3	46.1	19.35	50.2	20.74
Comparison group mean:	0.2	37.7	9.00	42.7	14.99
Difference:	0.1*** (0.02)	8.4* (4.9)	10.35*** (3.4)	7.5 (4.8)	5.75 (3.7)
Observations (intervention group):	217	217	217	217	217
Observations (total):	557	557	557	557	557

PSM estimates. Bootstrapped standard errors in parenthesis. \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

**Figure 5.6: Proportion of households scoring positively in terms of characteristics of access to contingency resources and support in Bahr el Gazal**



**Figure 5.7: Proportion of households scoring positively in terms of characteristics of access to contingency resources and support in Guéra**



## 5.6.4 Dimension 4: Integrity of the natural and built environment

The fourth dimension included in the resilience indices concerns the integrity of the natural and built environment. Three characteristics are considered in Bahr el Gazal:<sup>9</sup> access to drinking water, access to water for vegetable crops and access to water for livestock, and two in Guéra: access to drinking water and access to water for vegetable crops. An index with the proportion of characteristics in which households scored positively is shown in column 1 of Table 5.13. We found that, on average, households in the project communities scored positively in more characteristics than households in the comparison group in both regions.

The first characteristic included in the integrity of the natural and built environment dimension is access to drinking water. Households scored positively in this outcome if their main source of drinking water was a borehole, a covered well, a public drinking fountain, a hand pump, a water seller, or piped water from a tap, and additionally if that water was available during the entire year. Although this characteristic is not connected to any of the project activities, we find in column 2 that households in project communities were more likely than their counterparts in comparison communities to have access to drinking water from one of these improved sources. In Bahr el Gazal, project households were significantly 22.9 percentage points more likely to score positively in the access to drinking water outcome than households in comparison villages, while in Guéra, project households were significantly 9 percentage points more likely to score positively in the outcome than their counterparts.

Column 3 presents the matching estimates of the access to water for market gardening indicator. Households scored positively if they practised market gardening in 2014, i.e. if they have produced at least one vegetable crop in 2014, and had water available for this activity for at least six months during that year. We observed that households in project villages were almost 9 percentage points more likely than households in comparison villages to score positively in the access to water for market gardening indicator.

Finally, households scored positively in the access to water for livestock characteristic if their main source of water for livestock was a borehole, an *abreuvoir* or a *borne fontaine*, and water was available for at least 8 months in the past year. As discussed in Section 5.4, we did not find that the project had any significant effect on this outcome in Bahr el Gazal, however, we did observe more access from the intervention group.

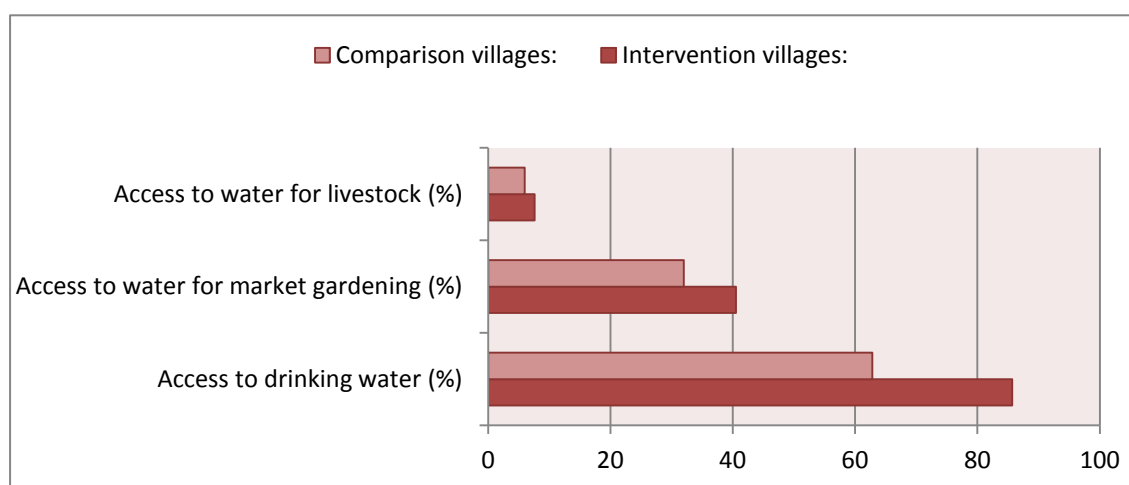
Figures 5.8 and 5.9 show the proportion of households scoring positively in terms of integrity of the natural and built environment.

**Table 5.13: Households scoring positively in terms of characteristics of integrity of the natural and built environment**

	1	2	3	4
	Index of integrity of the natural and built environment	Access to drinking water (%)	Access to water for market gardening (%)	Access to water for livestock (%)
<b>Bahr el Gazal</b>				
Intervention group mean:	0.4	85.7	40.5	7.6
Comparison group mean:	0.3	62.8	32.0	6.0
Difference:	0.1*** (0.02)	22.9*** (4.2)	8.5* (4.4)	1.6 (2.4)
Observations (intervention group):	210	210	210	210
Observations (total):	579	579	579	579
<b>Guéra</b>				
Intervention group mean:	0.5	75.1	31.3	-
Comparison group mean:	0.4	66.1	22.2	-
Difference:	0.1*** (0.04)	9.0** (4.5)	9.1** (4.6)	-
Observations (intervention group):	217	217	217	-
Observations (total):	557	557	557	-

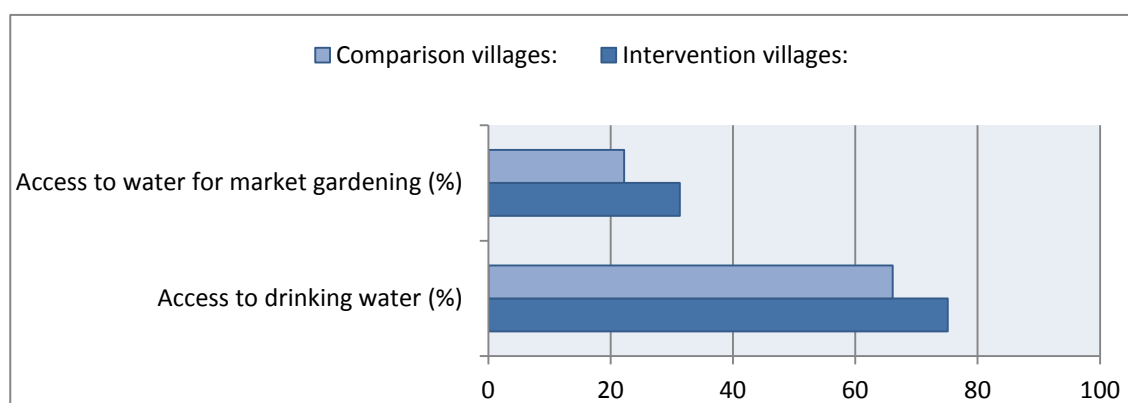
PSM estimates. Bootstrapped standard errors in parenthesis.  
 \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

**Figure 5.8: Proportion of households scoring positively in terms of characteristics of integrity of the natural and built environment in Bahr el Gazal**



**Figure 5.9: Proportion of households scoring positively in terms of characteristics of integrity of the natural and built environment in Guéra**





## 5.6.5 Dimension 5: Social and institutional capability

The fifth and final dimension of resilience concerns social and institutional capabilities. Three characteristics shape this dimension: social cohesion in the community, participation in community groups, and support from state extension services. Column 1 of Table 5.14 shows the proportion of characteristics in which households scored positively. We did not find any evidence suggesting differences between households in the project communities and those in the comparison group.

Households that, according to the respondent, provided support to other people in the community and/or received help from others in the community at least three times in the past year, scored positively in the social cohesion in the community characteristic (column 2). Households from the comparison communities in Bahr el Gazal were significantly 9.8 percentage points more likely to score positively in this outcome compared to project households. In Guéra, on the other hand, we did not find significant evidence of the effect of the project on this outcome; however, we did find that more comparison households scored positively in this outcome than project households. A potential explanation for the negative difference in Bahr el Gazal is that social cohesion as we define it in this report, is highly determined by unobserved factors, such as personal values. As discussed in previous sections, matching is performed on the basis of observed characteristics and any unobserved factors are assumed to be equal among groups; this assumption may not necessarily be correct. Another explanation for why this question may not work as an indicator of social cohesion is that people may want to understate how much support they get from others in their community, so as to seem more in need of support. In light of this, we should not necessarily assume that the project activities have had a negative effect on social cohesion – though this conclusion cannot be ruled out.

The second item in the social and institutional capability dimension is participation in community groups, being positive for households with at least one female and one male member participating in a community group, such as a market gardening group, a farmers' group, an association, a tontine, a community savings fund, a cooperative, or the water committee. Column 3 in Table 5.14 shows that households in project communities were significantly 11 percentage points more likely to participate in community groups than households in the comparison communities. We did not find a significant difference between groups in Guéra region, although we observed more participation from households in the intervention communities.

The last characteristic in this dimension involves the support from state extension services. If any member of the household received support, training or advice from the state extension services at some point since 2010, then households scored positively in this item. We found significant evidence that households in intervention communities in Bahr el Gazal and Guéra were 6.3 and 8.6 percentage points, respectively, more likely to score positively in this characteristic than households in the comparison group.

Figures 5.10 and 5.11 show the proportion of households scoring positively in terms of social and institutional capability.

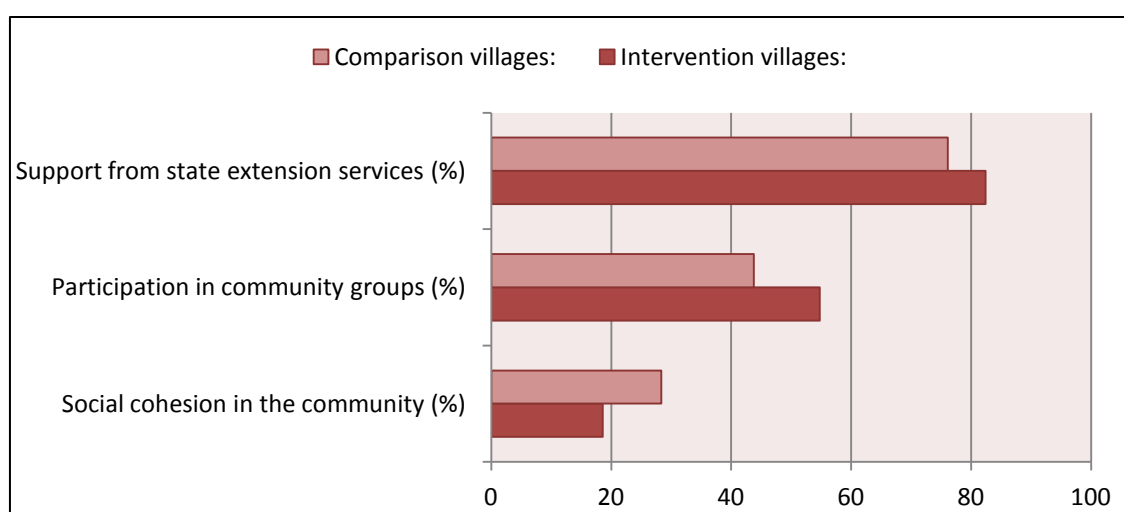
**Table 5.14: Households scoring positively in terms of characteristics of social and institutional capability**

	1	2	3	4
	Index of social and institutional capability	Social cohesion in the community (%)	Participation in community groups (%)	Support from state extension services (%)
<b>Bahr el Gazal</b>				
Intervention group mean:	0.52	18.6	54.8	82.4
Comparison group mean:	0.49	28.4	43.8	76.1
Difference:	0.03 (0.03)	-9.8** (4.4)	11.0** (5.0)	6.3* (3.7)
Observations (intervention group):	210	210	210	210
Observations (total):	579	579	579	579
<b>Guéra</b>				
Intervention group mean:	0.51	35.5	42.4	74.7
Comparison group mean:	0.48	42.5	36.6	66.1
Difference:	0.03 (0.03)	-7.0 (5.0)	5.8 (4.7)	8.6* (4.5)
Observations (intervention group):	217	217	217	217
Observations (total):	557	557	557	557

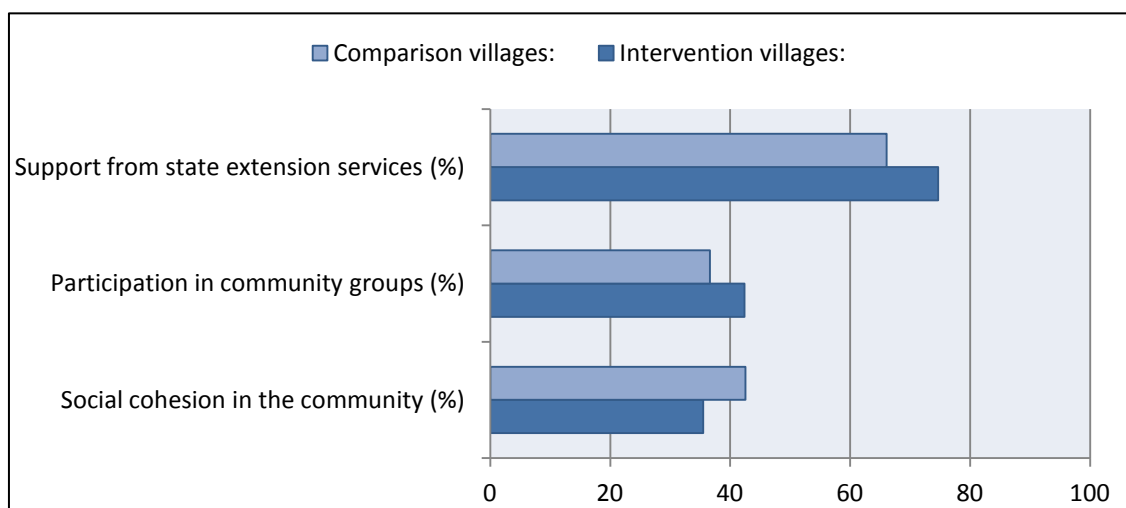
PSM estimates. Bootstrapped standard errors in parenthesis.

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

**Figure 5.10: Proportion of households scoring positively in terms of social and institutional capability in Bahr el Gazal**



**Figure 5.11: Proportion of households scoring positively in terms of social and institutional capability in Guéra**



# 6 CONCLUSIONS

## 6.1 CONCLUSIONS

This Effectiveness Review has found that the projects 'Reinforcing Resilience Capacity in Bahr el Gazal' and 'Improving the Food Security Information System in Guéra region' (also known by its French acronym PASISAT) have had a positive effect on several outcomes of interest. In terms of agricultural activities, the survey results provide good evidence that the market gardening intervention in Guéra has been successful in increasing the number of crops sold (both staple and vegetable crops) and thus we found higher revenues from their sale in households among the intervention group. Moreover, both projects enhanced the use of improved agricultural techniques, such as use of improved seeds and phytosanitary treatment. In particular, households in intervention communities in Guéra were significantly more likely to employ row planting than their counterparts in comparison communities. Other techniques employed by project households in Bahr el Gazal were biological treatment and soil conservation techniques.

Livestock-rearing activities in Bahr el Gazal have improved access to veterinary care and boosted vaccination of livestock among project communities. Nevertheless, we did not find that the project activities in the region have had any effect in the number of livestock owned or on water availability for animals.

Both projects aimed at improving dietary diversity and food security among its project participants. We did not find evidence however, that any of the projects have had a statistically significant effect on dietary diversity: the average household in our sample (both in intervention and comparison communities) had consumed mainly grains and tubers in the seven days before the survey. There is no evidence either that men, women or children in the household had better access to food during the previous lean season. We found a positive effect of the project in Bahr el Gazal in reducing severe food insecurity, while the results suggest a negative effect of the project in this outcome in Guéra. Perhaps the most interesting result is in terms of expenditure in food consumption. We found that households in project villages increased their expenditure in food consumed in the seven days prior to the survey by 20 per cent.

We created a wealth index, measured in terms of agricultural and household asset ownership. We then estimated the change in wealth index between 2010 and the date of the survey (2014) and scaled it so that a household that saw no changes in wealth indicators has a score of zero, while the household that saw the greatest change in wealth indicators has a score of 1. We found that, on average, the change in wealth index in households in project villages was not significantly different from that of the comparison group. Nevertheless, a change in wealth indicators is something expected to happen over the long term rather than be an immediate result of short-term projects, such as the ones being evaluated in this Effectiveness Review.

Another aspect of great interest is the households' ability to cope with change. We looked at three different specifications of resilience indicators based on five dimensions: livelihood viability, innovation potential, access to contingency resources and support, natural and built environment, and social and institutional capability. Overall, results showed a positive impact of the projects in improving resilience. However, the two projects affected the results in different ways.

The project 'Reinforcing Resilience Capacity in Bahr el Gazal' contributed positively in promoting the use of improved seeds by 10.4 percentage points; improving access, availability and quality of veterinary care by 9.9 percentage points; and in enhancing the ownership of assets by 15.1 percentage points.<sup>10</sup> There is no evidence to conclude that the project had any effect on improving the innovation potential of households in intervention communities. In terms of access to contingency resources and support, we found that project households in the region were 16.8 percentage points more likely to have access to a grain bank and 8 percentage points more likely to be able to finance

an investment of 50,000 francs CFA (approximately 85 USD) or an unexpected medical treatment from savings. Households in project communities were also 22.9 percentage points more likely to access clean drinking water and 8.5 percentage points more likely to have better access to water for market gardening than their counterparts in comparison communities. The project enhanced participation in community groups by 11 percentage points. Finally, households in project communities are significantly 6.3 percentage points more likely to receive support from state extension services than their counterparts.

On the other hand, there is no evidence that PASISAT's activity had any effect in terms of the resilience dimensions of livelihood viability and innovation potential. However, we found that households in project communities were 8.6 percentage points more likely to receive support from state extension services than those in comparison villages. In the natural and built environment dimension, we found that the project had a positive impact in improving access to drinking water by 9 percentage points and providing access to water for market gardening by 9.1 percentage points, compared to non-project households. We also observed that individuals in project villages were 8.4 percentage points more likely to have access to grain banks and 10.35 more likely to have access to medical care.

Overall, households in the project communities in Bahr el Gazal were assessed as scoring positively in 50 per cent of the characteristics of resilience, against 40 per cent in the comparison communities, while in Guéra, project households scored positively in 45 per cent of the characteristics of resilience, against 42 per cent in the comparison group. The work undertaken in both projects appears to have had a positive effect on outcomes that should enable project participants to cope better with shocks, stresses and uncertainty in the future.

## 6.2 PROGRAMME LEARNING CONSIDERATIONS

### **Exploring the lack of effect on innovation potential and social cohesion**

The report has found the project had no effect on modifying attitudes towards climate change, change and innovation, and the adoption of new practices. Such attitudes are believed to improve a household's ability to positively adjust to change. Training activities could include an awareness component of these topics that could lead to better results on the subject. 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, the results on social cohesion, suggest that projects should take into account this element from the project design stage. Building social capacity, through the establishment of farmers' organisations and through improving linkages to extension services and other service providers, for example, may lead to a greater improvement in a recipient's resilience.

### **Determining the mechanisms by which change is achieved**

A different set of activities was carried out in each community, particularly in Bahr el Gazal. Therefore, it was not possible to isolate the effects of each specific activity and determine which actions are most cost-effective. This is important to enable the effective targeting of resources in future interventions. It is advisable to consider a few combinations of project activities and test them in different project communities to be able to compare the effect of each intervention.

### **Considering capacity building activities for state services**

Some of the project activities, such as the ones related to veterinary care, were firstly implemented by Oxfam operators and then passed over to state services. In such partnerships, it is advisable to invest in capacity building of state authorities and in follow-up visits, in order to ensure the durability of the interventions.

# APPENDIX 1: THRESHOLDS FOR CHARACTERISTICS OF RESILIENCE

Dimension	Characteristic	Threshold: a household scores positively if...	Directly connected to project logic?
Livelihood viability	Access to land for cultivation	Household cultivated at least 2 hectares in 2014.	No
	Use of improved seeds	Household used improved seeds for at least one of the crop types – food and vegetable crops – cultivated during 2014.	Yes
	Ownership of livestock	In Bahr el Gazal: household owns at least 15 head of livestock (excluding poultry). In Guéra: household owns at least 2 head of livestock (excluding poultry).	Yes <sup>1</sup>
	Access, availability and quality of veterinary care	Respondent states that the household has access to veterinary care (from a specialist veterinarian or a community animal health worker) when needed, that the support is at least sometimes available when necessary, and is of at least 'medium' quality.	Yes <sup>1</sup>
	Diversification in sources of income	At least one female and one male household member engages in non-agricultural work which could be maintained (even with difficulty) in the event of a drought, including providing a paid service to others, running a household business/ shopkeeper or formal employment.	No
	Ownership of productive assets	Household owns at least one large asset (cart, plough, motor pump, sheller, sewing machine, motorbike or motor vehicle) or at least three small assets (bicycle, lamp or torch, iron, mobile phone).	No
Innovation potential	Understanding of climate change	Respondent agrees that 'It is important that agricultural or pastoral activities take the meteorological conditions into account' and that 'The climate changes from year to year, and we have to be prepared to face its negative effects', in preference to the two opposing statements.	Yes <sup>1</sup>
	Attitude to change and innovation	Respondent agrees that 'To better succeed in the future, people should experiment more with new methods and innovations' and that 'We need to use new methods and innovations to improve our living conditions', in preference to the two opposing statements.	Yes
	Adoption of new practices or initiatives	Respondent reports that the household has adopted some new practice or behaviour at some time since 2010, other than those originating with a project or NGO.	Yes
Access to contingency resources and support	Access to a grain bank	Respondent reports that there is a grain bank in the community, and that the household would be able to access grain from the bank during the coming year if necessary.	No <sup>2</sup>
	Access to medical care	Respondent states that household members can access medical care from a health centre (public or private, or run by an NGO or religious body) if necessary, rather than relying only on home care or traditional healers, and that the treatment could be financed without resorting to asset sales or borrowing.	No

Dimension	Characteristic	Threshold: a household scores positively if...	Directly connected to project logic?
	Savings	Respondent reports that the household could finance a 50,000 francs CFA investment from their savings if necessary, or would be able to finance unexpected medical treatment from savings if necessary.	No
	Access to remittances	Household had some income from remittances during the past 12 months.	No
Integrity of the natural and built environment	Access to drinking water	Household's main source of drinking water is a borehole, a covered well, a public drinking fountain, a hand pump, a water seller or piped water from a tap, and that water is available from this source for 12 months during the year.	Yes
	Access to water for market gardening	Household practised market gardening in 2014, and that water was available for this activity for at least 6 months during 2014.	Yes
	Access to water for livestock	Household's main source of water for livestock is a borehole, <i>abreuvoir</i> or <i>borne fontaine</i> , and water was available in the normal grazing lands for at least 8 months during 2014.	Yes <sup>1</sup>
Social and institutional capability	Social cohesion in the community	Respondent reports that the household provided support to others in the community and/or received support from others in the community at least 3 times during 2014.	No
	Participation in community groups	At least one female and one male household member(s) participate(s) regularly in some groups in the community.	Yes
	Support from state extension services	Some household member has received support, training or advice from the state extension services at some time since 2010.	No

<sup>1</sup> Bahr el Gazal only.

<sup>2</sup> Although this indicator is connected to the project's logic, none of the communities in our sample benefited directly from this activity.



## APPENDIX 2: BASELINE STATISTICS BEFORE MATCHING

	Bahr el Gazal				Guéra			
	Intervention mean	Comparison mean	Difference	Standard error	Intervention mean	Comparison mean	Difference	Standard error
Household size	6.28	5.77	0.505***	0.19	7.00	6.75	0.252	0.27
Number of children in household	6.31	6.49	-0.182	0.31	7.58	7.02	0.558	0.38
Number of adults in household	3.11	2.53	0.581***	0.12	2.74	2.80	-0.062	0.14
Number of men in household	1.57	1.30	0.276***	0.09	1.31	1.30	0.003	0.09
Number of women in household	1.53	1.23	0.305***	0.08	1.43	1.49	-0.065	0.09
Age of household head	46.72	43.34	3.373***	0.98	40.81	43.90	-3.089**	1.26
Household head is male (%)	63.43	62.60	0.824	4.15	58.90	66.47	-7.566*	4.17
Household head with no education (%)	100.00	100.00	0	0.00	60.73	71.18	-10.45**	4.05
Household head attended Koranic school (%)	0.00	0.00	0	0.00	21.92	28.82	-6.906*	3.80
Age of respondent	45.41	42.43	2.981***	1.00	39.78	43.65	-3.869***	1.26
Respondent is male (%)	51.39	54.20	-2.812	4.28	49.32	65.00	-15.68***	4.22
Respondent with no education (%)	100.00	100.00	0	0.00	60.73	71.18	-10.45**	4.05
Respondent attended Koranic school (%)	0.00	0.00	0	0.00	21.92	28.82	-6.906*	3.80
Natural logarithm (Ln) of land cultivated in 2010	1.19	1.09	0.097***	0.03	0.96	0.98	-0.025	0.04
Natural logarithm (Ln) of land cultivated with vegetable crops in 2010 <sup>1</sup>	1.20	1.11	0.084	0.12	0.78	0.45	0.330***	0.11
Any food crops planted in 2010 (%)	92.13	89.16	2.97	2.54	95.43	94.71	0.728	1.89
Any vegetable crops planted in 2010 (%)	45.37	39.30	6.075	4.22	32.88	21.47	11.41***	3.77
Number of food crops planted in 2010	1.02	1.02	-0.001	0.05	3.21	3.14	0.066	0.13
Number of sold food crops in 2010	0.42	0.38	0.045	0.05	1.47	1.33	0.148	0.14
Number of vegetable crops planted in 2010	1.06	1.00	0.065	0.13	0.85	0.60	0.246**	0.12
Number of sold vegetable crops in 2010	0.73	0.67	0.059	0.11	0.63	0.43	0.205**	0.10
Number of agricultural techniques employed in 2010	1.37	1.51	-0.136	0.16	0.85	0.74	0.116	0.10
Number of livestock heads (excluding poultry) owned by household in 2010	22.57	18.07	4.509**	1.97	5.51	6.45	-0.942	1.11
Some household member(s) engaged in agricultural labour in 2010 (%)	17.59	23.58	-5.985*	3.51	48.40	42.06	6.343	4.31
Some household member(s) processed agricultural output for sale in 2010 (%)	18.06	15.99	2.066	3.20	10.96	10.88	0.077	2.71

	Bahr el Gazal				Guéra			
	Intervention mean	Comparison mean	Difference	Standard error	Intervention mean	Comparison mean	Difference	Standard error
Some household member(s) engaged in casual labour in 2010 (%)	9.72	11.38	-1.66	2.66	24.66	25.88	-1.225	3.78
Some household member(s) worked in a small business in 2010 (%)	19.91	17.62	2.292	3.33	19.18	12.06	7.119**	3.07
Some household member(s) had regular salaried employment in 2010 (%)	0.93	0.81	0.113	0.79	4.57	7.65	-3.081	2.13
Household received money transfers from outside the community in 2010 (%)	28.24	30.89	-2.654	3.93	15.98	13.53	2.452	3.05
Time to nearest market (minutes)	244.66	680.08	-435.4***	101.25	70.96	104.36	-33.4	22.53
Some household member(s) participated in any community group in 2010 (%)	37.96	33.06	4.901	4.08	59.82	49.71	10.11**	4.31
Household was in the lowest 20% of the sample according to wealth indicators recalled from 2010 (%)	24.07	17.62	6.459*	3.42	17.35	21.76	-4.413	3.47
Household was in the second 20% of the sample according to wealth indicators recalled from 2010 (%)	27.78	15.45	12.33***	3.39	18.72	20.88	-2.161	3.47
Household was in the middle 20% of the sample according to wealth indicators recalled from 2010 (%)	15.74	22.49	-6.752***	3.42	24.20	17.35	6.848**	3.46
Household was in the fourth 20% of the sample according to wealth indicators recalled from 2010 (%)	13.89	23.58	-9.688***	3.41	20.09	20.00	0.091	3.47
Household was in the upper 20% of the sample according to wealth indicators recalled from 2010 (%)	18.52	20.87	-2.349	3.43	19.63	20.00	-0.365	3.46

<sup>†</sup> Measured in 'planches' for Bahr el Gazal and square metres for Guéra.

The construction of the wealth index is described in Section 5.5. Variables dated 2010 are estimates, based on recall data.

\* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01.

## APPENDIX 3: METHODOLOGY USED FOR PROPENSITY SCORE MATCHING

Results presented in Section 5 of this report were estimated using propensity-score matching (PSM). PSM is a statistical technique that allows us to estimate the effect of an intervention by accounting for the covariates that predict receiving the intervention, or ‘treatment’. The idea behind PSM is to match similar individuals in the treatment or intervention group to those in the comparison group, based on observed characteristics they share at baseline. After each participant is matched with a non-participant, the treatment effect on the treated (those who benefited from the intervention) is equal to the difference in average outcomes of the intervention and the comparison groups after project completion.

This appendix describes and tests the specific matching procedure employed in this effectiveness review. A practical guide on the different approaches to matching may be found in Caliendo and Kopeinig (2008).

### Estimating propensity scores

Finding an exact match for treated individuals, based on various baseline characteristics would be very hard to implement in practice. Rosenbaum and Rubin (1983) demonstrated that a ‘propensity score’ could summarise all this information in one single variable. The propensity score is defined as the conditional probability of receiving intervention (or the project, under the Effectiveness Review context) given background variables. Specifically, propensity scores are calculated using a statistical probability model (e.g. probit or logit) to estimate the probability of participating in the project, conditional on a set of characteristics.

Tables A3.1 and A3.2 show the variables used to estimate propensity scores. As suggested in Caliendo and Kopeinig (2008), only variables being likely to influence the participation decision and simultaneously not be affected by participation in the project, were included in each model. In each table, the dependent variable is a dummy, equal to one for all ‘intervention’ households in one of the communities that benefited from the project activities, and zero otherwise. Coefficients in both tables correspond to the marginal effects, i.e. the change in the probability of the intervention if the independent variable changes in one unit.

**Table A3.1: Estimating propensity score for Bahr el Gazal**

	Coefficient	Standard error	p-value
Natural logarithm (Ln) of land cultivated in 2010 (ha)	0.122	0.060	0.041
Natural logarithm (Ln) of area planted with vegetable crops in 2010 (' <i>planches</i> ')	0.012	0.022	0.598
Number of sold food crops in 2010	0.048	0.037	0.202
Number of sold vegetable crops in 2010	0.006	0.021	0.774
Any household member processed farm products for sale in 2010 (=1)	-0.057	0.062	0.376
Any household member participated in a market gardening group and/or a water committee in 2010 (=1)	0.137	0.054	0.011
Number of improved agricultural techniques implemented in 2010	-0.023	0.014	0.092
Household size	0.015	0.010	0.117
Gender of household head (1=male)	0.013	0.045	0.768
Age of household head	-0.019	0.012	0.098
Head's age squared	0.000	0.000	0.033
Number of livestock in 2010	0.003	0.001	0.001
Time to nearest market in 2010 (minutes)	-0.000	0.000	0.000
Household was in the bottom 20% of the sample according to wealth indicators recalled from 2010 (=1)	0.265	0.079	0.001
Household was in the second 20% of the sample according to wealth indicators recalled from 2010 (=1)	0.251	0.075	0.001
Household was in the third 20% of the sample according to wealth indicators recalled from 2010 (=1)	0.016	0.078	0.839
Household was in the fourth 20% of the sample according to wealth indicators recalled from 2010 (=1)	-0.019	0.073	0.798
Chaddra district (=1)	-0.050	0.068	0.458

Probit regression. Variables dated 2010 are estimates, based on recall data. Explanatory variables expressed as x=1 represent binary variables taking values of either 0 or 1. The dependent variable is 1 if the household is in one of the project communities, and 0 otherwise. The estimated coefficients represent the marginal change in the probability of benefiting from the project (being exposed to the 'intervention') given a marginal change in each explanatory variable. Households in the fifth quintile are the reference category against those included in the model.

**Table A3.2: Estimating propensity score for Guéra**

	Coefficient	Standard error	p-value
Natural logarithm (Ln) of harvested area in 2010 (ha)	-0.053	0.053	0.317
Natural logarithm (Ln) of area planted with vegetable crops in 2010 (m2)	0.064	0.026	0.014
Number of sold food crops in 2010	0.001	0.015	0.951
Number of sold vegetable crops in 2010	0.000	0.030	0.990
Any household member processed farm products for sale in 2010 (=1)	-0.101	0.066	0.147
Any household member participated in a market gardening group and/or a farmers group/union in 2010 (=1)	0.129	0.044	0.004
Number of implemented agricultural techniques in 2010	0.000	0.021	0.993
Household size	0.017	0.008	0.031
Gender of household head (1=male)	0.315	0.117	0.016
Age of household head	0.005	0.026	0.843
Head's age squared	0.000	0.000	0.497
Gender of respondent (1=male)	-0.459	0.119	0.001
Age of respondent	-0.016	0.025	0.525
Respondent's age squared	0.000	0.000	0.343
Number of livestock in 2010	-0.001	0.001	0.380
Time to nearest market in 2010 (minutes)	-0.001	0.000	0.003
Household was in the bottom 20% of the sample according to wealth indicators recalled from 2010 (=1)	0.011	0.087	0.896
Household was in the second 20% of the sample according to wealth indicators recalled from 2010 (=1)	-0.012	0.082	0.883
Household was in the third 20% of the sample according to wealth indicators recalled from 2010 (=1)	0.094	0.080	0.231
Household was in the fourth 20% of the sample according to wealth indicators recalled from 2010 (=1)	0.012	0.075	0.873
Communities that benefited from market gardening intervention or comparison communities with similar characteristics (=1) <sup>1</sup>	-0.196	0.047	0.000
Median highest school level attained at the HH level	-0.038	0.015	0.009

Probit regression. Variables dated 2010 are estimates, based on recall data. Explanatory variables expressed as x=1 represent binary variables taking values of either 0 or 1. The dependent variable is 1 if the household is in one of the project communities, and 0 otherwise. The estimated coefficients represent the marginal change in the probability of benefiting from the project (being exposed to the 'intervention') given a marginal change in each explanatory variable.

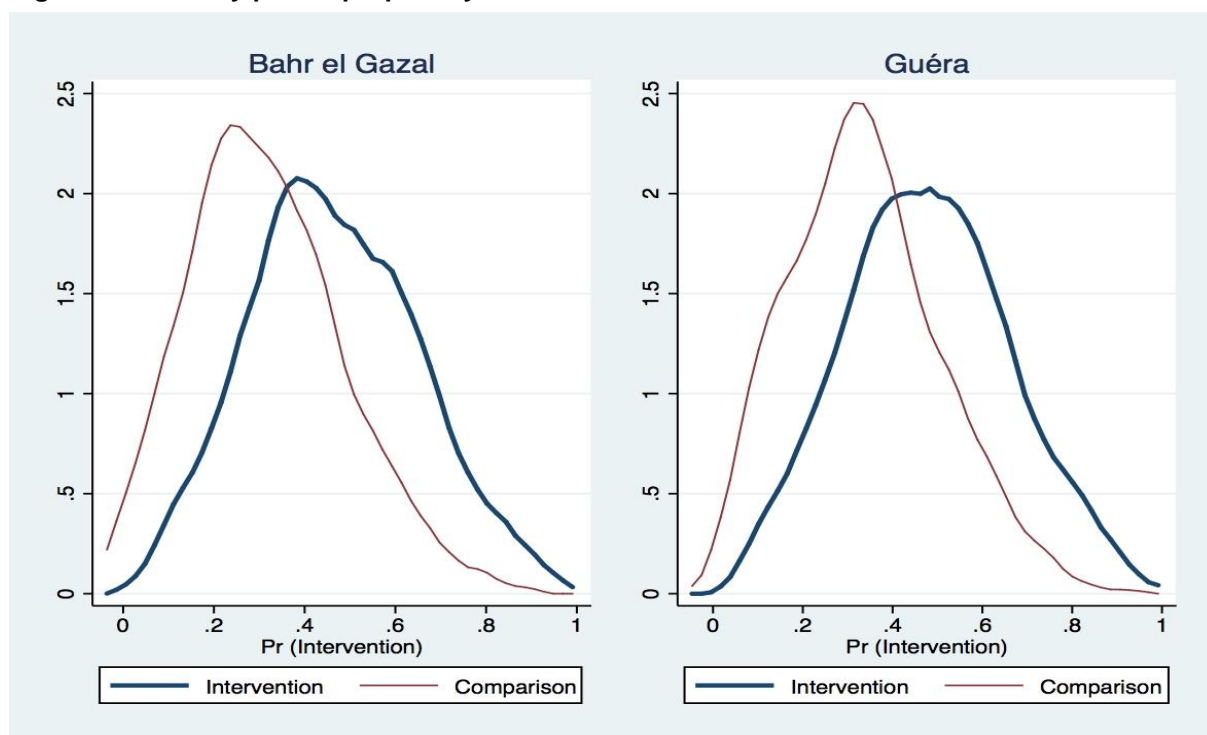
<sup>1</sup> Refer to Section 4.2.1.

Households in the fifth quintile are the reference category against those included in the model.

## Defining the region of common support

After estimating the propensity scores, we need to verify that there is a potential match for the observation in the intervention group with those from the comparison group. We need to verify then the presence of a good *common support area*. The area of common support is the region where the propensity score distributions of the intervention and comparison groups overlap. The common support assumption ensures that '[the observation receiving the intervention] has a comparison observation "nearby" in the propensity score distribution' (Heckman, Lalonde and Smith, 1999). Figure A1 shows the propensity score density plots for both groups in each region. We observe that there exists a good overlap in both cases, in fact, only six observations in Bahr el Gazal and two in Guéra from the intervention group, were dropped because there was not a suitable match for them.

**Figure A1: Density plot of propensity scores**



# Matching intervention households to comparison households

Following Rosenbaum and Rubin (1983), households are matched on the basis of their propensity score. The literature has developed a variety of matching procedures. After a series of checks, we decided to employ the kernel-matching algorithm for the results presented in this Effectiveness Review.<sup>11</sup> Kernel matching assigns more weight to the closest comparison group observations that are found within a selected 'bandwidth'. Thus 'good' matches are given greater weight than 'poor' matches. We used the *psmatch2* module in Stata using the default bandwidth of 0.06, and restricted the analysis on the area of common support. When using PSM, standard errors of the estimates are bootstrapped using 1,000 repetitions, to account for the additional variation caused by the estimation of the propensity scores and the determination of the common support.

## Check balancing

For PSM to be valid, the intervention group and the matched comparison group need to be balanced. In other words, the intervention and the comparison groups need to be similar in terms of their observed characteristics. The most straightforward way to do this is to test whether there are any statistically significant differences in baseline covariates between both groups in the matched sample. The balance of each of the matching variables after kernel matching is shown in Tables A3.3 and A3.4. Looking at the third column, we found that none of the variables implemented for the matching is statistically significant in the matched sample: all variables have a p-value larger than 0.2, and thus we can conclude that we have found a satisfactory match for our sample.

**Table A3.3: Balancing test on matching variables in Bahr el Gazal**

Variable	Unmatched (U)	Mean		%reduct		t-test		V <sub>e</sub> (T)/V <sub>e</sub> (C)
	Matched (M)	Treated	Control	% bias	bias	t	p> t	
Natural logarithm (Ln) of land cultivated in 2010 (ha)	U	1.19	1.09	23.90		2.84	0.01	1.39*
	M	1.17	1.19	-5.30	77.90	-0.54	0.59	0.96
Natural logarithm (Ln) of area planted with vegetable crops in 2010 (' <i>planches</i> ')	U	1.20	1.11	6.20		0.72	0.47	0.98
	M	1.18	1.09	6.50	-4.80	0.68	0.50	1.11
Number of sold food crops in 2010	U	0.42	0.38	7.30		0.86	0.39	1.14
	M	0.42	0.43	-1.20	83.60	-0.12	0.90	1.08
Number of sold vegetable crops in 2010	U	0.73	0.67	4.60		0.54	0.59	1.10
	M	0.70	0.65	3.80	17.30	0.40	0.69	1.11
Any household member processed farm products for sale in 2010 (=1)	U	0.18	0.16	5.50		0.65	0.52	1.10
	M	0.18	0.17	1.50	72.10	0.16	0.88	1.01
Any household member participated in a market gardening group and/or a water committee in 2010 (=1)	U	0.32	0.25	15.60		1.83	0.07	1.06
	M	0.31	0.26	11.70	25.10	1.19	0.23	0.88
Number of improved agricultural techniques implemented in 2010	U	1.37	1.51	-7.50		-0.86	0.39	0.75*
	M	1.38	1.36	1.00	86.10	0.11	0.91	0.95
Household size	U	6.28	5.77	21.90		2.61	0.01	1.24
	M	6.23	6.22	0.20	98.90	0.02	0.98	0.99
Gender of household head (1=male)	U	0.63	0.63	1.70		0.20	0.84	0.99
	M	0.63	0.64	-1.50	10.30	-0.16	0.88	0.98

Variable	Unmatched (U)	Mean		%reduct		t-test		V_e(T)/V_e(C)
	Matched (M)	Treated	Control	% bias	bias	t	p> t	
Age of household head	U	46.72	43.34	28.70		3.43	0.00	1.17
	M	46.16	45.47	5.80	79.70	0.57	0.57	1.01
Head's age squared	U	2346.40	1990.80	30.80		3.72	0.00	1.28*
	M	2280.30	2216.60	5.50	82.10	0.55	0.58	0.98
Number of livestock in 2010	U	32.35	23.49	27.80		3.31	0.00	1.33*
	M	31.41	32.68	-4.00	85.60	-0.34	0.73	0.63*
Time to nearest market in 2010 (minutes)	U	244.66	680.08	-40.30		-4.30	0.00	0.23**
	M	249.80	234.27	1.40	96.40	0.27	0.79	0.75*
Household was in the bottom 20% of the sample according to wealth indicators recalled from 2010 (=1)	U	0.24	0.18	15.90		1.89	0.06	1.34*
	M	0.24	0.24	1.90	88.00	0.19	0.85	1.05
Household was in the second 20% of the sample according to wealth indicators recalled from 2010 (=1)	U	0.28	0.15	30.20		3.63	0.00	1.49*
	M	0.28	0.28	-0.20	99.30	-0.02	0.99	1.01
Household was in the third 20% of the sample according to wealth indicators recalled from 2010 (=1)	U	0.16	0.22	-17.20		-1.97	0.05	0.79*
	M	0.16	0.15	0.60	96.50	0.07	0.95	1.01
Household was in the fourth 20% of the sample according to wealth indicators recalled from 2010 (=1)	U	0.14	0.24	-25.00		-2.84	0.01	0.71*
	M	0.13	0.13	-0.30	99.00	-0.03	0.98	0.99
Chaddra district (=1)	U	0.69	0.69	1.90		0.22	0.83	1.02
	M	0.70	0.68	3.90	-104.00	0.40	0.69	1.05

\* if 'of concern', i.e. variance ratio in [0.5, 0.8) or (1.25, 2]

\*\* if 'bad', i.e. variance ratio <0.5 or >2

Variables dated 2010 are estimates, based on recall data. Explanatory variables expressed as x=1 represent binary variables taking values of either 0 or 1. Households in the fifth quintile are the reference category against those included in the model.

Sample	Ps R2	LR chi2	p>chi2	MeanBias	MedBias	B	R	%concern	%bad
Unmatched	0.121	93.6	0	17.3	16.6	85.5*	0.84	44	6
Matched	0.004	2.58	1	3.1	1.7	15.7	1.21	11	0

\* if B>25%, R outside [0.5; 2]



**Table A3.4: Balancing test on matching variables in Guéra**

Variable	Unmatched (U)	Mean		%reduct		t-test		V_e(T)/V_e(C)
	Matched (M)	Treated	Control	% bias	bias	t	p> t	
Natural logarithm (Ln) of harvested area in 2010 (ha)	U	0.96	0.98	-6.00		-0.68	0.50	0.61*
	M	0.96	0.97	-2.50	57.80	-0.29	0.77	0.83
Natural logarithm (Ln) of area planted with vegetable crops in 2010 (m2)	U	0.78	0.45	26.40		3.13	0.00	1.51*
	M	0.78	0.77	0.10	99.50	0.01	0.99	0.97
Number of sold food crops in 2010	U	1.47	1.33	9.40		1.08	0.28	0.97
	M	1.47	1.35	7.70	18.00	0.80	0.42	0.98
Number of sold vegetable crops in 2010	U	0.63	0.43	16.80		1.96	0.05	1.24
	M	0.63	0.67	-3.20	80.80	-0.31	0.76	0.93
Any household member processed farm products for sale in 2010 (=1)	U	0.11	0.11	0.20		0.03	0.98	1.00
	M	0.11	0.10	4.30	-1666.60	0.46	0.64	1.16
Any household member participated in a market gardening group and/or a farmers group/union in 2010 (=1)	U	0.56	0.43	26.00		3.00	0.00	0.92
	M	0.56	0.56	0.00	99.80	0.00	1.00	1.01
Number of implemented agricultural techniques in 2010	U	0.85	0.74	10.20		1.19	0.23	1.29*
	M	0.85	0.85	0.60	93.90	0.06	0.95	1.18
Household size	U	7.00	6.75	8.10		0.93	0.35	1.08
	M	7.00	7.19	-6.10	25.00	-0.64	0.52	1.05
Gender of household head (1=male)	U	0.59	0.66	-15.70		-1.82	0.07	1.08
	M	0.59	0.58	1.70	89.10	0.17	0.86	1.00
Age of household head	U	40.81	43.90	-21.40		-2.44	0.02	0.78*
	M	40.81	41.22	-2.80	86.80	-0.31	0.76	0.99
Head's age squared	U	1855.70	2153.30	-21.60		-2.46	0.01	0.69*
	M	1855.70	1888.00	-2.40	89.10	-0.27	0.79	0.98
Gender of respondent (1=male)	U	0.49	0.65	-32.00		-3.72	0.00	0.83
	M	0.49	0.53	-7.50	76.50	-0.77	0.44	0.83
Age of respondent	U	39.78	43.65	-26.80		-3.07	0.00	0.73*
	M	39.78	40.55	-5.30	80.10	-0.58	0.56	0.95
Respondent's age squared	U	1774.40	2129.20	-26.00		-2.95	0.00	0.63*
	M	1774.40	1834.30	-4.40	83.10	-0.49	0.62	0.93
Number of livestock in 2010	U	10.28	11.56	-7.00		-0.81	0.42	0.84
	M	10.28	10.49	-1.10	84.10	-0.12	0.90	1.09
Time to nearest market in 2010 (minutes)	U	70.96	104.36	-14.10		-1.48	0.14	0.20**
	M	70.96	68.62	1.00	93.00	0.38	0.70	1.24
Household was in the bottom 20% of the sample according to wealth indicators recalled from 2010 (=1)	U	0.17	0.22	-11.10		-1.27	0.20	0.83
	M	0.17	0.16	2.90	74.00	0.32	0.75	1.13
Household was in the second 20% of the sample according to wealth indicators recalled from 2010 (=1)	U	0.19	0.21	-5.40		-0.62	0.53	0.92
	M	0.19	0.19	-1.40	75.00	-0.14	0.89	0.98

Variable	Unmatched (U)	Mean		%reduct		t-test		V_e(T)/V_e(C)
	Matched (M)	Treated	Control	% bias	bias	t	p> t	
Household was in the third 20% of the sample according to wealth indicators recalled from 2010 (=1)	U	0.24	0.17	16.90		1.98	0.05	1.23
	M	0.24	0.24	-0.10	99.40	-0.01	0.99	1.01
Household was in the fourth 20% of the sample according to wealth indicators recalled from 2010 (=1)	U	0.20	0.20	0.20		0.03	0.98	1.01
	M	0.20	0.21	-3.00	-1236.90	-0.31	0.75	0.95
Communities that benefited from market gardening intervention or comparison communities with similar characteristics (=1)1	U	0.47	0.57	-21.10		-2.43	0.02	1.04
	M	0.47	0.43	7.00	66.90	0.73	0.47	1.09
Median highest school level attained at the HH level	U	1.50	1.64	-8.50		-0.96	0.34	0.67*
	M	1.50	1.50	0.50	93.70	0.06	0.95	0.82

\* if 'of concern', i.e. variance ratio in [0.5, 0.8) or (1.25, 2]

\*\* if 'bad', i.e. variance ratio <0.5 or >2

Variables dated 2010 are estimates, based on recall data. Explanatory variables expressed as x=1 represent binary variables taking values of either 0 or 1. Households in the fifth quintile are the reference category against those included in the model

Sample	Ps R2	LR chi2	p>chi2	MeanBias	MedBias	B	R	%concern	%bad
Unmatched	0.113	84.39	0	15	14.9	56.5*	0.24*	36	5
Matched	0.01	6.2	1	3	2.7	23.9	1.3	0	0

\* if B>25%, R outside [0.5; 2]

## APPENDIX 4: ROBUSTNESS CHECKS

In order to address the validity of the results presented in Section 5, a series of robustness checks were carried out to ensure the preferred matching algorithm is the one that best performs the matching between intervention and comparison groups. This section presents a number of alternative matching algorithms used to test the robustness of the estimates presented in Section 5.

### Multivariate regression

The first basic specification for estimating the impact of project participation is an OLS model (when the dependent is continuous) or probit model when the dependent is binary.

$$Y_i = \alpha + \beta_1 \text{Project participation}_i + \delta' X_i + \varepsilon_i$$

Where  $Y_i$  is the dependent variable;  $X_i$  is a vector of household covariates used in the model in Table A2.1; finally the variable of interest is the dummy variable Project Participation that assumes a value equal to one when the household is enrolled in the project, zero otherwise. When the dependent variable  $Y_i$  is binary variable, a probit model replaces the OLS specification. It is important to note that in the absence of randomised allocation of the project among the population in our sample, OLS and probit models fail to identify the causal effect of the programme, and can only be used as additional qualitative checks for the non-parametric estimates. Only the estimate of  $\beta_1$  will be reported.

### Propensity Score Matching – Nearest Neighbour

The nearest neighbour (NN) matching algorithm finds an observation from the comparison group to be matched with an observation from a treated individual that is closest in terms of their propensity score. Several variants of NN matching are possible, e.g. NN matching 'with replacement' and 'without replacement'. In the former case, an untreated individual can be used more than once as a match, whereas in the latter case it is considered only once. Matching with replacement involves a trade-off between bias and variance. If we allow replacement, the average quality of matching will increase and the bias will decrease. This is of particular interest with data where the propensity score distribution is very different between the treatment and the control group (Caliendo and Kopeinig, 2008).

### Propensity Score Matching – Caliper

NN matching faces the risk of bad matches if the closest neighbour is far away. This can be avoided by imposing a tolerance level on the maximum propensity score distance (caliper). Imposing a caliper works in the same direction as allowing for replacement. Bad matches are avoided and hence the matching quality rises. However, if fewer matches can be performed, the variance of the estimates increases. Applying caliper matching means that an individual from the comparison group is chosen as a matching partner for a treated individual that lies within the caliper ('propensity range') and is closest in terms of propensity score. Estimates in this analysis will impose a caliper of 0.1.

### Propensity Score Weighting

Following the example of Hirano and Imbens (2001) we implemented a regression adjustment with weights based on the propensity score. The average treatment effect can be estimated in a parametric framework as follows:

$$Y_i = \alpha + \beta_1 \text{Project participation}_i + \delta_2' Z_i + \delta_1' X_i + \varepsilon_i$$

Where  $Y_i$  represents the outcome of interest; Project participation<sub>i</sub> is a dummy binary variable equal to one if an individual/household is enrolled into the programme and zero otherwise;  $X_i$  is a vector of matching covariates used to estimate the propensity score match; and  $Z_i$  is a vector of control variables that cannot be used for the matching as they are not supposed to influence project participation. The regression is estimated with weights equal to one for the treated units and  $\hat{e}(x)/(1 - \hat{e}(x))$  for control units.

This parametric regression analysis framework has the advantage of exploring heterogeneity in the treatment effect. Moreover it allows controlling for variables that cannot be included in the propensity score equation. The robustness check tables will only report  $\beta_1$ .

The following tables report the results of the robustness checks.

**Table A4.1a: Land and agricultural production**

	Bahr el Gazal				Guéra			
	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting
Natural logarithm of land cultivated (ha)	-0.361 (0.359) 585	0.016 (0.046) 585	0.016 (0.046) 585	-0.948** (0.473) 571	-0.013 (0.298) 559	-0.029 (0.069) 559	-0.029 (0.068) 559	0.157 (0.339) 553
Number of staple crops	0.853 (0.583) 585	0.171** (0.073) 585	0.171** (0.070) 585	-0.948** (0.473) 571	-0.512 (1.301) 559	0.175 (0.165) 559	0.175 (0.156) 559	-0.322 (1.345) 553
Number of sold staple crops	0.080 (0.466) 585	-0.038 (0.065) 585	-0.038 (0.065) 585	0.310 (0.482) 571	2.242** (0.963) 559	0.263* (0.154) 559	0.263 (0.160) 559	1.828* (1.050) 553
Natural logarithm of revenue from sales of staple crops (francs CFA)	1.462 (2.332) 585	-0.612* (0.370) 585	-0.612 (0.379) 585	3.185 (3.339) 571	8.233** (4.005) 559	1.342** (0.660) 559	1.342** (0.659) 559	6.192 (4.391) 553
Natural logarithm of area under market gardening <sup>1</sup>	-0.327 (1.158) 585	-0.005 (0.204) 585	-0.005 (0.200) 585	-0.618 (1.405) 571	-1.404 (1.072) 559	0.396** (0.197) 559	0.396** (0.190) 559	-2.194* (1.150) 553
Number of months with water for vegetable crops	-	0.235 (0.468) 272	0.235 (0.461) 272	8.848* (4.713) 269	-8.219 (5.088) 221	0.798 (0.596) 221	0.798 (0.563) 221	-10.342** (4.800) 220
Number of vegetable crops	0.254 (1.408) 585	0.314 (0.235) 585	0.314 (0.221) 585	0.304 (1.792) 571	-3.184** (1.413) 559	0.304 (0.269) 559	0.304 (0.262) 559	-4.070** (1.587) 553
Number of sold vegetable crops	0.103 (1.120) 585	0.086 (0.193) 585	0.086 (0.185) 585	0.337 (1.305) 571	-0.951 (1.118) 559	0.318 (0.215) 559	0.318 (0.206) 559	-1.363 (1.113) 553
Natural logarithm of revenue from sales of vegetable crops (francs CFA)	5.627 (3.686) 585	0.459 (0.706) 585	0.459 (0.698) 585	8.873* (4.929) 571	-1.299 (3.156) 559	1.417** (0.582) 559	1.417** (0.597) 559	-1.835 (3.267) 553

<sup>1</sup> Responses in 'planches' in Bahr el Gazal and square metres in Guéra.

Robust standard errors in parentheses. PSM estimates bootstrapped 1,000 repetitions. Number of observations in italic.

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

**Table A4.1b: Adoption of improved agricultural techniques**

	Bahr el Gazal				Guéra			
	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting
Any staple crop with improved seeds (%)	143.611*** (45.723) 585	19.048*** (6.283) 585	19.048*** (6.070) 585	171.971*** (55.871) 571	15.909 (44.908) 559	0.922 (6.663) 559	0.922 (6.601) 559	7.807 (48.132) 553
Any vegetable crop with improved seeds (%)	47.914 (42.116) 585	15.714** (6.356) 585	15.714** (6.127) 585	31.187 (52.191) 571	4.943 (33.360) 559	10.138* (5.624) 559	10.138* (5.424) 559	-32.076 (39.434) 553
Household used animal manure (organic fertiliser) (%)	-12.328 (41.734) 585	-10.476** (4.810) 585	-10.476** (4.972) 585	5.630 (53.221) 571	20.257 (41.665) 559	5.991 (5.641) 559	5.991 (5.925) 559	10.201 (42.994) 553
Household used chemical fertiliser (%)	-46.983 (37.428) 585	4.286 (6.331) 585	4.286 (6.079) 585	-53.646 (44.002) 571	-6.064 (12.447) 559	2.304 (1.676) 559	2.304 (1.586) 559	-1.433 (10.369) 553
Household used compost (%)	3.981 (41.001) 585	5.714 (5.033) 585	5.714 (5.202) 585	-37.656 (44.622) 571	13.826 (10.217) 559	0.461 (0.913) 559	0.461 (0.910) 559	13.519 (10.217) 553
Household used phytosanitary treatment (%)	-23.672 (33.533) 585	8.571* (4.633) 585	8.571* (4.417) 585	-16.249 (33.809) 571	-15.607 (18.467) 559	5.530** (2.555) 559	5.530** (2.761) 559	-7.676 (18.208) 553
Household used biological treatment (%)	34.440 (32.342) 585	12.857*** (4.431) 585	12.857*** (4.270) 585	25.391 (36.041) 571	-11.728 (9.980) 559	0.922 (1.442) 559	0.922 (1.412) 559	-8.524 (10.565) 553
Household used row planting (%)	31.242 (46.591) 585	3.810 (6.330) 585	3.810 (5.896) 585	25.535 (55.903) 571	6.825 (42.748) 559	18.433*** (5.728) 559	18.433*** (5.870) 559	27.841 (44.648) 553
Household used a plough or a tractor (%)	20.872 (38.548) 585	3.810 (4.219) 585	3.810 (4.484) 585	70.055* (41.330) 571	-11.516 (35.606) 559	5.069 (5.335) 559	5.069 (5.269) 559	-13.194 (38.826) 553
Household used soil conservation techniques (%)	1.188 (31.726) 585	10.476*** (3.503) 585	10.476*** (3.495) 585	9.266 (35.578) 571	-9.950 (28.229) 559	2.304 (4.447) 559	2.304 (4.398) 559	11.522 (28.726) 553

Robust standard errors in parentheses. PSM estimates bootstrapped 1,000 repetitions. Number of observations in italic.

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

**Table A4.2: Livestock ownership and health in Bahr el Gazal**

	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting
Access to veterinary care (%)	19.797 (51.588) 556	4.902 (7.005) 556	4.902 (6.612) 556	-49.329 (64.764) 543
Some or all livestock heads are vaccinated (%)	10.571 (57.020) 556	6.863 (7.135) 556	6.863 (6.692) 556	-41.887 (67.481) 543
Total number of livestock <sup>1</sup>	-0.715 (16.102) 585	-2.043 (3.269) 585	-2.043 (3.122) 585	20.160 (22.131) 571
Number of livestock heads (excluding poultry)	-1.114 (13.467) 585	-2.314 (2.735) 585	-2.314 (2.557) 585	6.152 (17.510) 571
Number of months with water for animals	4.154 (3.906) 529	0.783* (0.469) 529	0.783* (0.456) 529	3.151 (4.546) 516

1 Including cows, sheep, goats, donkeys, horses, camels and poultry.

Robust standard errors in parentheses. PSM estimates bootstrapped 1,000 repetitions. Number of observations in italic.

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

**Table A4.3: Food security, dietary diversity and wealth**

	Bahr el Gazal				Guéra			
	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting
Food security diversity score	-1.460 (0.942) 585	-0.076 (0.119) 585	-0.076 (0.117) 585	-1.804* (1.060) 571	-0.682 (0.909) 559	0.032 (0.150) 559	0.032 (0.152) 559	-0.606 (0.951) 553
Food security score for women	-1.343 (3.366) 500	0.185 (0.392) 500	0.185 (0.418) 500	-1.321 (4.325) 487	-2.153 (1.872) 554	-0.255 (0.218) 554	-0.255 (0.219) 554	-3.292* (1.877) 548
Food security score for men	-0.073 (3.110) 496	-0.301 (0.397) 496	-0.301 (0.398) 496	0.113 (3.937) 483	-3.691* (2.018) 537	-0.203 (0.236) 537	-0.203 (0.215) 537	-4.943** (2.033) 531
Food security score for children	-0.425 (2.496) 496	-0.246 (0.354) 496	-0.246 (0.355) 496	2.959 (3.376) 483	0.346 (1.601) 548	0.061 (0.182) 548	0.061 (0.180) 548	-0.819 (1.509) 542
Household presenting severe food insecurity (%)	-26.911 (50.770) 585	-17.143*** (6.294) 585	-17.143*** (6.165) 585	-72.138 (62.268) 571	73.799* (43.252) 559	11.060* (6.042) 559	11.060* (6.311) 559	84.829* (44.908) 553
Change in wealth index between 2010 and the date of the survey	-0.029 (0.059) 585	-0.007 (0.007) 585	-0.007 (0.007) 585	-0.028 (0.088) 572	-0.033 (0.095) 559	0.012 (0.015) 559	0.012 (0.015) 559	0.000 (0.099) 553
Normalised wealth index in 2014	0.217 (5.406) 585	0.231 (0.820) 585	0.231 (0.836) 585	0.019 (7.617) 572	-7.330 (6.726) 559	0.033 (1.621) 559	0.033 (1.666) 559	-6.750 (7.602) 553

Robust standard errors in parentheses. PSM estimates bootstrapped 1,000 repetitions. Number of observations in italic.

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

**Table A4.4: Overall indices of resilience**

	Bahr el Gazal				Guéra			
	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting
Base resilience index	-0.032 (0.093) <i>585</i>	0.069*** (0.012) <i>585</i>	0.069*** (0.011) <i>585</i>	-0.069 (0.107) <i>571</i>	-0.114 (0.125) <i>559</i>	0.049** (0.022) <i>559</i>	0.049** (0.021) <i>559</i>	-0.163 (0.128) <i>553</i>
Households with positive overall resilience (%)	20.777 (14.361) <i>585</i>	2.381** (1.064) <i>585</i>	2.381** (1.070) <i>585</i>	17.144 (15.656) <i>571</i>	-48.524* (28.402) <i>559</i>	5.069 (3.768) <i>559</i>	5.069 (3.878) <i>559</i>	-61.592** (30.768) <i>553</i>
AF resilience index	-0.054 (0.139) <i>585</i>	0.103*** (0.018) <i>585</i>	0.103*** (0.017) <i>585</i>	-0.108 (0.159) <i>571</i>	-0.136 (0.174) <i>559</i>	0.074** (0.030) <i>559</i>	0.074** (0.029) <i>559</i>	-0.184 (0.175) <i>553</i>

Robust standard errors in parentheses. PSM estimates bootstrapped 1,000 repetitions. Number of observations in italic.  
 \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

**Table A4.5: Households scoring positively in terms of characteristics of livelihood viability**

	Bahr el Gazal				Guéra			
	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting
Access to land for cultivation (%)	-21.672 (53.883) <i>585</i>	0.476 (5.039) <i>585</i>	0.476 (5.114) <i>585</i>	-64.563 (57.441) <i>571</i>	-5.481 (39.735) <i>559</i>	5.069 (6.108) <i>559</i>	5.069 (6.333) <i>559</i>	-26.506 (42.033) <i>553</i>
Use of improved seeds (%)	137.662*** (42.243) <i>585</i>	15.238*** (5.875) <i>585</i>	15.238*** (5.806) <i>585</i>	155.189*** (53.039) <i>571</i>	43.082 (42.839) <i>559</i>	9.217 (6.854) <i>559</i>	9.217 (6.496) <i>559</i>	23.765 (45.442) <i>553</i>
Livestock ownership (%)	-4.711 (49.818) <i>585</i>	2.857 (6.446) <i>585</i>	2.857 (6.567) <i>585</i>	-6.034 (56.955) <i>571</i>	-32.183 (41.569) <i>559</i>	-0.922 (6.431) <i>559</i>	-0.922 (6.555) <i>559</i>	-45.033 (45.511) <i>553</i>
Access, availability and quality of veterinary care (%)	-19.965 (51.322) <i>585</i>	8.095 (6.485) <i>585</i>	8.095 (6.622) <i>585</i>	-110.720* (62.305) <i>571</i>	-57.605 (40.193) <i>559</i>	7.834 (5.887) <i>559</i>	7.834 (5.805) <i>559</i>	-42.643 (42.817) <i>553</i>
Diversification in sources of income (%)	-61.026 (43.050) <i>585</i>	0.952 (5.694) <i>585</i>	0.952 (5.569) <i>585</i>	-107.528* (57.066) <i>571</i>	-66.580 (43.061) <i>559</i>	-2.765 (6.299) <i>559</i>	-2.765 (6.454) <i>559</i>	-55.472 (47.722) <i>553</i>
Productive asset ownership (%)	1.070 (41.174) <i>585</i>	20.476*** (5.909) <i>585</i>	20.476*** (5.883) <i>585</i>	-27.456 (48.445) <i>571</i>	-8.162 (35.257) <i>559</i>	-0.461 (6.782) <i>559</i>	-0.461 (6.758) <i>559</i>	-24.365 (35.870) <i>553</i>

Robust standard errors in parentheses. PSM estimates bootstrapped 1,000 repetitions. Number of observations in italic.  
 \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

**Table A4.6: Households scoring positively in terms of characteristics of innovation potential**

	Bahr el Gazal				Guéra			
	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting
Understanding of climate change (%)	28.134 (51.583) 585	-10.952* (6.521) 585	-10.952* (6.335) 585	119.462** (58.338) 571	81.349* (44.328) 559	0.922 (6.255) 559	0.922 (6.482) 559	98.907** (45.863) 553
Attitude to change and innovation (%)	-59.896 (51.276) 585	7.619 (6.173) 585	7.619 (6.032) 585	-78.320 (60.414) 571	-14.104 (43.180) 559	-1.843 (6.479) 559	-1.843 (6.699) 559	-14.670 (45.102) 553
Adoption of new practices or initiatives (%)	-44.352 (40.409) 585	2.857 (4.282) 585	2.857 (4.654) 585	-44.072 (49.462) 571	20.433 (27.358) 559	0.922 (4.037) 559	0.922 (3.936) 559	4.020 (31.296) 553

Robust standard errors in parentheses. PSM estimates bootstrapped 1,000 repetitions. Number of observations in italic.

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

**Table A4.7: Households scoring positively in terms of characteristics of access to contingency resources and support**

	Bahr el Gazal				Guéra			
	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting
Access to a grain bank (%)	102.887*** (27.383) 585	16.667*** (2.874) 585	16.667*** (2.861) 585	126.783*** (34.636) 571	51.160 (42.382) 559	8.756 (6.393) 559	8.756 (6.322) 559	44.027 (44.291) 553
Access to medical care (%)	-20.517 (54.565) 585	12.381** (6.136) 585	12.381** (6.062) 585	25.280 (62.490) 571	-19.910 (30.052) 559	11.060*** (3.662) 559	11.060*** (3.577) 559	-24.667 (32.184) 553
Savings (%)	-7.069 (53.750) 585	10.000 (6.178) 585	10.000* (5.967) 585	14.157 (64.877) 571	11.325 (40.691) 559	16.129** (6.273) 559	16.129*** (6.055) 559	7.127 (45.279) 553
Access to remittances or formal earnings (%)	-88.305* (51.342) 585	-3.333 (5.444) 585	-3.333 (5.460) 585	-149.049** (59.756) 571	7.487 (37.223) 559	9.677** (4.625) 559	9.677** (4.594) 559	12.306 (37.587) 553

Robust standard errors in parentheses. PSM estimates bootstrapped 1,000 repetitions. Number of observations in italic.

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



**Table A4.8: Households scoring positively in terms of characteristics of integrity of the natural and built environment**

	Bahr el Gazal				Guéra			
	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting
Access to drinking water (%)	15.489 (36.804) 585	19.524*** (6.155) 585	19.524*** (5.862) 585	56.959 (51.518) 571	-79.375** (39.907) 559	6.452 (5.849) 559	6.452 (5.898) 559	-69.549* (40.876) 553
Access to water for market gardening (%)	41.641 (43.309) 585	10.000 (6.447) 585	10.000* (5.963) 585	59.857 (51.078) 571	-89.566*** (33.248) 559	7.373 (5.973) 559	7.373 (5.704) 559	-117.854*** (37.798) 553
Access to water for livestock (%)	-31.013 (27.513) 585	2.857 (2.935) 585	2.857 (2.825) 585	-54.183 (33.590) 571	-	-	-	-

Robust standard errors in parentheses. PSM estimates bootstrapped 1,000 repetitions. Number of observations in italic.

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

**Table A4.9: Households scoring positively in terms of characteristics of social and institutional capability**

	Bahr el Gazal				Guéra			
	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting	OLS/Probit	PSM NN	PSM Caliper	Propensity Score Weighting
Social cohesion in the community (%)	-28.494 (41.816) 585	-5.714 (5.865) 585	-5.714 (5.875) 585	-57.685 (47.300) 571	32.518 (43.081) 559	-2.304 (6.315) 559	-2.304 (6.049) 559	10.380 (44.696) 553
Participation in community groups (%)	-8.713 (47.590) 585	12.857* (6.809) 585	12.857** (6.557) 585	23.673 (57.499) 571	-18.616 (41.567) 559	1.382 (6.476) 559	1.382 (6.483) 559	-32.280 (41.574) 553
Support from state extension services (%)	8.745 (48.611) 585	8.571 (5.659) 585	8.571 (5.733) 585	-12.517 (50.813) 571	-60.355 (42.812) 559	11.982* (6.141) 559	11.982* (6.139) 559	-41.772 (47.799) 553

Robust standard errors in parentheses. PSM estimates bootstrapped 1,000 repetitions. Number of observations in italic.

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

# NOTES

- 1 The positive and significant differences between the intervention group and the comparison group in terms of asset ownership are not inconsistent with there being no clear effects on the wealth index. There are two key reasons for this. Firstly, the wealth index includes more items than the asset ownership variable. Asset ownership refers only to productive items, such as carts, motor pumps, and sewing machines. The wealth index includes these productive items as well as other household goods and consumer durables, such as watches, mobile phones, and stoves. Secondly, the two variables have different formats. The change in the wealth index is constructed as a continuous variable capturing the difference in wealth between 2010 and 2014 and then scaled so that the largest (positive) change in wealth corresponds to a value of 1. The asset ownership variable, by contrast, is binary. It takes the value 1 if a household scores positively in terms of asset ownership and 0 otherwise. This is explained further in Appendix 1.
- 2 We assume that the projects under review did not have any effect on households' demographic characteristics, given the relatively short period over which they were implemented.
- 3 We tested as well the effect of the project in modifying the allocation of time of women and men in households. We found strong evidence that in both regions, women and men in project communities have increased their time spent in community meetings compared to their counterparts in comparison communities. There is no evidence suggesting that adults in the household modified the time allocated to leisure, sleeping, taking care of children, housekeeping or productive activities, such as agricultural work, market gardening, livestock-rearing and small business activities, when compared to household members in the comparison group.
- 4 Staple crops include millet, sorghum, corn, rice, beans, peanuts, tubers and wheat.
- 5 Vegetable crops include tomatoes, onions, eggplants, cabbages/lettuces, carrots, okra and peppers.
- <sup>6</sup> Cronbach's alpha was used to measure this inter-item correlation. The Cronbach's alpha obtained for all the indicators for the recalled 2010 data was 0.6408 in Bahr el Gazal and 0.8243 in Guéra. This alpha was increased to 0.7951 in Bahr el Gazal and 0.8556 in Guéra by removing those items that had a low correlation with the others. The alpha derived for the index of change in wealth indicators (using both recalled 2010 and 2014 data) was originally 0.7896 in Bahr el Gazal and 0.8527 in Guéra, and was increased to 0.8352 and 0.8884 respectively, by removing those items that had a low correlation with the others.
- 7 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>.
- 8 It should be noted that in calculating these overall measures of resilience, each of the individual characteristics presented in Table 5.8 was weighted equally. This means that the index is weighted more towards characteristics of livelihood viability, and less 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.
- 9 Respondents in Guéra were not asked about their access to water for livestock.
- 10 The positive and significant differences between the intervention group and the comparison group in terms of asset ownership are not inconsistent with there being no clear effects on the wealth index. There are two key reasons for this. Firstly, the wealth index includes more items than the asset ownership variable. Asset ownership refers only to productive items, such as carts, motor pumps, and sewing machines. The wealth index includes these productive items as well as other household goods and consumer durables, such as watches, mobile phones, and stoves. Secondly, the two variables have different formats. The change in the wealth index is constructed as a continuous variable capturing the difference in wealth between 2010 and 2014 and then scaled so that the largest (positive) change in wealth corresponds to a value of 1. The asset ownership variable, by contrast, is binary. It takes the value 1 if a household scores positively in terms of asset ownership and 0 otherwise. This is explained further in Appendix 1.
- 11 Kernel matching (bw=0.06) outperformed other matching algorithms, such as nearest neighbour, caliper and mahalanobis. We found that in our sample, kernel matching (bw=0.06) had the lowest pseudo R2 after matching, maximum reduction in mean and median bias, and no signs of bad variance.

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