Community-Led Disaster Risk Reduction in Mongu, Zambia Project Effectiveness Review

Full Technical Report

Oxfam GB
Adaptation and Risk Reduction Outcome Indicator

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Photo: – Effects of the seasonal flooding of the Zambezi River in Liyoyelo village, Mongu district. Oxfam GB -.

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Executive summary

Under Oxfam Great Britain's (OGB) Global Performance Framework (GPF), sufficiently mature projects are being randomly selected each year and their effectiveness rigorously assessed. Zambia's 'Community-Led Disaster Risk Reduction' project was randomly selected for an Effectiveness Review under the adaptation and risk reduction thematic area. The project aims to increase resilience to climatic shocks among target groups in Mongu district of western Zambia, through: a) strengthening the capacity of target communities to manage and respond to floods and droughts; and b) encouraging livelihood diversification and asset growth.The community-level activities undertaken to achieve the first objective included the development of early-warning systems, based on local knowledge and linked to wider support systems (e.g. weather stations). In order to achieve the second objective, a range of activities, including provision of fishing nets, canal clearing, embankment building, establishment of banana plantations and use of conservation agriculture were implemented. These project activities were undertaken between 2009 and 2012 in six communities located in the Zambezi floodplain by a local partner organisation – Peoples Participation Service (PPS).

To assess the effectiveness of this project, a quasi-experimental impact evaluation was implemented. This involved carrying out surveys with households in the six communities supported by the project, as well as with households in six nearby comparison communities. In all, surveys were carried out with 491 households. At the analysis stage, the statistical tools of propensity-score matching and multivariable regression were used to control for demographic and baseline differences between the intervention and comparison groups.

The effectiveness of the project in effecting 31 'resilience characteristics' was assessed through this process. These characteristics fall under five interrelated dimensions: livelihood viability; innovation potential; access to contingency resources and support; integrity of the natural and built environment; and social response capability. Composite indices were developed to aggregate the data associated with the 31 characteristics, following the Alkire-Foster method used by the Oxford Poverty and Human Development Initiative (OPHI) to measure multi-dimensional poverty. One of these indices, in particular, referred to as the Alkire-Foster resilience index informs Oxfam GB's global outcome indicator for its adaptation and risk reduction thematic area.

Following analysis of the data, there is evidence that the project positively affected several characteristics assumed important for promoting resilience among the intervention population. In particular, even after controlling for measured differences between the intervention and comparison households, the former performed between eight and 13 percentage points, and four to six points, better than the latter on Oxfam GB's global Adaptation and Risk Reduction (ARR) indicator and the Alkire-Foster resilience index, respectively. Such performance in relation to the global indicator shows that in total, 64 per cent of surveyed intervention households demonstrate greater ability to reduce risk and adapt to emerging trends and uncertainty (as measured by the ARR resilience index).

While this Effectiveness Review generated some positive results, it also identified opportunities for reflection and learning. Oxfam in general, and the Zambia country team and partners in particular, are encouraged to consider the following:

- Undertake further research to evaluate the effects of advocacy efforts connected to this project.
- Explore how to involve community members more widely in community-level drought preparedness activities, and to ensure that training and early-warning information is fully disseminated.
- Continue monitoring changes in behaviour and experiences of households in the project communities to learn whether the project activities will eventually result in higher-level changes in risk-reduction behaviour.

1 Introduction and purpose

This report documents the findings of a project Effectiveness Review, focusing on outcomes related to risk reduction and adaptation to climate change

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

The global outcome indicator for the adaptation and risk reduction thematic area is defined as the percentage of households demonstrating greater ability to minimise risk from shocks and adapt to emerging trends and uncertainty, compared to a 'typical' comparison household. This indicator is explained in more detail in Section 3 below.

The Effectiveness Review, which took place in Mongu district, Zambia in January/February 2013, intended to evaluate the success of the Community-Led Disaster Risk Reduction Project in promoting resilience to climatic shocks among supported households.

The focus of the review was on the six communities in the Zambezi floodplain supported by the project through to its completion in March 2012. These communities experience perennial flooding, and such events have resulted in recurrent crop failure and property destruction that has undermined household food security and perpetuated a cycle of asset depletion.

In response to these issues, the overall objectives of the project, implemented by a local partner organisation – People's Participation Service (PPS), were:

- To strengthen capacity of target communities, as well as Oxfam staff, local and district leaders to manage and respond to floods and droughts in Mongu district of western Zambia.
- To increase household and community resilience to disasters through poverty reduction/economic justice, power in markets, awareness of response options, livelihood diversification and asset creation.
- To improve government capacity to lead and manage comprehensive and effective disaster risk reduction and emergency response from local to national levels.

The community-level activities undertaken to achieve the first objective included the development of early-warning systems, based on local knowledge and linked to wider support systems (e.g. weather stations). In order to achieve the second objective, a range of activities including provision of fishing nets, canal clearing, embankment building, establishment of banana plantations and use of conservation agriculture were implemented.

The third objective of the project was not limited to the project communities in Mongu district, and thus it is not formally covered by the results of this Effectiveness Review.

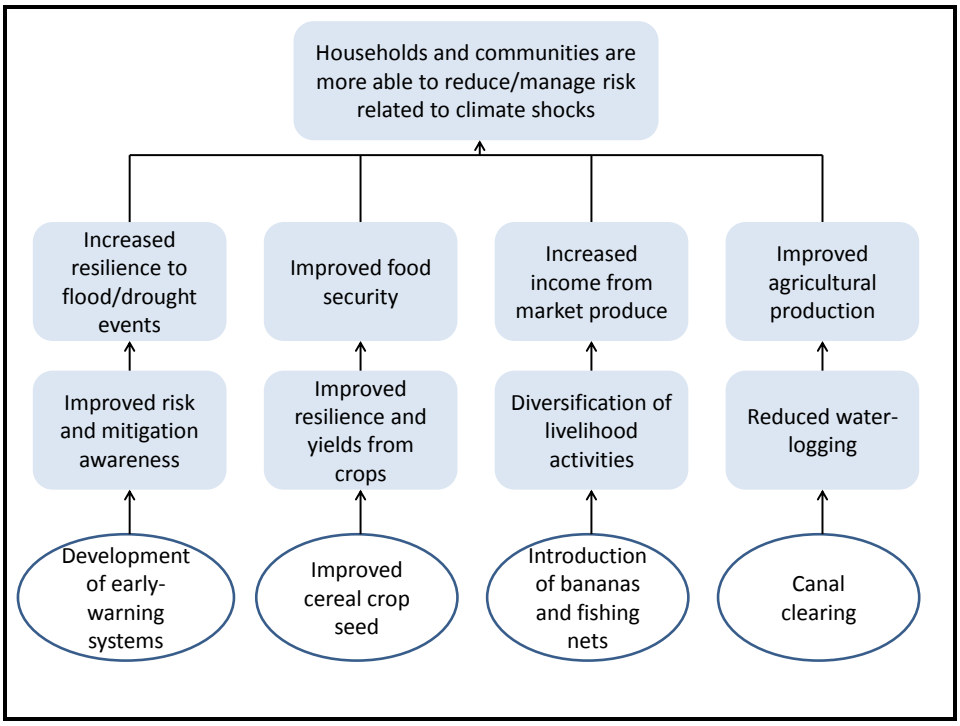
Figure 1.1: Location of project implementation

This report presents the findings of the project Effectiveness Review. Section 2 begins by reviewing the intervention logic of the project. Section 3 introduces the framework for measuring resilience that was adopted. Section 4 describes the evaluation design, and Section 5 describes how this design was implemented. Section 6 presents the results of the data analysis, including the descriptive statistics on the population surveyed and the differences in outcome measures between the intervention and comparison groups. Section 7 concludes with a summary of the findings and some programme learning considerations.

2 Intervention logic of project

Figure 2.1 shows graphically the theory of change behind the project activities. The project's overall objective was to strengthen the capacity of communities and households to manage the risks associated with climatic shocks, such as flooding, drought, water scarcity and crop failure.

Figure 2.1: Project theory of change (simplified)



The development of early-warning systems contributes to this through increasing community members' awareness of flooding and drought hazards, and providing a forum to discuss mitigation measures that can be applied at a community level. Specific activities included:

- Community sensitisation on early-warning information through school activities, radio messages and community meetings.
- Strengthening community relationships with district-level early-warning institutions (e.g. weather monitoring departments).
- Review of community preparedness plans, including integration of traditional early-warning signs.

The project is also providing high yielding variety seeds of major cereal crops suitable to the local climatic conditions, with the intention of increasing crop yield, especially when and where rainfall is erratic. Introduction of these seeds was expected to improve food security of the targeted families, and therefore their resilience to drought events.

The introduction of banana plantations and fishing nets to the project communities was intended to encourage a more diversified livelihood base for farmers, who have traditionally relied on subsistence crops. As well as reducing the risk of food insecurity in the event of cereal-crop failure, it was envisaged that that there would also be the opportunity for increased income gained from the sale of these higher-value food items.

These activities were complemented by a number of canal clearing interventions. One of the key issues affecting agricultural production in the flood-plain project villages is waterlogging. An Oxfam assessment prior to project commencement found that the effective utilisation of the wetlands for crop production was poor due to waterlogging of most of the productive land. This was a result of clogged drainage canals, and therefore the project included canal clearing in order to improve drainage and irrigation.

3 The ARR Outcome Indicator and its conceptual underpinnings

3.1 Introducing the ARR Outcome Indicator

As part of Oxfam GB's (OGB) Global Performance Framework, efforts are being undertaken to develop an innovative approach to measuring the resilience of households to shocks and stress and their ability to adapt to change. This approach involves capturing data on various household and community characteristics falling under the five interrelated dimensions presented in Figure 3.1. Following the Alkire-Foster method used in the measurement of multidimensional poverty,[1] a binary cut-off is defined for each characteristic. A household is considered to be faring well in relation to the characteristic if it is above this cut-off, and not well if below. Weighted indices, described further in Section 6, are then developed from these binary indicators. These indices can be used as continuous outcome measures in statistical analysis. Alternatively, binary outcome variables can be created by defining cut-off points for the index, with 1 specified for households that have surpassed this threshold and 0 for those below it. For OGB's global Adaptation and Risk Reduction (ARR) outcome indicator, the binary version of this indicator is defined as follows:

The 'characteristic approach' assumes that households that are better able to cope with shocks and adapt to change possess particular attributes

- **Proportion of targeted households demonstrating greater ability to minimise risk from shocks and adapt to emerging trends and uncertainty**

The term *greater ability* appears in the wording of the indicator because of how it is computed in practice. Specifically, a household is coded with 1 if it is above the median of the comparison group in relation to the Alkire-Foster resilience index and 0 if otherwise. Thus, households demonstrating greater ability are those that are above the typical household of the comparison group in relation to this index.

One reason why measuring concepts such as resilience and adaptive capacity is complicated is because we can only really assess whether a system has successfully coped or adapted after the fact.[2] In other words, we would have to wait until after a disaster has struck and/or climatic change has taken place in order to assess the effectiveness of the intervention in question.

The characteristic approach attempts to get around this issue by hypothesising that there are particular characteristics of households (and even communities, organisations, governments, etc.) 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

[1] Alkire, S. & Foster, J. (2011), Counting and multidimensional poverty measurement. *Journal of Public Economics,* 95**:** 476–487.
[2] Dodman, D., Ayers, J. and Huq, S. (2009), 'Building Resilience', Chapter 5, in World Watch Institute (ed), *2009 State of the World: Into a Warming World*, Washington D.C: World Watch Institute, pp. 151–168.

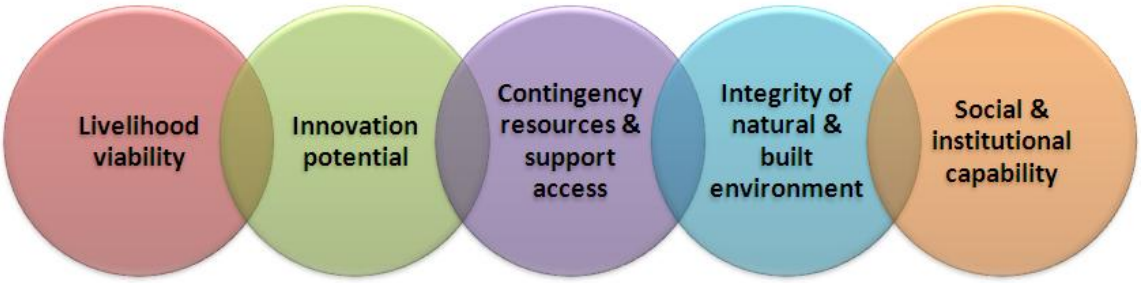
The characteristics are context-specific but informed by a framework comprising five distinct dimensions

characteristics actually are; rather, we assume they are important based on common sense, theory, and/or field experience. However, there is nothing preventing them from being informed by stronger empirical evidence and/or community consultation. It is further recommended that they be continuously updated as the body of research on the determinants of resilience and adaptive capacity grows.

The characteristics that inform the ARR indicator fall under the five dimensions presented in Figure 3.1. First, if we think about what a household would need in order to cope with current and future shocks, stresses and uncertainly, a viable livelihood is likely to be one of them. If a shock happens a household dependent on just one precarious livelihood activity is likely to be more negatively affected than another that has one or more less sensitive alternatives to fall back on, *all other things being equal*. In addition, households that are on the margins of survival are likely to be less resilient than their wealthier 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 3.1:

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



Extent livelihood strategies can thrive in spite of shocks, stresses, and uncertainty	***Ability to take appropriate risks and positively adjust to change***	***Access to back up resources and appropriate assistance in times of crisis***	***Health of local ecosystems, soundness of natural resource management practices, and robustness of essential physical infrastructure***	***Extent formal & informal institutions are able to reduce risk, support positive adaptation, and ensure equitable access to essential services in times of shock/stress.***

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

Moreover, there 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, emergency services, etc. – are, therefore, likely to be critical in supporting households in coping with shocks and positively adjusting to change.

It is further recognised that healthy ecosystems are better able to cope/adjust to climatic shocks/change than those that are more degraded.[3] 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 shocks and stress, the livelihoods and/or health of community members can be negatively affected.

In most, if not all cases, it is necessary to look beyond the household level when examining resilience and adaptive capacity. Indeed, it is reasonable to assume that households are likely better able to successfully adjust to climatic shocks/change when they are part of larger coordinated efforts at the community level and beyond. The social and institutional capability dimension, in particular, is concerned with the effectiveness of informal and formal institutions in reducing risk, supporting positive adaptation, and ensuring equitable access to essential services in times of shock/stress. In the absence of this capability, we can assume that community-level duty-bearers will be less effective in fulfilling their responsibilities in supporting community members to reduce risk and/or successfully adapt.

Efforts must be undertaken to identify specific characteristics relevant to the context in question

Specific characteristics believed to influence both resilience and adaptation fall under each of the five dimensions. However, no ‘one size’ fits all; that is, many of the characteristics appropriate for a particular population (e.g. slum dwellers in Mumbai, India) may not be so for another (e.g. Bolivian shifting cultivationists). As such, each particular suite of characteristics needs to be appropriately specified given the nature of the population in question and the hazards and change processes to which it is likely to be subjected.

3.2 The particular ARR characteristics used in the Zambia Effectiveness Review

There is no one generic set of ‘resilience’ characteristics that are applicable to all contexts. Given this, efforts were made to specify characteristics relevant to the Mongu climatic and agricultural context. These characteristics are presented in Table 3.1 by dimension, along with a summary rationale for including each.

[3] Ibid

Table 3.1: Specific ARR characteristics used in the Zambia Effectiveness Review

Dimension	Characteristic	Rationale for inclusion
Livelihood viability	Household wealth status	Poor households assumed to be more at risk
	Household food security	Food insecure HHs assumed to have less viable livelihoods
	Household dietary diversity	HHs with poorer nutrition assumed to be more at risk
	Livelihood diversification	HHs with more diverse livelihoods assumed to be at less risk
	Crop portfolio	HHs with a greater crop portfolio assumed to be at less risk
	Availability and use of early-warning information	Enables the household to plan and reduce risk
	Flood preparedness practice	Indicates that the household is proactive in minimising risk
Innovation potential	Attitudes towards new livelihood practices	HHs less open to new practices are less likely to innovate
	Awareness of climate change	HHs with more awareness in better position to adapt
	Innovation practice	Direct indicator that HH is innovative
	Access to credit	Enables HH to access resources to support innovation
	Access to state innovative support	Sustainable access to such support conducive for innovation
	Market access	Better access to markets = more livelihood opportunities
Access to contingency resources and support	Group participation	More opportunities for support in times of crises
	Social connectivity	More opportunities for support in times of crises
	Perceptions of local government emergency support	Level of confidence of HHs assumed related to what will actually happen in times of crises
	Savings	More savings a HH has, the more it can cope in crises
	Remittances or formal earnings	Better access to remittances = better coping in crises
	Ownership of convertible livestock (goats and poultry)	Enables the household to get by in times of crises
Integrity of the natural and built environment	Fertility of local soils	High fertility increases productivity
	Extent of soil erosion	High level of soil erosion decreases productivity
	Access to irrigation for farming	Enables yields to be maintained despite rainfall variability
	Access to water for drinking and livestock	More difficulties in access makes it more difficult to cope
	Extent farming activities affected by flooding	Greater impact of flooding on farming = more risk
	Use of improved sanitation	Fewer health risks in the event of flooding
Social and institutional capability	Awareness of disaster preparedness plan	Indicates planning is taking place + public participation
	Participation in disaster prep. meetings	Indicates planning is taking place + public participation
	Receipt of disaster prep. information	Indicates that community institutions are fulfilling roles
	Awareness of community-level disaster risk-reduction initiatives	Indicates that community institutions are fulfilling roles
	Water resource dispute experience	Levels of conflict reflects capacity to address disputes
	Awareness that local leaders are undertaking action	Indicates that community institutions are fulfilling roles
	Level of confidence in effectiveness of local leaders/institutions	Level of confidence of HHs assumed related to the effectiveness of the actions of local leaders and institutions

As can be seen in the table, data were collected on a total of 32 characteristics. Seven characteristics were defined for the Livelihood Viability dimension. Several of these characteristics relate to the ability of households to meet their basic needs. Those on the margins of survival are assumed to be in a worse position to cope with flooding or drought than are their more wealthy counterparts. The levels of livelihood and crop diversification are also assumed to be important, so that that the household in question has something to fall back on in times of stress. Finally, having access to flood and drought warning information, and taking action on the basis of this information, are additionally assumed to be important for reducing risk.

Data were collected on a total of 32 characteristics under the five dimensions

Six characteristics were defined for the innovative potential dimension. It is assumed that households are more likely to positively adapt to change if they are open to modifying their livelihood practices, are aware that climate change is happening, and have good access to credit, innovation support and markets. In addition, they are assumed more likely to innovate in the future if they have done something new and innovative in the past.

As implied by the resilience framework presented in Subsection 3.1, there will be times when even households with significantly viable livelihoods and internal adaptive capacity will find it difficult to cope with serious shocks (e.g. a severe drought). Consequently, having access to both local and external resources and support during such events is clearly advantageous. Six characteristics are defined under the Access to Contingency Resources and Support dimension. Three of these relate to things directly possessed or received by the household in question: savings, remittances/formal earnings, and livestock which can be liquidated relatively easily if necessary (goats and poultry. Being strongly connected to social networks within the community is further assumed to be important, hence the group participation and social connectivity characteristics. However, there will often be times when the state (or, in its absence, other external actors) will need to intervene. Given this, household perceptions on how well they would be supported by local government in the event of a serious crisis were also solicited.

Six characteristics were defined for the Integrity of the Natural and Built Environment dimension. Given the context, the loss of crops due to flooding is clearly a critically important characteristic. Also, given that the vast numbers of households are dependent on agriculture, the extent of soil erosion, soil fertility, and access to irrigation facilitates were also deemed important.

This brings us to the Social and Institutional Capability dimension, where data were collected on seven characteristics. The characteristics are intended to measure the strength of community level institutions to both reduce risk and support adaptation. Hence, such capacity is assumed to be high when community members are significantly aware of, and participate in, relevant disaster risk reduction and adaption processes, experience minimal conflict over natural resources, and are confident in the capacity of local leaders and institutions.

3.3 Constructing the resilience indices

Following the Alkire-Foster[4] method, binary cut-offs were defined for each of the 32 characteristics. A household was coded as being non-deprived if it can be considered as faring reasonably well in relation to the characteristic in question. The particular cut-offs used for each characteristic are presented in Appendix 1. There is inevitably a degree of arbitrariness in defining such cut-offs. However, the results presented in Section 6 also include some alternative measures, which act as a check on the robustness of the results obtained from applying the cut-offs. Each of the dimensions presented in Table 3.1 was then weighted equally (20 per cent) in order to calculate the overall resilience measures.

3.4 The overall resilience measures

The first measure of overall resilience used to derive the results detailed in Section 6.2 is the proportion of characteristics on which the household scored positively. Further, a household was defined as having positive resilience *overall* if it met the cut-off for positive resilience in at least two-thirds of these characteristics. A resilience index was created that takes a value of 1 if the household reaches that benchmark for overall resilience and otherwise is equal to the proportion of characteristics the household scored positively on.

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

In summary, the three key measures of overall resilience analysed in Section 6.2 are:

- The **base resilience index**: the proportion of characteristics for which the household reaches the cut-off for positive resilience.
- The **Alkire-Foster (AF) resilience index**: whether the household reaches the cut-off in at least two-thirds of the characteristics, and otherwise equal to the proportion of characteristics for which they do reach the cut-off.
- The **global indicator**: based on whether the AF resilience index is greater than the median of the comparison group or not.

The Effectiveness Review attempted to ascertain what would have happened in the intervention villages had the project never been implemented

4 Impact assessment design

4.1 Limitations in pursuing the 'gold standard'

A social programme's net effect is typically defined as the average gain participants realise in outcome (e.g. improved household food security) from their participation. In other words:

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

[4] See http://www.ophi.org.uk/research/multidimensional-poverty/alkire-foster-method/

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

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

However, implementing an ideal impact assessment design like this is only possible if it is integrated into the programme design from the start, since it requires the introduction of some random element that influences participation. To evaluate an ongoing or completed programme – as in this Effectiveness Review – or one where randomisation is judged to be impractical, it is therefore necessary to apply alternative techniques to approximate the counterfactual as closely as possible.

4.2 Alternative evaluation design pursued

There are several evaluation designs that can – particularly when certain assumptions are made – identify reasonably precise intervention effects when the comparison group is non-equivalent. One solution is offered by matching. Find units in an external comparison group that possess the same characteristics, e.g. ethnicity, age, and sex, relevant to the outcome variable, as those of the intervention group and match them on the bases of these characteristics. If matching is done properly in this way, the observed characteristics of the matched comparison group will be identical to those of the intervention group.

In an attempt to mitigate bias, two statistical procedures were used – propensity score matching and multivariable regression

The problem, however, with conventional matching methods is that, with large numbers of characteristics on which to match, it is difficult to find comparators with similar combinations of characteristics for each of the units in the intervention group. Typically, the end result is that only a few units from the intervention and comparison groups get matched up. This not only significantly reduces the size of the sample, but also limits the extent the findings can be generalised to all programme participants. (This is referred to as the 'curse of dimensionality' in the literature.)

Fortunately, matching on the basis of the propensity score – the conditional probability of being assigned to the programme group, given particular background variables or observable characteristics – offers a way out. Propensity score matching (PSM) works as follows. Units from both the intervention and comparison groups are pooled. A statistical probability

model is estimated, typically through logit or probit regression. This is used to estimate programme participation probabilities for all units in the pooled sample. Intervention and comparison units are then matched within certain ranges of their conditional probability scores. Tests are further carried out to assess whether the distributions of characteristics are similar in both groups after matching. If not, the matching bandwidth or calliper is repeatedly narrowed until the observed characteristics of the groups are statistically similar. Provided that a) the dataset in question is rich and of good quality; b) the groups possess many units with common characteristics (i.e. there is a large area of common support); and c) there are no unobserved differences relevant to the outcome lurking among the groups, PSM is capable of identifying unbiased intervention effects.

Multivariable regression is another approach that is also used to control for measured differences between intervention and comparison groups. It operates differently from PSM in that it seeks to isolate the variation in the outcome variable explained by being in the intervention group *net of other explanatory variables* (key factors that explain variability in outcome) included in the model. The validity of both PSM and multivariable regression is founded heavily on the 'selection on observables' assumption, and, therefore, treatment effect estimates can be biased if unmeasured (or improperly measured) but relevant differences exist between the groups.[5] Both PSM and multivariable regression were used to analyse the data collected for this Effectiveness Review, and efforts were made to capture key explanatory variables believed to be relevant in terms of the assessed outcomes, e.g. sex and age of household head, educations levels, etc. (see Section 6).

In this case no baseline data were available, so efforts were made, as explained below, to reconstruct it through respondent recall. This method does have limitations, e.g. memory failure, confusion between time periods, etc. However, for data that can be sensibly recalled, e.g. ownership of particular household assets, it can serve to enhance the validity of a cross-sectional impact evaluation design. The reconstructed baseline data were used in two ways. Firstly, several of the variables included in the PSM and regression procedures were baseline variables constructed from recalled baseline data. One variable, for example, was related to the respondents' wealth status at baseline derived through the construction of a household wealth index based on asset ownership and other wealth indicators. This was done in an attempt to control for baseline wealth differences between the intervention and comparison groups.

The second way the reconstructed baseline data were used was to derive pseudo difference-in-difference (double difference) intervention effect estimates. With longitudinal or panel data, this is implemented by subtracting each unit's baseline measure of outcome from its endline measure of outcome (i.e. endline outcome status minus baseline outcome status). The intention here is to control for time invariant differences between the groups. Bearing in mind the limitations associated recalled baseline data, using PSM and/or regression and the double difference approaches together is considered to be a strong quasi-experimental impact evaluation design.

[5] One of the MVR procedures that were used attempted to control for possible unobserved differences between the groups. This is the Heckman Selection Model or 2-step Estimator. Here, efforts are made to directly control for the part of the error term associated with the participation equation that is correlated with both participation and non-participation. The effectiveness of this method, however, depends, in part, on how well the drivers of participation are modelled.

4.3 Intervention and comparison villages surveyed

The evaluation design made a comparison between households in the intervention villages versus households in matched comparison villages

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

In this case, the project activities under review had been implemented in communities in an area that was specifically chosen as being particularly vulnerable or particularly in need of support in building risk-reduction capacity.

In order to ensure a plausible comparison, similar villages from neighbouring areas had to be selected. This was done in conjunction with local field staff, who have significant experience in working across Mongu district. Field staff confirmed that communities in the implementation areas are highly homogenous in the risks they face. In all cases, field staff were therefore able to identify nearby communities that were believed to have similar characteristics to the communities where the project was implemented, and so could be suitable for comparison.

5 Methods of data collection and analysis

5.1 Data collection

A household questionnaire was developed by Oxfam staff and translated by the local partners to capture data on various outcome and intervention exposure measures associated with the measurements of resilience discussed in Section 3. Demographic data and recalled baseline data were also collected, to statistically control for differences between the project and comparison households that could not plausibly be affected by the project. The questionnaire was pre-tested first by Oxfam local staff and then by the enumerators during a practice exercise, and revised accordingly.

A team of 14 enumerators was locally recruited from Mongu district. These enumerators participated in a two-day training workshop, which was led by the consultant with support from Oxfam staff. The second day of the workshop involved a practical exercise, carrying out the questionnaire in a community in Mongu district. Following this exercise, the performance of each of the enumerators was reviewed individually before their appointments were confirmed.

A total of 491 households were interviewed – 197 from intervention villages, and 294 from comparison villages

The enumerator team was divided into two groups and mobilised to different areas in the district to ensure smooth movement from one community to another. The movement plan was created in consultation with the field supervisor to ensure that completed surveys were collected and reviewed at the end of every day. Feedback was provided regularly to all enumerators regarding their performance.

Communities were informed in advance of the enumerators arriving to survey households through a local contact person. Using village household lists, respondents from both intervention and comparison villages were

selected randomly and mobilised appropriately. No major problems were encountered during the fieldwork, except for some logistical challenges in accessing the communities by boat.

Table 5.1 shows the numbers of households interviewed in each community in the survey. A total of 491 households were interviewed, of which 197 were in project communities and the remainder in comparison communities.

The work of the enumerators was closely monitored and scrutinised by the consultant and Oxfam staff. Oxfam's Oxford-based adviser spent the first two days of the survey monitoring the interviews, reviewing the completed questionnaires, and providing detailed feedback to the consultant and enumerators to ensure that the appropriate quality standards were met.

Table 5.1: Intervention and comparison villages and sample sizes

Intervention villages		***Matched comparison villages***	
Village name	**HHs interviewed**	**Village name**	**HHs interviewed**
Liyoyelo	28	Imalyo	68
Tapo	29	Lukalanya	68
Mutalaeti	31	Lukweta	72
Ng'anga	51	Matamena	29
Kaama	18	Natonga	28
Ndau	40	Sasenda	29
Totals	**197**		**294**

5.2 Data analysis

Data-entry tools were developed in Adobe Acrobat Pro. A team of four temporary staff, managed by the consultant entered the data from the completed questionnaires. Data analysis was performed in Stata by staff from OGB's office in Oxford.

The results of this analysis are presented in Section 6. Most of the analyses involved group mean comparisons using *t*-tests, as well as PSM with the *psmatch2* module and various multivariable regression approaches. Kernel and nearest neighbour matching without replacement were used to implement PSM. Variables used in the matching process were identified by using backwards stepwise regression to identify those variables correlated with being in an intervention village at *p*-values of 0.20 or less. Covariate balance was checked following the implementation of each matching procedure, and efforts were made to ensure that the covariates were balanced across groups at *p*-values greater than 0.20. Bootstrapped standard errors enabled the generation of confidence intervals to enable statistical hypothesis testing. (See Appendix for further details.)

All the covariates presented in Table 6.1 were included in the various regression approaches undertaken, i.e. regression with robust standard errors (to address issues of heteroscedasticity), robust regression (to reduce the influence of outliers), and regression with control functions (to attempt to control for relevant unobserved differences between the intervention and comparison groups).

5.3 Main problems and constraints encountered

Despite some of the logistical difficulties related to operating in fairly remote parts of Mongu district, the data collection process was completed successfully. However, some factors were encountered that affect the analysis process and the interpretation of results presented in Section 6.

Some significant baseline and demographic differences were found between the intervention and comparison populations

- **Some significant differences baseline and demographic differences between intervention and comparison groups**
  As presented in Section 6.1 below, there are some systematic differences between the intervention and comparison groups in terms of the baseline and demographic characteristics reported in the survey. In the analysis of the outcome measures, both PSM and regression procedures were used to control for these differences to the greatest extent possible. However, in the case of the former, some of the project households were dropped because of the absence of appropriate comparison households. In particular, 16 of the 197 intervention households were dropped using the PSM kernel model, and 23 were dropped using the no-replacement model. This means that the estimates of differences in outcome characteristics between the various treatment groups only apply to those intervention households that were not dropped; that is, they do not represent the surveyed population as a whole.

- **Measurement challenges using the Likert scales**
  Efforts were made to measure five of the 30 'resilience characteristics' using six-item, four-point Likert scales. These characteristics include: 1) attitudes towards new livelihood practices; 2) awareness of climate change; 3) social connectivity; 4) perceived effectiveness of local government emergency support; and 5) perceived effectiveness of local leaders and institutions in supporting disaster preparedness. The statements for each of the scales were mixed at random and placed in two sections of the household questionnaire. At the analysis stage, the extent to which the respondents agreed with each was subsequently analysed. Ideally, there should be a high degree of internal consistency with respect to the level of agreement the respondents had with the six statements developed for each of the five characteristics. In other words, each respondent should have agreed with each statement associated with each characteristic-specific set in a similar way, given that these statements are intended to measure the same underlying latent construct. The degree of such internal consistency is often measured using Cronbach's alpha statistic. Unfortunately, for the awareness of climate change characteristic the alpha statistic was low (0.58). This means that the respondents were not responding to the items related to awareness of climate change in a significantly consistent fashion. Consequently, there is reason to be suspicious of how accurately this characteristic was measured. As a result, this particular measure was dropped from the analysis. That being said, the other four characteristics measured using the Likert scales show higher degrees of internal consistency.

6 Results

A statistics introduction
We set out to write a report that is free of excessive technical jargon. Whenever possible, we tried to present findings in meaningful terms, our prose aided by several tables and figures. While we believe that the lessons of the report can be understood without a background in statistics, there are a few concepts that are good to review.

Impact or effect size
Simply put, impact refers to the size of the difference between groups when evaluating outcomes. In this report, impact will often be stated as the average difference between people who received Oxfam support (intervention) and people who did not (comparison).

Statistical significance
You will notice in our tables that we report probabilities known as p-values. When p-values are less than the generally accepted cut-offs (1%, 5%, 10%), we indicate this with one or more asterisks. P-values help us to evaluate our study hypotheses. The default hypothesis is always that there are no differences between the intervention and comparison groups, or that the project has no impact. When we detect a difference, we use the p-value to evaluate whether we should reject the default hypothesis that there are no differences and conclude that the program had an impact.

For instance, let's say that the average Oxfam beneficiary has a resilience score higher than the average member of the control group and the associated p-value is less than 0.01. We would indicate this with three asterisks in the table (***). This p-value means that, if there were truly no differences in resilience between the treatment and control groups, the probability of finding the reported difference would be less than one per cent. Since the probability is so small, we can reject the default hypothesis that the project had no impact on resilience. We would say that the result is 'significant'. This is different from saying that the magnitude of the result is large; magnitude refers to effect size or impact as explained above. Taken together, significance and magnitude help us to know what to make of our results.

Average, mean and median
The term 'average' refers to the central value of a group of numbers, in our case the central value for an outcome among members of the intervention communities or the comparison communities. The arithmetic mean and the median are two measures of the central value. When we say 'average', we are referring to the mean. Because means can be distorted by extreme values – people who do really well or really poorly – we sometimes report the median, the precise middle value in the group (the 50th percentile).

6.1 General characteristics

Table 6.1 presents statistics for various household characteristics obtained through the administration of the questionnaires to the respondents from both the intervention and comparison villages. The asterisks indicate differences between the groups that are statistically significant at a 90 per cent confidence level or greater.

Table 6.1: Descriptive statistics for intervention and comparison respondents

	Intervention mean	Comparison mean	Difference	*t*-statistic
HH head has basic literacy	0.838	0.701	0.137***	3.50
Female-headed household	0.406	0.306	0.100**	2.29
Head has secondary education	0.340	0.187	0.153***	3.90
Adult has secondary education	0.579	0.381	0.198***	4.38
HH elderly headed	0.193	0.187	0.006	0.16
Age of head of HH	47.240	45.517	1.723	1.18
Head of HH is productive	0.797	0.878	-0.081**	-2.43
Household size	6.675	5.667	1.008***	4.10
Number of adults in HH	3.102	2.510	0.591***	4.38
Number of children in HH	3.574	3.156	0.417**	2.24
Number of young children in HH	2.406	2.146	0.260*	1.77
Number of dependents	2.817	2.361	0.457***	2.95
Number of unproductive adults	0.411	0.214	0.197***	3.55
Number of productive adults	2.594	2.207	0.386***	3.02
HH has only one adult	0.117	0.160	-0.043	-1.34
HH grew crops at baseline	0.949	0.949	0.000	0.01
HH reared livestock at baseline	0.726	0.711	0.015	0.36
HH did agricultural labour at baseline	0.396	0.412	-0.016	-0.35
HH did casual labour at baseline	0.360	0.381	-0.021	-0.46
HH did fishing at baseline	0.650	0.371	0.279***	6.29
HH ran off-farm IGA at baseline	0.371	0.252	0.119***	2.84
HH did formal work at baseline	0.071	0.112	-0.041	-1.52
Household received remittances at baseline	0.279	0.167	0.113***	3.01
HH wealth index at baseline (PCA)	0.383	-0.257	0.639***	2.60
Land area used for crops at baseline	1.741	2.092	-0.351**	-2.46
Observations	**197**	**294**		

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

As is evident, there are several significant differences between the intervention and comparison households. In particular:

- Household heads in the project communities are, on average, more likely to have basic literacy.
- Households in the project communities are more likely to be female-headed than households in the comparison communities.
- Household heads in the project community are more likely to have received secondary-level education, and project households are more likely to have at least one adult who has received secondary-level education.
- Household heads in the comparison community are more likely to be economically productive.
- Households in the project community are larger, on average, than comparison households. Subsequently, households in the project communities have, on average, a significantly greater number of adults, children (including young children) and dependents.
- Perhaps linked to the above, households in project communities have a greater number of unproductive *and* productive adults.

Given that there are several significant baseline and demographic differences between the project and comparison households, comparing the outcomes directly could result in biased estimates of the impacts of the project. It was therefore important to control for these baseline and demographic differences during the analysis of the data.

6.2 Differences between the intervention and comparison households on the outcome measures

This subsection presents the results of the analysis that compared the respondents from the intervention and comparison communities in relation to the outcome measures described in Section 3.

6.2.1 Results on the resilience index

As discussed in Section 3.2, the measures of households' overall ability to reduce risk and adapt to climate trends analysed in this Effectiveness Review are based on the characteristics of resilience listed in Table 3.2.1. Cut-offs were defined for each characterstics. Those above the cut-offs are assumed to be non-deprived in relation to the charactersitcs and deprived if otherwise. The cut-offs used in this analysis are presented in Appendix 1.

Just over a fifth of supported households scored positively on two-thirds or more of the resilience characteristics

Just over a fifth of supported households (20 per cent) were found to have met the overall benchmark for positive resilience (i.e. households that scored positively on at least two-thirds of indicators). However, there is considerable variation among the households in the number of characteristics in which they met the cut-offs. Figure 6.1 is a histogram representing the proportion of characteristics in which households from supported communities scored positively. This index is referred to as the *base resilience index* in this report. It can be seen that no household scored positively on more than 85 per cent of the characteristics, but that the majority of households scored positively on between 40 per cent and 65 per cent of the characteristics.

Figure 6.2 overlays the proportion of characteristics in which households from comparison communities scored positively. What is apparent is that there are some differences in distribution between the intervention and comparison households. The majority of comparison households scored positively on between 35 per cent and 55 per cent of characteristics, and the distribution as a whole is slightly skewed towards a lower percentage of characteristics (indicating lower levels of resilience) than households supported by the project. These differences will be investigated in more detail in subsequent sections.

There is considerable variation among the interviewed households for the computed base resilience index

Figure 6.1: Histogram of base resilience index for intervention households

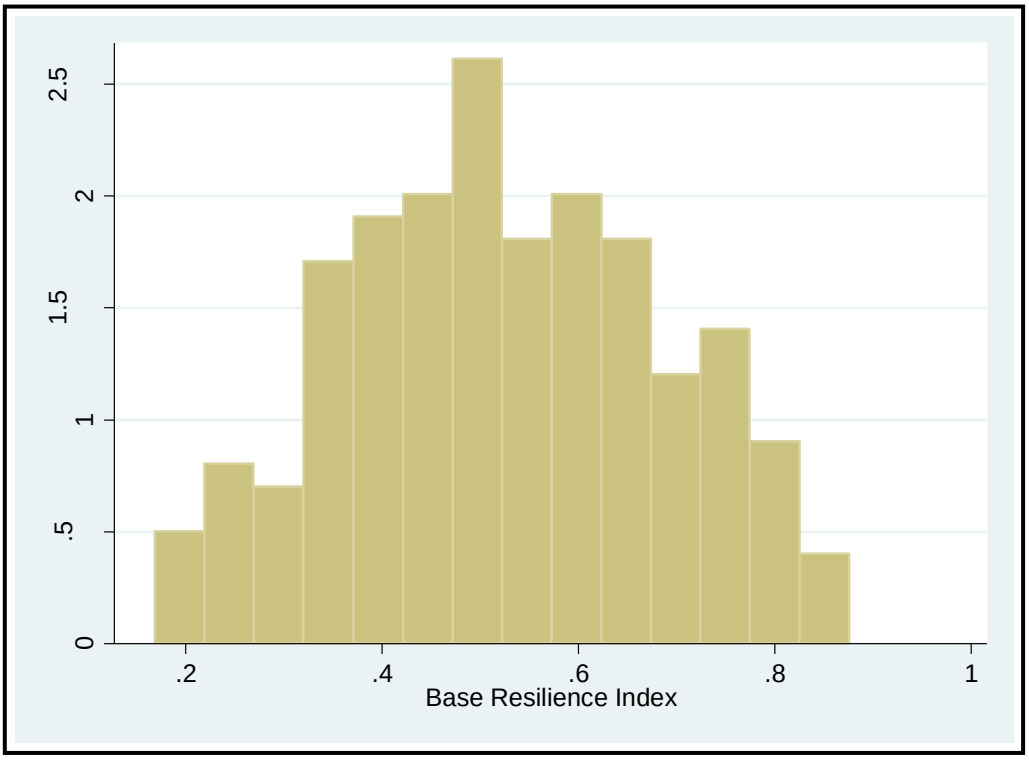
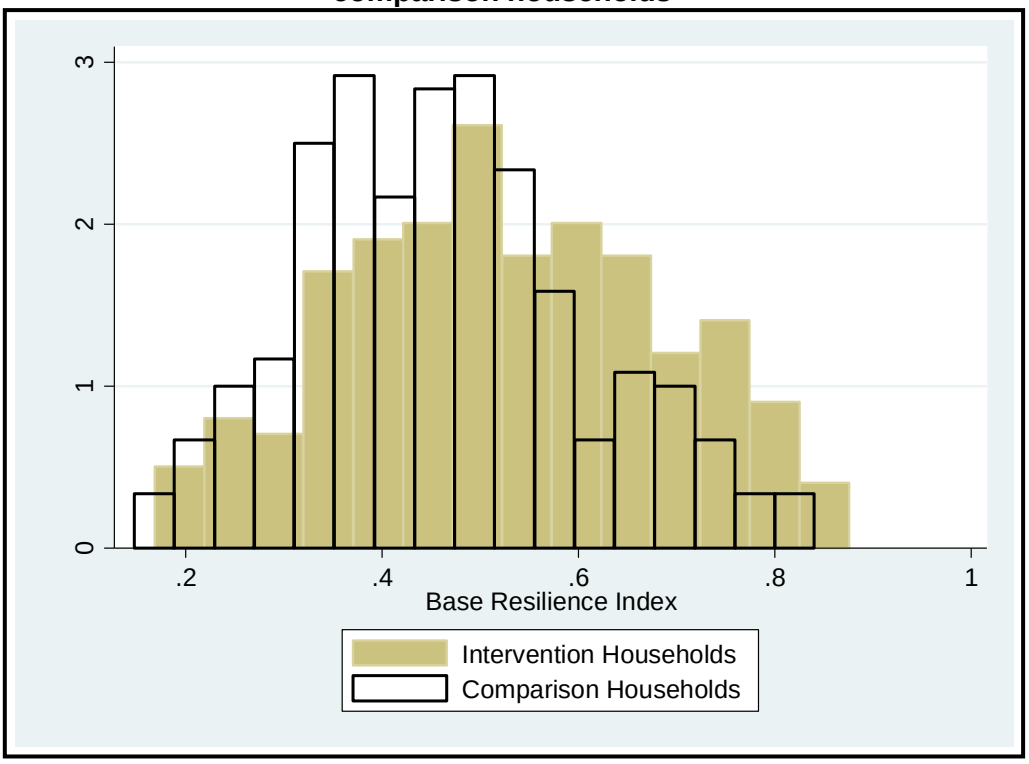


Figure 6.2: Histogram of base resilience index for intervention and comparison households



Recall the three overall measures of resilience described in Section 3.2:

- The **base resilience index**: the proportion of characteristics for which the household reaches the cut-off for positive resilience.

- **The Alkire-Foster (AF) resilience index**: whether the household reaches the cut-off in at least two-thirds of the characteristics, and otherwise equal to the proportion of characteristics for which they do reach the cut-off.
- The **global indicator**, based on whether the AF resilience index is greater than the median of the comparison group or not.

Table 6.2 shows the differences between project- supported households and households from the comparison communities, in terms of these three different resilience measures.

Higher scores on the various resilience indices used in this report imply greater resilience

Table 6.2: Overall resilience indices – intervention HHs versus comparison HHs

	1 Base Resilience Index (BRI)	2 AF Resilience Index	3 Oxfam GB global resilience indicator	4 % of HHs above overall resilience cut-off
Unadjusted				
Intervention group mean:	0.523	0.579	0.640	0.218
Comparison group mean:	0.464	0.496	0.507	0.119
Unadjusted difference:	0.060***	0.083***	0.133***	0.099***
	(4.31)	(3.96)	(2.92)	(2.97)
Observations:	**491**	**491**	**491**	**491**
PSM				
Post-matching difference (kernel):	0.037** (1.97)	0.066** (2.46)	0.077 (1.27)	0.108** (2.57)
Observations:	**475**	**475**	**475**	**475**
Post-matching difference (no replacement):	0.057*** (3.33)	0.087*** (3.59)	0.126** (2.32)	0.121*** (2.98)
Observations:	**468**	**468**	**468**	**468**
Multivariable regression				
MVR coefficient (robust standard errors):	0.037*** (3.00)	0.059*** (3.34)	0.082 (1.36)	0.078*** (3.19)
Observations:	**490**	**490**	**490**	**465**
MVR coefficient (robust regression):	0.038*** (3.19)	0.017 (1.44)	n/a	n/a
Observations:	**490**	**490**		
MVR coefficient (with control functions):	0.037*** (3.07)	0.061*** (3.46)	0.094 (1.59)	0.079*** (3.19)
Observations:	**490**	**490**	**490**	**465**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores
Probit regression used for binary outcomes

The upper section of the table shows the raw unadjusted differences in the values. Column 1 shows that supported households scored positively on an average of 52 per cent of characteristics, and the comparison households in 46 per cent of characteristics. The second section uses two different forms of propensity-score matching (PSM), while the third section uses three different regression models, to provide various estimates of the difference between the intervention and comparison groups. As column 1 shows, all five statistical models concur that the project households were resilient in a higher proportion of the characteristics than were the comparison group households. Here, the estimates of this difference range from four to six percentage points – a difference which is highly statistically significant.

It is clear from the table that there are also differences between the intervention and comparison households for both the Alkire-Foster Resilience Index (column 2), and Oxfam GB's global resilience indicator (column 3). Four of the five models concur that the differences on the Alkire-Foster Resilience Index are significant, however only one model found a significant difference in regards to the global indicator.

In order to generate the Alkire-Foster Index an overall binary cut-off for the entire weighted index must be defined. Households above this cut-off are considered to demonstrate positive overall resilience because they are only deprived on a relatively smaller proportion of the weighted indicators. As discussed previously, a household is defined as demonstrating positive overall resilience if it reached these cut-offs in more than two thirds of the characteristics, i.e. 21 or more of the 31 characteristics. The *Alkire-Foster (AF) resilience index* is defined to take the value of 1 (the maximum) if the household was found to be resilient in more than two-thirds of the characteristics, and takes the value of the base resilience index otherwise. The differences between the supported and comparison households, in terms of the AF resilience index are shown in column 2 of Table 6.2.

The intervention population outperformed the comparison population on all the resilience indices

Column 3 of Table 6.2 presents the difference between supported and comparison households using Oxfam GB's global indicator for resilience. In order to calculate the global indicator, the median value of the comparison group is taken as a benchmark. Households score positively on the global indicator if they have an AF resilience index score greater than the median of the comparison group, and zero otherwise. In this way, the global indicator reflects whether a household is resilient in more characteristics than a 'typical' household, as represented by the median of the comparison group. Therefore in essence, the information in column 3 shows that 64 per cent of surveyed intervention households demonstrate greater ability to reduce risk and adapt to emerging trends and uncertainty (as measured by this index).

The final column 4 presents the proportion of households scoring positively in more than two-thirds of the resilience characteristics. As is evident, just over a fifth of intervention households are above this cut-off, compared to 12 per cent of comparison households. This difference is statistically significant.

In summary, therefore, we can say that **there is some evidence that the project has successfully affected overall resilience** – as measured by the indices in Table 6.2.

Sensitivity analysis

Given the non-experimental nature of the data, it is of interest to explore how much unobserved bias would be needed to 'explain away' the positive effect estimates. In other words, how sensitive are the effect estimates to the possible presence of unobserved bias in favour of the intervention population?

Sensitivity analysis is an approach used for exploring this. It was implemented using Rosenbaum sensitivity analysis[4] with Stata's *rbounds* command. Here, unobserved bias is assumed to exist in favour of the intervention population at different log odds ratios. How large can the log odds ratio be in order to render an effect estimate non-significant? Table 6.3 presents the results that were obtained from undertaking such an analysis with the nearest-neighbour one-to-one matching effect estimate for the AF Resilience index. The table reveals that the presence of unobserved bias

would need to be present at a log odds ratio of 1.5 in favour of the intervention households in order for the effect estimate to be rendered statistically insignificant with a 95 per cent level of confidence. Qualitatively, we can say that the effect estimate is moderately robust to the possible existence of omitted variable bias.

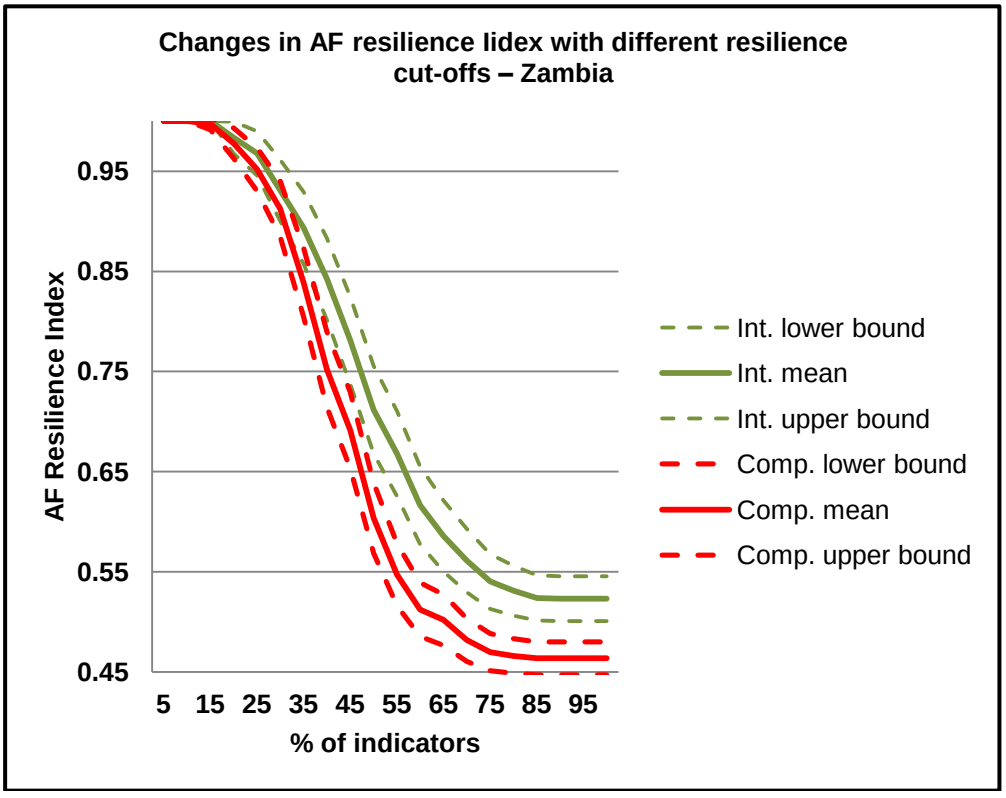
The estimated impact of the projects on the AF resilience index is moderately robust to omitted variable bias

Table 6.3: Results of Rosenbaum sensitivity analysis where unobserved, positive bias is assumed to exist a various log odds ratios among the intervention households – AF index

Log Odds Ratio of Hidden Bias	*p*-value of effect estimate with bias	Estimated effect estimate with bias	95% confidence level – two tailed	
			CI+	CI−
1	0.000158	0.089048	0.041905	0.134286
1.1	0.001103	0.075714	0.028572	0.146667
1.2	0.00504	0.064286	0.016667	0.16
1.3	0.016648	0.054286	0.004285	0.171905
1.4	0.042719	0.04381	-0.00619	0.183334
1.5	0.089838	0.034048	-0.01524	0.194761
1.6	0.161229	0.025238	-0.02429	0.205238

Another important question is how robust the resilience index is to the choice of two thirds (21 characteristics) as the cut-off for positive overall resilience. Figure 6.3 shows how the value of the resilience index for the project households and comparison households varies according to the cut-off applied. In this chart, the solid lines represent the mean resilience index value for the supported households (in green) and the comparison households (in red). The dashed lines represent the corresponding 95 per cent confidence intervals. For regions of the graph where the confidence intervals overlap, it cannot be claimed with a high degree of confidence that there is a real difference between the intervention and comparison households.

Figure 6.3: Variation of resilience index with choice of cut-off among supported and comparison households



For the cut-off of two thirds (21 of the 31 characteristics) it is clear that there is a significant difference between project and comparison households. However, reducing the cut-off to 40 per cent or less would lead to overlap in the confidence intervals, and so there would be less confidence that this represents a positive result.

Project-specific indices

It is further important to point out that the resilience measurement framework presented in Section 3 resulted in capturing data *both* on characteristics the project was intending to affect and those that it was not. It is therefore also of interest to examine the extent to which differences between the intervention and comparison households change when only the former characteristics are incorporated into the analysis. The specific characteristics from those presented in Table 3.1 that the project was intentionally attempting to affect include:

- Livelihood diversification
- Crop portfolio
- Availability and use of early-warning information
- Flood preparedness practice
- Attitudes towards new livelihood practices
- Innovation practice
- Access to state innovative support
- Extent farming activities affected by flooding
- Awareness of disaster preparedness plan
- Participation in disaster preparedness meetings
- Receipt of disaster preparedness information
- Awareness of community-level disaster-preparedness initiatives

In addition, several additional characteristics can reasonably be linked to the intervention logic of the project. These include:

- Household wealth status
- Household food security
- Household dietary diversity
- Market access
- Perceptions of local-government emergency support
- Ownership of convertible livestock (goats and poultry)
- Savings
- Access to irrigation for farming
- Access to water for drinking and livestock
- Water resource dispute experience
- Awareness that local leaders are undertaking action
- Level of confidence in effectiveness of local leaders/institutions

In light of this, two additional indices were created – one focused on the first set of characteristics (called the ‘project-specific resilience index’) and the other focused on the characteristics of both lists (called the ‘expanded project-specific resilience index’). Given that these characteristics are not distributed similarly across the dimensions, as is the case in the original framework, they were each given equal weight in both indices. Table 6.4 presents the results of a comparison of these new indexes in comparison with the Base Resilience Index (BRI) presented above. The BRI was chosen because it is most similar in structure to the newly created indices, given that

it is a weighted composite of the 31 indicators.

As is evident, the *t*-statistics are quite different across the various indices. This is perhaps not surprising, particularly when the results for the base resilience index are compared with the project-specific resilience index, given that the former and latter are based on 31 and 12 characteristics, respectively. The analysis shows that the differences between the intervention and comparison households are much greater and more significant when we narrow in on just those particular indicators the project was trying to effect. The differences are also greater and more significant when we consider the expanded list of 24 characteristics. This suggests that at this stage, the project has successfully affected characteristics of resilience specifically targeted by the project, but has not yet affected wider characteristics of resilience to the same extent.

The results are more positive when we analyse those characteristics the project was specifically trying to affect

Table 6.4: Base Resilience Indices versus project-focused resilience indices

	Base Resilience Index	Project-specific resilience index	Expanded project resilience index
Unadjusted			
Intervention group mean:	0.523	0.611	0.552
Comparison group mean:	0.464	0.486	0.467
Unadjusted difference:	0.060***	0.125***	0.086***
	(4.31)	(7.27)	(5.77)
Observations:	**491**	**491**	**491**
PSM			
Post-matching difference (kernel):	0.037**	0.092***	0.063***
	(1.97)	(4.16)	(3.20)
Observations:	**475**	**475**	**475**
Post-matching difference (no replacement:	0.057***	0.116***	0.079***
	(3.33)	(5.74)	(4.44)
Observations:	**468**	**468**	**468**
Multivariable regression			
MVR coefficient (robust standard errors):	0.037***	0.105***	0.067***
	(3.00)	(6.20)	(4.99)
Observations:	**490**	**490**	**490**
MVR coefficient (robust regression):	0.038***	0.108***	0.072***
	(3.19)	(6.46)	(5.43)
Observations:	**490**	**490**	**490**
MVR coefficient (with control functions):	0.037***	0.105***	0.067***
	(3.07)	(6.16)	(5.02)
Observations:	**490**	**490**	**490**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

From the analysis of these overall indices, we can summarise that there is **some evidence that the project has successfully affected overall resilience**, as measured by this framework. However, the evidence is more robust for characteristics of resilience specifically targeted by the project.

6.2.2 Decomposition of resilience index

Given that there is some evidence that the project has increased overall resilience, the following sections seek to identify which characteristics in particular have been affected.

6.2.3 Dimension 1: Livelihood viability

As per the resilience measurement framework presented in Section 3, the first dimension examined pertains to livelihood viability. To what extent is there evidence that households in the intervention villages possess livelihoods that are more resilient to shocks than the comparison households? In other words, to what extent are they better off in relation to the characteristics assessed under the livelihood viability dimension?

To answer this question, an index specific to the livelihood viability dimension was created. This index comprises of this dimension's seven characteristics using the binary cut-offs presented in Appendix 1. Each characteristic was given equal weight. Consequently, the index simply represents the percentage of indicators in which the interviewed households scored positively. Table 6.5 presents the results of a comparison of the intervention and comparison households in relation to this index.

Table 6.5: Comparison of intervention and comparison households on livelihood viability index

	Livelihood viability index
Unadjusted	
Intervention group mean:	0.547
Comparison group mean:	0.472
Unadjusted difference:	0.075***
	(3.59)
Observations:	**491**
PSM	
Post-matching difference (kernel):	0.028
	(1.08)
Observations:	**475**
Post-matching difference (no replacement:	0.053**
	(2.19)
Observations:	**468**
Multivariable regression	
MVR coefficient (robust standard errors):	0.027
	(1.42)
Observations:	**490**
MVR coefficient (robust regression):	0.032
	(1.57)
Observations:	**490**
MVR coefficient (with control functions):	0.025
	(1.32)
Observations:	**490**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

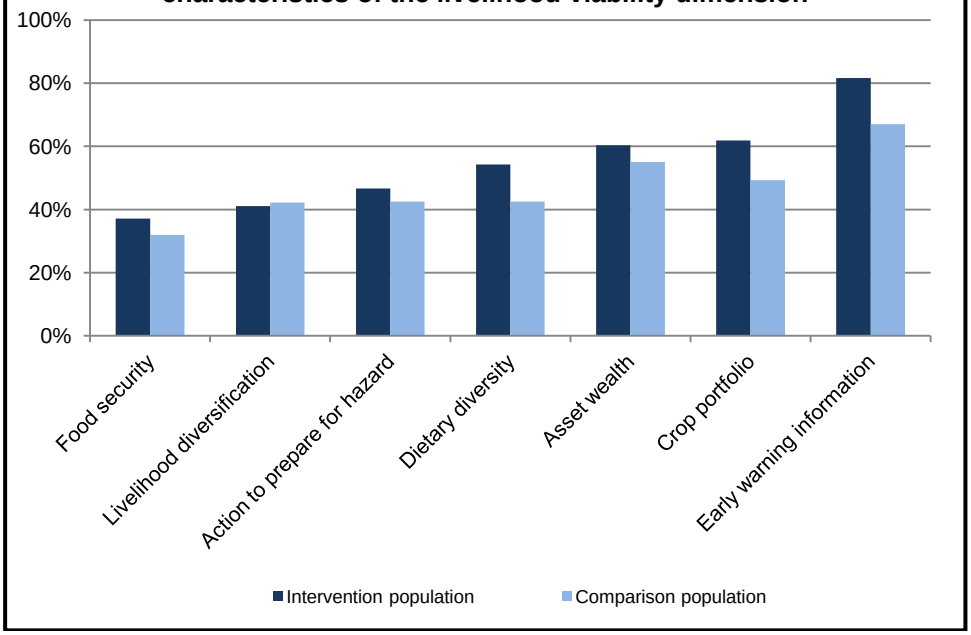
There is only marginal evidence that the project enhanced the livelihoods of the intervention population

As is clear, on average, the intervention households scored positively on 55 per cent of the seven indicators, while the comparison households scored positively on 47 per cent. However, this difference is statistically significant in only one of the five statistical procedures with at least a 95 per cent level of confidence. There is therefore only marginal evidence that the project has enhanced the livelihoods of the intervention population.

The intervention population is most deprived in relation to food security

It is, of course, essential to understand which of the underlying characteristics are contributing to these overall differences between the intervention and comparison groups. Figure 6.4 presents the percentage of households scoring positively on each of the indicators in the livelihood viability dimension. The indicators have been ranked for the intervention population from most deprived to least deprived. As is evident, both the general intervention and comparison populations are most deprived in relation to food security.

Figure 6.4: Percentage of HHs scoring positively on characteristics of the livelihood viability dimension



Differences between the intervention and comparison households are also apparent from the graph. The intervention households perform marginally better in relation to the comparison households for several of the characteristics. However, the graph was constructed with the data before it was analysed with PSM and multivariable regression. Table 6.6 presents the results of these analyses for each characteristic.

Turning our attention to the characteristic with the lowest proportion of households scoring positively – i.e. food security (column 2), we see that there are no significant differences between the intervention and comparison households. As a reminder, the cut-offs for determining whether a household receives a positive score on a particular characteristic are detailed in Appendix 1. For this particular characteristic, the cut-off is whether the household reported having had to cut the size of meals, eat fewer meals, or reduce food consumed by adults in household fewer than three times in the past week and reports no incidence of having to borrow food, going to sleep hungry, or going through a whole day with no food. As is evident, 37 per cent of intervention households scored positively in this regard, compared to 32 per cent of comparison households. As this difference is not significant, we cannot claim that the project has successfully affected this outcome.

In terms of the other indicators in this domain, it is clear that of the seven indicators, only two exhibited statistically significant differences between the intervention and comparison households. The first of these relates to dietary diversity. Overall, 54 per cent of project households scored positively on the

dietary diversity characteristic (column 3), compared to 43 per cent of comparison households. This difference is statistically significant; indicating that there is evidence that the project has increased the diversity of food types consumed by supported households.

Table 6.6: HH characteristic scores – livelihood viability dimension

	1 Asset wealth	2 Food security	3 Dietary diversity	4 Livelihood diversification	5 Crop portfolio	6 Early warning information	7) Action to prepare for hazard
Unadjusted							
Intervention group mean:	0.604	0.371	0.543	0.411	0.619	0.817	0.467
Comparison group mean:	0.551	0.320	0.425	0.422	0.493	0.670	0.425
Unadjusted difference:	0.053	0.051	0.118**	-0.011	0.126***	0.147***	0.042
	(1.16)	(1.16)	(2.58)	(-0.23)	(2.77)	(3.64)	(0.91)
Observations:	**491**	**491**	**491**	**491**	**491**	**491**	**491**
PSM							
Post-matching difference	0.045	-0.035	0.097*	-0.041	0.041	0.105**	-0.056
(kernel):	(0.77)	(-0.62)	(1.72)	(-0.30)	(0.74)	(2.13)	(-1.00)
Observations:	**475**	**475**	**475**	**475**	**475**	**475**	**475**
Post-matching difference	0.046	-0.006	0.121**	-0.078	0.069	0.121**	-0.011
(no replacement:	(0.86)	(-0.11)	(2.26)	(-0.56)	(1.32)	(2.52)	(-0.21)
Observations:	**468**	**468**	**468**	**468**	**468**	**468**	**468**
Multivariable regression							
MVR coefficient	-0.024	-0.022	0.104**	-0.016	0.081	0.137***	-0.064
(robust standard errors):	(-0.42)	(-0.42)	(1.84)	(-0.30)	(1.49)	(3.01)	(-1.14)
Observations:	**490**	**490**	**490**	**490**	**490**	**490**	**490**
MVR coefficient	-0.026	-0.019	0.110*	-0.030	0.073	0.137***	-0.058
(with control functions):	(-0.45)	(-0.37)	(1.92)	(-0.56)	(1.33)	(3.05)	(-1.03)
Observations:	**490**	**490**	**490**	**490**	**490**	**490**	**490**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

There is evidence that the project successfully affected two of the characteristics under the livelihood viability dimension, namely; dietary diversity, and access to early-warning information

The second characteristic in which there is a significant difference relates to the availability of early-warning information. Households were asked to think back to the flooding event of 2012, and recall whether they received early-warning information that enabled them to plan and protect their livelihoods. Overall, 82 per cent of project households reported receiving such information, compared to 67 per cent of comparison households – a difference that is highly statistically significant. This indicates that there is strong evidence that the project has successfully affected the household's access to early-warning information. Respondents were also asked to record the source of such information; for example, 32 per cent of project households reported receiving the information from community leaders, 50 per cent from the Community Disaster Risk Management Committee, 28 per cent from government officers, and 69 per cent from the radio.

It is interesting to note that while there is evidence of a strong project effect on access to early-warning information, there is no evidence that the project affected whether households took any specific precautionary actions in preparation for the flooding of 2012. Less than half (47 per cent) of project households reported taking any such action, compared to 43per cent of comparison households – a difference that is not statistically significant.

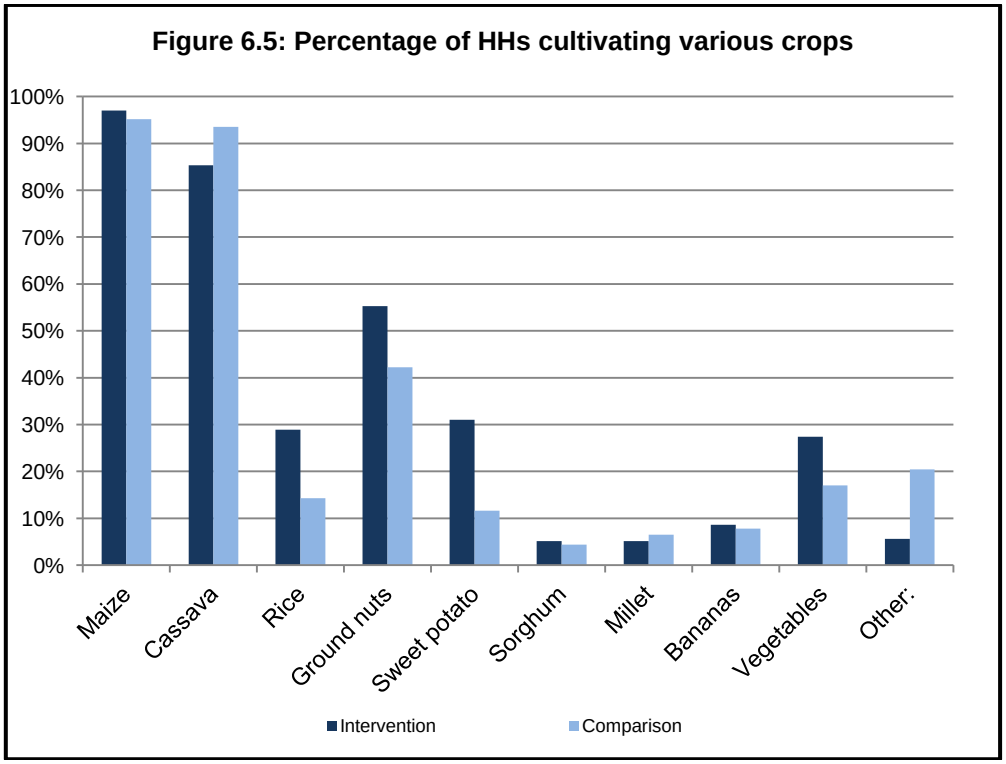
Further, there is no evidence that the project has successfully affected important resilience characteristics, such as livelihood diversification, and the range of crops on which a household depends. The latter warrants further investigation, particularly as mentioned above, there is evidence that the

project households have greater dietary diversity than their comparators.

For the livelihood diversification characteristic, the cut-off is whether the household is at least 50 per cent dependent on at least two different livelihood activities that are assumed to be significantly drought or flood tolerant. When examining the underlying data (not shown here) on the *total number* of livelihood activities in which each household engages, both the project and comparison households are, on average, engaged in three different activities. This result, taken in conjunction with the diversification indicator, shows that while households appear to have a diverse livelihood base in terms of the raw *number* of activities, the *nature* of these activities is still highly susceptible to drought or flood. There is, therefore, no evidence of a difference between the intervention and comparison households in terms of livelihood diversification into more *drought or flood tolerant* activities.

As one of the key project interventions was provision of improved cereal seeds and banana plantations, it is interesting to compare the proportion of households cultivating various crops in the intervention and comparison villages. Figure 6.5 illustrates these differences.

Figure 6.5: Percentage of HHs cultivating various crops



The most significant difference between the intervention and comparison households is the proportion of households growing sweet potatoes. Over 30 per cent of project households reported growing sweet potatoes, compared to 10 per cent of comparison households. Statistically significant differences are also evident for rice, ground nuts and other vegetables. Interestingly, a significantly smaller proportion of households in the intervention villages reported cultivating cassava. Perhaps most interesting is still the very small proportion of household reporting cultivating bananas. Despite the intervention to provide banana suckers, only eight per cent of project households reported cultivating bananas in the preceding year. What the graph does not show is that this was an increase from four per cent of project households cultivating at baseline (2009). However, there is no evidence that the project has affected a significant shift to banana cultivation.

The final characteristic of livelihood viability is an indicator of a household's wealth status – as measured by asset ownership. For this indicator (column 1), there is no clear difference between households in the project and comparison villages. Supporting analyses (not shown here) including assessing changes in a household's wealth status between 2009 and 2012, confirm the analysis shown in column 1 in that there is no significant difference between the intervention and comparison households in asset wealth. Unfortunately this implies that there is no evidence of a change in household wealth.

6.2.4 Dimension 2: Innovation potential

As presented in Section 3, data were collected on five characteristics falling under the innovation potential dimension. Similar to the livelihood viability dimension, a composite index was developed with all five characteristics being weighted equally. Table 6.7 presents the results of a comparison of the intervention and comparison households for the resulting index. The intervention mean of 0.57 means that, on average, the project households scored positively on 57 per cent of the five characteristics, compared to 44 per cent for comparison households. This difference is highly statistically significant at the 99 per cent level. This indicates a positive project effect on the characteristics that make up the innovation dimension. The remainder of this subsection will explore what particular characteristics are driving this difference.

Significant differences in favour of supported households were found for the innovation potential index

Table 6.7: Comparison of intervention and comparison households on innovation potential index

	Innovation potential index
Unadjusted	
Intervention group mean:	0.571
Comparison group mean:	0.444
Unadjusted difference:	0.127***
	(5.92)
Observations:	**491**
PSM	
Post-matching difference (kernel):	0.073***
	(2.58)
Observations:	**475**
Post-matching difference (no replacement:	0.105***
	(3.99)
Observations:	**468**
Multivariable regression	
MVR coefficient (robust standard errors):	0.076***
	(3.40)
Observations:	**490**
MVR coefficient (robust regression):	0.074***
	(3.31)
Observations:	**490**
MVR coefficient (with control functions):	0.080***
	(3.62)
Observations:	**490**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

Figure 6.6 presents the percentage of households scoring positively on each of the indicators in the innovation potential dimension. The indicators have been ranked for the intervention population from most deprived to least deprived. As is evident, there are clear differences between the proportions of households scoring positively on the different characteristics. Interestingly, households scored most positively on innovation practice, and least positively on access to markets.

The intervention population is better off on four out of the five characteristics falling under the innovation potential dimension

Figure 6.6: Percentage of HHs scoring positively on characteristics of the Innovation Potential Dimension

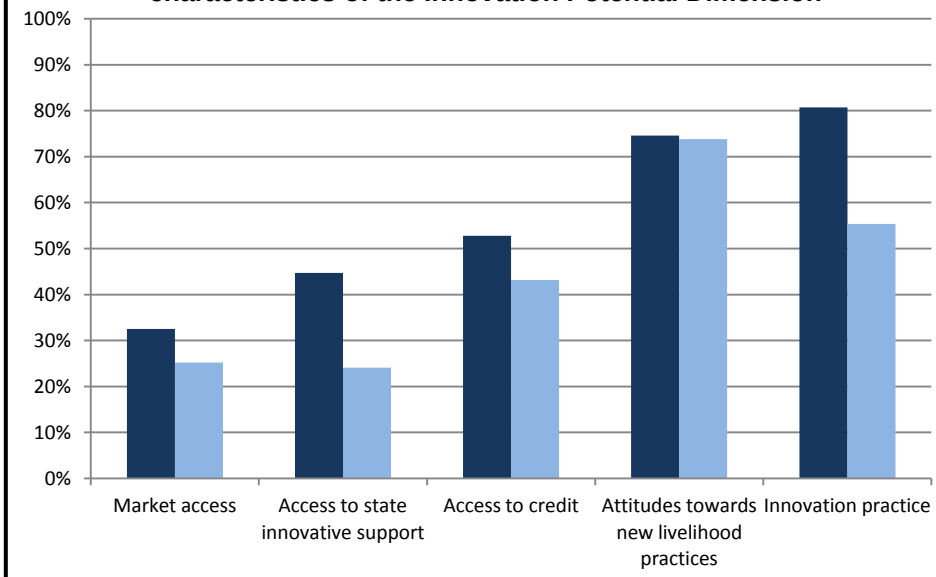


Table 6.8 examines the differences between the intervention and comparison households for each of the characteristics shown in Figure 6.6.

The 'access to state innovative support' characteristic was one of the indicators in which households scored least positively. However, Table 6.8 shows that all four of the adjustment methods estimate a highly significant difference between the proportion of intervention and comparison households above the cut-off (column 4), i.e. they reported having received support from government extension programmes and found the support helpful. Assuming there are no geographical differences in how state support is made available to households, this may indicate that the project has successfully affected the way in which households engage with this type of support. However, an alternative explanation may be that respondents were confused, and that in this instance they were actually referring to support received from Oxfam, rather than from state extension workers. This will require further follow up with the project team.

Just over half of project households scored positively on the access to credit measure (column 3), i.e. reporting that they would be able to access a modest-sized loan if required, compared to 43 per cent of comparison households. However, the difference between the groups is not significant. Similarly there was no significant difference in the proportion of households reporting no severe issues in accessing markets or market information.

Table 6.8: HH characteristic scores – Innovation Potential Dimension

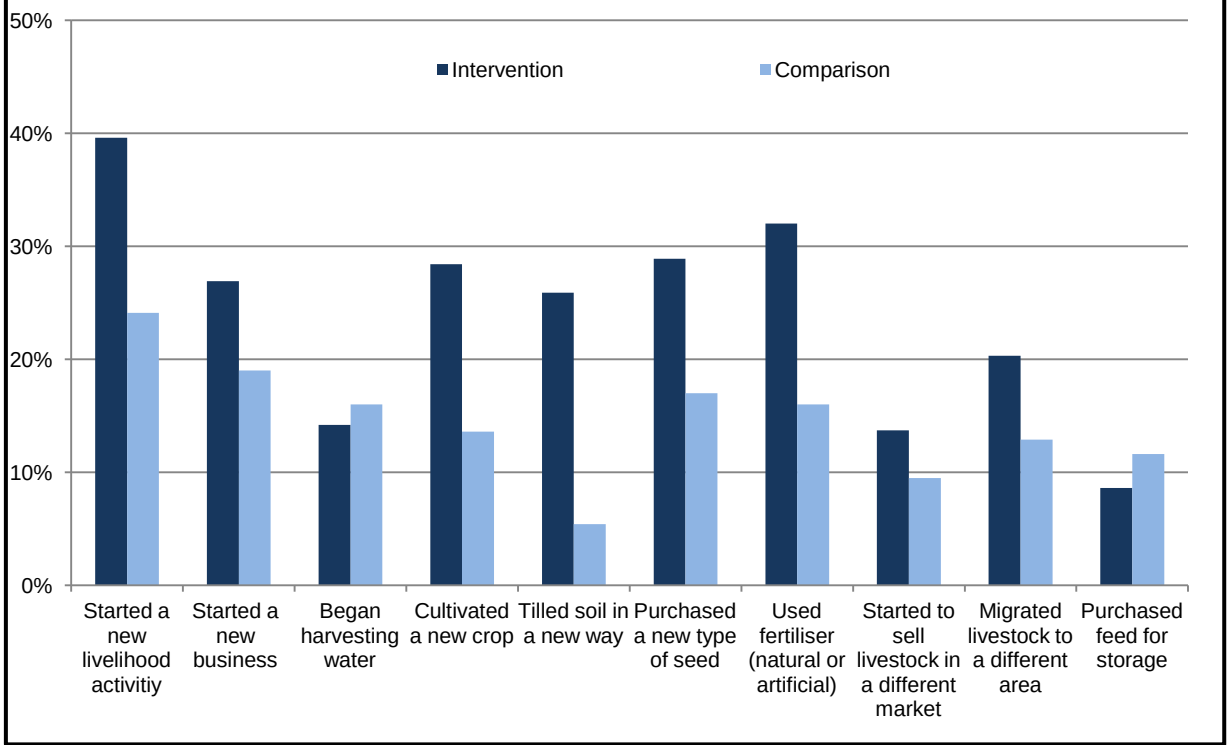
	1 Attitudes towards new livelihood practices	2 Innovation practice	3 Access to credit	4 Access to state innovative support	5 Market access
Unadjusted					
Intervention group mean:	0.746	0.807	0.528	0.447	0.325
Comparison group mean:	0.738	0.554	0.432	0.241	0.252
Unadjusted difference:	0.008	0.253***	0.096**	0.205***	0.073*
	(0.20)	(5.97)	(2.09)	(4.87)	(1.77)
Observations:	**491**	**491**	**491**	**491**	**491**
PSM					
Post-matching difference	-0.060	0.226***	0.039	0.129**	0.029
(kernel):	(-1.34)	(4.20)	(0.64)	(2.27)	(0.55)
Observations:	**475**	**475**	**475**	**475**	**475**
Post-matching difference	-0.017	0.236***	0.080	0.178***	0.040
(no replacement:	(-0.36)	(4.93)	(1.48)	(3.36)	(0.81)
Observations:	**468**	**468**	**468**	**468**	**468**
Multivariable regression					
MVR coefficient	-0.056	0.258***	0.008	0.217***	0.032
(robust standard errors):	(-1.17)	(4.70)	(0.14)	(4.09)	(0.66)
Observations:	**490**	**490**	**490**	**490**	**490**
MVR coefficient	-0.065	0.263***	0.011	0.229***	0.037
(with control functions):	(-1.36)	(4.77)	(0.21)	(4.32)	(0.77)
Observations:	**490**	**490**	**490**	**490**	**490**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

It is interesting to note that while the proportion of households scoring positively for their attitudes towards trying new livelihood practices (column 1) is very similar between the intervention and comparison households, there is a highly significant difference in the proportion of households scoring positively in actually *practising* innovative activities (column 2). Over 80 per cent of project households scored positively – i.e. they tried at least one new activity (e.g. cultivating new crops), in the previous two years – compared to 55 per cent of comparison households. This clearly implies a strongly successful project effect on innovative practice in supported households.

Such a strong effect warrants further analysis. Figure 6.7 presents the proportion of households who have tried a variety of activities for the first time in the two years leading up to the data collection. These are the same activities reported on under the 'Innovation Practice' indicator shown in Table 6.8. As is evident from the graph, just less than 40 per cent of project households said they had started a new livelihood activity, 28 per cent had started cultivating a new crop, 26 per cent had started tilling soil in a new way, and 32 per cent reported using fertiliser for the first time. For each of these activities the difference in the proportion of households in the intervention and comparison villages practising each is highly significant. While the differences in the proportion of intervention and comparison households who have started a new business and migrated livestock to a different area are smaller, significant differences still exist between the intervention and comparison households on these measures.

Figure 6.7: Percentage of HHs implementing activities for the first time



In summary, this highlights that the project has successfully affected the practice of more innovative activities in the intervention villages.

6.2.5 Dimension 3: Access to contingency resources and support

As presented in Section 3, data were collected on six characteristics falling under the access to contingency resources and support dimension. Similar to the previous dimensions, a composite index was developed, will all five characteristics being weighted equally. Table 6.9 presents the results of a comparison of the intervention and comparison households for the resulting index. The intervention mean of 0.38 shows that, on average, the supported households scored positively on 38 per cent of the five characteristics, compared to 44 per cent for comparison households. This negative difference is statistically significant indicating that the project has had no overall positive effect on this dimension, and that the comparison households are significantly better off in this regard. The remainder of this subsection will explore what particular characteristics are driving this difference.

Significant differences in favour of comparison households were found for the access to contingency resources and support index

Table 6.9: Comparison of intervention and comparison households on access to contingency resources and support index

	Access to contingency resources and support index
Unadjusted	
Intervention group mean:	0.378
Comparison group mean:	0.437
Unadjusted difference:	-0.058**
	(-2.49)
Observations:	**491**
PSM	
Post-matching difference (kernel):	-0.092***
	(-2.74)
Observations:	**475**
Post-matching difference (no replacement:	-0.051*
	(-1.78)
Observations:	**468**
Multivariable regression	
MVR coefficient (robust standard errors):	-0.097***
	(-4.21)
Observations:	**490**
MVR coefficient (robust regression):	-0.102***
	(-4.33)
Observations:	**490**
MVR coefficient (with control functions):	-0.096***
	(-4.17)
Observations:	**490**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

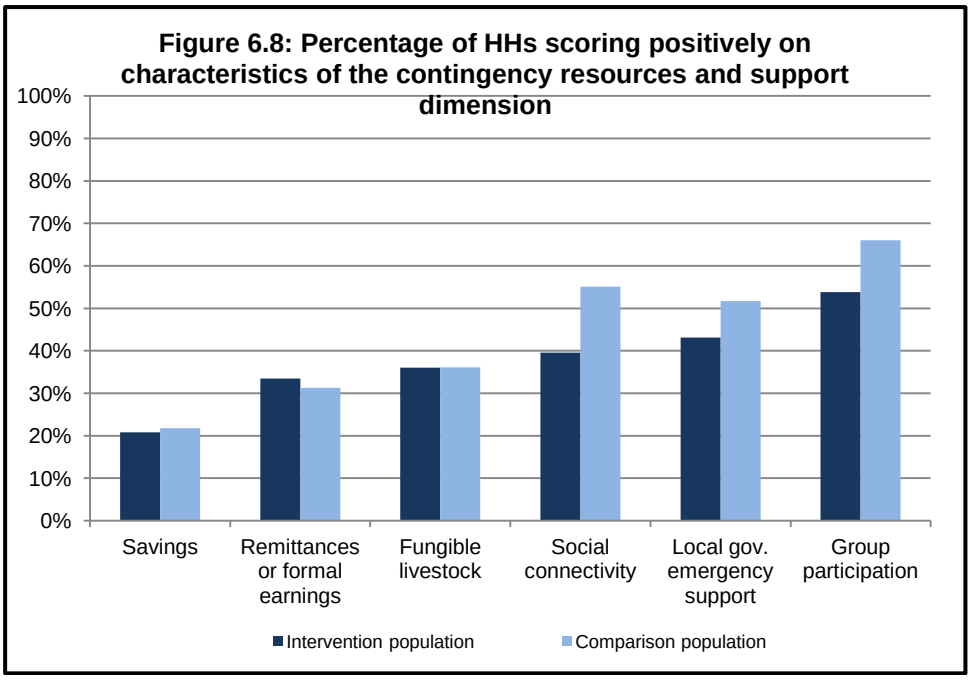


Figure 6.8 presents the percentage of households scoring positively on each

of the indicators in the access to contingency resources and support dimension. The indicators have been ranked for the intervention population from most deprived to least deprived. As is evident, the differences between the proportions of households scoring positively on the different characteristics are generally very small. Where slightly larger differences do exist, these tend to be in favour of the comparison households. Interestingly, households scored most positively on issues of group participation. Households scored least positively in regard to their level of savings.

Table 6.10: HH characteristic scores – contingency resources and support dimension

	1 Group participation	2 Social connectivity	3 Local gov. emergency support	4 Savings	5 Remittances or formal earnings	6 Fungible livestock
Unadjusted						
Intervention group mean:	0.538	0.396	0.431	0.208	0.335	0.360
Comparison group mean:	0.660	0.551	0.517	0.218	0.313	0.361
Unadjusted difference:	-0.122***	-0.155***	-0.086*	-0.010	0.022	-0.000
	(-2.73)	(-3.40)	(-1.86)	(-0.25)	(0.51)	(-0.00)
Observations:	**491**	**491**	**491**	**491**	**491**	**491**
PSM						
Post-matching difference	-0.185***	-0.226***	-0.128**	0.018	0.024	-0.057
(kernel):	(-3.55)	(-3.95)	(-2.22)	(0.37)	(0.44)	(-1.03)
Observations:	**475**	**475**	**475**	**475**	**475**	**475**
Post-matching difference	-0.109**	-0.149***	-0.063	0.023	0.034	-0.046
(no replacement:	(-2.02)	(-2.83)	(-1.16)	(0.53)	(0.68)	(-0.88)
Observations:	**468**	**468**	**468**	**468**	**468**	**468**
Multivariable regression						
MVR coefficient	-0.230***	-0.240***	-0.121**	0.002	-0.053	-0.055
(robust standard errors):	(-4.17)	(-4.23)	(-2.22)	(0.06)	(-0.96)	(-1.03)
Observations:	**490**	**490**	**490**	**490**	**490**	**490**
MVR coefficient	-0.236***	-0.253***	-0.125**	0.004	-0.041	-0.047
(with control functions):	(-4.25)	(-4.41)	(-2.30)	(0.09)	(-0.77)	(-0.89)
Observations:	**490**	**490**	**490**	**490**	**490**	**490**

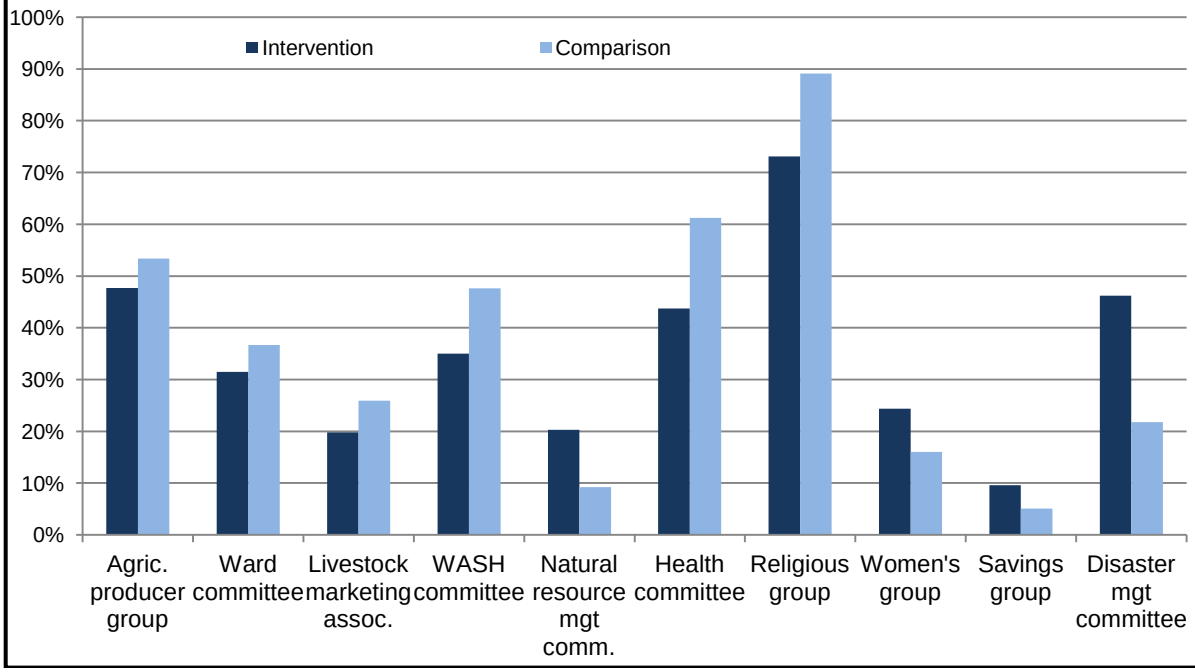
t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

Table 6.10 presents the results of the six characteristics making up the index of access to contingency resources and support. The first factor analysed is the household's participation in community groups. It can be clearly seen in column 1 that more of the comparison households reported actively participating in community groups than did the intervention households. The negative difference is highly statistically significant, indicating no positive project effect on group participation – indeed, the comparison households are actually better off in this regard.

Particularly interesting is the analysis of the type of groups in which households are participating. Figure 6.9 illustrates the proportion of households that participate in the various groups appropriate to the context. It is important to consider the group memberships that the project was particularly trying to affect. So while there is no overall positive effect on active group membership among the project households, there are clear – and significant – differences in the proportion of households participating in the community disaster management and natural resource management committees. These are the committees particularly targeted by interventions connected to this project. However, for the majority of community-based

groups, households in the comparison villages were found to be more active and participatory.

Figure 6.9: Percentage of HHs participating in various community groups



It is interesting to note that the result for the social connectivity characteristic (column 2) is corroborated by the previous result related to the group participation characteristic, i.e. the comparison households are significantly better off in this regard. The measurement of this characteristic looks at how respondents perceive the strength of their social support system. For example, questions consider: how confident respondents are that neighbours, friends or relatives would support them in times of difficulty; their involvement in important meetings in the community; and other characteristics related to the household's social interaction in the community. Overall, 40 per cent of project households scored positively for this measure, compared to 55 per cent of comparison households.

Further, there is also no evidence of a positive project effect in regard to how households perceive the efficacy of the local government support system in the event of a disaster (column 3). While this issue may have not been under the direct jurisdiction of the project, it is still important to note that only 43 per cent of project households had confidence in the local government disaster support measures, compared to 52 per cent of comparison households.

As mentioned, households scored least positively in relation to the level of savings available to the household (column 4). Households were not asked directly for the monetary value of their savings, but were instead asked, if they had a crisis and had to live on their cash savings without other income sources, how long they would be able to do so. Just over a fifth of the intervention households scored positively on this measure, meaning that they could live from their savings for more than 7 days. No significant differences between the project and comparison households on this measure are evident.

The final two characteristics analysed in Table 6.10 are the availability within the household of remittances or formal employment (column 5), and the availability of fungible livestock, such as goats or poultry (column 6). In both cases, approximately one-third of intervention and comparison households scored positively, with no significant differences between the two groups.

6.2.6 Dimension 4: Integrity of the natural and built environment

As presented in Section 3, six characteristics were identified for the integrity of the natural and built environment dimension. Again, a composite index was developed, with each characteristic weighted equally. The intervention mean of 0.49 shows that, on average, the project households scored positively on just less than half of the six characteristics, compared to 49 per cent for comparison households. This difference is not statistically significant, indicating no positive project effect on this dimension as a whole. The remainder of this subsection will explore the particular characteristics that make up this dimension.

Table 6.11: Comparison of intervention and comparison households on integrity of the natural and built environment index

No significant differences were found between intervention and comparison households in relation to the integrity of the natural and built environment index

	Integrity of the Natural and Built Environment Index
Unadjusted	
Intervention group mean:	0.486
Comparison group mean:	0.487
Unadjusted difference:	-0.001
	(-0.06)
Observations:	**491**
PSM	
Post-matching difference (kernel):	0.025
	(0.82)
Observations:	**475**
Post-matching difference (no replacement:	0.019
	(0.73)
Observations:	**468**
Multivariable regression	
MVR coefficient (robust standard errors):	0.025
	(1.02)
Observations:	**490**
MVR coefficient (robust regression):	0.027
	(1.08)
Observations:	**490**
MVR coefficient (with control functions):	0.026
	(1.04)
Observations:	**490**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

Figure 6.10 presents the percentage of households scoring positively on each of the indicators in the integrity of the natural and built environment dimension. The indicators have been ranked for the intervention population from most deprived to least deprived. As is evident, with the exception of two indicators, the differences between the proportions of households scoring positively on the different characteristics are negligible. Interestingly, households scored most positively on aspects related to access to water for

farming and soil erosion, whereas households scored least positively on how they perceived the fertility of their local soils.

Figure 6.10: Percentage of HHs scoring positively on characteristics of the integrity of the natural environment dimension

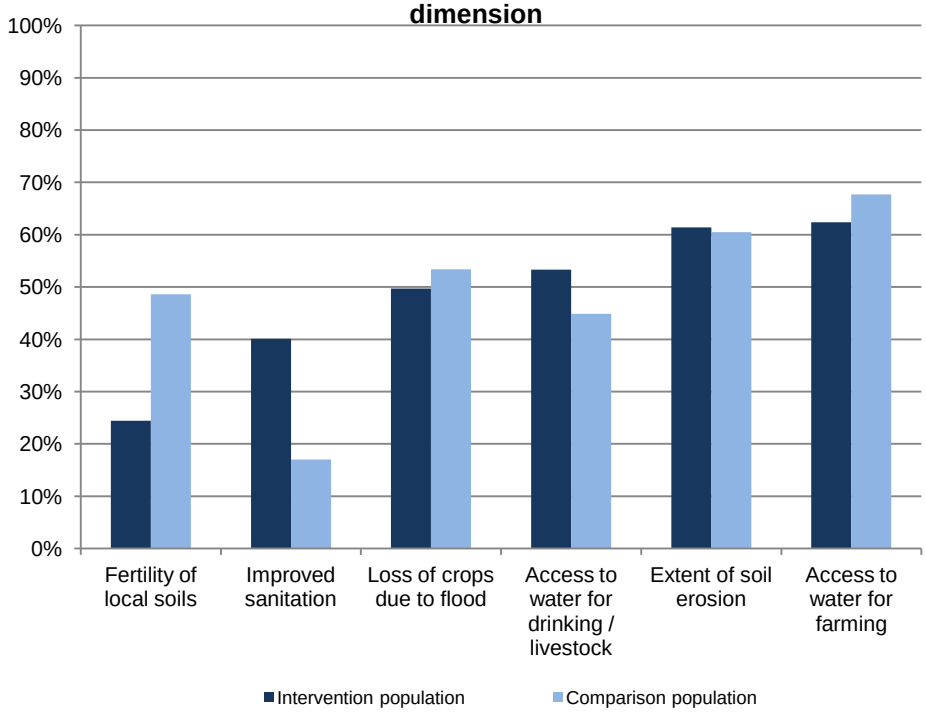


Table 6.12 presents the results of the six characteristics making up the integrity of the natural and built environment dimension. The first factor analysed is the households' perception of the fertility of their agricultural land (column 1). Almost a quarter of project households reported the fertility had either stayed the same or improved – therefore, almost 75 per cent reported some decline in soil fertility over the past two years. This compares to almost 50 per cent of comparison households – a difference that is statistically significant. This suggests that the project households are significantly *worse off* than the comparison households in this regard.

The majority of project and comparison households scored positively for the soil erosion characteristic (column 2) – i.e. they responded that their land was not severely affected by erosion. The differences between the groups are negligible and not significant, indicating no positive project effect on this particular characteristic.

Columns 3 and 4 consider a household's access to water for farming and their access to water for drinking and livestock. Just over 60 per cent of intervention households reported either irrigating their land in the last year, or would be able to water at least part of their land in the event of a drought. The difference between the intervention and comparison household is not significant. This therefore indicates there is no evidence that the project has successfully affected the way in which households are able to access water for agriculture. A different picture emerges in terms of how the project has increased access to water for drinking and livestock. Just over half of intervention households (53 per cent) reported no difficulties in accessing water for themselves or their animals during the dry season of 2012. This compares to 45 per cent of comparison households – a difference that is

statistically significant across all four of the estimation models. This indicates that the project has positively affected supported households' ability to access water for their own drinking or livestock watering purposes.

Table 6.12: HH characteristic scores – integrity of the natural environment dimension

	1 Fertility of local soils	2 Extent of soil erosion	3 Access to water for farming	4 Access to water for drinking / livestock	5 Loss of crops due to flooding	6 Improved sanitation
Unadjusted						
Intervention group mean:	0.244	0.614	0.624	0.533	0.497	0.401
Comparison group mean:	0.486	0.605	0.677	0.449	0.534	0.170
Unadjusted difference:	-0.243***	0.009	-0.053	0.084*	-0.037	0.231***
	(-5.56)	(0.19)	(-1.20)	(1.83)	(-0.79)	(5.89)
Observations:	**491**	**491**	**491**	**491**	**491**	**491**
PSM						
Post-matching difference	-0.165***	-0.013	0.007	0.108*	-0.015	0.227***
(kernel):	(-2.96)	(-0.23)	(0.12)	(1.83)	(-0.24)	(4.65)
Observations:	**475**	**475**	**475**	**475**	**475**	**475**
Post-matching difference	-0.213***	0.034	-0.011	0.098*	-0.023	0.230***
(no replacement:	(-4.05)	(0.62)	(-0.23)	(1.73)	(-0.41)	(4.89)
Observations:	**468**	**468**	**468**	**468**	**468**	**468**
Multivariable regression						
MVR coefficient	-0.240***	0.052	0.002	0.116**	0.022	0.202***
(robust standard errors):	(-4.25)	(1.00)	(0.04)	(2.05)	(0.41)	(4.47)
Observations:	**490**	**490**	**490**	**490**	**490**	**490**
MVR coefficient	-0.241***	0.048	-0.001	0.119**	0.023	0.208***
(with control functions):	(-4.26)	(0.93)	(-0.02)	(2.09)	(0.41)	(4.68)
Observations:	**490**	**490**	**490**	**490**	**490**	**490**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

No differences were found between the groups in regard to the loss of crops due to the flooding in 2012

Column 5 of Table 6.12 presents a very important characteristic in terms of this project's aims and objectives. For a household to score positively on the 'loss of crops due to flooding' characteristic, they had to report losing less than half of their harvest due to the flooding that occurred in 2012. Overall, 50 per cent of supported households lost *less* than half of their crops, compared to 53 per cent of households in the comparison villages. In reversing this measure, it is sobering to consider that half of the intervention households and 47 per cent of comparison households lost more than half of their harvest due to the flooding. The differences between the intervention and comparison households are not significant, indicating that the project did not positively affect the loss of crops by supported households.

Column 6 presents strong evidence of project impact in regard to the use of improved sanitation facilities. This is an important aspect to consider, especially in areas prone to frequent flooding. Just over 40 per cent of project households reported using improved sanitation, compared to 17 per cent of comparison households – a difference that is highly statistically significant. This indicates that the project has successfully affected the sanitation used by project households. It will be important to follow up with the project team to consider the specific interventions that may have contributed to this positive result, as this was not a primary project intervention.

6.2.7 Dimension 5: Social and institutional capability

The final dimension of resilience considered in this Effectiveness Review is the capability of institutions in the community. Another composite index was developed for this dimension and the characteristics were again weighted equally. Table 6.13 presents the results of comparisons of the intervention and comparison households. On average, the supported households scored positively on 64 per cent of the seven characteristics that make up this dimension, compared to 48 per cent for comparison households. This difference is highly statistically significant at the 99 per cent level. This indicates a strongly positive project-effect on the characteristics that make up this dimension. The remainder of this subsection will explore what particular characteristics are driving this difference.

Table 6.13: Comparison of intervention and comparison households on Social and Institutional Index

	Social and institutional capability index
Unadjusted	
Intervention group mean:	0.635
Comparison group mean:	0.479
Unadjusted difference:	0.156***
	(6.42)
Observations:	**491**
PSM	
Post-matching difference (kernel):	0.152***
	(4.93)
Observations:	**475**
Post-matching difference (no replacement:	0.162***
	(5.49)
Observations:	**468**
Multivariable regression	
MVR coefficient (robust standard errors):	0.152***
	(6.30)
Observations:	**490**
MVR coefficient (robust regression):	0.161***
	(6.63)
Observations:	**490**
MVR coefficient (with control functions):	0.152***
	(6.33)
Observations:	**490**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

The intervention households outperformed the comparison households on the social and institutional capability Index

Figure 6.11 presents the percentage of households scoring positively on each of the indicators in the social and institutional capability dimension. The indicators have been ranked for the intervention population from most deprived to least deprived. As is evident, there are clear differences between the proportions of households scoring positively on the different characteristics. Households scored most positively on aspects related to their experience of water-resource disputes and awareness of community-level disaster preparedness activities, whereas households scored least positively in receiving disaster preparedness information. Given the focus of the project under review, it is particularly interesting to compare the proportion of households who are aware of community-level disaster

preparedness activities, with those who have participated in preparedness meetings, received preparedness information, or are aware of any preparedness plan. While the supported households did not score particularly well on these latter characteristics, they are clearly better off in these regards than households in the comparison villages. It is worth pointing out that the majority of all the interviewed households said that they had not been involved in a dispute over access to water in the previous two years, hence resulting in strong performance among both groups on this measure.

Almost 80 per cent of households in the intervention villages reported being aware of disaster-preparedness activities taking place in their community

Figure 6.11: Percentage of HHs scoring positively on characteristics of the social and institutional capability dimension

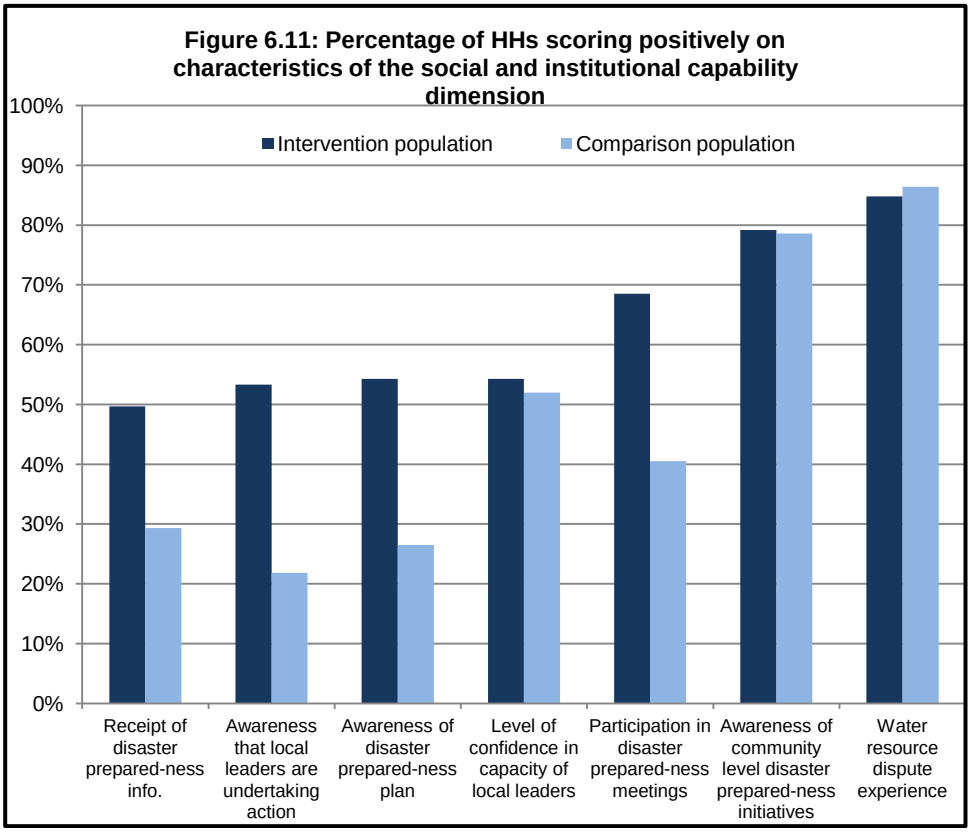


Table 6.14 presents both the unadjusted and adjusted results of the seven characteristics making up this dimension.

If we consider the first three indicators in columns 1 to 3 , we see that just over half of intervention households score positively in terms of their awareness of a community disaster-preparedness plan and their receipt of disaster-preparedness information. Over two-thirds of intervention households reported participating in disaster-preparedness meetings. The differences between the intervention and comparison households in each of these characteristics are highly statistically significant. Similar differences emerge in terms of respondents' awareness that local leaders are undertaking action (column 7). It will be important to clarify whether the relatively low proportion of households scoring positively, particularly on the former two characteristics, is a result of only a subset of villages preparing disaster-preparedness plans or holding preparedness meetings. From an initial analysis of the data, it does not appear that this is the case. While there are some differences between the villages – with Kaama and Mutalaeiti scoring lower, and Tapo and Liyoyelo scoring higher – no project village scored lower than 40 per cent on either of these two measures. Regardless of this, the results presented in Table 6.14 provide strong

evidence that the project overall has successfully affected these particular outcomes.

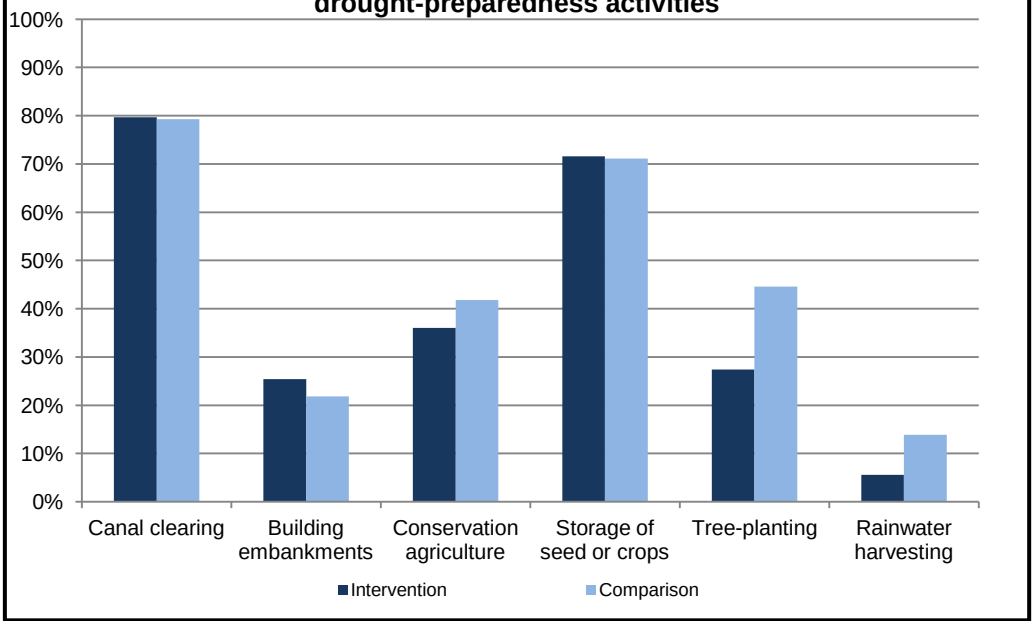
Table 6.14: HH characteristic scores – social and institutional capability dimension

	1 Awareness of disaster prepared-ness plan	2 Participation in disaster prepared-ness meetings	3 Receipt of disaster prepared-ness info.	4 Awareness of community level disaster prepared-ness initiatives	5 Water resource dispute experience	6 Level of confidence in capacity of local leaders	7 Awareness that local leaders are undertaking action
Unadjusted							
Intervention group mean:	0.543	0.685	0.497	0.792	0.848	0.543	0.533
Comparison group mean:	0.265	0.405	0.293	0.786	0.864	0.520	0.218
Unadjusted difference:	0.278***	0.281***	0.205***	0.006	-0.016	0.023	0.315***
	(6.48)	(6.33)	(4.69)	(0.16)	(-0.50)	(0.49)	(7.61)
Observations:	**491**	**491**	**491**	**491**	**491**	**491**	**491**
PSM							
Post-matching difference	0.265***	0.271***	0.232***	-0.036	0.013	0.001	0.318***
(kernel):	(4.89)	(4.80)	(4.23)	(-0.79)	(0.32)	(0.02)	(6.03)
Observations:	**475**	**475**	**475**	**475**	**475**	**475**	**475**
Post-matching difference	0.259***	0.299***	0.224***	0.011	0.029	0.000	0.305***
(no replacement:	(5.00)	(5.60)	(4.16)	(0.26)	(0.74)	(0.00)	(6.05)
Observations:	**468**	**468**	**468**	**468**	**468**	**468**	**468**
Multivariable regression							
MVR coefficient	0.321***	0.355***	0.265***	-0.007	0.045	-0.018	0.334***
(robust standard errors):	(5.62)	(6.18)	(4.72)	(-0.16)	(1.40)	(-0.32)	(6.33)
Observations:	**490**	**490**	**490**	**490**	**490**	**490**	**490**
MVR coefficient	0.322***	0.353***	0.264***	-0.009	0.044	-0.008	0.337***
(with control functions):	(5.62)	(6.14)	(4.67)	(-0.23)	(1.34)	(-0.15)	(6.39)
Observations:	**490**	**490**	**490**	**490**	**490**	**490**	**490**

t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

Column 4 presents the proportion of households reporting awareness that disaster-preparedness activities have been carried out in their community. It is interesting to note that while scores are lower for aspects related to the more formal structures of community-level disaster-preparedness *planning* (see above), almost 80 per cent of supported households are aware of community-level *activities* that are intended to mitigate some of the effects of flooding and drought. This figure is very similar to the proportion of households scoring positively in the comparison villages, and therefore the difference is not significant. With both intervention and comparison households scoring highly on this measure, this may indicate pre-existing DRR activities in the comparison villages. As a result it is difficult to estimate the effect of the project on this measure. This is supported by the results shown in Figure 6.12, which provides a breakdown of the particular activities for which respondents were asked to report on in their community. A high proportion of both intervention and comparison households report canal clearing and seed storage – both key project activities. Interestingly, comparison villages were more likely to have implemented tree-planting and rainwater harvesting interventions.

Figure 6.12: Percentage of HHs reporting awareness of various drought-preparedness activities



No significant differences were detected in the proportion of households reporting disputes related to access to or use of water (column 5).

The final characteristic to review in this dimension is the level of confidence in the capacity of local leaders to provide leadership and support in times of crisis (column 6). Just over half of intervention and comparison households scored positively on this measure. The differences between the groups are not significant, indicating no positive project effect on people's confidence in local leaders.

7 Conclusions and learning considerations

7.1 Conclusions

This Effectiveness Review found evidence that the 'Community-Led Disaster Risk Reduction Project' has positively affected several characteristics assumed important for promoting resilience among the intervention population. In particular, even after controlling for measured differences between the intervention and comparison households, the former performed between eight to 13 percentage points and four to six points better than the latter on Oxfam GB's global ARR indicator and the Base Resilience Index, respectively. Such performance in relation to the global indicator shows that 64 per cent of surveyed intervention households demonstrate greater ability to reduce risk and adapt to emerging trends and uncertainty.

Data were collected on a total of 31 indicators under five dimensions. Separate indices were created for each of these dimensions, and the intervention population was found to be better off than the comparison population on all five of them. Interestingly, evidence of impact was strongest for the 'access to contingency resources and support' and 'social and institutional capability' dimensions, and less for the 'livelihood viability' dimension. Table 7.1 summarises the Effectiveness Review's findings for each of the dimensions, as well as the specific characteristics under each of the five dimensions.

Table 7.1 shows that out of the 31 characteristics, statistically significant differences in favour of the intervention population were identified for 10 of them. The table also displays which of the characteristics were directly targeted by the project and those related to their intervention logic, as presented in Section 2. Out of the 12 characteristics directly targeted by the project, there is evidence that the projects successfully affected six of them. And, out of the 24 characteristics connected to the projects' intervention logic, there is evidence that nine were positively affected. In this light, the findings of the Effectiveness Review are reasonably positive.

In looking at more detail at the results in Table 7.1, there are some noteworthy points to be made. A first, overarching point is that some of the largest differences between the intervention and comparison households were in more output-related measures, such as participation in disaster-preparedness meetings. There is little evidence that these activities have yet resulted in changes at higher levels of the logic model presented in Section 2. For example, there was no evidence that the project has affected important resilience characteristics, such as food security, livelihood diversification, flood preparedness practice, and level of savings. It is particularly interesting to note that the lowest scores in Table 7.1 tend to be reserved for these particular characteristics. It is also important to note that while there are differences between the intervention and comparison households in the measures related to receipt of disaster-preparedness information or awareness of community-level plans, the overall scores are reasonably low. Approximately 50 per cent of project households scored positively for these measures, highlighting that there may be more work required in disseminating this important information more widely.

These observations form the basis of some of the learning considerations discussed below.

Table 7.1: Summary of disaggregated results for intervention households

Dimension	Index characteristic	Evidence of impact	Large/ modest impact	Directly targeted by project	Connected to project logic	% intervention households scoring positively
Livelihood viability	**Livelihood viability index**	**Yes**	**M**			
	Household wealth status	No		No	Yes	60%
	Household food security	No		No	Yes	37%
	Household dietary diversity	Yes	M	No	Yes	54%
	Livelihood diversification	No		Yes	Yes	41%
	Crop portfolio	No		Yes	Yes	62%
	Availability and use of early warning information	Yes	M	Yes	Yes	82%
	Flood preparedness practice	No		Yes	Yes	47%
Innovation potential	**Innovation potential index**	**Yes**	**L**			
	Attitudes towards new livelihood practices	No		Yes	Yes	75%
	Innovation practice	Yes	L	Yes	Yes	81%
	Access to credit	No		No	No	53%
	Access to state innovative support	Yes	L	Yes	Yes	45%
	Market access	No		No	Yes	33%
Access to contingency resources and support	**Contingency resources & support index**	**No**				
	Group participation	No		No	No	54%
	Social connectivity	No		No	No	40%
	Perceptions of local government emergency support	No		No	Yes	43%
	Savings	No		No	Yes	21%
	Remittances or formal earnings	No		No	No	34%
	Ownership of convertible livestock	No		No	Yes	36%
Integrity of the natural and builteEnvironment	**Natural & built environment index**	**No**				
	Fertility of local soils	No		No	No	24%
	Extent of soil erosion	No		No	No	61%
	Access to irrigation for farming	No		No	Yes	62%
	Access to water for drinking and livestock	Yes	M	No	Yes	53%
	Extent farming activities affected by flooding	No		Yes	Yes	50%
	Use of improved sanitation	Yes	L	No	No	40%
Social and institutional capability	**Social & institutional capability index**	**Yes**	**L**			
	Awareness of disaster preparedness plan	Yes	L	Yes	Yes	54%
	Participation in disaster prep. meetings	Yes	L	Yes	Yes	69%
	Receipt of disaster prep. information	Yes	L	Yes	Yes	50%
	Awareness of community level disaster risk reduction initiatives	No		Yes	Yes	79%
	Water resource dispute experience	No		No	Yes	85%
	Awareness that local leaders are undertaking action	Yes	L	No	Yes	53%
	Level of confidence in effectiveness of local leaders/institutions	No		No	Yes	54%

7.2 Programme learning considerations

While some of the findings from this Effectiveness Review are positive, there are additional lessons emerging from the results that can be applied to other projects of this type in Zambia and elsewhere. The Zambia country team, and the project team in particular, are encouraged to consider the following:

- ***Consider further research to evaluate the effects of advocacy efforts connected to this project.***

  As mentioned in the introduction to this report, the Effectiveness Review only considered the impact of the community-level interventions connected to this project. One key intended outcome from the wider project was to 'improve government capacity to lead and manage comprehensive and effective disaster risk reduction and emergency response from local to national levels'. As noted in the report, the proportion of households – particularly in comparison villages – who knew how to access state adaptation support, or had confidence in the quality of such support, was very low. These results indicate there is more work required in both improving the linkages between communities and local government support, and in strengthening the support offer from state institutions. It is interesting to note that the results for the former were more positive in the intervention villages, indicating a positive project effect on these particular issues. Findings from further research should help highlight how and why the project has positively impacted these particular results, and how advocacy efforts across the district and beyond can best be targeted.

- ***Explore how to involve community members more widely in community-level drought preparedness activities, and to ensure that training and early-warning information is fully disseminated.***

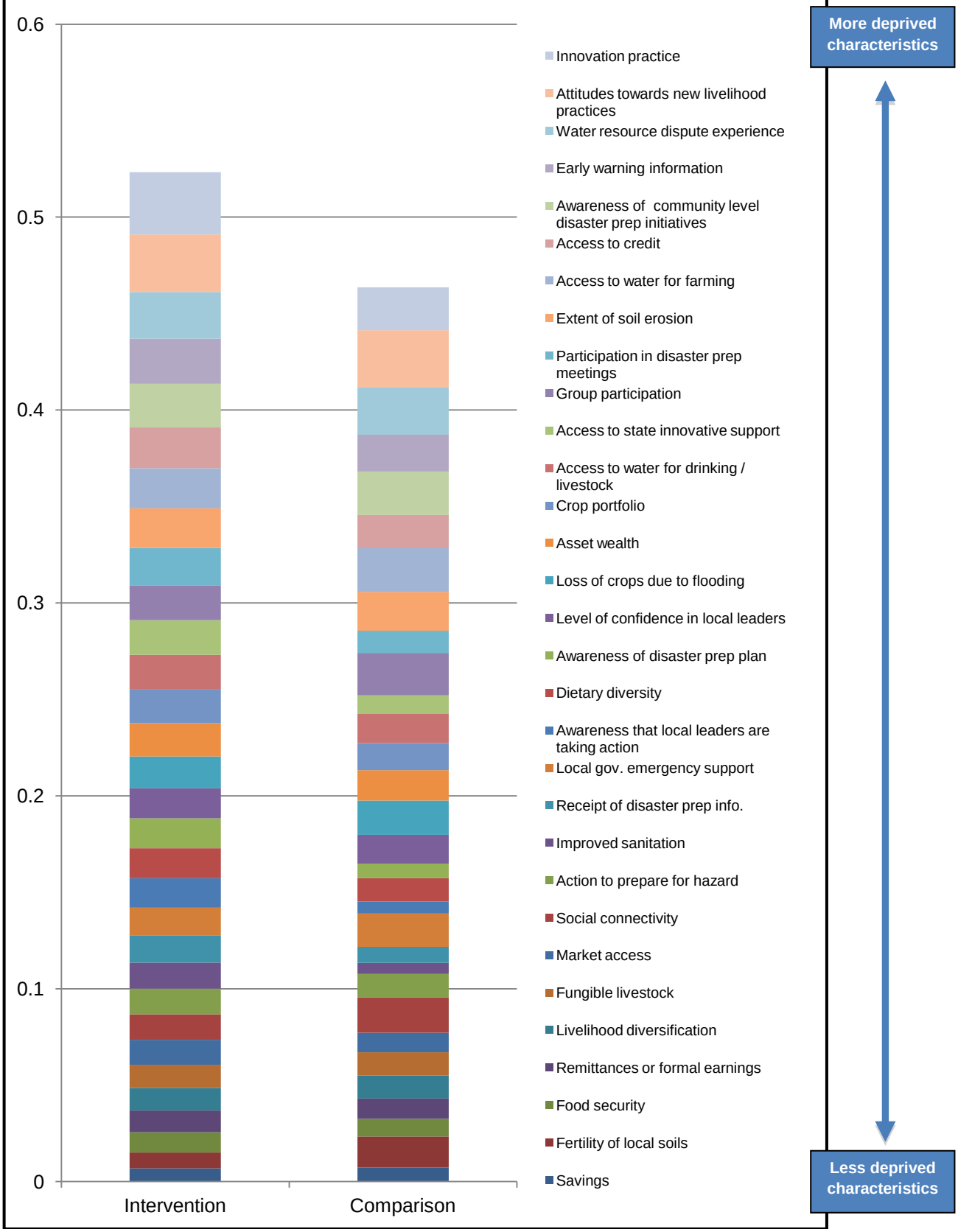
  While the project was found to have had some effect on the distribution of disaster preparedness information to community members, the fact that only half of households reported receiving or being aware of such information is a cause for concern. This suggests that there is still scope for further embedding these activities in the life of the community, and for ensuring that all households are involved and can fully benefit.

- ***Continue monitoring changes in behaviour and experiences of households in the project communities, to learn whether the project activities will eventually result in higher-level changes in risk-reduction behaviour.***

  An important observation arising from the results of this Effectiveness Review is that most of the characteristics on which the projects appear to have had impact are those directly connected to project outputs: receipt of early-warning information, involvement in community-level preparedness planning, and so on. There is little evidence that these successes have as yet resulted in higher-level changes in risk-management practices or households' vulnerability. In particular, households that received early-warning information before the flooding of 2012 were no more likely to take key preventative actions. Perhaps as a consequence, the losses suffered by these households in that year were no different from those in comparison communities.

  It is possible that more time is needed for people to build trust in the early-warning information and community-level planning structures established under this project, and so incorporate them into their household-level decision-making. In any case, it will clearly be important to continue monitoring the experience of households in the project areas and the decisions they make, to understand the extent to which any further changes come about.

Figure 7.1: Percentage of weighted characteristics households scored positively, with contribution of each to Base Resilience Index
(Characteristics ranked from most deprived to least deprived for the intervention population)



Appendix 1: Cut-offs and weights used for each characteristic

Dimension	Characteristic	Cut-off: A HH scores positively if...	Weight
Livelihood viability (20%)	• Household wealth status	It owns >=3 small assets Or >=2 big assets Or 2 small assets + 1 big asset.[6]	0.2/7
	• Household food security	It reports having to cut the size of meals, eat fewer meals, or reduce food consumed by adults in household <3 times in past week and reports no incidence of having to borrow food, going to sleep hungry, or going through a whole day with no food.	0.2/7
	• Household dietary diversity	It consumed in the past 7 days a carbohydrate source >=7 times; a protein source >=3 times; and any vegetable source >=3 times.	0.2/7
	• Livelihood diversification	It engages in >=2 livelihood activities with >= 50% dependency on activities assumed to be significantly drought tolerant.	0.2/7
	• Crop portfolio	It cultivated >=3 crop types, including at least one drought-resistant crop.	0.2/7
	• Availability and use of early warning information	It received early-warning information prior to the flooding in 2012.	
	• Flood preparedness practice	It took preparatory actions to protect the household or its assets from flooding in 2012.	0.2/7
Innovation potential (20%)	• Attitudes towards new livelihood practices	Respondent either does not agree at all or agrees only to a small extent with 2 out of the 3 negatively phrased statements (Likert scale).[7]	0.2/5
	• Innovation practice	Respondent reports having tried out or experimented with at least one new activity over the past 2 years.[8]	0.2/5
	• Access to credit	Respondent reports that household took out loan in last 2 years Or could borrow at least 500 ZMK in the event it was needed from a money lender, non-local family members, savings group, or bank/credit institution.	0.2/5
	• Access to state innovative support	Respondent reports having had accessed state extension support in new techniques in the last two years and reports at least finding the support moderately helpful.	0.2/5
	• Market access	Respondent reports having had no severe problems in accessing markets or market information.	0.2/5
Access to contingency resources and support (20%)	• Group participation	Respondent reports being an active participant in at least 2 groups with medium involvement in decision making in at least one.	0.2/6
	• Social connectivity	Respondent agrees at least to a medium extent with 3 out of the 5 positively phrased statements.	0.2/6
	• Perceptions of local government emergency support	Respondent agrees at least to a medium extent with 1 out of the 2 positively phrased statements.	0.2/6
	• Savings	Respondent states that there is enough savings to enable them to survive for at least 7 days	0.2/6

[6] One recognised way of measuring a household's wealth status is by examining the assets it owns. The 'small assets' considered here include: plough, CD player, bed, mobile phone, radio, and solar panel, while 'big assets' included milling machine, sewing machine, pressure cooker, TV, motorbike, and car. As presented in Appendix 3, data were collected on a much larger number of assets and other household wealth indicators. However, these were selected as the focus of defining the binary wealth status indicator because these assets assumed to reasonably differentiate exceptionally poorer household from those that are better off. The binary wealth status indicator is also significantly correlated with the 2012 asset index (*t*-statistic = 14.96; R2 = 0.3396).

[7] One of these statements was actually positively phrased, but the scores on the four-point agreement scale were reversed during data analysis.

[8] The list of innovative practices included doing any of the following for the first time: harvesting rainwater; cultivating a new crop; tilling soil in a new way; purchasing a new type of seed; using fertiliser; starting a new business; starting to sell crops to a new market; began rearing livestock; beginning using irrigation for crops. 'Other' was also an option, and if something was mentioned, it was assumed to be an innovative practice.

Dimension	Characteristic	Cut-off: A HH scores positively if...	Weight
		in the event of a drought.	
	• Remittances or formal earnings	It reports have receipt of transfer money from outside community and/or someone in the home has a formal job.	0.2/6
	• Ownership of fungible livestock	It reports owning at least 5 goats or at least 5 poultry.	0.2/6
Integrity of the natural and built environment (20%)	• Fertility of local soils	It reports no negative change in fertility of farm plot.	0.2/6
	• Extent of soil erosion	It does not report experiencing severe erosion.	0.2/6
	• Access to irrigation for farming	It reports having access to irrigation facilities.	0.2/6
	• Access to water for drinking and livestock	It reports no difficulties in accessing water for the household or its animals during the 2012 dry season.	0.2/6
	• Extent farming activities affected by flooding	It reports having experienced only of small portion of its crops being lost during the 2012 flooding.	0.2/6
	• Use of improved sanitation	It reports using improved sanitation facilities.	0.2/6
Social and institutional capability (20%)	• Awareness of disaster preparedness plan	It is at least partly aware of the contents of the plan.	0.2/7
	• Participation in disaster preparedness meetings	It has participated at least one meeting in past 12 months.	0.2/7
	• Receipt of disaster preparedness info.	It had received such information in past 12 months.	0.2/7
	• Awareness of community level disaster risk reduction initiatives	It is aware of at least 2 community level initiatives taken place in past 3 years.	0.2/7
	• Water resource dispute experience	It does not report being involved in any disputes in past 2 years.	0.2/7
	• Awareness of local leader/community institution action on adaptation	It is at least partly aware that community leaders/institutions are doing something on the adaptation front.	0.2/7
	• Level of confidence in effectiveness of local leaders/institutions	Respondent agrees at least to a medium extent with 1 out of the 2 positively phrased statements.	0.2/7

Appendix 2: Covariate balance following propensity score matching procedures

A. General intervention households versus comparison households

Step 1: Backwards stepwise regression: covariate ( ) excluded from participation model if .

```
. stepwise, pr (.2): logit intervention $matchvars
                     begin with full model
p = 0.8962 >= 0.2000  removing adult_s_sec
p = 0.7411 >= 0.2000  removing hh_farming_09
p = 0.7086 >= 0.2000  removing singleadultHH
p = 0.6847 >= 0.2000  removing hh_livestock_09
p = 0.6587 >= 0.2000  removing children
p = 0.6578 >= 0.2000  removing hhsize
p = 0.6142 >= 0.2000  removing age_hhh
p = 0.6400 >= 0.2000  removing eld_hhh
p = 0.4052 >= 0.2000  removing prod_hhh
p = 0.3338 >= 0.2000  removing hh_remitt_09
p = 0.2335 >= 0.2000  removing wealth_ind_09

Logistic regression                               Number of obs   =        490
                                                  LR chi2(12)     =     131.59
                                                  Prob > chi2     =     0.0000
Log likelihood =  -263.9797                       Pseudo R2       =     0.1995
```

intervention	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
literacy	.8107865	.2788483	2.91	0.004	.2642538	1.357319
fhhh	1.114328	.2491286	4.47	0.000	.6260445	1.602611
seceduc_hhh	.5813444	.2556434	2.27	0.023	.0802926	1.082396
land_09	-.2404648	.0772536	-3.11	0.002	-.3918792	-.0890505
hh_agriclab_09	-.3638701	.2333776	-1.56	0.119	-.8212819	.0935416
hh_casual_09	-.3638175	.2445106	-1.49	0.137	-.8430495	.1154146
hh_formal_09	-1.39107	.4435422	-3.14	0.002	-2.260397	-.5217437
hh_fishing_09	1.519364	.2340701	6.49	0.000	1.060595	1.978133
hh_IGA_09	.7527056	.2552387	2.95	0.003	.252447	1.252964
dependents	.1093994	.068158	1.61	0.108	-.0241879	.2429867
unprodads	.6952122	.2090473	3.33	0.001	.285487	1.104937
prodads	.2948375	.0815372	3.62	0.000	.1350275	.4546475
_cons	-2.899822	.4355897	-6.66	0.000	-3.753562	-2.046082

Step 2: Run psmatch2 with short-listed covariates, followed by pstest to assess covariate balance. pstest output – kernel:

psmatch2: Treatment assignment	psmatch2: Common support		
	Off suppo	On suppor	Total
Untreated	0	294	294
Treated	16	181	197
Total	16	475	491

```
.
. pstest `matchvars_gen_pop'
```

Variable	Sample	Mean Treated	Mean Control	%bias	%reduct |bias|	t-test t	t-test p>|t|
literacy	Unmatched	.83756	.70068	32.9		3.50	0.001
	Matched	.8232	.83326	-2.4	92.7	-0.25	0.800
fhhh	Unmatched	.40609	.30612	20.9		2.29	0.022
	Matched	.37569	.404	-5.9	71.7	-0.55	0.582
seceduc_hhh	Unmatched	.3401	.18707	35.2		3.90	0.000
	Matched	.32044	.32378	-0.8	97.8	-0.07	0.946
land_09	Unmatched	1.7411	2.0918	-22.8		-2.46	0.014
	Matched	1.7348	1.8475	-7.3	67.9	-0.77	0.442
hh_agricl~09	Unmatched	.39594	.41156	-3.2		-0.35	0.730
	Matched	.39779	.40315	-1.1	65.7	-0.10	0.917
hh_casual_09	Unmatched	.36041	.38095	-4.2		-0.46	0.645
	Matched	.35912	.32491	7.1	-66.5	0.68	0.494
hh_formal_09	Unmatched	.07107	.11224	-14.3		-1.52	0.129
	Matched	.07735	.05991	6.0	57.7	0.65	0.513
hh_fishin~09	Unmatched	.64975	.37075	58.0		6.29	0.000
	Matched	.62431	.62367	0.1	99.8	0.01	0.990
hh_IGA_09	Unmatched	.37056	.2517	25.8		2.84	0.005
	Matched	.36464	.32449	8.7	66.2	0.80	0.423
dependents	Unmatched	2.8173	2.3605	26.6		2.95	0.003
	Matched	2.6133	2.6045	0.5	98.1	0.05	0.960
unprodads	Unmatched	.41117	.21429	31.2		3.55	0.000
	Matched	.33702	.33735	-0.1	99.8	-0.01	0.996
prodads	Unmatched	2.5939	2.2075	27.3		3.02	0.003
	Matched	2.5083	2.3923	8.2	70.0	0.75	0.457

pstest output – noreplacement:

psmatch2: Treatment assignment	psmatch2: Common support		
	Off suppo	On suppor	Total
Untreated	0	294	294
Treated	23	174	197
Total	23	468	491

```
.
. pstest `matchvars_gen_pop'
```

Variable	Sample	Mean Treated	Mean Control	%reduct %bias	%reduct |bias|	t-test t	t-test p>|t|
literacy	Unmatched	.83756	.70068	32.9		3.50	0.001
	Matched	.81609	.78161	8.3	74.8	0.80	0.424
fhhh	Unmatched	.40609	.30612	20.9		2.29	0.022
	Matched	.37356	.37931	-1.2	94.3	-0.11	0.912
seceduc_hhh	Unmatched	.3401	.18707	35.2		3.90	0.000
	Matched	.3046	.26437	9.3	73.7	0.83	0.407
land_09	Unmatched	1.7411	2.0918	-22.8		-2.46	0.014
	Matched	1.7471	1.931	-11.9	47.6	-1.13	0.259
hh_agricl~09	Unmatched	.39594	.41156	-3.2		-0.35	0.730
	Matched	.4023	.38506	3.5	-10.3	0.33	0.743
hh_casual_09	Unmatched	.36041	.38095	-4.2		-0.46	0.645
	Matched	.35632	.33333	4.8	-11.9	0.45	0.653
hh_formal_09	Unmatched	.07107	.11224	-14.3		-1.52	0.129
	Matched	.08046	.08046	0.0	100.0	-0.00	1.000
hh_fishin~09	Unmatched	.64975	.37075	58.0		6.29	0.000
	Matched	.6092	.50575	21.5	62.9	1.95	0.052
hh_IGA_09	Unmatched	.37056	.2517	25.8		2.84	0.005
	Matched	.35632	.28161	16.2	37.1	1.50	0.136
dependents	Unmatched	2.8173	2.3605	26.6		2.95	0.003
	Matched	2.5805	2.4598	7.0	73.6	0.68	0.495
unprodads	Unmatched	.41117	.21429	31.2		3.55	0.000
	Matched	.32759	.26437	10.0	67.9	1.05	0.292
prodads	Unmatched	2.5939	2.2075	27.3		3.02	0.003
	Matched	2.4483	2.3391	7.7	71.7	0.71	0.476

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