Evaluation Climate Change Adaptation and Advocacy Project in Nepal

Project Effectiveness Review

Full Technical Report

Oxfam GB
Adaptation and Risk Reduction Outcome indicator

April, 2013

Acknowledgements

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Photo: Oxfam GB, Women from Dolakot village construct a pond to irrigate their land.

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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. Nepal's 'Climate Change Adaptation and Advocacy' project was randomly selected for an Effectiveness Review under the adaptation and risk reduction thematic area. The project aims to increase climate change resilience among target groups in Dadeldhura district of western Nepal, through creation of livelihood options and incorporation of climate change adaptation practices in district- and national-level plans and programmes.

The community-level activities carried out included awareness-raising on climate change, provision of high-yielding and drought-tolerant varieties of cereal crop seeds, introduction of other vegetable seeds to encourage crop diversification, together with the implementation of various water resource conservation schemes. These project activities were implemented between 2009 and 2012 in seven communities in the Alital Village Development Committee (VDC) area in Dadeldhura, by a local partner organisation – Integrated Development Society (IDeS).

To assess the effectiveness of this project, a quasi-experimental impact evaluation was implemented. This involved carrying out surveys with households in the seven communities supported by the project, as well as with households in eight nearby comparison communities. In all, surveys were carried out with 437 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 affecting 30 '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 30 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:

- % of households demonstrating greater ability to minimise risk from shocks and adapt to emerging trends and uncertainty (as measured by the Alkire-Foster Resilience Index).

Following analysis of the data, there is evidence that the project positively affected several important 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 29 and 32 percentage points and 17–19 points better than the latter on Oxfam GB's global ARR indicator and the Alkire-Foster Resilience Index, respectively. Strong performance in relation to the global indicator shows that in total, 86 per cent of surveyed intervention households demonstrate greater ability to reduce risk and adapt to emerging trends and uncertainty than the 'typical' comparison household.

While this effectiveness review generated positive results, it also identified opportunities for reflection and learning. Oxfam in general and the Nepal country team and partners in particular are encouraged to consider the following:
- Consider further research to evaluate the effects of advocacy efforts connected to this project.
- Keep monitoring progress of the supported villages, and consider whether it is appropriate to scale-up the project interventions to the wider area.
- Explore options for strengthening the support to existing livelihood practices by considering greater investment in the improved cereal seed and water resource management components of the project.

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 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.

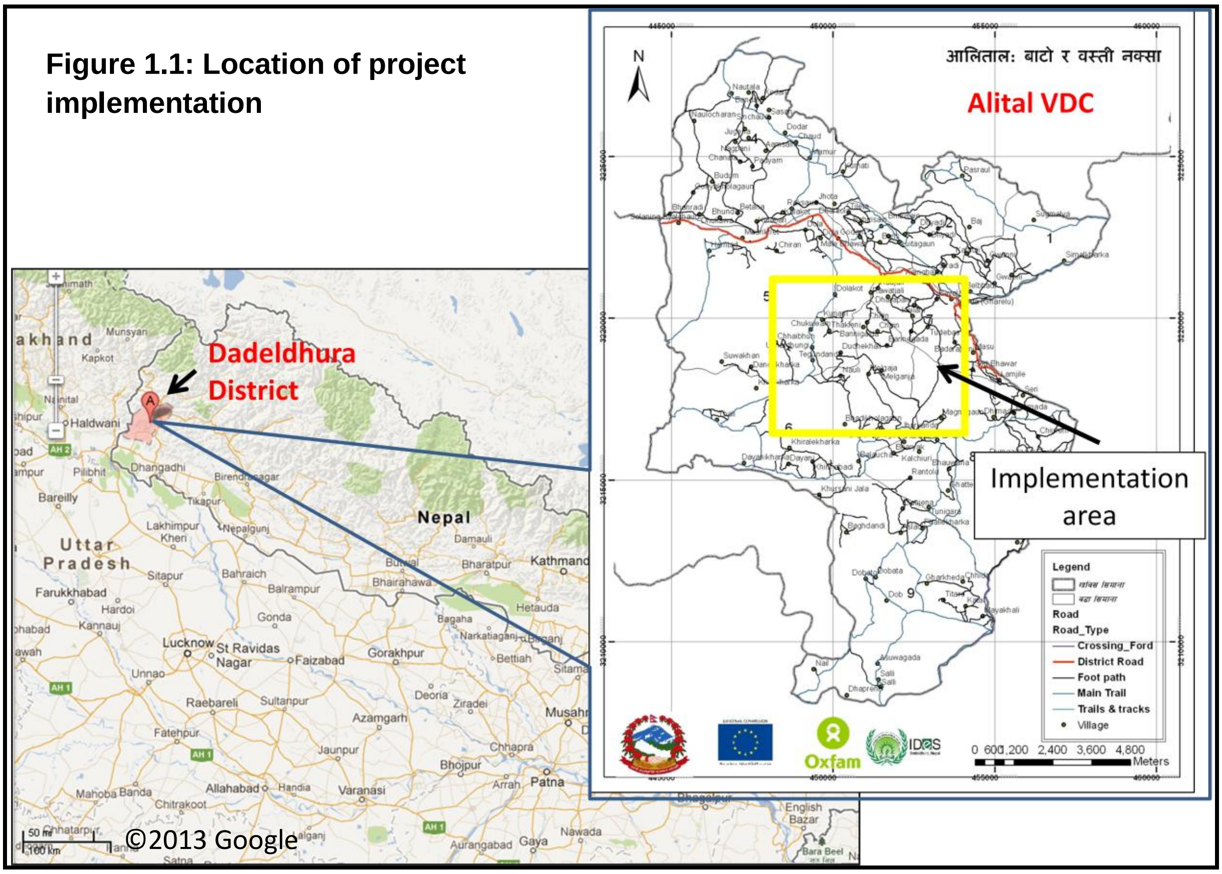
The effectiveness review that took place in Alital VDC in Dadeldhura district in December 2012, intended to evaluate the success of the Climate Change Adaptation and Advocacy Project in promoting resilience to climatic shocks among supported households. Although the project started in two districts – Dadeldhura and Nawalparasi, the activities in the latter were phased out during 2011 due to various programmatic and technical reasons. Therefore the focus of the review was on the seven communities in Dadeldhura supported by the project through to its completion in March 2012. The project activities were implemented by a local partner organisation – Integrated Development Society (IDeS).

The project's overall objective was to increase climate change resilience among target communities through the creation of livelihood options and incorporation of climate change adaptation practices in district- and national-level plans and programmes. The activities undertaken to achieve the first part of the objective included:

- Awareness raising on climate change: including posters depicting impact of climate change on people's livelihoods, development of training materials related to various adaptation measures, and two-day training events on community-based adaptation to climate change. Exposure visits were also organised between the communities to see where community-based adaptation schemes had been demonstrated successfully.
- Introduction of high-yielding-variety seeds of major cereal crops tolerant to local climatic conditions.
- Introduction of other vegetable seeds to encourage crop diversification.
- Implementing various water resource conservation schemes, including construction of check dams, tree planting, rehabilitation of springs, construction of household level rainwater harvesting tanks, and construction of irrigation ponds.

The second part of the objective was to be achieved through building the advocacy capacity of key climate action network and alliances, to ensure mainstreaming of community-based adaptation practices into national and district level plans and programmes. This component of the project was not limited to the supported communities in Alital VDC, 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, and Section 3 follows by introducing the framework for measuring resilience that was adopted. Section 4 then goes on to describe the evaluation design, while Section 5 describes how this design was implemented. Section 6 thereafter 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 the document with a summary of the findings and some programme learning considerations.

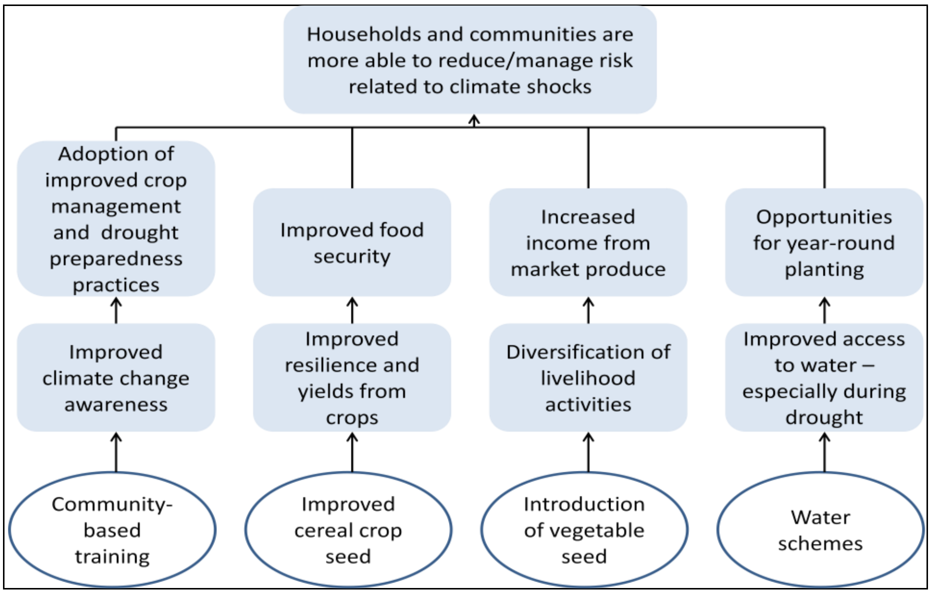
2 Intervention logic of project

Figure 2.1 shows a simple diagram of 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 drought, flood, water scarcity and crop failure.

The community-based training contributes to this through increasing the awareness of community members to climate-change hazards and providing a forum to discuss adaptation interventions that can be applied at a community level (e.g. check-dam construction, water-point rationing, etc.).

The project is also providing high yielding variety seeds of major cereal crops suitable to the local climatic conditions, with the intention to increase 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.

Figure 2.1: Project theory of change (simplified)



The introduction of vegetable seed – for example, peas, tomatoes and cauliflower – to the supported communities was intended to encourage a more diversified livelihood base for farmers, who have traditionally relied on subsistence crops, including wheat, maize and paddy. 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 high-value vegetables.

The introduction of both improved cereal and vegetable seeds was complemented by a number of water schemes, such as construction of check-dams, irrigation ponds, rehabilitation of water springs, and provision of household rainwater-harvesting tanks. The overarching aim of these various activities was to reduce current levels of water shortage, which are particularly exacerbated during the dry months (February–May). As well as providing more secure availability of safe drinking water, it was also intended to permit longer growing seasons in the supported communities.

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:

- **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.

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

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 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.

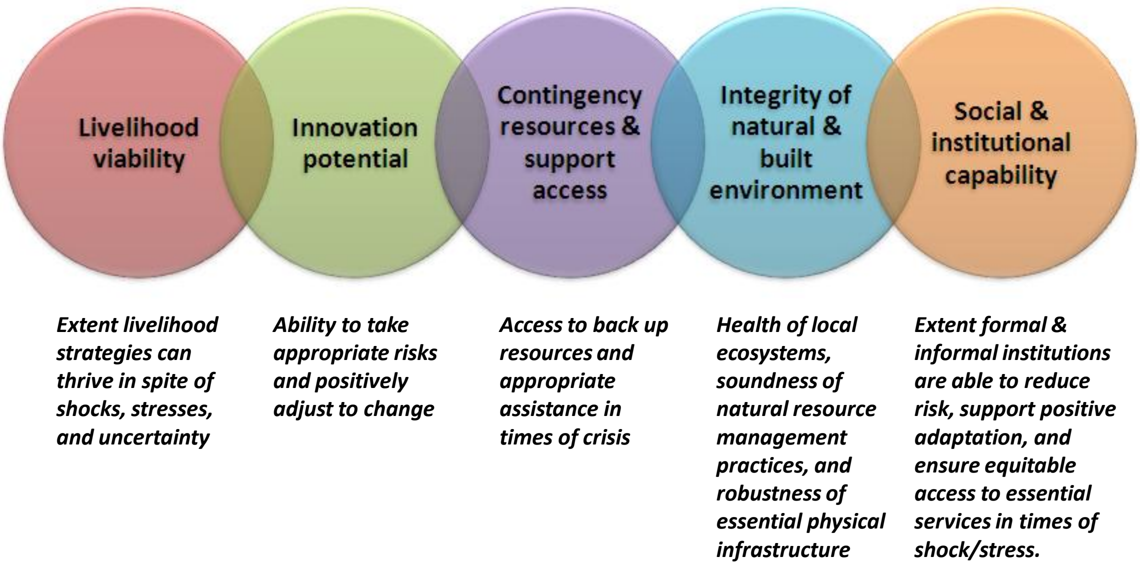
[1] Alkire, S. and Foster, J. (2011) 'Counting and multidimensional poverty measurement.' *Journal of Public Economics,* 95**:** 476–487.
[2] Dodman, D., Ayers, J. and Huq, S. (2009) 'Building Resilience', Chapter 5, in World Watch Institute (ed.), *2009 State of the World: Into a Warming World*, Washington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

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

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, for instance, a household dependent on just one precarious livelihood activity is likely to be more negatively affected than another that has one or more less sensitive alternatives to fall back on, *all other things being equal*. In addition, households that are on the margins of survival are less likely to be resilient than their relatively more wealthy counterparts. Where longer-term climatic trend prediction information exists, it is also important to assess how viable current livelihood strategies would be given the range of likely future climatic scenarios.

FIGURE 3.1:

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



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

It is further recognised that healthy ecosystems are better able to cope/adjust to climatic shocks/change than those that are relatively 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 of 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 specify 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 Nepal Effectiveness Review

As mentioned above, 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 Dadeldhura climatic and agricultural context. These characteristics are presented in Table 3.1 by dimension, along with a summary rationale for including each.

Data was collected on a total of 30 characteristics under the five dimensions

As can be seen in the table, data were collected on a total of 30 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 drought than are their more wealthy counterparts. The levels of livelihood and crop diversification are also assumed to be important, so that the household in question has something to fall back on in times of stress. The gender risk differential characteristic was further added to examine whether women’s livelihood activities are more at risk than are those of men. Finally, a farming household is also assumed more likely to cope better with drought if its crop portfolio is sufficiently diverse.

[3] Ibid

Table 3.1: Specific ARR characteristics used in the Nepal 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
	Livelihood risk – males in HH	HHs dependent on climate related activities = more risk
	Livelihood risk – females in HH	HHs dependent on climate related activities = more risk
	Crop portfolio	HHs with a greater crop portfolio assumed to be at less 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
Access to contingency resources and support	Group participation	More opportunities for support in times of crisis
	Social connectivity	More opportunities for support in times of crisis
	Perceptions of local government emergency support	Level of confidence of HHs assumed related to what will actually happen in times of crisis
	Savings	The more savings a HH has, the more it can cope in crises
	Remittances or formal earnings	Better access to remittances = better coping in crises
Integrity of the natural and built environment	Fertility of local soils	High fertility increases productivity
	Extent of soil erosion	High levels of soil erosion decrease productivity
	Access to irrigation for farming	Enables yields to be maintained despite rainfall variability
	Access to safe drinking-water year round	More difficulties in access makes it more difficult to cope
	Extent of vegetative cover in farm plot	Greater cover increases groundwater recharge
	Extent farming activities affected by drought	Greater impact of drought on farming = more risk
Social and institutional capability	Awareness of drought preparedness plan	Indicates planning is taking place + public participation
	Participation in drought prep. meetings	Indicates planning is taking place + public participation
	Receipt of drought prep. information	Indicates that community institutions are fulfilling roles
	Awareness of community level drought risk reduction initiatives	Indicates that community institutions are fulfilling roles
	Water resource dispute experience	Levels of conflict reflect 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

Five 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 and innovation support. 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. Five characteristics are defined under the Access to Contingency Resources and Support Dimension. Two of these relate to things directly possessed or received by the household in question: savings and remittances/formal earnings. 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, access to water in times of drought is clearly a critically important characteristic. However, given that vast numbers of households are dependent on agriculture, the extent of soil erosion, soil fertility, vegetation cover, 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.

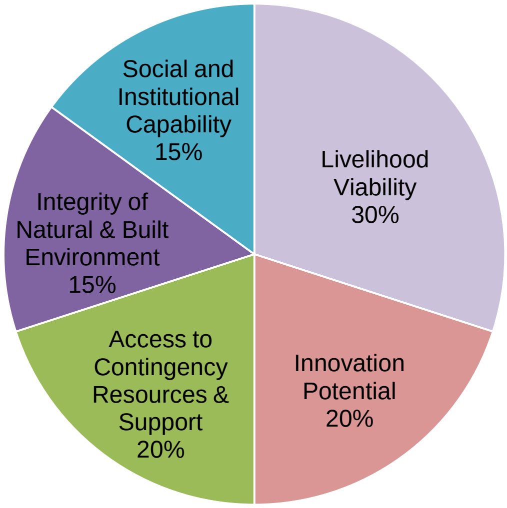
3.3 Constructing the resilience indices

Following the Alkire-Foster[4] method, binary cut-offs were defined for each of the 30 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 in order to calculate the overall resilience measures. Figure 3.2 presents the higher-level dimensional weights that were used to construct the resilience indices.

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

The 30 characteristics used to create the indices were not weighted equally

Figure 3.2:
Dimensional Weights Used



It is readily apparent that the dimensions are not weighted equally, something that requires justification. The context in which the project is being implemented in is one in which there are recurrent droughts, floods and other climatic shocks that negatively affect the livelihoods of the targeted population. Consequently, developing strong livelihoods that can still thrive is such a context is absolutely critical, hence, justifying the greater weight given to the livelihood viability dimension. At the same time, climate change is a reality and there is a need for both adaptation and access to resources and support during times of intense stress. Consequently, the innovation potential and access to contingency resources and support dimensions are each weighted at 20 per cent. The integrity of the natural environment in the context is important, but directly relates to securing viable livelihoods. As such, it is strongly connected to the livelihood viability dimension, resulting in it being given less weight. Finally, the ability of the targeted households to cope effectively with stress and adapt to emerging trends and uncertainty is assumed to be more influenced by their own characteristics and efforts, rather than those of local leaders and institutions. Therefore less weight was given to the social and institutional capability dimension.

3.4 The overall resilience measures

The first measure of overall resilience that was used to derive the results detailed in Section 6.2 below is the proportion of characteristics the household scored positively on. Furthermore, 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 which 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 or not the AF resilience index is greater than the median of the comparison group.

4 Impact assessment design

4.1 Limitations in pursuing the 'gold standard'

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

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*

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

The randomised experiment is regarded by many as the most credible way of estimating the counterfactual, particularly when the number of units (e.g. people, households, or, in some cases, communities) that are being targeted is large. The random assignment of a sufficiently large number of such units to intervention and control groups should ensure that the statistical attributes of the two resulting groups are similar in terms of 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 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 when the comparison group is non-equivalent that can – particularly when certain assumptions are made – identify reasonably precise intervention effects. 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.

The problem, however, with conventional matching methods is that, with large numbers of characteristics on which to match, it is difficult to find comparators with similar combinations of characteristics for each of the units in the intervention group. The end result, typically, is that only a few units from the intervention and comparison groups get matched up. 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.)

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

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. The way propensity score matching (PSM) works is a 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 are 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]

[5] One of the MVR procedures that was 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.

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 below).

While no baseline data were available, 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. First, 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 end line measure of outcome (i.e. end line 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.

4.3 Intervention and comparison villages surveyed

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 will likely 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.

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

In this case, the project activities under review had been implemented in communities from a VDC 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 Alital VDC. 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 Consultant 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 supported 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 16 enumerators was locally recruited from Dadeldhura 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 Alital VDC. Following this exercise, the performance of each of the enumerators was reviewed individually before their appointments were confirmed.

The enumerator team was divided into three groups and mobilised to different areas in the VDC 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 through a local contact person of the enumerators arriving to survey households. 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 in one case where a local leader of one of the selected villages refused to allow just one village in the Ward to be surveyed. Asladi-Dobato was one of the selected comparison communities with a total of 62 households. The coordinator of the local Citizen's Ward Forum requested that all 200 households in the Ward be surveyed or none at all. After attempts to explain the purpose of the survey, and the impracticality of surveying all 200 households failed to convince the local leader, two other communities were selected instead – Chaud, with a total of 49 households, and Chiraan, with an estimated 45–50 households. These have comparable background characteristics to project communities with regard to their socio-economic status, risk profile, market access, and agricultural practices.

A total of 437 households were interviewed – 173 from intervention villages, and 264 from comparison villages

Table 5.1 shows the numbers of households interviewed in each community in the survey. A total of 437 households were interviewed, of which 173 were in project communities and the remaining 264 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**
Jharkanda/Makwanpur	49	Bhandi/Aaakhali	60
Nauli	24	Lamijule	29
Chain	28	Dayani	20
Tekundanda	21	Chaud	42
Dandakharkha	11	Kantipur	19
Dolakot	13	Chaudala	28
Melganja	27	Mamur	23
		Chiraan	43
Totals	**173**		**264**

5.2 Data analysis

Data-entry tools were developed in Adobe Acrobat Pro. Date-entry from the completed questionnaires was done in the Oxfam office in Dadeldhura by a team of four temporary staff, managed by the Consultant. 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 facilitate statistical hypothesis testing. (See Appendix 2 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 Dadeldhura district, the data collection process was completed successfully. However, some factors were encountered which affect the analysis process and the interpretation of results presented in Section 6:

- **Some significant differences baseline and demographic differences between intervention and comparison groups**

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

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 supported households were dropped because of the absence of appropriate comparison households. In particular, eight of the 173 intervention households were dropped using the PSM kernel model, and eight 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 drought 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 (0.60). 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. That being said, the other four characteristics measured using the Likert scales show high degrees of internal consistency.

6 Results

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 stars 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
Respondent HH head	0.382	0.424	-0.043	-0.89
Respondent female	0.497	0.439	0.058	1.18
Distance to district centre (hrs)	4.48	4.29	0.192*	1.66
Distance to nearest market (mins)	81.127	72.231	8.896**	2.14
HH female headed	0.040	0.091	-0.050**	-2.01
Head has secondary education	0.202	0.220	-0.017	-0.43
Adult has secondary education	0.613	0.534	0.079	1.62
HH elderly headed	0.202	0.208	-0.006	-0.15
Age of head of HH	45.723	46.458	-0.736	-0.53
Head of HH is productive	0.873	0.830	0.043	1.23
Household size	6.832	6.913	-0.081	-0.27
Number of adults in HH	3.642	3.610	0.032	0.17
Number of children in HH	3.191	3.303	-0.112	-0.65
Number of young children in HH	2.098	2.250	-0.152	-1.00
Number of dependents	2.509	2.598	-0.090	-0.53
Number of unproductive adults	0.410	0.348	0.062	0.95
Number of productive adults	3.208	3.231	-0.023	-0.13
HH has only one adult	0.012	0.019	-0.007	-0.60
HH grew crops at baseline	0.994	0.981	0.013	1.16
HH reared livestock at baseline	0.925	0.833	0.092***	2.80
HH ran off-farm IGA at baseline	0.185	0.114	0.071**	2.10
HH did casual labour at baseline	0.711	0.606	0.105**	2.25
HH did formal work at baseline	0.098	0.064	0.034	1.29
Household received remittances at baseline	0.526	0.424	0.102**	2.09
HH wealth index at baseline (PCA)	0.047	-0.031	0.077	0.42
% income from farming at baseline	30.00	35.61	-0.561***	-3.30
% income from rearing livestock at baseline	24.57	23.11	0.146	1.01
% income from IGA at baseline	3.76	2.20	0.156*	1.79
% income from casual labour at baseline	16.59	17.65	-0.106	-0.59
% income from formal labour at baseline	2.54	1.97	0.057	0.69
% income from community at baseline	5.55	5.83	-0.028	-0.31
% income from remittances at baseline	16.99	13.64	0.336*	1.77
Land area used for crops at baseline	10.376	9.322	1.054	1.28
Observations	**173**	**264**		

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

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

- Households in the project communities are on average further from the district centre and nearest market.
- Households in the comparison communities are significantly more likely to be female-headed than households in the project communities.

- Household in the project communities were more likely to rear livestock at baseline (2009).
- Households in the project communities were also more likely to have run an off-farm IGA, and have members employed as casual labourers at baseline.
- Presumably as a consequence of the greater importance of these alternative income sources, farming was reported to be a less important contributor to overall household income at baseline in 2009. Specifically, households in the project communities reported that farming contributed 30 per cent of household income in 2009, compared to 36 per cent in the comparison communities.
- Further, a greater proportion of income in project households was reported as coming from remittances in 2009.

Given that there are some significant baseline and demographic differences between the supported 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 above, 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 characterstics and deprived if otherwise. The cut-offs which were used in this analysis are presented in Appendix 1.

Just less than half of supported households scored positively on two-thirds or more of the resilience characteristics

Just less than half of supported households (48 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 95 per cent of the characteristics, but that the majority of households scored positively on between 55 per cent and 75 per cent of the characteristics.

Figure 6.2 overlays the proportion of characteristics in which households from comparison communities scored positively. What is immediately apparent is the difference in distribution between the intervention and comparison households. The majority of comparison households scored positively on between 40 per cent and 70 per cent of characteristics, and the distribution as a whole is 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 BRI

Figure 6.1: Histogram of base Resilience Index for intervention households

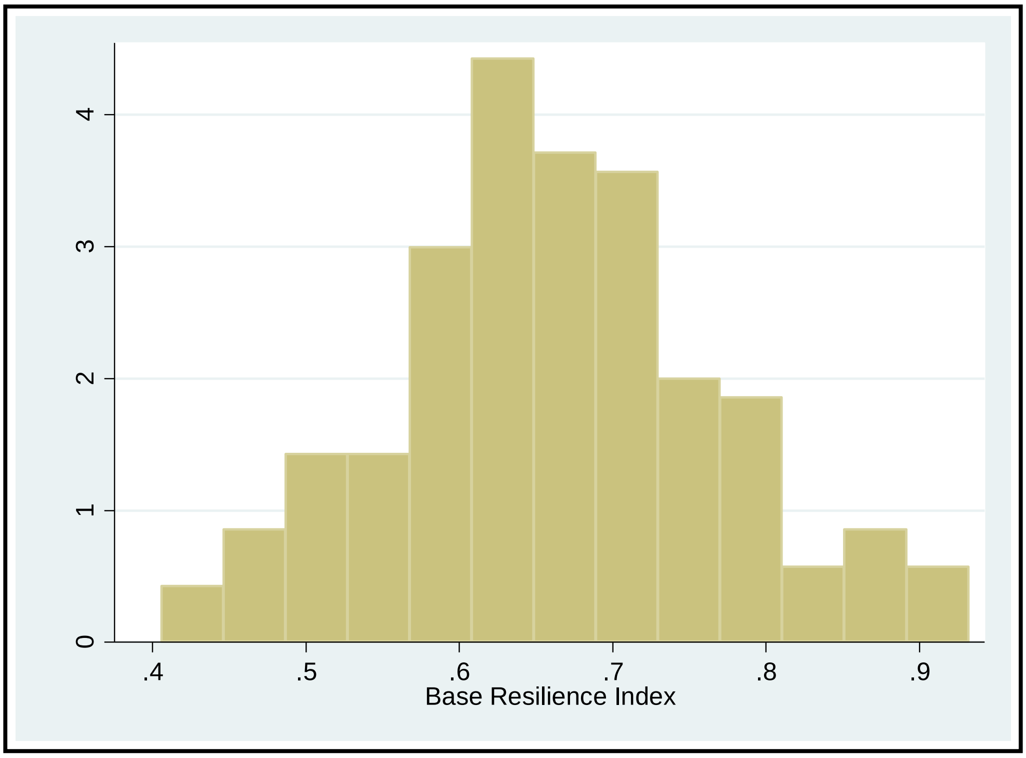
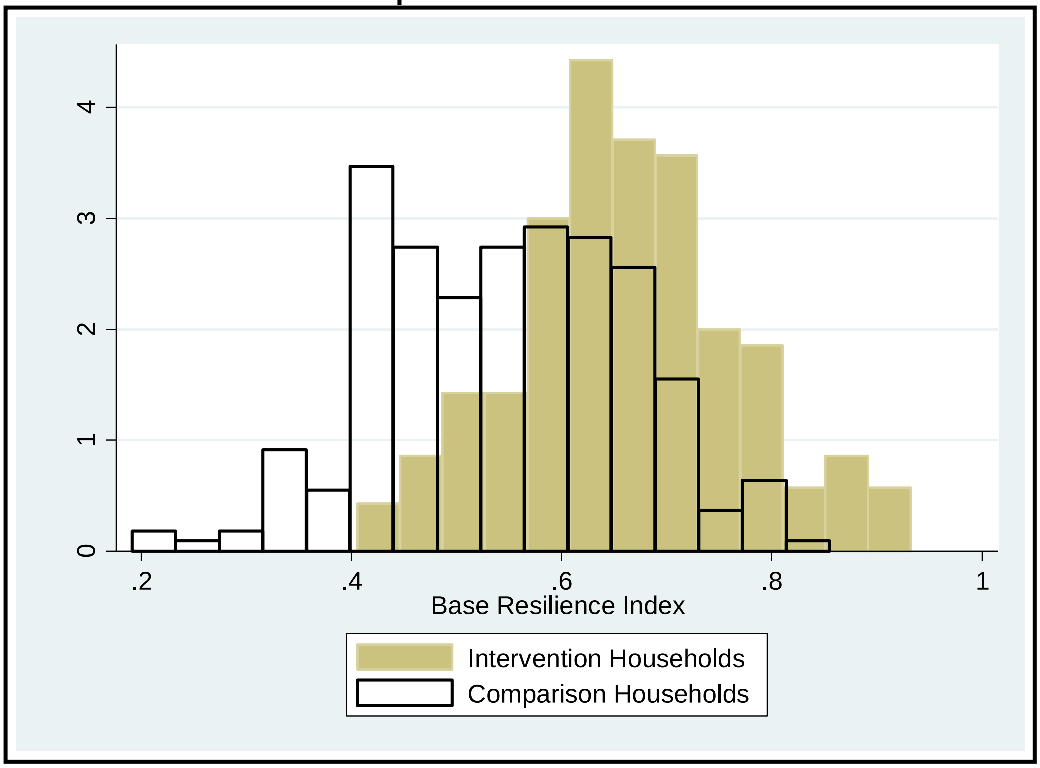


Figure 6.2: Histogram of base Resilience Index for intervention and comparison households



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

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.

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:	0.665	0.784	0.861	0.480
Comparison group mean:	0.545	0.591	0.500	0.163
Unadjusted difference:	0.119***	0.193***	0.361***	0.317***
	(10.57)	(9.54)	(8.27)	(7.59)
Observations:	**437**	**437**	**437**	**437**
PSM				
Post-matching difference	0.104***	0.183***	0.294***	0.327***
(kernel):	(8.89)	(8.94)	(6.08)	(7.04)
Observations:	**429**	**429**	**429**	**429**
Post-matching difference	0.106***	0.173***	0.321***	0.285***
(no replacement):	(8.41)	(7.56)	(7.09)	(5.79)
Observations:	**429**	**429**	**429**	**429**
Multivariable Regression				
MVR coefficient	0.103***	0.170***	0.370***	0.316***
(robust standard errors):	(9.81)	(8.71)	(6.94)	(6.53)
Observations:	**437**	**437**	**437**	**431**
MVR coefficient	0.102***	0.188***	n/a	n/a
(robust regression):	(9.23)	(9.04)		
Observations:	**437**	**437**		
MVR coefficient	0.104***	0.172***	0.380***	0.319***
(with control functions):	(9.91)	(8.81)	(7.00)	(6.64)
Observations:	**437**	**437**	**437**	**431**

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 67 per cent of characteristics, and the comparison households in 55 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, the five statistical models all concur that the supported group members were resilient in a higher proportion of the characteristics than were the comparison group members. Here, the estimates of this difference range from 10 to 11 percentage points – a difference which is highly statistically significant.

It is clear from the table that there are also highly statistically significant 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).

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

In order to generate the Alkire-Foster resilience 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. 20 or more of the 30 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.

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 **86 per cent of surveyed intervention households demonstrate greater ability to reduce risk and adapt to emerging trends and uncertainty than the 'typical' comparison household**.

Column 4 presents the proportion of households scoring positively in more than two-thirds of the resilience characteristics. As is evident, almost half of intervention households are above this cut-off, compared to 16 per cent of comparison households. Again, this difference is highly statistically significant.

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 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 3.0 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 robust to the possible existence of omitted variable bias.

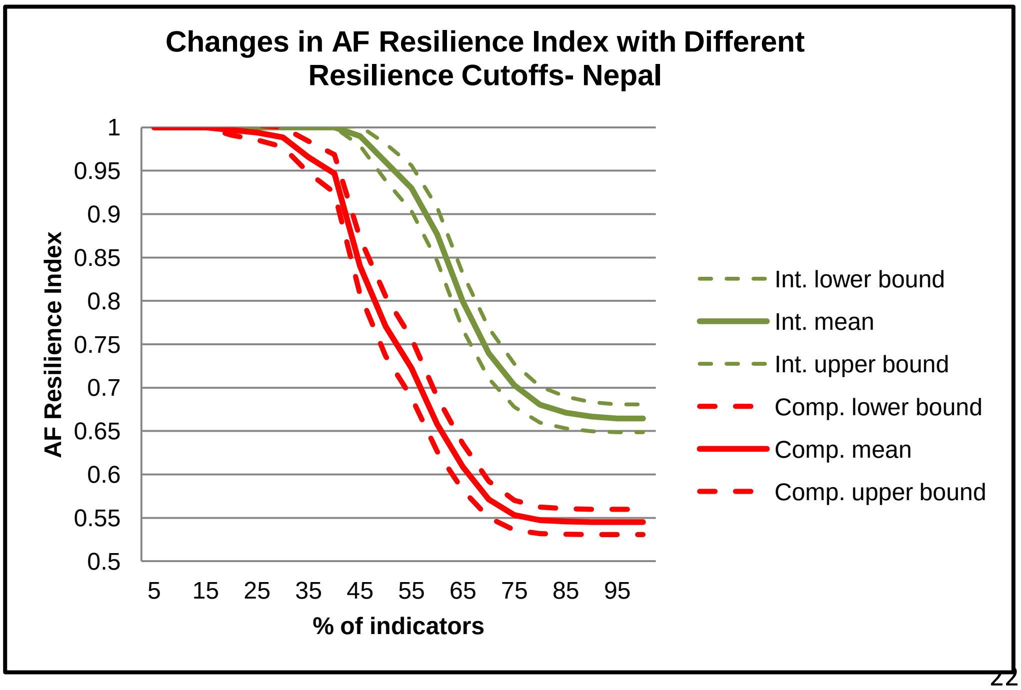
The estimated impact of the projects on the AF resilience index is robust to omitted variable bias

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−
1.8	0.000042	0.098214	0.040357	0.308571
2	0.000297	0.080357	0.027857	0.322143
2.2	0.001379	0.066428	0.018572	0.337857
2.4	0.004699	0.054643	0.011071	0.352143
2.6	0.012642	0.043214	0.001786	0.364643
2.8	0.028277	0.035357	-0.00036	0.379286
3	0.054621	0.0275	-0.00714	0.389643
3.2	0.093766	0.023214	-0.01429	0.398929
3.4	0.146244	0.017857	-0.02286	0.408214
3.6	0.210844	0.013214	-0.02714	0.418928
3.8	0.284882	0.008214	-0.03357	0.428929

Another important question is how robust the resilience index is to the choice of two-thirds (20 characteristics) as the cut-off for positive overall resilience. Figure 6.3 shows how the value of the resilience index for the supported 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). Clearly, the mean resilience score of the supported households is equal to or higher than the mean resilience score of the comparison households at all cut-off values. This indicates that we can be confident that the positive difference for this index holds, regardless of which cut-off we choose.

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



It is further important to point out that the resilience measurement framework presented in Section 3 resulted in capturing data on both the 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 projects were intentionally attempting to affect include:

- Livelihood diversification
- Crop portfolio
- Attitudes towards new livelihood practices
- Awareness of climate change
- Innovation practice
- Group participation
- Access to irrigation for farming
- Access to safe drinking-water year round
- Extent farming activities affected by drought
- Awareness of drought preparedness plan
- Participation in drought preparedness meetings
- Receipt of drought preparedness information
- Awareness of community-level drought risk reduction initiatives.

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

- Household wealth status
- Household food security
- Household dietary diversity
- Access to state innovative support
- Savings
- Fertility of local soils
- Extent of soil erosion
- Extent of vegetative cover in farm plot.

Further indices were created to analyse those specific characteristics the project was trying to affect

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 30 indicators.

As is evident, the *t*-statistics are very similar across the various indices. This is quite 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 30 and 13 characteristics, respectively. One may expect more significant differences when the focus is narrowed to only those characteristics that are directly related to the project. It is clear, however, that the strongly positive results do not change significantly regardless of whether the focus is on the project-specific, expanded or full list of resilience characteristics. This suggests that the project has successfully affected characteristics of resilience beyond those specifically targeted by the project.

The strongly positive results also apply when we just analyse those characteristics the project was specifically trying to affect

Table 6.4: Base resilience indices vs. project focused resilience indices

	Base Resilience Index	**Project-specific Resilience Index**	**Expanded Project Resilience Index**
Unadjusted			
Intervention group mean:	0.665	0.613	0.616
Comparison group mean:	0.545	0.429	0.473
Unadjusted difference:	0.119***	0.184***	0.143***
	(10.57)	(11.51)	(11.34)
Observations:	**437**	**437**	**437**
PSM			
Post-matching difference	0.104***	0.171***	0.136***
(kernel):	(8.72)	(9.75)	(9.77)
Observations:	**429**	**429**	**429**
Post-matching difference	0.106***	0.165***	0.132***
(no replacement:	(8.45)	(9.29)	(9.06)
Observations:	**429**	**429**	**429**
Multivariable Regression			
MVR coefficient	0.103***	0.160***	0.129***
(robust standard errors):	(9.81)	(10.10)	(10.50)
Observations:	**437**	**437**	**437**
MVR coefficient	0.102***	0.168***	0.127***
(robust regression):	(9.23)	(10.20)	(10.22)
Observations:	**437**	**437**	**437**
MVR coefficient	0.104***	0.161***	0.129***
(with control functions):	(9.91)	(10.17)	(10.55)
Observations:	**437**	**437**	**437**

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 **strong evidence that the project has successfully affected overall resilience**, as measured by this framework.

6.2.2 Decomposition of resilience index

Given that there is strong 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:	0.799
Comparison group mean:	0.743
Unadjusted difference:	0.056***
	(2.91)
Observations:	**437**
PSM	
Post-matching difference	0.028
(kernel):	(1.38)
Observations:	**429**
Post-matching difference	0.042**
(no replacement:	(2.02)
Observations:	**429**
Multivariable Regression	
MVR coefficient	0.038**
(robust standard errors):	(2.24)
Observations:	**437**
MVR coefficient	0.028
(robust regression):	(1.55)
Observations:	**437**
MVR coefficient	0.040**
(with control functions):	(2.32)
Observations:	**437**

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

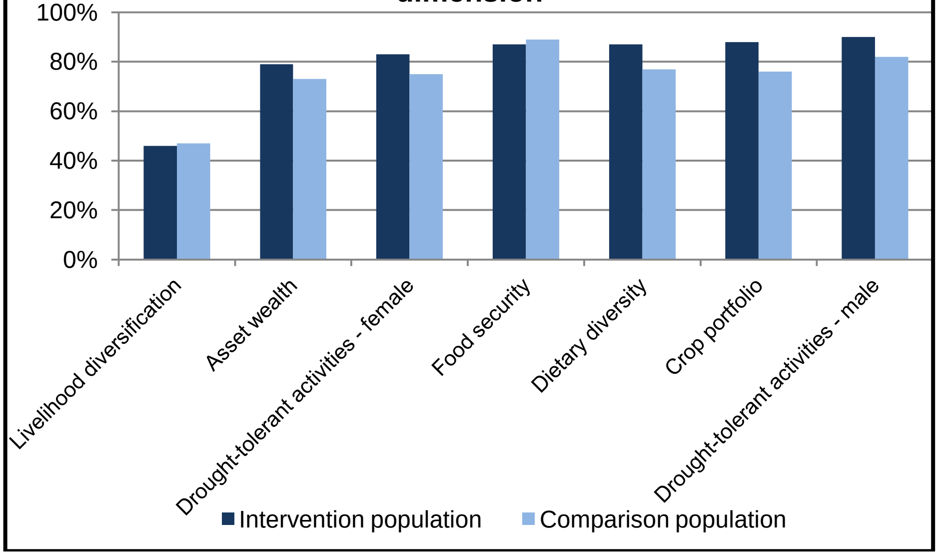
There is modest evidence that the project enhanced the livelihoods of the intervention population

As is clear, on average, the intervention households scored positively on 80 per cent of the seven indicators, while the comparison households scored positively on 74 per cent. This difference is statistically significant across three out of the five statistical procedures with at least a 95 per cent level of confidence. There is therefore modest evidence that the project has enhanced the livelihoods of the intervention population.

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 livelihood diversification. For the remaining indicators, it is interesting to note that the majority of households scored positively, both in the intervention and comparison villages.

The intervention population is most deprived in relation to livelihood diversification

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 clearly perform 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.

Table 6.6: HH characteristic scores – livelihood viability dimension

	(1) Asset wealth	(2) Food security	(3) Dietary diversity	(4) Livelihood diversification	(5) Drought tolerant activities – male	(6) Drought tolerant activities – female	(7) Crop portfolio
Unadjusted							
Intervention group mean:	0.786	0.873	0.873	0.457	0.902	0.827	0.879
Comparison group mean:	0.731	0.894	0.773	0.470	0.822	0.754	0.758
Unadjusted difference:	0.055	-0.021	0.100***	-0.013	0.080**	0.073*	0.121***
	(1.30)	(-0.68)	(2.64)	(-0.27)	(2.32)	(1.81)	(3.15)
Observations:	**437**	**437**	**437**	**437**	**437**	**437**	**437**
PSM							
Post-matching difference	0.013	-0.032	0.094**	-0.074	0.079*	0.026	0.088**
(kernel):	(0.29)	(-0.97)	(2.15)	(-1.33)	(1.85)	(0.62)	(2.25)
Observations:	**429**	**429**	**429**	**429**	**429**	**429**	**429**
Post-matching difference	0.036	-0.018	0.091**	-0.012	0.067*	0.042	0.085**
(no replacement:	(0.79)	(-0.52)	(2.12)	(-0.22)	(1.76)	(0.93)	(2.09)
Observations:	**429**	**429**	**429**	**429**	**429**	**429**	**429**
Multivariable Regression							
MVR coefficient	0.029	-0.018	0.093***	-0.060	0.048**	0.056	0.069*
(robust standard errors):	(0.81)	(-1.03)	(3.20)	(-1.03)	(2.30)	(1.33)	(1.79)
Observations:	**437**	**437**	**437**	**437**	**437**	**437**	**437**
MVR coefficient	0.031	-0.016	0.089***	-0.060	0.051**	0.055	0.070*
(with control functions):	(0.87)	(-0.96)	(3.14)	(-1.03)	(2.37)	(1.48)	(1.80)
Observations:	**437**	**437**	**437**	**437**	**437**	**437**	**437**

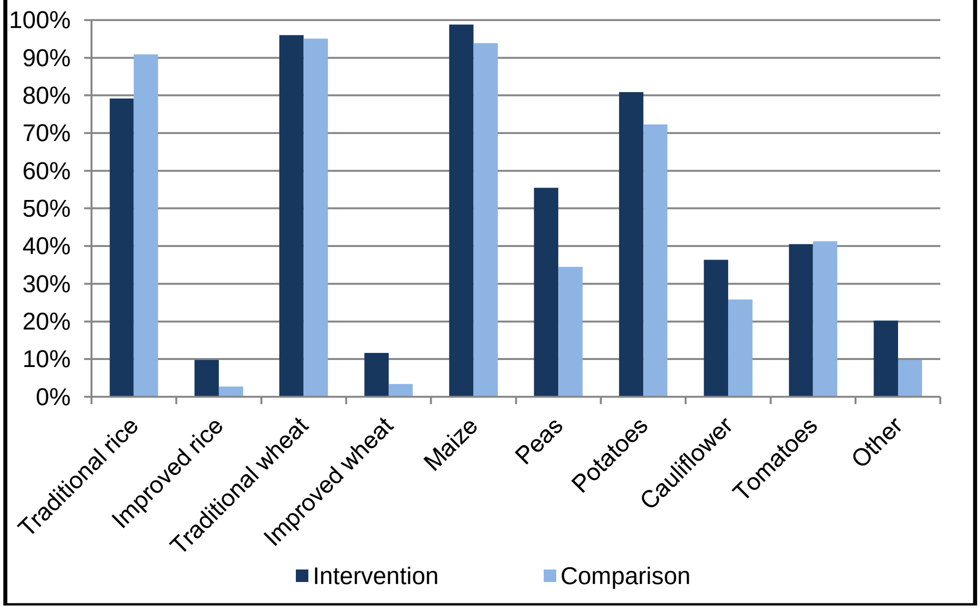
t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

Turning our attention to the characteristic with the lowest proportion of households scoring positively – i.e. livelihood diversification (column 4), we see that there are also 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 is at least 50 per cent dependent on at least two different livelihood activities that are assumed to be significantly drought tolerant. When examining the underlying data (not shown here) on the *total number* of livelihood activities in which each household engages, there is a significant difference: the supported households engage (on average) in at least 0.2 more livelihood activities than comparison households. This indicates that there is modest evidence that the project has successfully effected an increase in the number of different livelihood activities. However, as shown for the indicator in Table 6.6 there is no evidence of a difference between the intervention and comparison households in terms of livelihood diversification into more *drought tolerant* activities.

In terms of the other indicators in this domain, it is clear that overall a high proportion of households, both in the intervention and comparison villages, scored positively. However, there are some significant differences between the populations. For example, 87 per cent of supported households scored positively on the dietary diversity characteristic (column 3), compared to 77 per cent of comparison households. This difference is statistically significant; indicating that there is evidence the project has increased the diversity of food types consumed by supported households. There is also a more modest difference in the range of crops cultivated by intervention and comparison households (column 7).

As one of the key project interventions was the provision of improved cereal seeds and vegetable seeds, 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: % of HHs cultivating various crops



The most significant difference between the intervention and comparison households is the proportion of households growing peas. Over half of supported households reported growing peas, compared to one-third of comparison households. Statistically significant differences are also evident for other vegetables, including potatoes and cauliflower. Interestingly, a significantly smaller proportion of households in the intervention villages reported cultivating traditional rice. This appears to have been replaced by the cultivation of improved varieties of rice and wheat provided by the project. While the differences in the proportion of intervention and comparison households growing these improved varieties is significant, it is worth noting that at the time of survey, only about 10 per cent of households were engaged in doing so.

There is evidence that the project positively affected some of the characteristics under the livelihood viability dimension, including; dietary diversity, number of drought-tolerant livelihood activities in which male household members participate, and crop portfolio

The other characteristic in which there is a significant difference is the number of drought tolerant activities in which the male household members are involved. Column 5 indicates the proportion of households in which male household members are involved in at least one livelihood activity which is assumed to be significantly drought tolerant – for example, casual labour that is not affected by climatic shocks or being involved in irrigated crop cultivation. Overall 90 per cent of supported households score positively for this indicator, compared to 82 per cent of comparison households. In terms of women's involvement in drought-tolerant activities, the small positive difference between intervention and comparison households is not statistically significant, so it is not clear that this represents a real difference between the groups

The remaining two characteristics of livelihood viability are indicators of a household's wealth status – as measured by asset ownership, and its experience of food security. For both of these indicators (columns 1 and 2), there is no clear difference between households in the project and comparison villages. However, it should be noted that the proportion of households scoring positively for food security implies that in the four weeks preceding the household interviews, there was little experience of food insecurity. This is a limitation of the tool, and future iterations plan to try and capture experience of food insecurity over a greater time period. This should allow more meaningful analysis of potential project impact on a household's experience of food security.

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 0.67 means that, on average, the supported households scored positively on two-thirds of the five characteristics, compared to 57 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:	0.674
Comparison group mean:	0.571
Unadjusted difference:	0.103***
	(5.90)
Observations:	**437**
PSM	
Post-matching difference (kernel):	0.086*** (4.15)
Observations:	**429**
Post-matching difference (no replacement:	0.086*** (4.26)
Observations:	**429**
Multivariable Regression	
MVR coefficient (robust standard errors):	0.087*** (4.88)
Observations:	**437**
MVR coefficient (robust regression):	0.091*** (4.71)
Observations:	**437**
MVR coefficient (with control functions):	0.089*** (4.98)
Observations:	**437**

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 awareness of climate change issues and access to credit, and least positively on access to state support for innovation.

Table 6.8 examines the differences between the intervention and comparison households for each of the characteristics shown in Figure 6.5.

The ‘access to state innovative support’ characteristic was the indicator in which households scored least positively. However, Table 6.8 shows that three of the four adjustment methods estimate a significant difference between the proportion of intervention and comparison households above the cut-off (column 5), 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.

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

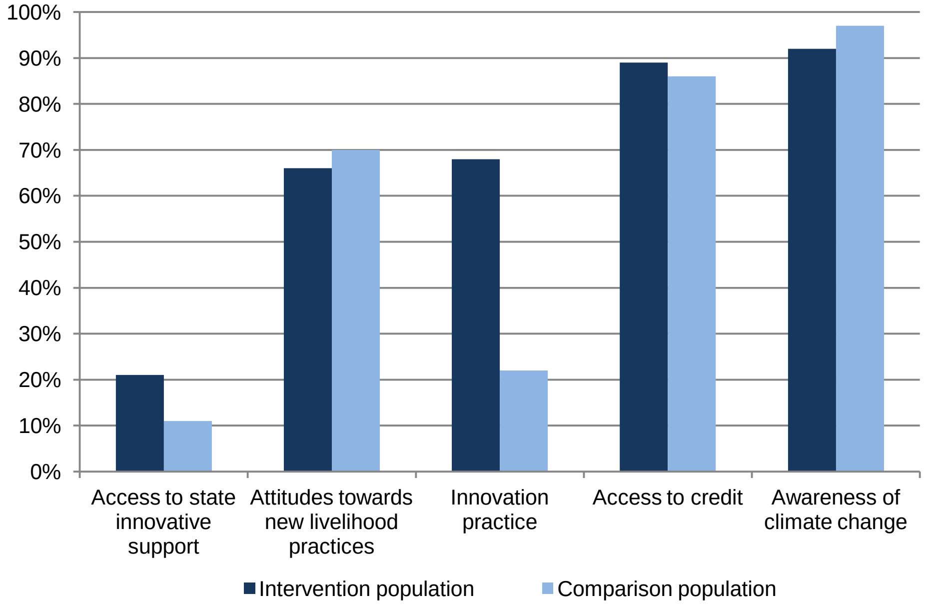


Table 6.8: HH characteristic scores – innovation potential dimension

	(1) Attitudes towards new livelihood practices	(2) Awareness of climate change	(3) Innovation practice	(4) Access to credit	(5) Access to state innovative support
Unadjusted					
Intervention group mean:	0.665	0.925	0.682	0.890	0.208
Comparison group mean:	0.697	0.966	0.223	0.864	0.106
Unadjusted difference:	-0.032	-0.041*	0.459***	0.027	0.102***
	(-0.71)	(-1.92)	(10.71)	(0.82)	(2.97)
Observations:	**437**	**437**	**437**	**437**	**437**
PSM					
Post-matching difference	-0.056	-0.054**	0.453***	0.013	0.077
(kernel):	(-1.08)	(-2.45)	(9.09)	(0.37)	(1.56)
Observations:	**429**	**429**	**429**	**429**	**429**
Post-matching difference	-0.079	-0.048*	0.424***	0.036	0.097**
(no replacement:	(-1.55)	(-1.91)	(8.61)	(0.96)	(2.35)
Observations:	**429**	**429**	**429**	**429**	**429**
Multivariable Regression					
MVR coefficient	-0.078	-0.027***	0.492***	0.019	0.090***
(robust standard errors):	(-1.53)	(-3.53)	(9.14)	(0.61)	(2.64)
Observations:	**431**	**426**	**431**	**437**	**430**
MVR coefficient	-0.071	-0.024***	0.500***	0.019	0.082**
(with control functions):	(-1.37)	(-3.51)	(9.26)	(0.62)	(2.50)
Observations:	**431**	**426**	**431**	**437**	**430**

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

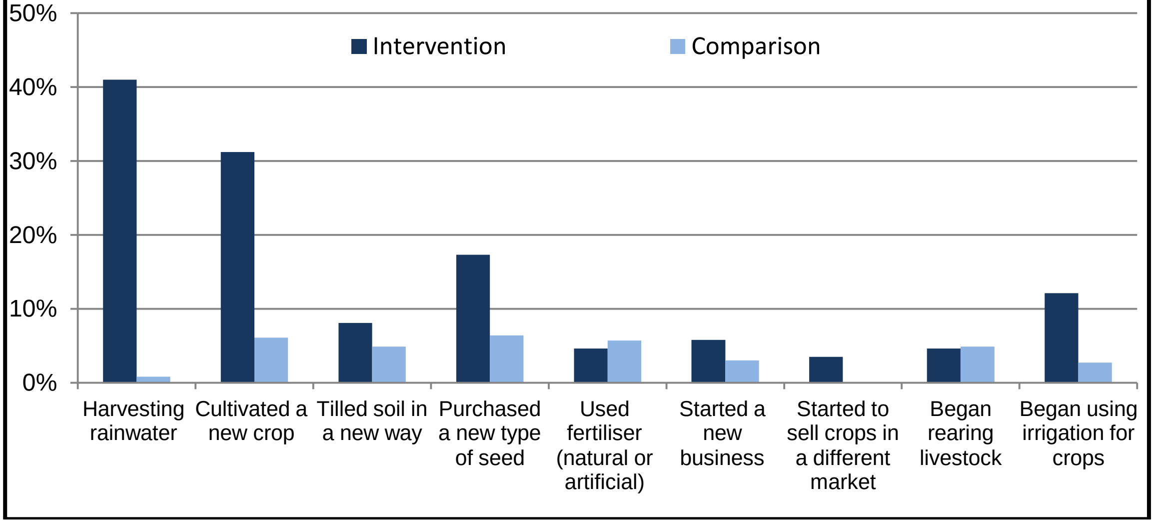
Interestingly, the proportion of households scoring positively for awareness of climate change issues was very high – 93 per cent of intervention households, and 97 per cent of comparison households. As mentioned in Section 5.3, there were some concerns regarding how accurately this characteristic was measured, both due to a lack of consistency of responses to the six Likert-scale questions related to this indicator, and reported difficulties from the fieldwork regarding translation of these particular questions. Therefore, while the results show significant positive differences in favour of the *comparison* households, these should be treated with a degree of caution.

A high proportion of households also scored positively on the access to credit measure (column 4), with 89 per cent of intervention households, and 86 per cent of comparison households reporting that they would be able to access a modest-sized loan if required. The difference between the groups is not significant.

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 two-thirds of supported households scored positively – i.e. they tried at least one new activity (e.g. cultivating new crops), in the previous two years – compared to 22 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 over 40 per cent of supported households said they had begun harvesting rainwater, just over 30 per cent had started cultivating a new crop, and 18 per cent had purchased a new type of seed. 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 proportions of intervention households who have started selling crops in a different market and begun using irrigation for crops is smaller, significant differences exist between the intervention and comparison households.

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



In summary, this highlights that the project has had a positive effect on 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 five characteristics falling under the access to contingency resources and support dimension. Similar to the previous dimensions, a composite index was developed with 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 0.64 shows that, on average, the supported households scored positively on almost two-thirds of the five characteristics, compared to 49 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 this 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 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:	0.644
Comparison group mean:	0.490
Unadjusted difference:	0.154*** (7.67)
Observations:	**437**
PSM	
Post-matching difference (kernel):	0.127*** (6.21)
Observations:	**429**
Post-matching difference (no replacement:	0.132*** (5.93)
Observations:	**429**
Multivariable Regression	
MVR coefficient (robust standard errors):	0.126*** (6.85)
Observations:	**437**
MVR coefficient (robust regression):	0.125*** (6.13)
Observations:	**437**
MVR coefficient (with control functions):	0.128*** (6.88)
Observations:	**437**

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, there are clear differences between the proportions of households scoring positively on the different characteristics. Interestingly, households scored most positively on issues of social connectivity and group participation. Households scored least positively in how they perceived the efficacy of the local government support system in the event of a disaster.

The intervention population is better off on all five characteristics falling under the access to contingency resources and support dimension

Figure 6.8: Percentage of HHs Scoring Positively on Characteristics of the Contingency Resources and Support Dimension

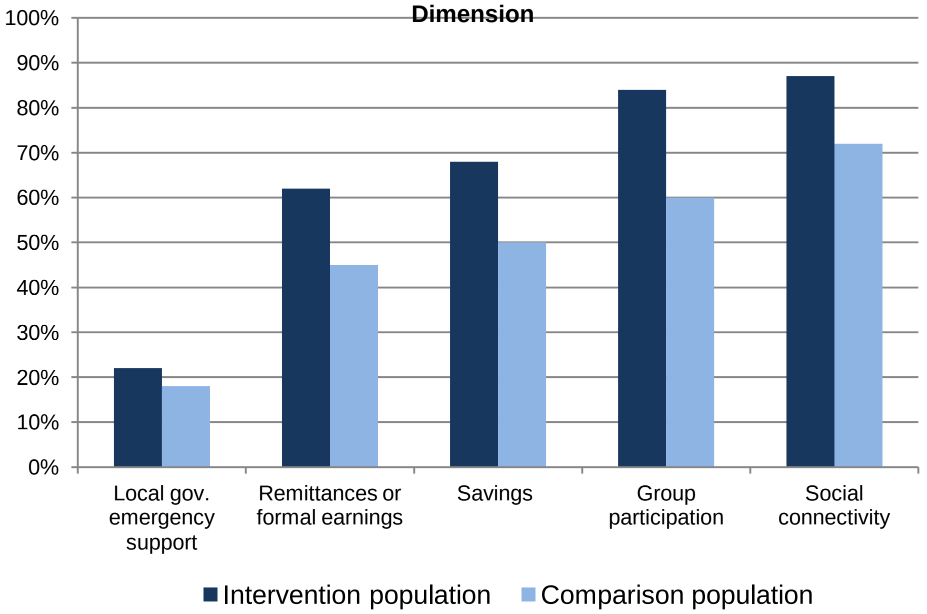


Table 6.10: HH characteristic scores – contingency resources and support dimension

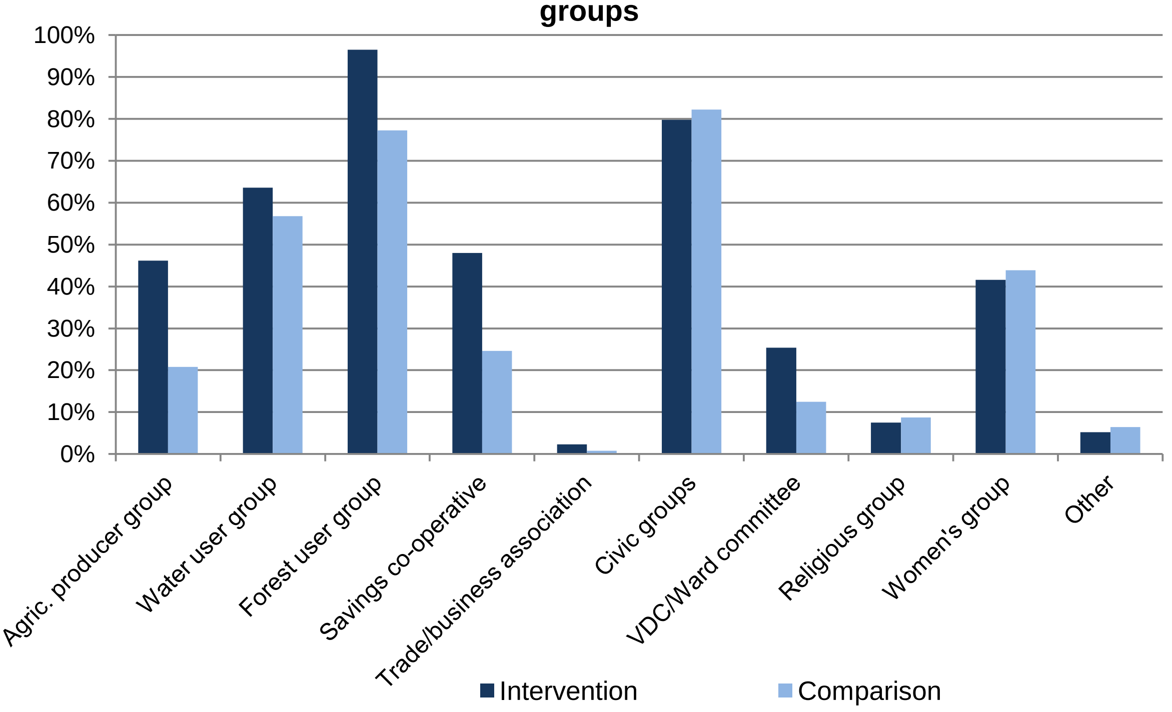
	(1) Group participation	(2) Social connectivity	(3) Local gov. emergency support	(4) Savings	(5) Remittances or formal earnings
Unadjusted					
Intervention group mean:	0.838	0.867	0.220	0.676	0.618
Comparison group mean:	0.598	0.716	0.182	0.500	0.455
Unadjusted difference :	0.240***	0.151***	0.038	0.176***	0.164***
	(5.48)	(3.76)	(0.97)	(3.69)	(3.39)
Observations:	**437**	**437**	**437**	**437**	**437**
PSM					
Post-matching difference (kernel):	0.232***	0.115***	0.077*	0.154***	0.060
	(4.48)	(2.61)	(1.76)	(2.76)	(1.10)
Observations:	**429**	**429**	**429**	**429**	**429**
Post-matching difference (no replacement:	0.200***	0.127***	0.055	0.152***	0.127**
	(4.08)	(2.94)	(1.26)	(2.69)	(2.33)
Observations:	**429**	**429**	**429**	**429**	**429**
Multivariable Regression					
MVR coefficient (robust standard errors) :	0.228***	0.143***	0.079**	0.155***	0.146**
	(4.70)	(3.76)	(2.05)	(2.88)	(2.27)
Observations:	**437**	**437**	**430**	**437**	**437**
MVR coefficient (with control functions):	0.224***	0.148***	0.083**	0.165***	0.132**
	(4.66)	(3.87)	(2.13)	(3.03)	(2.02)
Observations:	**437**	**437**	**430**	**437**	**437**

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 five 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 supported households reported participating widely in community groups than did the corresponding comparison households. The difference is highly statistically significant, indicating strong evidence of a positive project effect on this indicator.

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. Perhaps unsurprisingly there is a clear – and significant – difference in the proportion of households participating in agricultural producer groups, as this was an aspect deliberately targeted by the project. More interesting are the significant differences that exist in terms of participation in forest user groups, savings co-operatives and VDC/ward committees. This analysis indicates strong evidence that the project has affected participation in important groups, which are not necessarily directly connected to the project's activities.

Figure 6.9: Percentage of HHs participating in various community groups



The other characteristic in this dimension where there is a highly significant difference is in relation to 'social connectivity'. 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, and their involvement in important meetings in the community, as well as other characteristics related to the household's social interaction in the community. Overall, 87 per cent of supported households scored positively for this measure, compared to 72 per cent of comparison households (column 2). This indicates a positive project effect on supported household's perception of their social support systems.

As mentioned above, households scored least positively in how they perceived the efficacy of the local government support system in the event of a disaster (column 3). While this characteristic may not be explicitly linked to the project, it is still interesting to note that three of the four adjustment methods estimate a significant difference of 8 per cent in the proportion of households scoring positively.

Column 4 of Table 6.10 reports the results on the savings available to households. Households were not asked directly for the monetary value of their savings, but were instead asked the question, if they had a crisis and had to live on their cash savings without other income sources, how long would they be able to do so? Just over two-thirds of the intervention households scored positively on this measure, meaning that they could live from their savings for more than 14 days. There is a statistically significant difference among the supported households compared to the comparison households (50 per cent). It is interesting to note that while there was no overall difference between the intervention and comparison households in asset ownership (see Dimension 1), this result indicates a greater availability of current cash resources in the supported households.

The final characteristic analysed in Table 6.10 is the availability within the household of remittances or formal employment (column 5). Approximately 55 per cent of the survey respondents reported receiving remittances from relatives outside the community during the 12 months prior to the survey, and 11 per cent reported that a household member was receiving regular earnings. While these are important factors in determining the household's level of resilience, they cannot plausibly have been affected by the Climate Change Adaptation and Advocacy project. It is also worth recalling from Table 6.1 that there were significant differences in the proportion of households receiving remittances at baseline. The difference reported in Table 6.10 is likely to be a result of the regression and PSM models not fully controlling for the baseline differences.

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 0.61 shows that, on average, the supported households scored positively on almost two-thirds of the five characteristics, compared to 49 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 this dimension. The remainder of this subsection will explore what particular characteristics are driving this difference.

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, there are clear differences between the proportions of households scoring positively on the different characteristics. Interestingly, households scored most positively on aspects related to vegetation cover and soil erosion, whereas households scored least positively in how they perceived the fertility of their local soils.

The intervention households outperformed the comparison households against the integrity of the natural and build environment index

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

	Integrity of the Natural and Built Environment Index
Unadjusted	
Intervention group mean:	0.606
Comparison group mean:	0.494
Unadjusted difference:	0.112*** (4.86)
Observations:	**437**
PSM	
Post-matching difference (kernel):	0.117*** (4.65)
Observations:	**429**
Post-matching difference (no replacement:	0.106*** (4.02)
Observations:	**429**
Multivariable Regression	
MVR coefficient (robust standard errors):	0.097*** (3.96)
Observations:	**437**
MVR coefficient (robust regression):	0.106*** (4.19)
Observations:	**437**
MVR coefficient (with control functions):	0.096*** (3.90)
Observations:	**437**

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

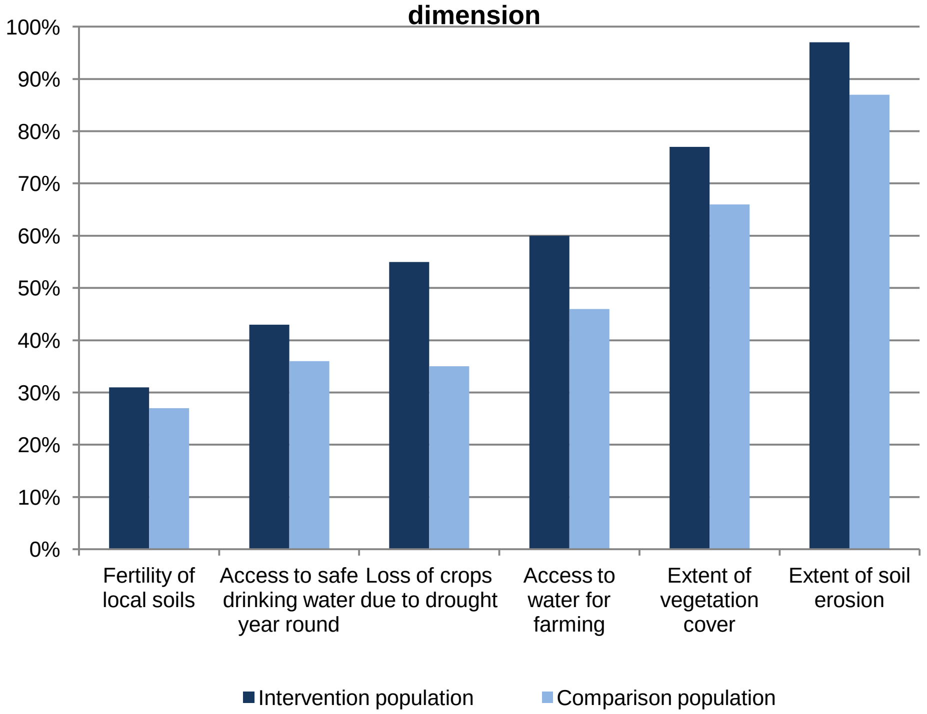


Table 6.12 presents the results of the six characteristics making up the index of access to contingency resources and support. The first factor analysed is the household's perception of how their agricultural land is affected by erosion (column 1). Almost all intervention households scored positively for this measure – i.e. they responded that that their land was not severely affected by erosion, compared to 87 per cent of households in the comparison group. This difference is highly statistically significant, although to be confident that this is a genuine effect of the project, further research is required to assess the level to which interventions that could plausibly affect this indicator – such as tree planting and conservation farming – were carried out in the supported communities. Some evidence in this regard is contained in section 6.2.7.

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

	(1) Extent of soil erosion	(2) Extent of vegetation cover	(3) Access to water for farming	(4) Loss of crops due to drought	(5) Access to year-round safe drinking water	(6) Fertility of local soils
Unadjusted						
Intervention group mean:	0.965	0.775	0.601	0.549	0.434	0.312
Comparison group mean:	0.867	0.655	0.462	0.352	0.364	0.265
Unadjusted difference:	0.098***	0.119***	0.139***	0.197***	0.070	0.047
	(3.47)	(2.68)	(2.86)	(4.13)	(1.46)	(1.06)
Observations:	**437**	**437**	**437**	**437**	**437**	**437**
PSM						
Post-matching difference	0.121***	0.125**	0.119**	0.182***	0.070	0.083*
(kernel):	(3.40)	(2.45)	(2.06)	(3.38)	(1.27)	(1.68)
Observations:	**429**	**429**	**429**	**429**	**429**	**429**
Post-matching difference	0.109***	0.115**	0.115**	0.164***	0.055	0.079
(no replacement:	(3.32)	(2.21)	(2.03)	(3.00)	(1.02)	(1.53)
Observations:	**429**	**429**	**429**	**429**	**429**	**429**
Multivariable Regression						
MVR coefficient	0.867***	0.106**	0.082	0.159***	0.071	0.077*
(robust standard errors):	(3.56)	(2.13)	(1.48)	(2.91)	(1.35)	(1.67)
Observations:	**397**	**437**	**437**	**437**	**437**	**431**
MVR coefficient	0.861***	0.100**	0.082	0.161***	0.072	0.077*
(with control functions):	(3.56)	(2.02)	(1.48)	(2.94)	(1.36)	(1.65)
Observations:	**397**	**437**	**437**	**437**	**437**	**431**

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

In follow up to this, it is interesting to note that there is also a significant difference in the proportion of households reporting that there is at least 5 per cent tree or other non-agricultural vegetation coverage in their agricultural land (Column 2). As this information was not collected for the baseline period, it is difficult to be sure that the differences can be attributed to project activity, rather than to existing differences in the ecological or topographic characteristics of the intervention and comparison villages. However, it should be noted that the project did implement interventions to encourage households to use a conservation approach to farming, e.g. minimal tilling. As for the first characteristic, further follow up research is recommended.

The third characteristic in this dimension considers a household's access to water for farming (column 3). 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 estimated to be significant by two of the estimation methods, with the remaining two methods showing no significant differences. This indicates there is some modest evidence that the project has successfully affected the way in which households are able to access water for agriculture.

The intervention households lost less of their harvest to the drought that occurred in 2011

Column (4) 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 drought' characteristic, they had to report losing less than half of their harvest due to the drought that occurred in 2011. Overall, 55 per cent of supported households lost *less* than half of their crops, compared to 35 per cent of households in the comparison villages. In reversing this measure, it is sobering to consider that 45 per cent of intervention households and 65 per cent of comparison households lost more than half of their harvest due to the drought. These differences are however, highly statistically significant. This provides strong evidence that the project has had a positive effect on this important measure.

It is interesting to note that evidence of project impact is weakest in the characteristic that considers the availability of safe drinking water. For a household to score positively in this measure, they had to respond that they had access to a year-round safe drinking water source, within 30 minutes round trip. Overall, 43 per cent of supported households scored positively, compared to 36 per cent of comparison households. Unfortunately, none of the estimation methods consider this difference to be significant, indicating there is no evidence of a positive project effect in this regard.

Finally, column 6 considers the characteristic related to soil fertility. Overall, 31 per cent of supported households scored positively in this measure, compared to 27 per cent of comparison households. This difference is estimated to be significant by three of the four models – although only at the 90 per cent confidence level. As for the first two characteristics, further research is recommended to confirm these differences; however, it is positive to note that the findings from these three indicators are consistent and therefore corroborate the theory that the project has successfully affected these outcomes.

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 just less than half of the seven characteristics that make up this dimension, compared to 24 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:	0.469
Comparison group mean:	0.240
Unadjusted difference:	0.229***
	(10.73)
Observations:	**437**
PSM	
Post-matching difference (kernel):	0.238***
	(9.42)
Observations:	**429**
Post-matching difference (no replacement:	0.229***
	(9.24)
Observations:	**429**
Multivariable Regression	
MVR coefficient (robust standard errors):	0.230***
	(9.95)
Observations:	**437**
MVR coefficient (robust regression):	0.158***
	(8.44)
Observations:	**437**
MVR coefficient (with control functions):	0.231***
	(9.99)
Observations:	**437**

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

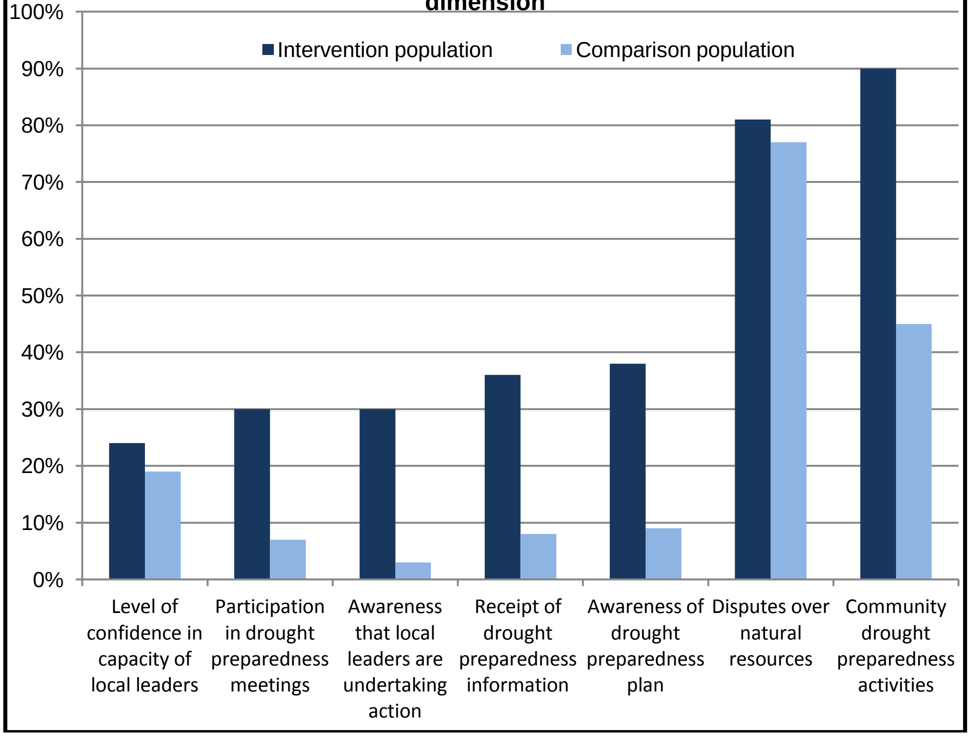


Figure 6.11 presents the percentage of households scoring positively on each of the indicators in the social and institutional capability dimension. The indicators have been ranked for the intervention population from most deprived to least deprived. As is evident, there are clear differences between the proportions of households scoring positively on the different characteristics. Households scored most positively on aspects related to their awareness of community-level drought preparedness activities, whereas households scored least positively in their level of confidence in the capacity of local leaders to provide leadership and support in times of crisis. Given the focus of the project under review, it is particularly interesting to compare the proportion of households who are aware of community-level drought 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 also 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.

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

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

	(1) Awareness of drought prepared-ness plan	(2) Participation in drought prepared-ness meetings	(3) Receipt of drought prepared-ness info.	(4) Awareness of community level drought 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:	0.376	0.301	0.358	0.902	0.809	0.237	0.301
Comparison group mean:	0.087	0.072	0.076	0.447	0.773	0.189	0.034
Unadjusted difference:	0.289***	0.229***	0.283***	0.455***	0.037	0.048	0.266***
	(7.84)	(6.63)	(7.89)	(10.80)	(0.91)	(1.20)	(8.46)
Observations:	**437**	**437**	**437**	**437**	**437**	**437**	**437**
PSM							
Post-matching difference	0.281***	0.230***	0.273***	0.481***	0.044	0.095**	0.262***
(kernel):	(6.12)	(5.73)	(6.35)	(10.37)	(0.92)	(2.34)	(6.70)
Observations:	**429**	**429**	**429**	**429**	**429**	**429**	**429**
Post-matching difference	0.273***	0.230***	0.261***	0.473***	0.048	0.067	0.255***
(no replacement:	(5.95)	(5.64)	(5.72)	(10.43)	(1.05)	(1.48)	(6.57)
Observations:	**429**	**429**	**429**	**429**	**429**	**429**	**429**
Multivariable Regression							
MVR coefficient	0.282***	0.228***	0.282***	0.509***	0.047	0.085**	0.235***
(robust standard errors):	(6.72)	(6.12)	(6.84)	(10.19)	(1.11)	(2.05)	(7.13)
Observations:	**426**	**426**	**426**	**437**	**430**	**426**	**426**
MVR coefficient	0.282***	0.227***	0.283***	0.510***	0.043	0.084**	0.190***
(with control functions):	(6.77)	(6.18)	(7.10)	(10.09)	(1.04)	(2.03)	(7.19)
Observations:	**426**	**426**	**426**	**437**	**430**	**426**	**426**

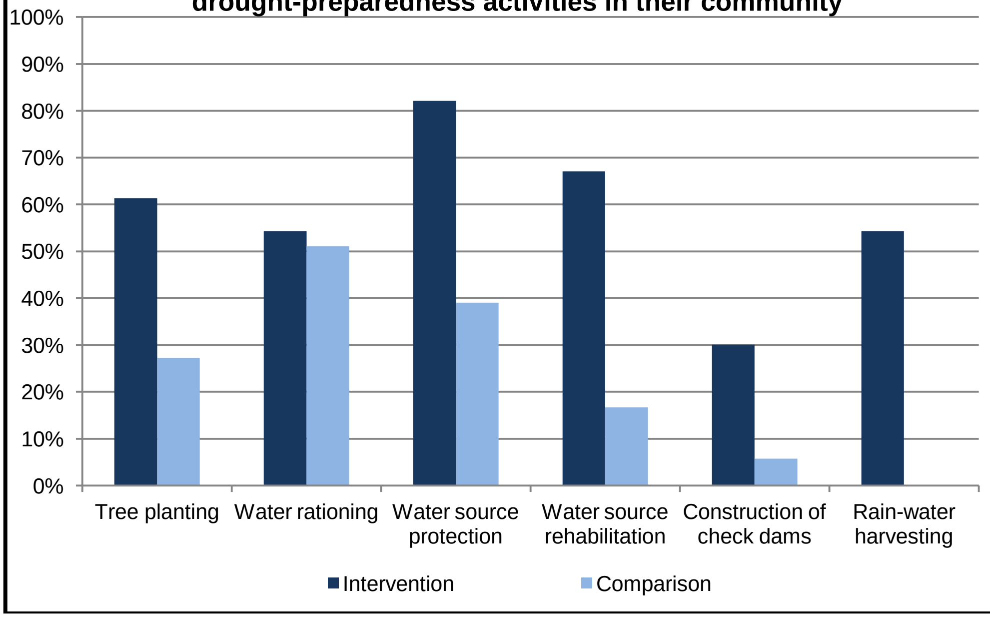
t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01
PSM estimates bootstrapped 1000 repetitions
Coefficients for covariates used in regression not presented, but the same as those used to compute propensity scores

If we consider the first three indicators in columns 1 to 3, we see that approximately a third of intervention households score positively in terms of their awareness of a community drought preparedness plan, their participation in drought preparedness meetings, and their receipt of drought preparedness information. While these proportions are relatively low, the differences between the intervention and comparison households 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 is a result of only a subset of villages preparing drought mitigation plans or holding preparedness meetings. From an initial analysis of the data, it appears that this may be the case, with either none, or very few households scoring positively in three of the supported villages – Dandakharda, Tekundanda and Dolakot. As the sample sizes are very small at a village level, we cannot say with statistical certainty that the differences between the villages are significant, however this does warrant further investigation. Regardless of this, the results presented in Table 6.14 provide strong evidence that the project overall, has successfully affected these particular outcomes.

More than 90 per cent of households in the intervention villages reported being aware of drought-preparedness activities taking place in their community

Column 4 presents the proportion of households reporting awareness that drought-preparedness activities have been carried out in their community. It is interesting to note that while scores are relatively low for aspects related to the more formal structures of community-level drought-preparedness *planning* (see above), over 90 per cent of supported households are aware of community-level *activities* that are intended to mitigate some of the effects of drought. This compares to less than half of households in comparison villages – a difference which is again highly statistically significant. Figure 6.12 provides a breakdown of the particular activities for which respondents were asked to report on in their community. With the exception of water rationing, the difference between the intervention and comparison households for each of the activities is statistically significant.

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



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). As noted above, this characteristic has the lowest proportion of households scoring positively. It is likely to be connected to some of the other measures in this dimension, which consider more formal community-level planning and preparedness. However, as in the case for those characteristics, significant differences between the intervention and comparison households are still apparent. While the differences are not as significant, there is still modest evidence that the project has successfully affected people's confidence in local community leadership.

6.2.8 Further analysis

The final part of the analysis considers whether there are differences between different sub groups of the intervention population. Firstly, it is interesting to examine whether there are differences between the supported households in the different villages in terms of their overall resilience. Recall that this is measured using the 'Base Resilience Index' – i.e. the proportion of characteristics in which the household scores positively.

This is done by adding a dummy variable to the standard regression model, which is defined to be positive only for households that reside in each particular village. The results of this analysis reported in Table 6.15. The first column reports the results from the first regression model shown in Table 6.2, confirming the highly significant differences between the intervention and comparison households in this measure. The second column shows what the differences would be if households from that particular village were not included. This confirms that there are no clear differences in terms of the project's impact between the various villages.

Table 6.15: Results of adding a village dummy variable to regression models for base resilience index

	(1) Original intervention coefficient	(2) Intervention coefficient with village dummy variable	(3) Coefficient on village dummy variable
Project village:			
Jharkanda/Makwanpur	0.103*** (9.81)	0.119*** (10.38)	-0.054*** (-2.96)
Melganja	0.103*** (9.81)	0.113*** (10.20)	-0.063*** (-3.84)
Nauli	0.103*** (9.81)	0.090*** (8.36)	0.104*** (5.43)
Chain	0.103*** (9.81)	0.094*** (8.79)	0.057** (2.53)
Dandakharkha	0.103*** (9.81)	0.103*** (9.51)	0.007 (0.28)
Tekundanda	0.103*** (9.81)	0.103*** (9.38)	-0.001 (-0.05)
Dolakot	0.103*** (9.81)	0.105*** (9.58)	-0.021 (-0.84)

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Coefficients for covariates not presented.

The third column indicates that there may be some small differences in overall resilience between the villages – for example, Nauli and Chain villages appear to indicate greater resilience; however the differences between columns 1 and 2 are so small that it is very difficult to draw any firm conclusions. A larger sample size might have yielded more definite results, but what we can say with more certainty is that overall resilience is stronger across *all* intervention villages than their comparators.

Table 6.16 presents a similar analysis, but this time considers the difference in overall resilience between intervention households affected by different project interventions. As mentioned in Section 2, there were several key project interventions, and while all communities received climate change awareness activities, there were differences in how some of the other interventions were implemented. Therefore, it is interesting to compare whether different interventions have resulted in significant differences in overall resilience. As for Table 6.15, column 2 confirms that the differences between the intervention and comparison households are large and statistically significant regardless of the type of intervention(s) a particular household received. Again, as in Table 6.15, the differences between columns 1 and 2 are generally very small, although there is some evidence in column 3 that households from communities that have benefited from irrigation ponds are scoring more positively for overall resilience.

Table 6.16: Results of adding a project-component dummy variable to regression models for base resilience index

	(1) Original intervention coefficient	(2) Intervention coefficient with intervention × interaction variable	(3) Coefficient on intervention × interaction variable
Project component:			
Rainwater harvesting	0.103*** (9.81)	0.102*** (7.35)	0.003 (0.15)
Rehabilitation of water source, including check dam	0.103*** (9.81)	0.099*** (7.45)	0.006 (0.39)
Seed support	0.103*** (9.81)	0.099*** (7.45)	0.006 (0.39)
Drip irrigation	0.103*** (9.81)	0.094*** (8.79)	0.057** (2.53)
Irrigation pond	0.103*** (9.81)	0.071*** (6.24)	0.082*** (5.60)

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Coefficients for covariates not presented.

7 Conclusions and learning considerations

7.1 Conclusions

This Effectiveness Review found evidence that the Climate Change and Advocacy project has positively affected several important 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 29 to 32 percentage points and 10–11 points better than the latter on Oxfam GB's global ARR indicator and the Base Resilience Index, respectively. Strong performance in relation to the global indicator shows that **86 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 30 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 30 characteristics, statistically significant differences in favour of the intervention population were identified for 21 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 13 characteristics directly targeted by the project, there is evidence that the projects successfully affected nine of them. And, out of the 21 characteristics connected to the project's intervention logic, there is evidence that 15 were positively affected. In this light, the findings of the Effectiveness Review are considerably 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 not just in more output-related measures, such as participation in groups or receipt of drought-preparedness information, but in key outcome measures, such as the proportion of crops lost due to drought and the proportion of households that had taken substantive action taken to adapt or innovate. Such findings are very encouraging.

A second point relates to the first dimension – livelihood viability, and the issue of livelihood diversification. A key intended outcome for this project was to improve the livelihood base of supported households by reducing their dependence on a small number of drought-affected activities. While there was evidence of both increased crop diversification and a slight increase in the average number of different livelihood activities in which the household was engaged, there was no difference in the proportion of households scoring positively for the diversification measure. The reason for this is that the indicator considers whether the household is at least 50 per cent dependent on at least two different livelihood activities that are assumed to be significantly drought tolerant.

However, as shown for the indicator in Table 7.1, less than half of supported households scored positively, and there is no evidence of a difference between the intervention and comparison households in terms of livelihood diversification into more *drought-tolerant* activities. It is also interesting to recall at this stage the results from Table 6.16, which showed that interventions to provide irrigation were indicating increased levels of overall resilience. This strengthens the case to consider not just increasing the *number* of livelihood activities or crops cultivated, but also to continue to consider how to strengthen the drought-tolerance of these activities.

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	% households scoring positively
Livelihood viability	**Livelihood viability index**	**Yes**	**M**			
	Household wealth status	No		No	Yes	79%
	Household food security	No		No	Yes	87%
	Household dietary diversity	Yes	M	No	Yes	87%
	Livelihood diversification	No		Yes	Yes	46%
	Livelihood risk – males in HH	Yes	M	No	No	90%
	Livelihood risk – females in HH	No		No	No	83%
	Crop portfolio	Yes	M	Yes	Yes	88%
Innovation potential	**Innovation potential index**	**Yes**	**L**			
	Attitudes towards new livelihood practices	No		Yes	Yes	67%
	Awareness of climate change	No		Yes	Yes	93%
	Innovation practice	Yes	L	Yes	Yes	68%
	Access to credit	No		No	No	89%
	Access to state innovative support	Yes	M	No	Yes	21%
Access to contingency resources and support	**Contingency resources and support index**	**Yes**	**L**			
	Group participation	Yes	L	Yes	Yes	84%
	Social connectivity	Yes	L	No	No	87%
	Perceptions of local government emergency support	Yes	M	No	No	22%
	Savings	Yes	M	No	Yes	68%
	Remittances or formal earnings	Yes	M	No	No	62%
Integrity of the Natural and Built Environment	**Natural and built environment index**	**Yes**	**L**			
	Fertility of local soils	Yes	M	No	Yes	31%
	Extent of soil erosion	Yes	L	No	Yes	97%
	Access to irrigation for farming	Yes	M	Yes	Yes	60%
	Access to safe drinking-water year round	No		Yes	Yes	43%
	Extent of vegetative cover in farm plot	Yes	M	No	Yes	78%
	Extent farming activities affected by drought	Yes	L	Yes	Yes	55%
Social and institutional capability	**Social and institutional capability index**	**Yes**	**L**			
	Awareness of drought preparedness plan	Yes	L	Yes	Yes	38%
	Participation in drought prep. meetings	Yes	L	Yes	Yes	30%
	Receipt of drought prep. information	Yes	L	Yes	Yes	36%
	Awareness of community level drought risk reduction initiatives	Yes	L	Yes	Yes	90%
	Water resource dispute experience	No		No	No	81%
	Awareness that local leaders are undertaking action	Yes	L	No	No	30%
	Level of confidence in effectiveness of local leaders /institutions	Yes	M	No	No	24%

It is particularly interesting to note that the lowest scores in Table 7.1 tend to be reserved for those characteristics connected to state-provided services, whether support for innovation, emergency support, or level of confidence in local government institutions. However, in each of these there were significant differences in the proportion of intervention and comparison households scoring positively. It appears, therefore, that the project has also either increased awareness of relevant state support, or taken steps to improve the quality of support received by supported households. Further investigation of this will be recommended in the following learning considerations.

Finally, it is important to note that while there are positive findings in relation to community-level drought-preparedness activities, there are low scores related to formal community-level drought-preparedness planning, meetings and receipt of preparedness information. The differences between the intervention and comparison households in these measures are still highly significant, but the results highlight that there may be more work required in expanding this particular work stream.

7.2 Programme learning considerations

While the majority of the findings of the effectiveness review are positive, there are additional lessons emerging from the results that can be applied to other projects of this type in Nepal and elsewhere. The Nepal 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 'increase advocacy capacity of network and alliances to ensure mainstreaming of community-based adaptation practices into national and district level plans and programmes'. 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 extremely 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 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.

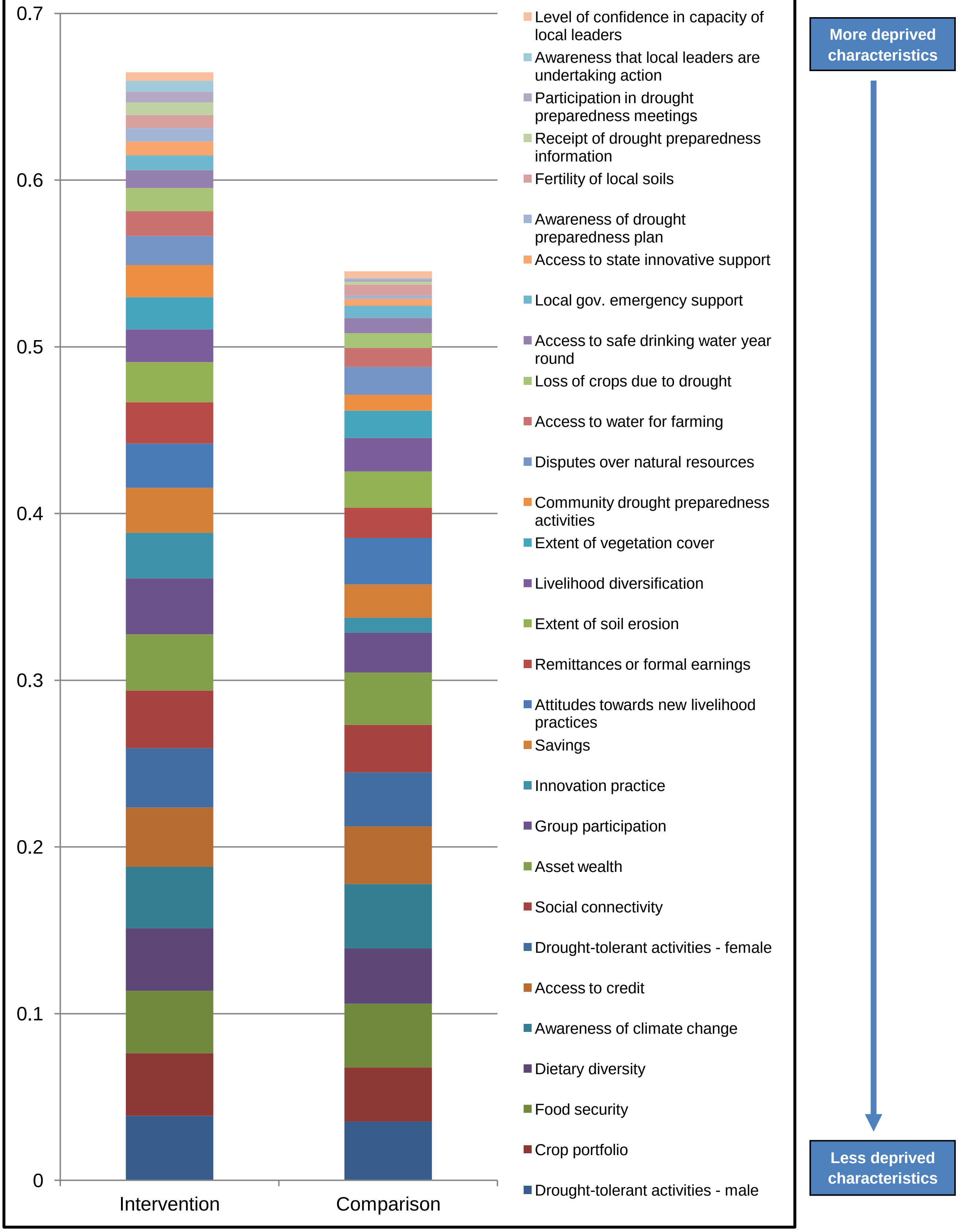
- ***Keep monitoring progress of the supported villages, and consider whether it is appropriate to scale-up the project interventions to the wider area.***

  It is clear from the results that the project has positively affected supported households in terms of their overall resilience. It will be useful to conduct further follow-up research – perhaps two to three years after the end of the project – to track the further progress of these households, particularly in relation to some of the longer term outcomes such as household wealth and environmental change. However, in the short-term it may be appropriate to consider options for scaling-up the activities to a wider area in the VDC – whether through expanding Oxfam support on the ground, or in attempting to leverage change through institutions at the VDC/district level

- ***Explore options for strengthening the support to existing livelihood practices by considering greater investment in the improved cereal seed and water resource management components of the project.***

  As mentioned in the report, it is evident that there are steps being taken towards new livelihood activities and crop diversification, however consideration is also required in terms of strengthening the 'drought-resilience' of existing livelihood practices. It is interesting to note that when analysing overall resilience by the type of project intervention, stronger resilience was evident for communities supported with irrigation. In the analysis, it is also evident that only 10 per cent of supported households were cultivating more drought-tolerant varieties of rice and wheat. There is therefore scope to consider attributing greater focus to such interventions.

Figure 7.1: Percentage of weighted characteristics HHs 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 is non-deprived if...	Weight
Livelihood viability (30%)	• Household wealth status	It owns >=3 small assets Or >=2 big assets Or 2 small assets + 1 big asset.[6]	0.3/7
	• Household food security	It reports having had 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.	0.3/7
	• 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.	0.3/7
	• Livelihood diversification	It engages in >=2 livelihood activities with >= 50% dependency on activities assumed to be significantly drought tolerant.	0.3/7
	• Livelihood risk – males in household	Male household members are involved in at least one livelihood activity that is assumed to be significantly drought tolerant.	0.3/7
	• Livelihood risk – females in household	Female household members are involved in at least one livelihood activity that is assumed to be significantly drought tolerant.	
	• Crop portfolio	It cultivated >=3 crop types, including at least one drought-resistant crop.	0.3/7
	•		
Innovation potential (20%)	• Attitudes towards new livelihood practices	Respondent either does not agree at all or agrees only to a small extent with 5 out of the 6 negatively phrased statements (Likert scale).[7]	0.2/5
	• Awareness of climate change	Respondent either does not agree at all or agrees only to a small extent with 5 out of the 6 negatively phrased statements (Likert scale).	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 10,000 rupees 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 accessed state extension support in new techniques in the last two years and reports finding the support at least moderately helpful.	0.2/5

[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; began using irrigation for crops. 'Other' was also an option, and if something else was mentioned, it was assumed to be an innovative practice.

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.	0.2/5
	• Social connectivity	Respondent agrees at least to a medium extent with 5 out of the 6 positively phrased statements.	0.2/5
	• Perceptions of local government emergency support	Respondent agrees at least to a medium extent with 5 out of the 6 positively phrased statements.	0.2/5
	• Savings	Respondent states that there is enough savings to enable them to survive for at least 14 days in the event of a drought.	0.2/5
	• Remittances or formal earnings	Respondent reports having receipt of transfer money from outside the community and/or someone in the home has a formal job.	0.2/5
Integrity of the natural and built environment (15%)	• Fertility of local soils	It reports no negative change in fertility of farm plot.	0.15/6
	• Extent of soil erosion	It does not report experiencing severe erosion.	0.15/6
	• Access to irrigation for farming	It reports having access to irrigation facilities or experienced only of small portion of its crops being lost during the 2011 drought.	0.15/6
	• Access to safe drinking-water year round	It did not report experiencing serious difficulties accessing drinking water for domestic use.	0.15/6
	• Extent of vegetative cover in farm plot	It reports having at least 5% coverage of agricultural land with trees/non-agricultural vegetation	0.15/6
	• Extent farming activities affected by drought	It reports having experienced only of small portion of its crops being lost during the 2011 drought.	0.15/6
Social and institutional capability (15%)	• Awareness of drought preparedness plan	It is at least partly aware of the contents of the plan.	0.15/7
	• Participation in drought preparedness meetings	It has participated at least one meeting in past 12 months.	0.15/7
	• Receipt of drought preparedness info.	It had received such information in past 12 months.	0.15/7
	• Awareness of community level drought risk reduction initiatives	It is aware of at least 2 community level initiatives taken place in past 3 years.	0.15/7
	• Water resource dispute experience	It does not report being involved in any disputes in past 2 years.	0.15/7
	• 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.	0.15/7
	• Level of confidence in effectiveness of local leaders/institutions	Respondent agrees at least to a medium extent with 5 out of the 6 positively phrased statements.	0.15/7

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 = 0.9932 >= 0.2000  removing distance_centre_now
p = 0.9796 >= 0.2000  removing resp_hhh
p = 0.9730 >= 0.2000  removing income_remittances_09
p = 0.9340 >= 0.2000  removing singleadultHH
p = 0.7703 >= 0.2000  removing prodads
p = 0.5486 >= 0.2000  removing income_casual_09
p = 0.5364 >= 0.2000  removing wealth_ind_09
p = 0.5399 >= 0.2000  removing dependents
p = 0.5897 >= 0.2000  removing age_hhh
p = 0.5855 >= 0.2000  removing eld_hhh
p = 0.5655 >= 0.2000  removing hh_IGA_09
p = 0.3177 >= 0.2000  removing distance_market_now
p = 0.2325 >= 0.2000  removing income_livestock_09
p = 0.2689 >= 0.2000  removing income_comm_09

Logistic regression                               Number of obs   =        437
                                                  LR chi2(16)     =      64.33
                                                  Prob > chi2     =     0.0000
Log likelihood = -261.19509                       Pseudo R2       =     0.1096
```

intervention	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
hh_farming_09	1.515198	1.160692	1.31	0.192	-.7597162	3.790112
resp_female	.3483347	.222179	1.57	0.117	-.0871282	.7837975
land_09	.0341779	.014296	2.39	0.017	.0061583	.0621976
hh_casual_09	.5336356	.2447862	2.18	0.029	.0538634	1.013408
fhhh	-.6569187	.4809115	-1.37	0.172	-1.599488	.2856505
seceduc_hhh	-.816776	.3299034	-2.48	0.013	-1.463375	-.1701774
adult_s_sec	.9631667	.3111458	3.10	0.002	.3533321	1.573001
hh_formal_09	.7904584	.4189408	1.89	0.059	-.0306505	1.611567
hh_remitt_09	.3359904	.2337321	1.44	0.151	-.1221161	.7940969
prod_hhh	1.217469	.4766173	2.55	0.011	.2833165	2.151622
hhsize	-.2887153	.0906892	-3.18	0.001	-.4664628	-.1109678
children	.213046	.1244005	1.71	0.087	-.0307745	.4568664
income_farming_09	-.2304639	.075389	-3.06	0.002	-.3782236	-.0827043
unprodads	.8374394	.2564079	3.27	0.001	.3348891	1.33999
income_IGA_09	.2495709	.1256341	1.99	0.047	.0033325	.4958092
hh_livestock_09	.883664	.3536853	2.50	0.012	.1904536	1.576874
_cons	-3.496133	1.274491	-2.74	0.006	-5.994089	-.9981758

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	264	264
Treated	8	165	173
Total	8	429	437

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

Variable	Sample	Mean Treated	Mean Control	%bias	%reduct |bias|	t-test t	t-test p>|t|
hh_farmin~09	Unmatched	.99422	.98106	11.9		1.16	0.249
	Matched	.99394	.99297	0.9	92.7	0.11	0.914
resp_female	Unmatched	.49711	.43939	11.6		1.18	0.238
	Matched	.49697	.51167	-2.9	74.5	-0.27	0.790
land_09	Unmatched	10.376	9.322	12.7		1.28	0.201
	Matched	10.37	10.966	-7.2	43.4	-0.60	0.550
hh_casual_09	Unmatched	.71098	.60606	22.2		2.25	0.025
	Matched	.70303	.67712	5.5	75.3	0.51	0.612
fhhh	Unmatched	.04046	.09091	-20.4		-2.01	0.045
	Matched	.04242	.04138	0.4	97.9	0.05	0.963
seceduc_hhh	Unmatched	.20231	.2197	-4.3		-0.43	0.665
	Matched	.20606	.2419	-8.8	-106.2	-0.78	0.436
adult_s_sec	Unmatched	.61272	.53409	15.9		1.62	0.105
	Matched	.6	.60727	-1.5	90.7	-0.13	0.893
hh_formal_09	Unmatched	.09827	.06439	12.4		1.29	0.197
	Matched	.07879	.09991	-7.7	37.6	-0.67	0.503
hh_remitt_09	Unmatched	.52601	.42424	20.4		2.09	0.037
	Matched	.51515	.4863	5.8	71.7	0.52	0.602
prod_hhh	Unmatched	.87283	.82955	12.2		1.23	0.220
	Matched	.86667	.86858	-0.5	95.6	-0.05	0.959
hhsize	Unmatched	6.8324	6.9129	-2.7		-0.27	0.784
	Matched	6.7818	6.9285	-4.9	-82.1	-0.45	0.652
children	Unmatched	3.1908	3.303	-6.5		-0.65	0.513
	Matched	3.1939	3.2621	-3.9	39.2	-0.37	0.714
income_far~g	Unmatched	2.7514	3.1742	-26.4		-2.62	0.009
	Matched	2.7939	2.8172	-1.4	94.5	-0.14	0.890
unprodads	Unmatched	.4104	.34848	9.1		0.95	0.341
	Matched	.38182	.40638	-3.6	60.3	-0.32	0.746
income_IG~09	Unmatched	.37572	.2197	17.2		1.79	0.073
	Matched	.32727	.37626	-5.4	68.6	-0.46	0.648
hh_livest~09	Unmatched	.92486	.83333	28.3		2.80	0.005
	Matched	.92121	.91461	2.0	92.8	0.22	0.828

pstest output – noreplacement:

psmatch2: Treatment assignment	psmatch2: Common support Off suppo	On suppor	Total
Untreated	0	264	264
Treated	8	165	173
Total	8	429	437

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

Variable	Sample	Mean Treated	Control	%bias	%reduct |bias|	t-test t	p>|t|
hh_farmin~09	Unmatched	.99422	.98106	11.9		1.16	0.249
	Matched	.99394	1	-5.5	53.9	-1.00	0.318
resp_female	Unmatched	.49711	.43939	11.6		1.18	0.238
	Matched	.49697	.47879	3.6	68.5	0.33	0.742
land_09	Unmatched	10.376	9.322	12.7		1.28	0.201
	Matched	10.37	9.8667	6.1	52.3	0.51	0.607
hh_casual_09	Unmatched	.71098	.60606	22.2		2.25	0.025
	Matched	.70303	.67273	6.4	71.1	0.59	0.554
fhhh	Unmatched	.04046	.09091	-20.4		-2.01	0.045
	Matched	.04242	.04848	-2.5	88.0	-0.26	0.792
seceduc_hhh	Unmatched	.20231	.2197	-4.3		-0.43	0.665
	Matched	.20606	.23636	-7.4	-74.3	-0.66	0.509
adult_s_sec	Unmatched	.61272	.53409	15.9		1.62	0.105
	Matched	.6	.6	0.0	100.0	-0.00	1.000
hh_formal_09	Unmatched	.09827	.06439	12.4		1.29	0.197
	Matched	.07879	.09091	-4.4	64.2	-0.39	0.694
hh_remitt_09	Unmatched	.52601	.42424	20.4		2.09	0.037
	Matched	.51515	.46061	11.0	46.4	0.99	0.323
prod_hhh	Unmatched	.87283	.82955	12.2		1.23	0.220
	Matched	.86667	.84848	5.1	58.0	0.47	0.638
hhsize	Unmatched	6.8324	6.9129	-2.7		-0.27	0.784
	Matched	6.7818	6.7879	-0.2	92.5	-0.02	0.984
children	Unmatched	3.1908	3.303	-6.5		-0.65	0.513
	Matched	3.1939	3.1697	1.4	78.4	0.13	0.893
income_far~g	Unmatched	2.7514	3.1742	-26.4		-2.62	0.009
	Matched	2.7939	3.0303	-14.7	44.1	-1.40	0.162
unprodads	Unmatched	.4104	.34848	9.1		0.95	0.341
	Matched	.38182	.38182	0.0	100.0	0.00	1.000
income_IG~09	Unmatched	.37572	.2197	17.2		1.79	0.073
	Matched	.32727	.27273	6.0	65.0	0.58	0.564
hh_livest~09	Unmatched	.92486	.83333	28.3		2.80	0.005
	Matched	.92121	.91515	1.9	93.4	0.20	0.841