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LIVELIHOODS IN ARMENIA

Evaluation of new economic opportunities for small-scale farmers in Tavush and Vayots Dzor regions

Effectiveness Review Series 2013/14

Photo: Oxfam in Armenia

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EXECUTIVE SUMMARY

Oxfam GB's Global Performance Framework is part of the organisation's effort to better understand and communicate its effectiveness, as well as enhance learning across the organisation. Under this Framework, a small number of completed or mature projects are selected at random each year for an evaluation of their impact, known as an 'Effectiveness Review'. The project ARMA62, 'New Economic Opportunities for Small-Scale Farmers in Tavush and Vayots Dzor Regions' in Armenia was one of those selected for an Effectiveness Review in the 2013/14 financial year.

The project was implemented in nineteen agriculture-dependent villages in two regions of Armenia. Tavush and Vayots Dzor, by Oxfam GB's Armenia office in conjunction with local partners Union of Agricultural Cooperatives, Work and Motherland NGO, Horizon Fund and Scientific Center of Vegetable and Industrial Crops (SCVIC). Project implementation started in April 2010 and concluded in November 2012. Implementation was staggered so that in the first year four villages were targeted, with more added in subsequent years. The overarching objective of the project was to support smallholder farmers to secure sustainable livelihoods through increasing access to economic opportunities in agricultural value chains and increasing resilience to natural disasters related to climate change.

The key intervention through which the project was implemented was the establishment of farmers' cooperatives in the targeted communities. These cooperatives provided a platform through which most other project activities were implemented. Key activities at community and household level included: regular training sessions on high-value and climate-risk-resilient crops, modern agricultural techniques, and harvest and business management; provision of inputs, such as improved seed/seedlings, fertilisers and pesticides; establishing cold stores; provision of sun dryers for fruit crops; building links between the cooperatives and national processors; dissemination of information about market prices for produce to cooperative members by twice-weekly SMS; and provision of subsidised (interest-free) microfinance loans and finance training to cooperative members.

Evaluation design

This Effectiveness Review used a quasi-experimental evaluation design to assess the impact of the project activities approximately four years after implementation started. The focus of the review was on the impact of the project on participating households in the eight villages, four each in Tavush and Vayots Dzor regions, in which implementation had started earliest. Two hundred households, all direct beneficiaries of the project, were sampled from these villages while 400 households were sampled from 15 neighbouring villages in which the project had not been implemented; these provided a 'comparison group' against which the beneficiary households were compared.

At the analysis stage, the statistical tool of propensity-score matching was used to control for demographic and baseline (before project implementation) differences between the beneficiary and comparison households surveyed, to provide additional confidence when making estimates of the project's impact.

It should be noted that, as described in more detail in Section 2, Oxfam GB Armenia continued to work in the targeted villages through subsequent projects. It is not possible to separate the impact of the project under review (ARMA62) from the impact of subsequent projects. All results presented here should be interpreted taking this into account.

Results

All results outlined below compare project beneficiary households to matched comparison households.

Key results of this Effectiveness Review

Outcome	Tavush	Vayots Dzor	Comments
Agricultural livelihoods activities and migration	MIXED		There is no evidence suggesting less household migration or reliance on migrant labour; however, there is some evidence to suggest a greater likelihood of increased income from agricultural activities.
Technological adoption and agricultural inputs	YES		There is evidence suggesting greater use of pesticides, sun-dryers, cold storage/collection centres and greenhouses in both regions.
	MIXED		The project appears to have had a significant impact on farmers' use of inorganic fertilisers in Tavush region only and on use of improved seed/seedlings in Vayots Dzor region only.
	YES	NO	In Tavush region only, there is some evidence that there is a positive impact on the amount of land cultivated (measured both as a proportion of total land used and by area).
Agricultural production	YES		There is evidence for greater harvests of several individual fruit and non-fruit crop types in both regions. In particular in Tavush region there is evidence for a substantial (approximately 4-fold) increase in production of traditional vegetable crops.
	NO		There is no evidence of a sustained increase in diversity of agricultural production (measured by number of crops) or sustained production of non-traditional vegetable crops.
	YES	NO	There is evidence suggesting greater yields of both fruit and non-fruit crops, and greater aggregate quantity of fruit harvests in Tavush region only.
Sales and access to markets	YES	NO	In Tavush region beneficiary households are more likely to be selling agricultural products, sell a higher proportion of their produce and receive greater revenue from produce sales.
Access to finance	YES		There is some evidence suggesting that the project has had a small positive impact on perceived access to credit. There is evidence of a positive impact on access to credit from microfinance organisations, particularly in Vayots Dzor.
	YES	NO	In Tavush region beneficiary households were able to access credit at lower interest rates from both microfinance organisations and commercial banks.
Household income	YES		There is some evidence of positive impact of the project on household income. Beneficiary households experienced greater increases in asset wealth over the period of the project.

The results from this Effectiveness Review suggest that the project under analysis, 'New Economic Opportunities for Small-Scale Farmers in Tavush and Vayots Dzor Regions', had a positive effect on household income, measured through per capita consumption expenditure and other outcome indicators. There is evidence that households in the intervention sample have expenditures 12 per cent greater on average than households in the matched comparison sample. The impact of the project on income is of similar magnitude in both regions examined individually.

As well as examining the project's impact on household income, this Effectiveness Review investigated the channels through which the project activities may have led to this impact. Clear evidence emerged for Tavush region throughout the steps of the project's theory of change, with increased adoption of technologies and use of fertilisers, larger harvests (particularly of fruit and traditional vegetable crops) and greater revenues from agricultural produce sales; furthermore there is some evidence for increased access to credit. The results for Vayots Dzor are more mixed, with impact evident in some parts of the chain, but not others.

Agricultural livelihoods activities

The overall aim of the project was to support agricultural livelihoods for smallholder farmers. It is possible that there could have been an impact on choice of livelihoods activities within the household; however, it appears that the project had little or no impact on the occupation of the household head or reliance on migrant labour.

There is mixed evidence on the share of income from agricultural livelihood activities. No impact is found in response to a question asking respondents to estimate income shares from all sources at baseline (2009) and at the time of the survey.

However, when asked about their perception of changes in income over this period (between 2009 and 2014), on average 26 per cent of households in the intervention group report an increase in income from agricultural activities, compared to just 12 per cent of households in the matched comparison group. The difference is highly significant and the impact is particularly large in Tavush region; beneficiary households were substantially more likely than matched comparison households to perceive an increase in income from agricultural activities. Similarly, beneficiary households were less likely than comparison households to report a decrease or no change in income from agricultural activities. However, it is important to note that in both the intervention and comparison groups, households were more likely to report a decrease than an increase in income from agricultural activities, and more likely to report an increase in income from non-agricultural activities. This suggests that, while there is considerable diversity at individual household level, there has been an overall shift away from agricultural livelihoods over the period of the project, which was ameliorated to some extent by the impact of the project for beneficiary households.

Technological adoption

The project activities included training sessions to enhance cooperative members' understanding and knowledge of modern and improved agricultural practices. There is evidence to suggest that the project succeeded in increasing the adoption of such practices among beneficiaries. A significantly higher proportion of farmers in the intervention group reported using improved seed, seedlings and pesticides, compared with the matched comparison group. There is also a significant difference in the proportion of households using facilities and technologies associated with the project, including sun-dryers, cold storage/collection centres and greenhouses (with associated drip irrigation systems). In Tavush region only, the project appears to have had a significant impact on farmers' use of inorganic fertilisers and ideal combination of fertilisers.

Agricultural inputs

The project does not seem to have had impact on total area of land used by beneficiary households. However, in Tavush region only, there is evidence of a positive impact on the amount of land cultivated, measured both as a proportion of total land used and by area. There is also some evidence suggesting an increase in the use of mechanical services in the intervention group in Tavush; however, these results are not robust and are sensitive to the model employed.

Agricultural production

Despite the project's success in supporting the adoption of improved agricultural technologies, there is no evidence suggesting higher diversity of agricultural production (measured by the number of crops and crop groups grown in the 12 months preceding the review) among beneficiary households. In both the intervention and comparison groups, each household produces almost ten different crops and crop groups on average; the magnitude of the difference between the intervention and matched comparison samples is small and not statistically significant.

There is evidence for significantly greater harvests of several individual crops and crop groups in the 12 months preceding the survey, both fruit and non-fruit, for beneficiary households in both regions. Of particular note is the substantially greater production of traditional vegetable crops in Tavush region; on average beneficiary households' harvests were approximately four times as much as comparison households'. This is likely to reflect the emphasis of the project under review after its first year, and follow-up projects, on cultivation of traditional vegetable crops using greenhouses to extend the growing season and increase yields and value of these vegetable crops. In both regions beneficiary households harvested significantly fewer potatoes, a relatively low-value crop. Conversely, there was no evidence for the sustained adoption, beyond the conclusion of the project activities, of the non-traditional vegetable crops that had been introduced through the project (broccoli, chilli peppers and cherry tomatoes). Their adoption had been noted by the project team and reported in annual reports during the period in which they were actively supported, but it appears that beneficiary households did not choose to continue cultivating these crops after directed support had concluded.[1]

When considering aggregate quantities of fruit and non-fruit crops harvested, there is some evidence suggesting a higher aggregate quantity of fruit harvested by beneficiary households for both regions considered together, and a large impact on overall harvest and fruit harvest in Tavush region only. However, this result should be interpreted with care, as it may not be meaningful to add quantities by weight of different crop types.

Beneficiary households in Tavush region only were more likely to perceive an increase in both fruit and non-fruit yields over the period between baseline and the time of the survey; this may reflect the significant impact of the project on the adoption of modern and improved agricultural practices and technologies in that region, in particular the use of fertilisers and greenhouses.

Access to markets

Several project activities aimed to enhance beneficiaries' access to market, including provision of price information by SMS and establishing direct links with national-level

agricultural processors. The project appears to have had a positive impact on access to markets in one of the two intervention regions. Beneficiary households in Tavush are on average more likely than comparison households to have sold any fruit and any non-fruit agricultural produce in the 12 months preceding the survey, and they sell a greater proportion of their produce. Furthermore, those beneficiary households in Tavush that are selling produce obtain, on average, 68 per cent greater revenue from their sales than households in the matched comparison group that are selling produce. They were also slightly (but statistically significantly) more likely than comparison households to sell produce at national level rather than in local markets, reflecting the new market linkages with big agricultural processors established with the support of the programme. However, there is no evidence of a difference in the probability of selling produce, selling higher proportion of production, or receiving higher revenues, for beneficiary households in Vayots Dzor.

Financial services

Project activities included training on finance (including credit risk) and provision of small interest-free loans through the cooperatives. The project appears to have had some impact on access to financial services. On average beneficiary households perceived a greater ability to borrow from a variety of sources than did comparison households. Furthermore, a significantly higher proportion of beneficiary households than comparison households actually accessed credit from microfinance organisations in the 12 months preceding the survey; this impact was particularly strong in Vayots Dzor.

On average beneficiary households who take up credit seem to be borrowing smaller amounts than households in the matched comparison sample. This is explained by the fact that a substantial proportion of beneficiary households continue to access relatively small interest-free loans offered by an Oxfam partner (Horizon Fund) through the project cooperatives. Focusing attention on loans from microfinance organisations and commercial banks, beneficiary households in Tavush region only appear to be able to access credit at lower interest rates than households in the matched comparison sample, suggesting that an impact of the project has been to improve their credit-worthiness.

Income and asset wealth

We assessed the overall impact of the project on household livelihoods by measuring household income and asset wealth.

The project has had a significant impact on household income measured as daily expenditure per capita; average expenditures among beneficiary households are 12 per cent greater than average expenditures among households in the matched comparison sample. Similarly, the proportion of the intervention group experiencing expenditures above the median of the unmatched comparison sample is eight percentage points greater that the proportion of the matched comparison sample (Oxfam GB's 'global indicator' for livelihoods project evaluation).

Finally, household wealth, measured by an asset index, increased significantly more over the period of the project for beneficiary households than households in the matched comparison sample.

Programme learning considerations

- We would like to encourage the project team to reflect on possible reasons for the more ambiguous impact of the project in Vayots Dzor region and to identify actions to mitigate the risks associated with such issues in future projects. Possible issues may include one or more of the following:
    - Particular vulnerability of this region to climatic shocks. Were there significant problems in the 12 months preceding the survey? (The period over which agricultural production information was collected.)
    - Problems with project implementation: were there particular challenges in specific communities?

- Particularly in Vayots Dzor, beneficiary farmers faced difficulties sourcing inputs, including quality seeds and seedlings, fertilisers and pesticides, on the local market. This meant that while beneficiaries were able to make use of these enhanced inputs during the duration of the project, they were not able to continue after the project had concluded, despite a desire to do so. With subsequent projects, when introducing farmers to improved inputs and technologies, we encourage the project team to consider and perhaps take actions to enhance the longer-term viability of these technologies in the communities being supported.

- The introduction of non-traditional vegetable crops (broccoli, chilli peppers and cherry tomatoes) that were perceived to be of high value and resistant to climatic risks, was a significant element of the project activities. However, we did not find evidence that the adoption of these non-traditional vegetable crops had been sustained beyond the period in which their cultivation was directly supported. We also understand that in the subsequent projects the focus of project activities shifted to support for cultivation of traditional vegetable crops, using greenhouses to increase yields and value of these crops, protect against climatic shocks and extend the growing season. This shift in focus may reflect learning considerations already recognised and acted upon by the project team. We would like to encourage the team to document the reasons for this shift in focus, which may include the following among others:
    - The value or resilience of these crops may not have been as high as anticipated.
    - It may have been difficult to source the required inputs.
    - It may have been difficult to access markets for these crops.

1 INTRODUCTION

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 to enhance learning across the organisation. This Framework requires project and programme teams to annually report output data across six thematic indicator areas. In addition, every year, for each thematic indicator area a modest sample of mature[2] projects are randomly selected to be evaluated through rigorous Effectiveness Reviews. One key focus is on the extent that these projects have promoted change in relation to relevant OGB global outcome indicators.

The global outcome indicator for the livelihoods thematic area is defined as the percentage of households demonstrating an increase in household income as measured by household expenditure per capita, compared to a 'typical' comparison household. This indicator is explained in more detail in Section 5.

The Effectiveness Review that took place in Armenia in April 2014 was intended to evaluate the success of the project 'New Economic Opportunities for Small-Scale Farmers in Tavush and Vayots Dzor Regions' (ARMA62) in promoting strengthened livelihood options among the project participants. This project was implemented in Tavush and Vayots Dzor, two of the eleven administrative districts of Armenia, between April 2010 and November 2012. The project was implemented by Oxfam GB's Armenia office in conjunction with local partners[3] Union of Agricultural Cooperatives, Work and Motherland NGO, Horizon Fund and Scientific Center of Vegetable and Industrial Crops. The focus of the review was on the activities in eight villages, four each in Tavush and Vayots Dzor, which had been included in the original project proposal, in which the project implementation had begun in 2010 or 2011 and in which the activities were largely funded through the project under review (ARMA62). The project had been extended to a further 11 villages (eight in Tavush and three in Vayots Dzor) but as implementation in these villages had begun less than two and a half years before the review was carried out, it was not felt that the project activities in them had reached sufficient maturity for inclusion in the review. Furthermore, some activities in these later villages were funded through different channels as described in Section 2.

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 describing the evaluation design. Section 4 describes how this design was implemented. Section 5 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 6 concludes the document with a summary of the findings and some programme learning considerations.

2 PROJECT DESCRIPTION

Background and motivation for the project

Prior to independence in 1991 the Republic of Armenia had been a Soviet Socialist Republic, in which the agricultural sector was structured according to a collective farm system employing ten per cent of the workforce.[4] On independence the collective farms were privatised, farming households receiving title to 1.4 hectares of arable land while mechanical assets (tractors, combine harvesters, etc.) were transferred to their operators. This resulted in a system of smallholder farming in which the use of modern industrial agricultural technology had significantly reduced[5] in comparison to the relatively industrialised collective farms. Simultaneously Armenia's industrial sector largely collapsed due to the breakdown of Soviet markets and there was a significant shift of labour into agriculture, with agricultural employment reaching 36 per cent of total employment in 1995[6] and 46 per cent in 2005[7] before falling to 39 per cent in 2010.[8]

Some rural communities are particularly impoverished, due to a combination of factors including a legacy of deindustrialisation in the local area, population by refugees from conflict-affected areas, vulnerability because of proximity to the disputed border with Azerbaijan, or remote location. Smallholder farmers often lack capital to invest in their farms, resulting in under-utilisation of inputs including mechanical cultivation services. Farmers are particularly disadvantaged by remote location as, in order to sell their produce, they may be dependent on locally monopolistic intermediaries who are able to capture the gains from trade. Farmers without adequate storage facilities are obliged to sell their produce immediately after harvest, when prices are relatively unfavourable, or in a degraded and thus low-value state.[9]

Project aim and specific objectives

The overall aim[10] of the project was to: 'Support small-scale farmers to secure sustainable livelihoods through increasing access to economic opportunities in the agricultural value chains and increasing resilience to natural disasters related to climate change.'

The specific objectives[11] of the project were:

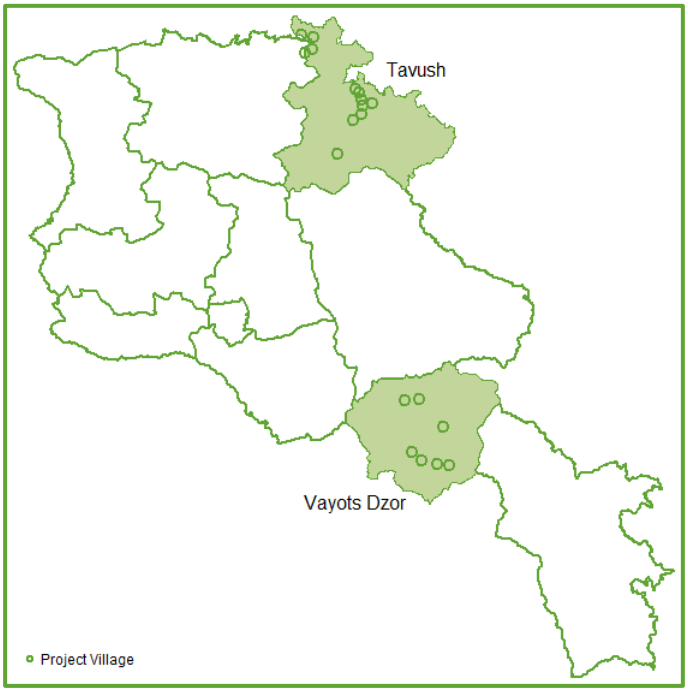
1. Supporting small-scale farmer producer groups to improve their position in the marketing value supply chain by bettering the management of their activities, from business planning to production, processing and marketing.
2. Enabling beneficiary villages to diversify income sources through tapping into the growing agro-tourism sector.
3. Piloting of the micro-insurance and micro-lending schemes to identify a mechanism for differentiated approach to respond to the needs of smallholder farmers.
4. Monitoring the implementation of proposed state programmes to reflect interests of smallholder farmers in the light of changed context and priorities due to global financial and economic crisis.
5. Support small-scale farmers in the targeted regions to become more resilient to climate-related disasters and to global climate change.

Intervention period and area

Tavush and Vayots Dzor regions were chosen for the project because agriculture dominates the local economy in these regions and because of the presence of particularly impoverished or vulnerable communities that had the potential to benefit. The project began in April 2010 and was initially envisaged to provide direct support to a total of 320 smallholder farmers from 10 targeted rural communities[12] in Tavush and Vayots Dzor regions, with an estimated total of 1,400 rural people directly benefiting from the project activities. Indirect benefits were anticipated for other agri-business participants including traders and processors, as well as consumers and tourists.

In practice, by March 2014 the project's activities had been extended to a total of 19 communities, twelve in Tavush and seven in Vayots Dzor, supporting a total of 603 smallholder farmers. However, as indicated in Table 2.1 some activities, particularly in the additional communities, were funded through different channels.[13] For this reason, and to ensure sufficient maturity, this review will focus on the first eight communities in which the project was implemented. The locations of the intervention regions and villages are indicated on the map Figure 2.1.

Figure 2.1: Location of intervention communities within Armenia



Project activities and logic model

Figure 2.2 presents a simplified logic model to show how the various activities implemented through the project were envisaged to affect the farmers' livelihood security.

The key intervention through which the project was implemented was the establishment of farmers' cooperatives in the targeted communities. Oxfam facilitated the establishment of these cooperatives through an intense process of open community mobilisation meetings, self-selection of interested and motivated farmers, then selection of a core 'action group'. This core group received management training and was supported to complete the formal aspects of registration as a non-profit

cooperative, after which the larger group of interested farmers came together to form the cooperative and elect a board and president.

Having established the farmers' cooperatives in the targeted communities, these provided a platform through which most other project activities were implemented. Key activities at community and household level included:

- Provision of training sessions on high-value and climate-risk-resilient crops, productivity-enhancing technologies, harvest management and financial management. *Rationale: higher productivity, diversification into higher-value crops and better farm management will all enhance farmers' incomes. Diversification, particularly into climate-risk-resistant crops, will increase livelihood security in the face of climatic risks.* (Objectives 1 and 5.)
- Provision of inputs (improved seed/seedlings, fertilisers and pesticides). *Rationale: as above; increased productivity and diversification enhances incomes and livelihoods security.* (Objectives 1 and 5.)
- Establishing cold stores in some of the project communities. *Rationale: with better storage facilities, farmers can market their produce in a better state and thus receive higher prices. In addition, they have more flexibility about when to market their produce and thus are not forced to sell at harvest time when prices are lowest. This should enhance farmers' incomes.* (Objective 1.)
- Provision of sun dryers for fruit crops in some project villages. *Rationale: sun drying fruit crops moves farmers up the value chain; sun dried fruit are of higher value than unprocessed fruit, so marketing sun-dried produce enhances farmers' incomes. Sun dried fruit also have greater longevity giving more flexibility about when the produce may be sold, allowing the farmers to take advantage of favourable market conditions.* (Objective 1.)
- Holding harvest festivals and building links between the cooperatives and national processors. *Rationale: individual smallholder farmers produce on too small a scale to establish relationships with national processors, but by joining together as a cooperative the scale of production may be large enough for interest from these processors. Selling directly to processing firms reduces reliance on intermediaries and thus may increase the price received for produce.* (Objective 1.)
- Dissemination of information about market prices for produce to cooperative members by twice-weekly SMS. *Rationale: If the farmers are better informed about market prices, this may improve their negotiating position with intermediary agents, enabling them to receive higher prices for their produce. Alternatively they may choose to market their produce through different channels or at different times so as to maximise their revenue.* (Objective 1.)
- Development of agro-tourism in cooperative communities (Vayots Dzor only) through links with national tourist agencies and local NGOs.[14] *Rationale: Agro-tourism activities may give farmers access to higher-return income sources and diversification increases resilience in the face of climatic and other risks associated with farm production.* (Objectives 2 and 5.)
- Provision of subsidised (interest-free) microfinance loans[15] and finance training to cooperative members. *Rationale: access to credit will help credit-constrained farming households to finance productivity-enhancing farm inputs including fertilisers, seeds and machinery, and to increase their cultivated area. Finance training and the opportunity to demonstrate creditworthiness through repayment of the subsidised loans will enable them to access credit from commercial*

providers in the future, thus relaxing the credit constraints that they face. (Objective 3.)

Other activities associated with the project included national-level policy advocacy to ensure that government policies and regulations reflect the interests of, and are responsive to the needs of smallholder farmers. The Effectiveness Review can only evaluate impact at household level; this national-level intervention affects beneficiary and non-beneficiary communities and households equally and so cannot be evaluated in the present review.

Note that greenhouses were also provided in some of the project villages; these extend the growing season, enhance productivity and allow farmers to grow crops that would not otherwise be feasible given the climatic constraints. However, in all but one of the villages these greenhouses were financed from sources other than the project under review, ARMA62. Unfortunately it will not be possible to separate the impact of the greenhouses from the impact of the activities financed through ARMA62, so the results of this Effectiveness Review should be interpreted taking that into account.

The distribution of community-based project activities across the participating villages is summarised in Table 2.1; those villages highlighted (the first four in each region) are the villages that have been included in this Effectiveness Review.

Figure 2.2: Simplified logic model for project

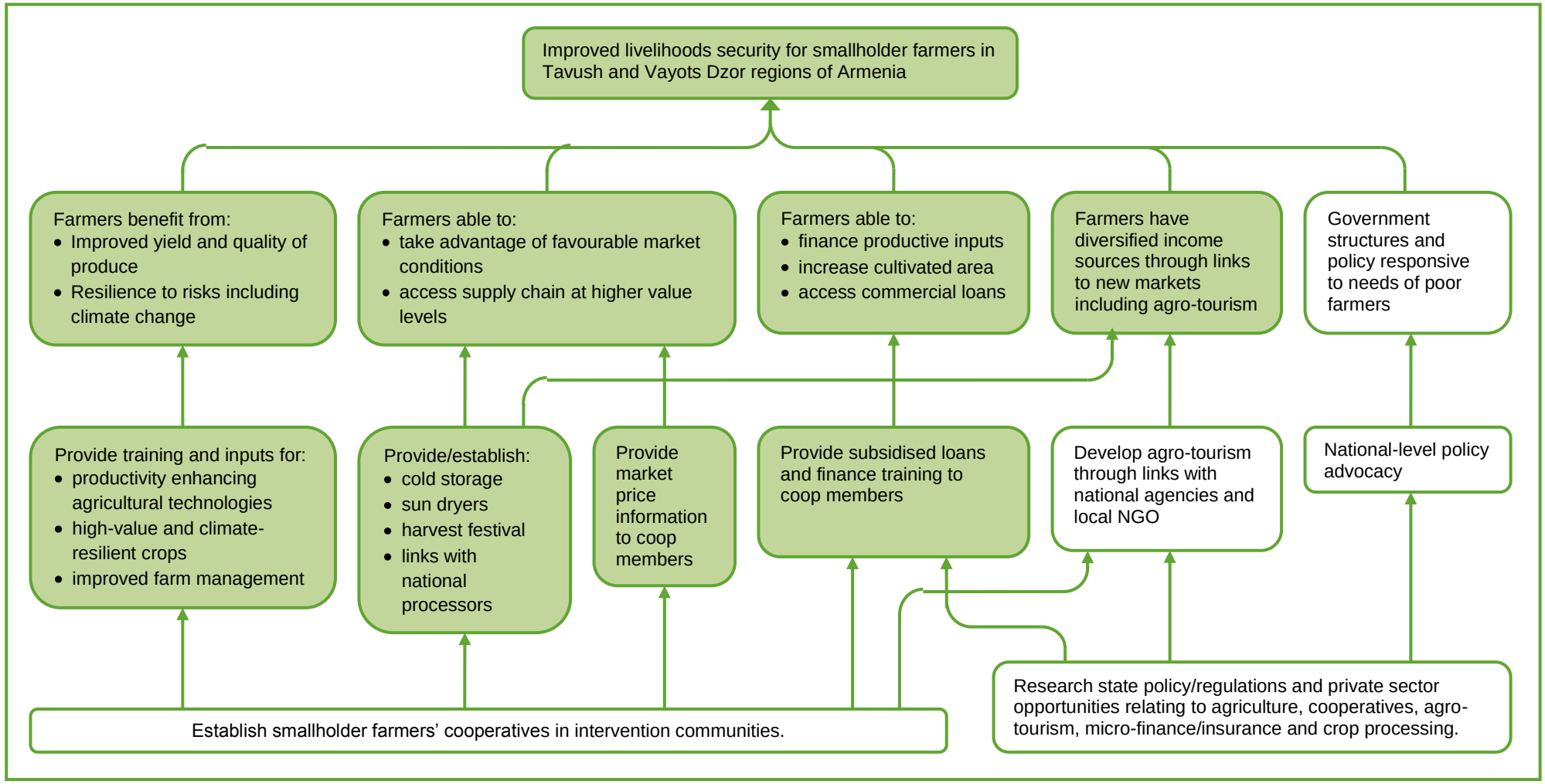


Table 2.1: Project cooperatives: membership, key activities and funding information

Region	FY Coop established	Village	Coop Members			Activities (✓ ARMA62; ✳ other funding source)					Notes
			Men	Wo-men	Total	Train-ing	Price Info	Cold store	Green-house(s)	Sun dryers	
Tavush	2010–11	Village 1	22	20	42	✓	✓	✓	✓ and ✳	✓	Greenhouses joint funded with UNDP; Farm School
		Village 2	30	2	32	✓	✓	-	✳	✓	Can use Aknaghbyur cold store; UNDP greenhouses
	2011–12	Village 3	36	4	40	✓	✓	✓	-	-	
		Village 4	21	9	30	✓	✓	-	✳	✓	UNDP established greenhouses in 2013
		Village 5	24	6	30	✓	✓	-	-	✓	
		Village 6	15	16	31	✓	✓	-	-	-	
	2012–13	Village 7	13	20	33	✓	✓	✳	✳	-	Cold store, greenhouses funded by ADC
		Village 8	12	11	23	✓	✓	-	✳	-	Greenhouses funded by ADC
		Village 9	9	26	35	✓	✓	-	✳	-	Greenhouses funded by ADC
		Village 10	19	15	34	✓	✓	-	-	-	Can use Ayrum cold store
	2013–14	Village 11	-	31	31	✳	✳	-	✳	-	Greenhouses funded by ADC
		Village 12	19	11	30	✳	✳	-	✳	-	Greenhouses funded by ADC
	Total	12 Coops	220	171	391						
Vayots Dzor	2010–11	Village 13	5	30	35	✓	✓	✓	✳	-	Greenhouses funded by Projects Direct
		Village 14	32	-	32	✓	✓	-	-	✓	Can use Zaritap cold store
	2011–12	Village 15	-	38	38	✓	✓	-	✳	✓	Will use Yeghegis cold store; greenhouse ARMA69.
		Village 16	-	36	36	✓	✓	✓	-	-	Cold store delayed; under construction
	2012–13	Village 17	-	37	37	✳	✳	✳	✳	-	Funding from Projects Direct (women's empowerment)
		Village 18	-	33	33	✳	✳	✳	✳	-	Funding from Projects Direct (women's empowerment)
		Village 19	-	31	31	✳	✳	✳	✳	-	Funding from Projects Direct (women's empowerment)
	Total	7 Coops	37	205	242						
Total		**19 Coops**	**257**	**376**	**633**						

Challenges faced during implementation

The Oxfam project team and implementing partners seemed generally confident in the implementation of the project. However, they did report having faced a number of challenges:

- The cooperatives generally had 30–40 members, but it proved hard to achieve collective action in a group of that size. In practice, a core group of approximately 15 members actively participated in the cooperative activities while other members were less active. It is possible that this effect means that the project has a greater impact for the least disadvantaged within the communities.
- The project team had hoped to involve the youth in these agricultural communities actively in the project activities. However, their impression was that most youth had little interest in agricultural livelihoods, instead choosing to migrate to Yerevan (the capital city) or Russia to find work. While this would not affect the results of the present Effectiveness Review, it does raise concerns about the long-term sustainability of smallholder agriculture in Armenia and the agricultural cooperatives founded as part of the project. Looking ahead to the results, the project has not had a significant impact on migration decisions for beneficiary households (Section 5.3.1).
- Related to the above point, the male economically active members of many households in the intervention villages were working in the capital (Yerevan) or in Russia on a seasonal or permanent basis; this meant that the majority of agricultural activities in the intervention areas were carried out by women. In accordance with Oxfam's global priorities and in response to this local reality, the project was implemented with a particular focus on supporting these women. In some communities the cooperatives were specifically women's groups; in communities where the cooperatives were mixed a particular effort was made to encourage women's participation and leadership. This was reported to be more effective in some communities than others.
- Supporting agro-tourism activities were an important part of the original project proposal (Objective 2). During the first year of the project, implementation of these activities had started in Vayots Dzor region, with creation of community maps and publication of books and a CD. However, this part of the project was found not to be in line with Oxfam GB's priorities and so was not continued after the first year. This was regretted by the project team who felt that agro-tourism activities had the potential to significantly enhance livelihoods security for beneficiary households. Any residual impact of these activities on beneficiary households' livelihoods cannot be assessed separately from the impact of other project activities in this Effectiveness Review.
- As envisaged in the original project proposal, the Oxfam project team planned to research and implement a pilot micro-insurance scheme for smallholder farmers as well as the micro-credit provision that was actually implemented. Unfortunately, as reported by the Oxfam project team and the microfinance partner NGO (Horizon Fund) it proved impossible to find a commercial insurance provider to act as a partner for this part of the project. The understanding of the Oxfam project team and the Horizon Fund representative was that this was at least in part due to regulatory changes for motor insurance in Armenia which meant that all commercial insurance providers were focusing their activities in the new market for motor insurance and were not interested in

creating agricultural insurance products for smallholder farmers. It may also have been the case that the commercial providers did not see agricultural insurance for smallholder farmers as a commercially viable proposition, not least because Armenia is a small country and the climatic risks faced by the farmers are highly correlated, meaning that it would not be possible to pool risks over a sufficiently diverse area. As this part of the project was never implemented, there can be no impact to assess in the Effectiveness Review.

3 EVALUATION DESIGN

3.1 EVALUATION APPROACH

The central problem in the evaluation of any social programme is how to compare the outcomes that result from that programme with *what would have been the case* had that programme not been carried out. In the case of this Effectiveness Review, the situation of households in the villages where the project was implemented were examined through a household questionnaire – but clearly it was not possible to observe what their situation would have been had they not had the opportunity to participate in this project. In any evaluation, that 'counterfactual' situation cannot be directly observed, it can only be estimated.

In the evaluation of programmes that involve a large number of units (whether individuals, households, or communities), common practice is to make a comparison between units that were subject to the programme and units that were not. Units where the programme was not implemented can, indeed, provide a good estimate of the counterfactual as long as these – at the outset of the project – can be assumed to be similar to the beneficiary group in all respects except for the implementation of the specific programme.

The 'golden standard' approach to an impact evaluation is to select the units in which the programme will be implemented at random. Random selection minimises the probability of there being systematic differences between the programme and non-programme units ex-ante, and so maximises the confidence that any differences in outcomes ex-post are due to the effects of the programme.

In the case of the project examined in this Effectiveness Review, the unit at which the programme was implemented was the village: within each of the targeted regions (Tavush and Vayots Dzor), specific villages were selected for Oxfam support while others were not selected. The selection of beneficiary villages was not made at random; in fact, villages were deliberately chosen by Oxfam according to remoteness, vulnerability (refugee population, location close to border with Azerbaijan or post-Soviet economic history) and the potential to benefit from improved positioning in the value chain. However, discussions with the implementation staff revealed that there were in fact in these regions more villages considered suitable for implementation than could have been covered by the project. Therefore, a 'quasi-experimental' evaluation approach was adopted, in which the situation of households in those non-implementation villages was assumed to provide a reasonable counterfactual for the situation of households in the implementation villages.

To improve the confidence in making this comparison, households in the project villages were 'matched' with households with similar characteristics in the non-project (or 'comparison') villages. Matching was performed on the basis of a variety of characteristics – including household size, education level, productive activities, and indicators of material wellbeing, such as housing conditions and ownership of assets. Since some of these characteristics may have been affected by the project itself (particularly those relating to productive activities and wealth indicators), matching

should be performed on the basis of these indicators *before* the implementation of the project. Although baseline data were not available in this case, survey respondents were asked to recall some basic information about their household's situation from 2009, before the project was implemented. While this recall data is unlikely to be completely accurate, this should not lead to significant bias in the estimates as long as the measurement errors associated with recall are not significantly different for the treatment and comparison groups.

The survey data provided a number of baseline household characteristics on which matching could be carried out. These characteristics were used to calculate a 'propensity score', which is the conditional probability of the household being in an intervention village, given particular background variables or observable characteristics. Households in the project and comparison villages were then matched based on their having propensity scores within certain ranges. Please refer to Appendix 1 for a more extensive explanation of the matching procedure, and a discussion of the tests carried out to assess whether the baseline distributions of each characteristic are similar between the two groups after matching.

In addition to running a propensity-score matching process, we used various alternative models to test the robustness of our results. For instance, we used multivariate regression models to control for measured differences between intervention and comparison groups by isolating the variation in the outcome variable explained by being in the intervention group after the effects of other explanatory variables have been accounted for.

It should be noted that both propensity-score matching and standard multivariate regression models rely on the assumption that the 'observed' characteristics (those that are collected in the survey and controlled for in the analysis) capture all of the relevant differences between the two groups. If there are 'unobserved' differences between the groups, then estimates of outcomes derived from them may be misleading. Unobserved differences between the groups could potentially include differences in attitudes or motivation (particularly important when individuals have taken the initiative to participate in a project), differences in community leadership, or local-level differences in weather or other contextual conditions faced by households. The choice of which intervention and comparison villages to survey for this Effectiveness Review was made principally to minimise the potential for any such unobservable differences to bias the results.

Details on the intervention and comparison cells are provided in the next section.

3.2 SELECTION OF INTERVENTION AND COMPARISON GROUPS

A key factor in ensuring the validity of any non-randomised impact evaluation design is to select an appropriate comparison group. This is particularly true for ex-post, cross-sectional evaluation designs, such as that carried out in this Effectiveness Review. A comparison group that differs in relevant baseline characteristics and/or is subjected to different external events and influences is likely to result in misleading conclusions

about project impact. Identifying a plausible comparison group is therefore critically important and is, generally speaking, not an easy task in non-experimental work. This section explains the selection process followed for this review.

The first stage in identifying an appropriate comparison group is to understand the process by which project participants or beneficiaries were selected. For this project, that involved two steps: first the selection of targeted villages and then the selection of beneficiaries within those villages.

The project activities were based on and delivered through agricultural cooperatives that were set up with Oxfam's support in the targeted villages. As described in Section 3.1 the targeted villages were chosen by the Oxfam project team according to remoteness, vulnerability (refugee population, location close to contested border with Azerbaijan or post-Soviet economic history) and the potential to benefit from improved positioning in the value chain.

The second step was selection of project beneficiaries within the targeted villages. The direct beneficiaries of the project were the cooperative members and other members of their households, so it is important to understand how the cooperative members were selected. Oxfam facilitated the establishment of cooperatives in the targeted villages through an intense process of open community mobilisation meetings, leading to self-selection of approximately 30–40 interested and motivated farmers who wanted to participate in the cooperative, then selection of a core 'action group'. This core group received management training and was supported to complete the formal aspects of registration as a non-profit cooperative, after which the larger group of interested farmers came together to form the cooperative and elect a board and president. All 30–40 members of the cooperative had access to the cooperative's services and project activities.

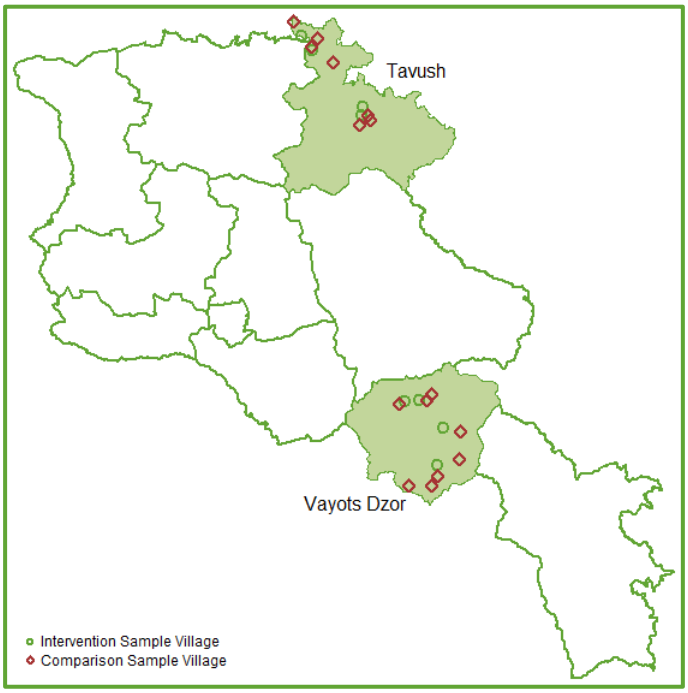
As mentioned in Section 2, the project implementation was staged. The first four cooperatives were set up in 2010 and more were added in subsequent years. However some activities, particularly in the later communities, were funded through different channels.[16] For this reason and to ensure sufficient maturity for impact to be manifested, this Effectiveness Review focuses on the first eight communities in which the project was implemented, which form the intervention group for the analysis.

With one exception, the comparison group was sampled from communities distinct from the intervention villages. This was in order to minimise the possibility of spillover effects from the project impacting households in the comparison group, and also because there may be unobservable differences between non-beneficiary and beneficiary households in the same communities. Comparison villages were selected from the same regions (Tavush and Vayots Dzor) as the intervention villages.

In order to achieve effective matching, a larger comparison sample is required than intervention sample. Therefore, for most of the intervention villages, two comparison villages were identified using the local knowledge of the Oxfam project team, together with official statistics, to select as close a match as possible in terms of livelihoods, socio-economic and agro-climatic characteristics. The household matching for the analysis was, however, carried out within regions rather than within these village-level

matches. The approximate locations of the sampled intervention and comparison villages are illustrated in Figure 3.1.

Figure 3.1: Location of intervention and comparison communities



As the intervention villages had not been chosen at random, but targeted according to official statistics and the Oxfam project team's knowledge of local conditions, this approach to choosing comparison groups is likely to yield the best possible matches between intervention and comparison households.

In Tavush region, it was, in most cases, fairly straightforward to identify comparison villages with characteristics similar to the intervention villages. There was one exception, a small urban community in which much of its population nevertheless depended on agriculture and several individuals were members of one of the project cooperatives. Post-Soviet deindustrialisation had led to substantial deprivation in this community and households that had relied on industrial jobs were forced to take up agriculture in order to survive. Due to the particular characteristics of this community it was difficult to identify any other communities likely to contain households with similar characteristics. Therefore, given that as a small town its population was significantly larger than the other communities, it was decided to include households from the same community in the comparison group. In principle this may lead to some spillover effects, but in practice our understanding from discussions with the Oxfam project team, and in the field, suggests that these will be negligible. This community may be excluded from the analysis as a robustness check, to ensure that this does not significantly affect the results.

In Vayots Dzor the identification of comparison villages was more challenging than in Tavush as the population density is lower, the terrain is more mountainous and varied, and some of the intervention villages had particular characteristics, such as significant refugee populations, that were not found in any potential comparison communities. In order to identify suitable comparison communities it was necessary to look further

afield within the region than in Tavush, as can be seen on the map of intervention and comparison villages (Figure 3.1). Nevertheless, it was possible in the propensity score matching procedure to construct a satisfactory matched comparison sample that did not differ significantly from the intervention sample in terms of baseline characteristics including distance from market. (Full details are presented in Appendix 1.) We therefore do not anticipate that this will have an effect on the results of our analysis.

Within the comparison villages the sample was chosen at random across the whole village, subject to the constraint that all sampled households should be engaged in agricultural or horticultural activities. This reflected as closely as possible the way in which cooperative members had been chosen in intervention villages.

However, as described above, the project cooperatives were formed through an extended process of community meetings, which would have required commitment and enthusiasm from participants who later became the project beneficiaries. It is therefore possible that cooperative members are different in terms of intrinsic motivation or enthusiasm for agricultural innovation from non-members in the same community. It was impossible to replicate this selection process in the comparison villages, and it is possible that the observable characteristics on which we carried out the matching process will not adequately proxy for these unobservable intrinsic characteristics. This raises the possibility of a bias in our results, such that any effect that we find may be partially due to differences in intrinsic characteristics of individuals and households rather than the impact of the project. However, as described in the results section (Section 5) we trace the impact through intermediate outcomes that can be ascribed more directly to the project; this increases our confidence that the reported effects are really due to the impact of the project.

In the next section we describe how the intervention and comparison households were sampled from the intervention and comparison groups.

4 DATA COLLECTION

4.1 SAMPLING STRATEGY

As described in Section 3.2, eight intervention villages (those in which project implementation had started in 2010 or 2011 and was primarily funded by ARMA62) were selected for this Effectiveness Review. In total, 200 beneficiary households were sampled from these eight villages. In order to implement the matching procedure effectively it is necessary to have a substantially larger sample of comparison households. Fifteen communities were identified, as described in Section 3.2, from which 400 households were sampled for the comparison group.

The intervention and comparison sample sizes are summarised in Table 4.1.

Table 4.1: Intervention and comparison groups sample sizes

Region	Project Participants		Sample Project Participants			Sample Comparison Group	
	Villages participating[17]	Households participating	Villages surveyed	Households participating	Households interviewed	Villages surveyed	Households interviewed
Tavush	12	391	4	144	100	7	200
Vayots Dzor	7	242	4	141	100	8	200
Total	**19**	**633**	**8**	**285**	**200**	**15**	**400**

In the eight intervention villages selected for the Effectiveness Review, the sampling frame was the list of cooperative members. The number of cooperative members in these communities varied between 30 and 42; from each of the cooperatives a sample of 25 was chosen uniformly at random. (Note that this procedure relatively over-samples from smaller cooperatives, so the results should not be interpreted as representative of the population of all beneficiaries. Rather, the results should be representative at the cooperative, rather than beneficiary level.) The remaining cooperative members were randomly sorted into a list from which replacements were drawn in case any of the sample households were unable to respond to the survey.

The Oxfam project team held telephone numbers for almost all beneficiary households. Telephone calls were made ahead of the survey team's visit to ensure that household members were aware of the visit and could plan to ensure that a suitable respondent was available for the survey. This maximised the chances of being able to interview the randomly sampled households. However, it did prove impossible to interview all of the sampled households, for a variety of reasons. Replacements were needed for 34 of the 200 randomly sampled households (17 per cent). The reason for replacement was not recorded in all cases, but reasons that were recorded included death or migration of the entire household or the cooperative member, refusal (just one case), and non-availability of any eligible respondent.[18] We may be concerned that this relatively high rate of replacement will make the sample non-random and thus bias our results. However, in general we would expect similar distortion of the sample[19] for both the intervention and the comparison groups, so the exclusion of such households will not bias the results of the analysis, which is based on differences between the intervention and matched comparison samples. (However, we should be careful to

bear in mind when interpreting the results, that the impact has been measured for a particular subset of the project beneficiaries, those who were available to respond to the survey.)

In 14 of the 15 comparison villages, 25 households were selected for the comparison sample. (In the remaining, relatively large, community, 50 households were selected.) In the comparison villages no list of households was available to use as the sampling frame, so an alternative procedure (random route sampling) was used. On arrival in the village, the survey team supervisor met with the village head. (In all cases, the local government had authorised the survey visit and the arrival of the team was expected.) In consultation with the village head, the survey team supervisor sketched a map of the village and estimated the total number of households and the number in each part of the village. The number of steps, n, for the random route sampling was determined by dividing the total number of households by the number required for the sample. The enumerators were assigned to the various parts of the village and instructed to follow a route, interviewing every n^{th} household. This strategy samples approximately uniformly across the whole village.

The project under review addressed agricultural livelihoods and the cooperative members in intervention villages all engage in agricultural or horticultural activities. Therefore, a preliminary sampling question was asked to determine whether any member of the potential comparison household was engaged in agricultural or horticultural production activities (whether or not any produce was taken to market). In the occasional case that they did not, the enumerators were instructed to sample the next household on their route.

Because the comparison villages were of different sizes, the number of steps varied between one and six. We may be concerned that this sampling procedure relatively over-samples from the smaller villages. However, the objective is not to have a representative sample from the comparison villages, but a sample containing good matches for the intervention households, which is unlikely to be representative of the comparison villages. The matching procedure should take care of any issues with composition of the comparison sample.

4.2 FIELDWORK

A household questionnaire was developed by Oxfam staff to capture data on various outcome and intervention exposure measures associated with the project's activities. Demographic data and recalled baseline data were also collected, to control statistically for differences between the supported and comparison households that could not plausibly have been affected by the project. The questionnaire was translated from English into Armenian. It was reviewed by the Oxfam project team and then by the enumerators during a practice exercise and the pilot exercise; it was revised accordingly. During the review process a number of errors in translation were identified and corrected; these errors had generally arisen in places where the English of the draft questionnaire was not fully clear or where technical terms had been used.

Two supervisors and 15 enumerators were recruited by the local consultant in Yerevan, the capital of Armenia. Most of the enumerators had prior experience undertaking

household surveys in Armenia. The enumerators participated in a three-day training workshop, which was led by the local consultant and Oxfam staff. The third day of the workshop was a piloting exercise, administering the questionnaire in one of the project villages in Tavush region that had not been identified for inclusion in the Effectiveness Review. Following this exercise, the performance of each of the enumerators was reviewed individually and the appointments of 12 were confirmed.

The enumerators were divided into two teams of six, each with a supervisor. Each enumerator undertook four household questionnaires per day while the supervisor did one, in addition to her supervisory duties. This meant that each team could survey 25 households per day, corresponding to one intervention or comparison village. With two teams and the equivalent of 24 villages to be surveyed, this required 12 days of fieldwork, six each in Tavush and Vayots Dzor regions. The movement plan was created in consultation with the overall 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; contact telephone numbers had been recorded for all surveyed households, and where omissions or ambiguities were identified in the review process, the enumerators were required to call back to clarify the information. The close supervision and call-back process resulted in an exceptionally clean dataset. The fieldwork took place between 12 and 23 April 2014, and the data entry was completed by 12 May.

4.3 DESCRIPTIVE STATISTICS

Table 4.2 presents summary statistics on the demographic and recalled baseline characteristics captured by the survey, and compares the averages between the households in the beneficiary group (the 'intervention' group) and those in the comparison group, before matching. The asterisks indicate differences in averages between the groups that are statistically significant at the 10 per cent significance level or lower.

The table demonstrates that there are some important differences between the households in the intervention villages and those in the comparison villages. In particular:

- Households in the intervention group have a younger composition, with a significantly smaller proportion of elderly members and significantly younger household head (both regions).
- Greater proportions of adult household members in the intervention group have secondary and vocational education, and the household head is more likely to have secondary or vocational education (Tavush region only).
- Households in the intervention group derived a significantly greater share of their income from farming (agriculture and horticulture) in 2009 than households in the comparison group (both regions; greater difference in Tavush region).
- Households in the intervention group derived a significantly smaller share of their income from, and the household head's principal occupation was less likely to be rearing livestock in 2009 than households in the comparison group (difference significant in Tavush region but not Vayots Dzor).
- Households in the intervention group derived a significantly smaller share of their income from producing livestock or dairy products in 2009 than

households in the comparison group (Tavush region only).

- Households in the intervention group derived a significantly smaller share of their income from pensions and other social security payments in 2009 than households in the comparison group (both regions; related to younger composition of the intervention households).
- Households in the intervention group grew significantly more distinct fruit crops in 2009 than households in the comparison group (both regions).
- Households in the intervention group cultivated significantly more (Tavush region) or significantly less (Vayots Dzor region) owned land in 2009 than households in the comparison group.
- Households in the intervention group were significantly closer to the nearest market where they could sell produce than households in the comparison group in 2009 (Vayots Dzor region only).
- The principal occupation of the household head was more likely to be a public sector salaried job in the intervention group than in the comparison group (significant in Vayots Dzor region only).

For these reasons, it is particularly important to control for demographic and baseline differences when making estimates of the project's impact. All of the variables listed in Table 4.2 have been taken into account in the Propensity Score Matching (PSM) models used to derive the results presented in Section 5 below.

Note that we have not included recall variables on agricultural practices, use of agricultural services and use of credit. This is because we consider that their values may have been affected by the intervention; the intervention group was more familiar with the terminology used for these practices and so there could have been a systematic difference in responses between the intervention and comparison groups that did not reflect a true difference in practices.

Table 4.2: Descriptive statistics: comparison between intervention and comparison households at baseline

		Overall			Tavush Region			Vayots Dzor Region		
	Variable source	Intervention mean	Comparison mean	Difference	Intervention mean	Comparison mean	Difference	Intervention mean	Comparison mean	Difference
Numerical variables (null hypothesis: no difference in means between intervention and comparison groups)										
Household size in 2009	Constructed	4.285	4.410	-0.125	4.240	4.670	-0.430*	4.330	4.150	0.180
Proportion of HH members younger than 6 years in 2009	Constructed	0.073	0.071	0.002	0.073	0.094	-0.021	0.073	0.048	0.025*
Proportion of HH members older than 60 years in 2009	Constructed	0.113	0.178	-0.064***	0.121	0.184	-0.062**	0.105	0.171	-0.066**
Proportion of HH members male adults (16 years or older) in 2009	Constructed	0.417	0.439	-0.021	0.434	0.434	-0.000	0.401	0.443	-0.042*
Age of HH head in 2009 (years)	Constructed	49.985	53.605	-3.620***	51.110	54.690	-3.580**	48.860	52.520	-3.660**
Proportion of adult HH members who have secondary education	Current	0.871	0.817	0.054**	0.867	0.774	0.093***	0.875	0.860	0.015
Proportion of adult HH members who have vocational education	Current	0.464	0.379	0.085***	0.492	0.367	0.124***	0.437	0.391	0.045
Proportion of adult HH members who have university education	Current	0.136	0.115	0.021	0.127	0.105	0.022	0.145	0.124	0.021
Share of HH income in 2009 from farming (agriculture/horticulture)	Recall	0.278	0.154	0.124***	0.361	0.175	0.186***	0.195	0.133	0.062***
Share of HH income in 2009 from processing crops/natural products	Recall	0.009	0.005	0.004	0.012	0.006	0.006	0.005	0.003	0.002
Share of HH income in 2009 from rearing livestock	Recall	0.098	0.137	-0.039**	0.060	0.103	-0.042*	0.135	0.172	-0.036
Share of HH income in 2009 from production of livestock or dairy products	Recall	0.074	0.091	-0.017	0.024	0.058	-0.034**	0.123	0.123	-0.000
Share of HH income in 2009 from running non-agricultural business	Recall	0.024	0.013	0.011	0.028	0.016	0.012	0.020	0.009	0.010
Share of HH income in 2009 from casual labour	Recall	0.031	0.046	-0.016	0.033	0.066	-0.032	0.029	0.027	0.001
Share of HH income in 2009 from unskilled private-sector salaried job	Recall	0.017	0.030	-0.013	0.007	0.030	-0.024*	0.028	0.030	-0.002
Share of HH income in 2009 from skilled private-sector salaried job	Recall	0.052	0.042	0.011	0.073	0.044	0.030	0.032	0.039	-0.008
Share of HH income in 2009 from unskilled public sector salaried job	Recall	0.030	0.024	0.006	0.034	0.025	0.009	0.025	0.023	0.003
Share of HH income in 2009 from skilled public sector salaried job	Recall	0.158	0.127	0.031	0.140	0.111	0.028	0.177	0.144	0.033

		Overall			Tavush Region			Vayots Dzor Region		
	Variable source	Intervention mean	Comparison mean	Difference	Intervention mean	Comparison mean	Difference	Intervention mean	Comparison mean	Difference
Share of HH income in 2009 from remittances	Recall	0.087	0.098	-0.012	0.083	0.123	-0.040	0.090	0.074	0.017
Share of HH income in 2009 from pensions or other social security payments	Recall	0.135	0.230	-0.095***	0.128	0.236	-0.108***	0.141	0.223	-0.083**
Number of fruit crops grown in 2009	Recall	5.465	4.420	1.045***	6.240	4.815	1.425***	4.690	4.025	0.665**
Number of grain/vegetable/other crops grown in 2009	Recall	3.725	3.757	-0.032	3.480	3.320	0.160	3.970	4.195	-0.225
Area of land owned in 2009 by HH (hectares)	Recall	1.373	1.403	-0.030	0.850	0.607	0.243**	1.897	2.199	-0.302
Area of land rented or other not owned in 2009 by HH (hectares)	Recall	0.274	0.241	0.033	0.214	0.138	0.076	0.334	0.344	-0.010
Area of land owned AND cultivated in 2009 by HH (hectares)	Recall	0.811	0.914	-0.103	0.610	0.447	0.162**	1.013	1.382	-0.369**
Area of land rented/other AND cultivated in 2009 by HH (hectares)	Recall	0.263	0.205	0.058	0.174	0.116	0.058	0.351	0.294	0.057
Number of migrant workers HH relied on for remittances in 2009	Recall	0.260	0.230	0.030	0.280	0.270	0.010	0.240	0.190	0.050
Number of minutes (return on foot) to fetch water from main water source in 2009	Recall	10.760	9.313	1.448	20.200	17.740	2.460	1.320	0.885	0.435
Number of minutes (on foot) to reach village centre in 2009	Recall	9.685	10.973	-1.288*	10.830	11.445	-0.615	8.540	10.500	-1.960*
Number of minutes (on foot) to reach nearest marketplace to sell produce in 2009	Recall	280.890	415.195	-134.305*	169.930	186.065	-16.135	391.850	644.325	-252.475**
Indicator variables (null hypothesis: no difference in proportions between intervention and comparison groups)										
HH head is female	Current	0.160	0.170	-0.010	0.190	0.205	-0.015	0.130	0.135	-0.005
HH head has secondary education	Current	0.900	0.823	0.077**	0.900	0.770	0.130***	0.900	0.875	0.025
HH head has vocational education	Current	0.530	0.448	0.083*	0.540	0.375	0.165***	0.520	0.520	0.000
HH head has university education	Current	0.130	0.108	0.022	0.120	0.085	0.035	0.140	0.130	0.010
HHH principal occupation in 2009 was farming (agriculture/horticulture)	Recall	0.355	0.340	0.015	0.470	0.360	0.110*	0.240	0.320	-0.080
HHH principal occupation in 2009 was processing crops/natural products	Recall	0.005	0.003	0.003	0.010	0.005	0.005	0.000	0.000	0.000
HHH principal occupation in 2009 was rearing livestock	Recall	0.080	0.142	-0.063**	0.030	0.110	-0.080**	0.130	0.175	-0.045

		Overall			Tavush Region			Vayots Dzor Region		
	Variable source	Intervention mean	Comparison mean	Difference	Intervention mean	Comparison mean	Difference	Intervention mean	Comparison mean	Difference
HHH principal occupation in 2009 was production of livestock or dairy products	Recall	0.055	0.070	-0.015	0.010	0.045	-0.035	0.100	0.095	0.005
HHH principal occupation in 2009 was running non-agricultural business	Recall	0.030	0.010	0.020*	0.030	0.015	0.015	0.030	0.005	0.025*
HHH principal occupation in 2009 was casual labour	Recall	0.045	0.045	0.000	0.050	0.065	-0.015	0.040	0.025	0.015
HHH principal occupation in 2009 was private-sector salaried job	Recall	0.140	0.133	0.007	0.150	0.135	0.015	0.130	0.130	0.000
HHH principal occupation in 2009 was public sector salaried job	Recall	0.220	0.147	0.072**	0.180	0.140	0.040	0.260	0.155	0.105**
HH grew non-traditional crops (broccoli/chillies/cherry tomatoes) in 2009	Recall	0.030	0.020	0.010	0.010	0.015	-0.005	0.050	0.025	0.025
HH collected berries in 2009	Recall	0.610	0.532	0.077*	0.750	0.675	0.075	0.470	0.390	0.080
HH wealth in second quintile (2009)	Recall	0.200	0.200	0.000	0.200	0.200	0.000	0.200	0.200	0.000
HH wealth in third quintile (2009)	Recall	0.240	0.180	0.060*	0.320	0.140	0.180***	0.160	0.220	-0.060
HH wealth in fourth quintile (2009)	Recall	0.215	0.193	0.022	0.210	0.195	0.015	0.220	0.190	0.030
HH wealth in fifth quintile (2009)	Recall	0.180	0.210	-0.030	0.160	0.220	-0.060	0.200	0.200	0.000

1. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
2. The construction of the wealth index is described in Section 5.3.9.
3. HH = household, HHH = household head

5 RESULTS

5.1 INTRODUCTION

The results of the Effectiveness Review analysis are presented in this section of the report. The results presented below compare outcomes for the intervention sample (households equally weighted) with outcomes for the *matched* comparison sample,[20] in which the households are weighted to obtain a sample that was a similar as possible to the intervention sample at baseline. The matching was carried out with a non-parametric Propensity Score Matching (PSM) procedure using kernel weighting as the matching algorithm. The procedure and its implementation for this Effectiveness Review is described and assessed in detail in Appendix 1 of the report.

This report attempts to be jargon-free and therefore detailed technical discussions are moved to the appendices. However there are a few statistical concepts that are useful to introduce here before reviewing the results. An overview of these concepts is provided in Box 5.1.

Box 5.1. Introduction to some statistical concepts

Impact or effect size

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

Statistical significance

When we talk about 'significant impact' in this report, we mean an impact that is 'statistically significant'. For example, imagine that we measure that the average sampled Oxfam beneficiary household earned £100 more than the average sampled comparison household. Although this difference seems quite large, we remember that this estimated average impact is derived from data on a *sample* of intervention and comparison individuals, rather than data on the *true* population of beneficiaries and their respective counterfactual values (see discussion in Section 3.1). Given that we only have one sample available, there is always a possibility that we have been unfortunate with our sample and that we happen to have drawn beneficiaries with relatively high values from a population pool with a true average impact of zero. Therefore, it is necessary to take into consideration the statistical probability of measuring impacts of £100 (or more) if there were truly no differences in earnings between the intervention and comparison groups, that is, if in reality the impact was zero. This probability is usually referred to as the *p-value*. P-values help to evaluate study hypotheses. The default hypothesis is always that there are no differences between the intervention and comparison groups. When a difference is detected, the p-value is used to evaluate whether the default hypothesis should be rejected and we may conclude that the project had an impact. If the p-value is small, for instance one per cent, this means that the probability of obtaining an estimate of £100 (or more) if the true impact was zero is very small (one per cent) so we can reject the hypothesis that the project had no impact on earnings 'at the one per cent significance level'. We would then say that the result is 'significant'. This is different from saying that the magnitude of the result is large, because magnitude refers to effect size or impact, as explained above. Taken together, significance and magnitude help us to interpret the results.

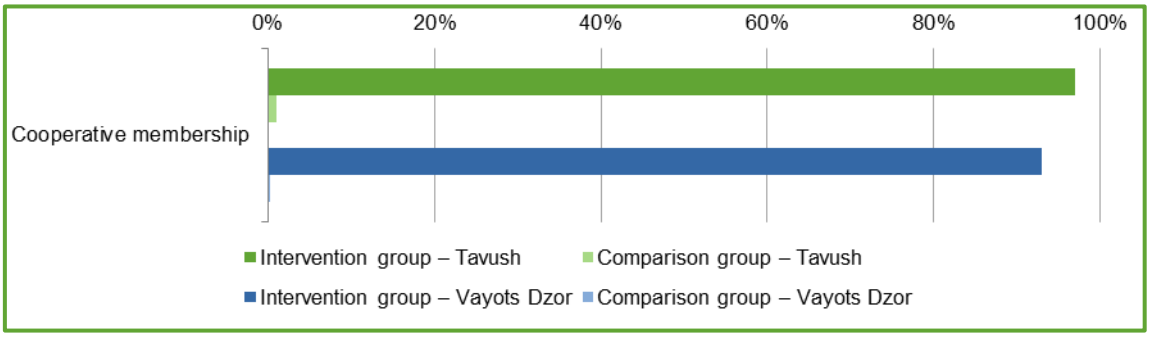
In the results tables below, statistical significance will be indicated with asterisks, with one asterisk (*) indicating a p-value of less than one per cent, two asterisks (**) indicating a p-value of less than 5 per cent and three asterisks (***) indicates a p-value of less than ten per cent. The higher the p-value, the less confident we are that the measured estimate reflects a non-zero impact. Values with a p-value of more than 10 per cent are considered statistically insignificant in this report. Note that the smaller the sample size and the greater the variation in the outcomes (i.e. *standard errors*) among the sampled households, the less confident we are in the accuracy of the estimated impact, the larger the p-value, and, hence, the less likely we are to conclude that a result is statistically significant.

5.2 EXPOSURE TO PROJECT ACTIVITIES

Before considering outcome-level changes, it is interesting to consider the proportion of respondents who report exposure to project-related interventions. This is an important consideration, firstly as it represents the analysis of the first step of the project's theory of change – i.e. are project participants being exposed to the intended livelihood-support interventions? Secondly, it is important to assess whether respondents in comparison areas also report receiving such support in their communities, as this may have an effect on the differences that may be detected between the intervention and comparison groups in the outcome measures reported subsequently.

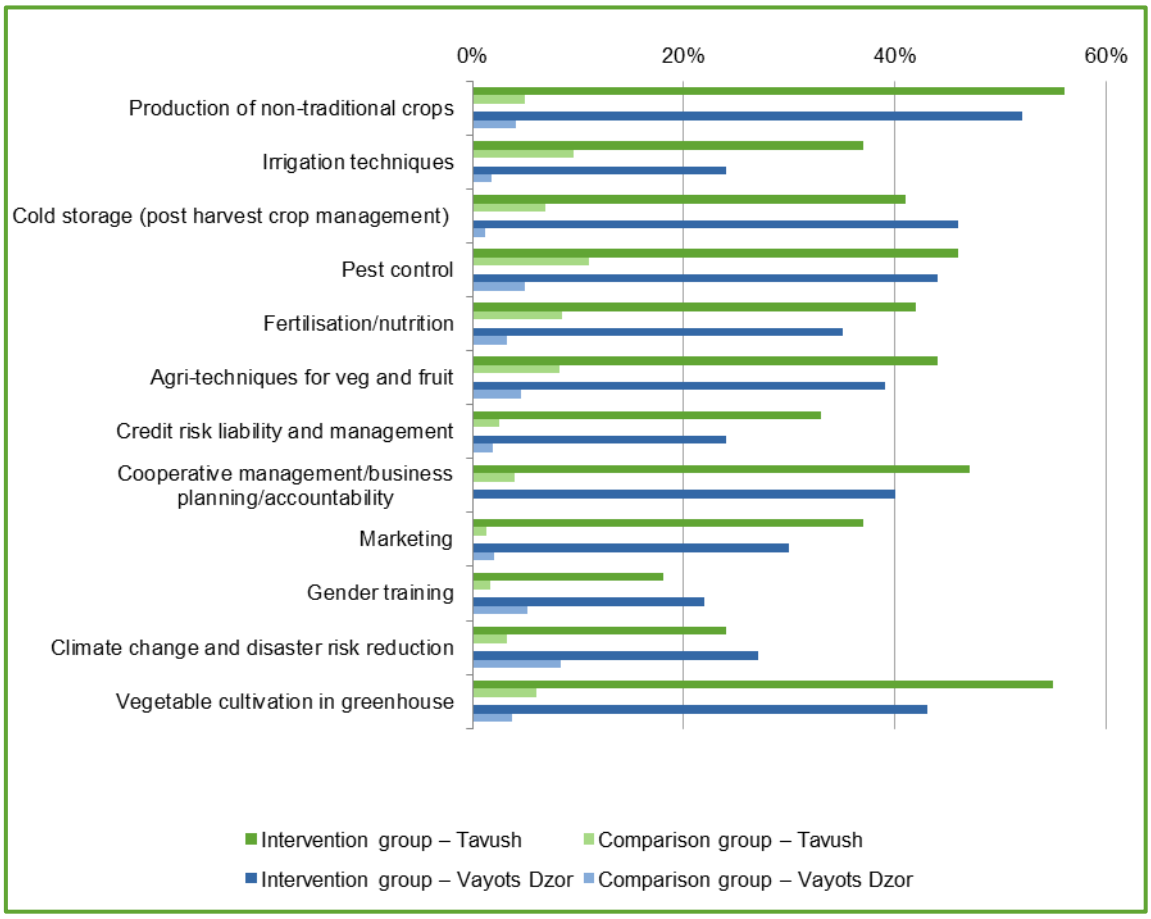
As described in Section 2, the project activities were implemented through farmers' cooperatives whose foundation was facilitated by the Oxfam project team. Figure 5.1 illustrates the proportion of households in the intervention and matched comparison groups who reported having at least one member of a farmers' cooperative at the time of the survey. Note that the proportion of intervention households with cooperative membership is not quite 100 per cent (97 per cent in Tavush and 93 per cent in Vayots Dzor);[21] as the sampling frame was Oxfam's list of cooperative members, some must have subsequently left the cooperative. In total just five of the comparison households reported being members of a cooperative (these were distinct from the project cooperatives); the proportion in the matched comparison sample was just 0.5 per cent so any effect on our estimates of the project's impact will be negligible.

Figure 5.1: Proportion of households with at least one registered member of cooperative at time of survey



As described in Section 2, training sessions were delivered to cooperative members on a wide variety of topics, including high-value and climate-risk-resistant crops, productivity-enhancing technologies, harvest management and financial management. Figure 5.2 presents the proportion of respondents in the intervention and comparison communities reporting having received various trainings since 2009. (The Oxfam project team reported that training had been delivered on each of these topics to members of the project cooperatives.)

Figure 5.2: Proportion of households reporting that a member has attended training sessions since 2009 on various topics



In both regions and for all types of training, a substantially greater proportion of the intervention group than the matched comparison group reported having received training. In all cases the differences are highly statistically significant with $p<0.01$. Interestingly, for each type of training less than 60 per cent of the intervention group reported having received the training; as this is recall data we cannot distinguish whether these reported participation rates reflect incomplete participation,[22] incomplete recall or both. It is also possible that in cases where the respondent was not the cooperative member, they were unaware that the cooperative member had attended training on specific topics. However, it is worth noting that 84 per cent of the intervention group in Tavush and 69 per cent in Vayots Dzor reported participating in at least one type of training, compared to just 20 per cent and 14 per cent in the respective matched comparison groups (figure 5.4).

Despite the fact that very few members of the matched comparison group belong to farmers' cooperatives, a small but non-negligible proportion of the comparison group did report having received training on most of the topics. Such training may have been made available by government agencies, NGOs[23] or through other channels. Nevertheless, it is clear that access to training on the assessed topics was substantially higher for members of the project cooperatives than for the comparison sample.

As well as training sessions on the topics described above, several other forms of material support were provided to cooperative members. This included provision of agricultural inputs (seeds, fertilisers, pesticides, etc.) for free or at subsidised prices, provision of market price information and links with national processors, organisation of events to showcase produce and the provision of cold storage and collection centres for produce. Figure 5.3 presents the proportion of respondents in the intervention and matched comparison groups reporting having received various types of support since 2009.

There are substantial and highly significant ($p<0.01$) differences between intervention and matched comparison groups in both regions for most types of support. An exception is the provision of fertilisers, for which the difference is not significant for Tavush district, and not highly significant for Vayots Dzor. Furthermore, the difference for 'other' support was not significant for either district. Again, it is interesting to note that although significantly higher proportions of the intervention group than matched comparison group reported receiving most types of support, the proportions reporting having received support varied between 13 per cent and 54 per cent in cases where there was a significant difference. As with receipt of training, as this is recall data we cannot distinguish whether these reported support rates reflect incomplete participation among cooperative members, incomplete recall or both. It is also possible that in cases where the respondent was not the cooperative member, they were unaware that support had been provided to the household.

Overall, it is clear that members of the intervention group had significantly higher access to several types of support for agricultural livelihood activities than did members of the matched comparison group. As illustrated in Figure 5.4, 74 per cent of the intervention group in Tavush and 80 per cent in Vayots Dzor reported receiving at least one type of support, compared to just 25 per cent and 31 per cent in the respective matched comparison groups.

Figure 5.3: Proportion of households that have received various types of support since 2009

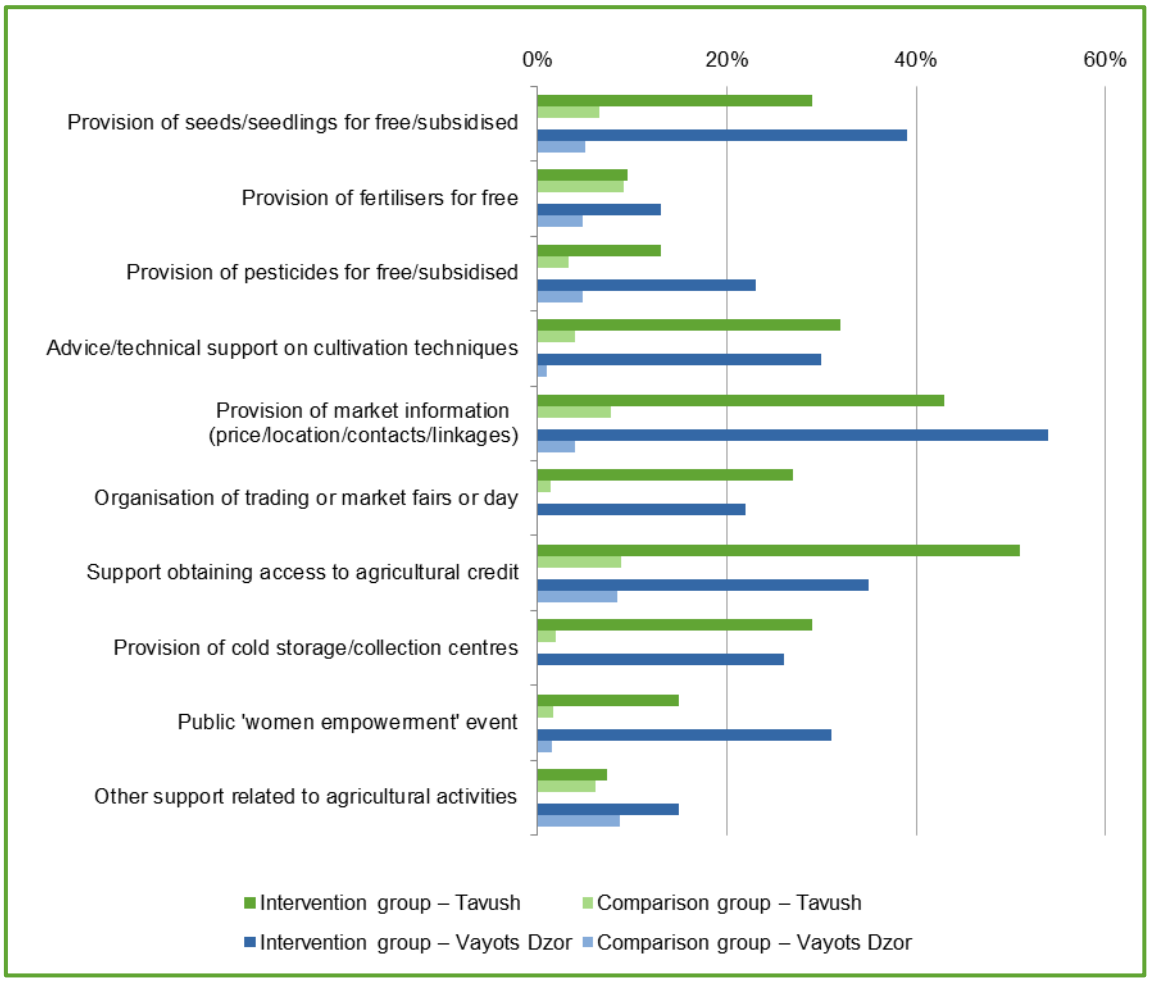
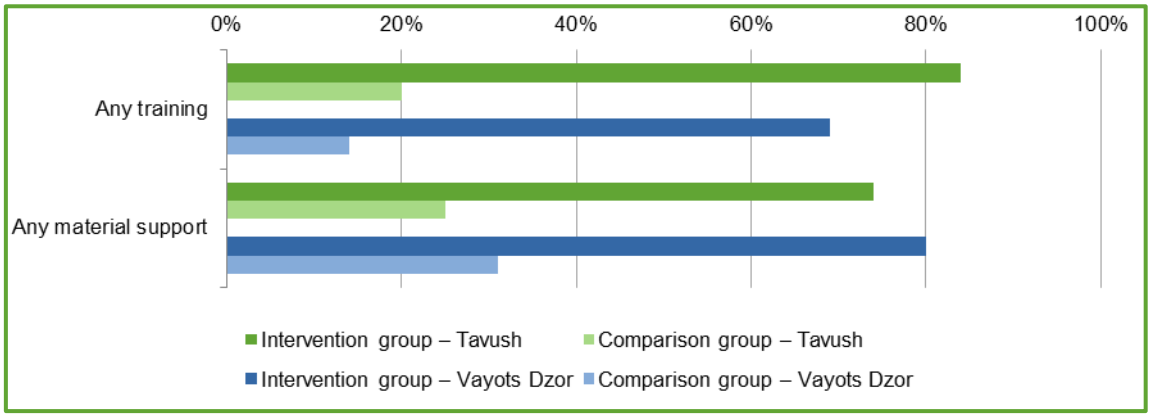


Figure 5.4 shows that there is a substantial (and highly significant) difference between the proportion of households in the intervention and matched comparison groups that reported receiving any type of training or any type of support.

Figure 5.4: Proportion of households that have received any of various types of training and any of various types of support since 2009



When interpreting the analysis of outcomes below, the reader should bear in mind that a large proportion, but not all of the intervention sample appear to have participated in the project activities and received direct support, while a small proportion of the

comparison sample appear to have received similar support from different sources. We will therefore expect the evaluated differences in outcomes between the intervention and matched comparison groups to be smaller than they would have been had all households in the intervention group and none of the households in the comparison group received support. Of course, the evaluation of the project should reflect the fact that not all intended beneficiaries may have in fact benefitted from the project, while the project did not take place in a vacuum and similar support may have been available to some non-beneficiary households. Therefore, this is the appropriate comparison to make for evaluation of the project.

5.3 ANALYSIS OF OUTCOMES

This section will examine the differences between households in the intervention communities and households in the comparison communities, in terms of outcome measures examined in the survey and discussed as part of the project's theory of change in Section 2. All of the outcome measures assessed refer to the date that the survey was implemented (April 2014) or the preceding 12 months and therefore relate to outcomes for the households directly after the close of the project.

The outcomes to be considered are as follows:

- Household livelihoods activities and migration
- Agricultural practices
- Agricultural inputs (land use and mechanical services)
- Agricultural production (diversity, output and yields)
- Sale of agricultural produce (proportion of output sold and value of sales)
- Market linkages and access to market
- Access to credit (potential and actual access, amount and interest rates)
- Household income (expenditure and perception of changes in income)
- Household asset wealth

5.3.1 Household livelihoods activities and migration

We first examine whether the project had any impact on the livelihoods activities carried out by the household. Because the project focused on supporting farming (agricultural and horticultural production, including fruit crops, vegetables, and produce collected in the wild) and the processing of agricultural/horticultural produce (for example, sun-drying fruit), we focus on these activities, examining both whether the household head's main occupation was one of these activities and what share of household income originated from these activities. We also examine whether there is any impact on migrant labour and remittances; if beneficiary households' income and livelihoods security from farming have increased due to the project then we may expect to see less dependence on migrant labour among beneficiary households than the comparison group.

The results are summarised in Table 5.1. We calculate the means of each of the measures for the intervention group and the matched comparison group then determine whether there is a significant difference between the two groups. Asterisks are used to indicate where the differences are statistically significant to at least the 10 per cent significance level. (One asterisk * indicates significance at the 10 per cent

level, two ** indicate significance at the 5 per cent level and three *** indicate significance at the 1 per cent level.)

As described above and detailed in Appendix 1, the matched comparison group was determined by propensity score matching (PSM) based on baseline characteristics of the two groups, using a kernel algorithm to determine weights for the matched comparison group. The analysis was restricted to intervention households for which good matches were available (the 'common support'), therefore the sample sizes are slightly smaller than the full sample surveyed and the results should be interpreted as applying to these matched beneficiary households rather than the full population of beneficiary households.

Table 5.1: Agricultural livelihoods activities (Year to April 2014)

	Agriculture/horticulture		Processing agricultural produce		Remittances from migrants	
	HHH main occupation	HH income share	HHH main occupation	HH income share	Number of migrants	HH income share
Overall						
Intervention group mean:	0.33	0.23	0	0.0085	0.33	0.10
Comparison group mean:	0.31	0.22	0.001	0.0034	0.38	0.11
Difference:	0.022 (0.052)	0.015 (0.028)	-0.001 (0.001)	0.0051 (0.0033)	-0.048 (0.077)	-0.0039 (0.024)
Observations (intervention group):	192	192	192	192	192	192
Observations (total):	549	549	549	549	549	549
Tavush Region						
Intervention group mean:	0.41	0.31	0	0.014	0.32	0.078
Comparison group mean:	0.41	0.27	0.002	0.0057	0.41	0.13
Difference:	0.0036 (0.081)	0.039 (0.051)	-0.002 (0.002)	0.0079 (0.0064)	-0.099 (0.11)	-0.055 (0.034)
Observations (intervention group):	95	95	95	95	95	95
Observations (total):	278	278	278	278	278	278
Vayots Dzor Region						
Intervention group mean:	0.26	0.16	0	0.0035	0.35	0.13
Comparison group mean:	0.22	0.16	0	0.0012	0.35	0.082
Difference:	0.041 (0.065)	-0.0083 (0.025)	0 (0)	0.0023 (0.0019)	0.0010 (0.10)	0.046 (0.035)
Observations (intervention group):	97	97	97	97	97	97
Observations (total):	271	271	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

There is no significant difference in the proportion of household heads whose main occupation is farming (agriculture/horticulture) between the intervention and matched comparison groups. (The proportions are the same in Tavush; slightly higher in the intervention group in Vayots Dzor, but not statistically significant at the 10 per cent significance level.) Similarly, there is no significant difference in average household

income shares from farming (slightly higher for the intervention group in Tavush but not significantly different; no difference in Vayots Dzor).

Essentially no household heads in either group or region[24] had as their main occupation the processing of agricultural produce. The average income shares derived from this activity were very low, at less than 1 per cent for both intervention and comparison groups. While the average income shares were higher in the intervention group than comparison group for both regions, neither difference was significant.

The average number of migrants per household was lower for the intervention households in Tavush than the matched comparison sample (0.32 versus 0.41); however this difference was not significant. Similarly, the average income share from remittances in Tavush was slightly lower in the intervention group (8 per cent versus 13 per cent) but again the difference was not significant. In Vayots Dzor there was no difference in the number of migrants, while average share of income from remittances was actually higher in the intervention group (13 per cent versus 8 per cent); again the difference was not statistically significant.

Overall, it appears from these results that the project had little or no impact on the occupation of the household head, reliance on migrant labour or shares of income from related livelihoods activities. We cannot exclude the possibility that there was a small effect on these variables, but it is not significant due to the relatively small sample size.

There are several issues that we should bear in mind when interpreting these results. The 'share of income' questions do not reflect possible changes in the total income, which may reflect a change in income from agriculture as well as income from other sources. The responses to the 'share of income' questions were estimated by the respondent in the course of the survey and not derived from a detailed examination of household productive activities and income streams. It was observed in the field that many respondents found it quite difficult to answer this question so we should be aware that there may be a significant amount of measurement error in the responses.

We shall examine in more detail in subsequent sections the impact of the project on agricultural productivity and income from sales of agricultural produce.

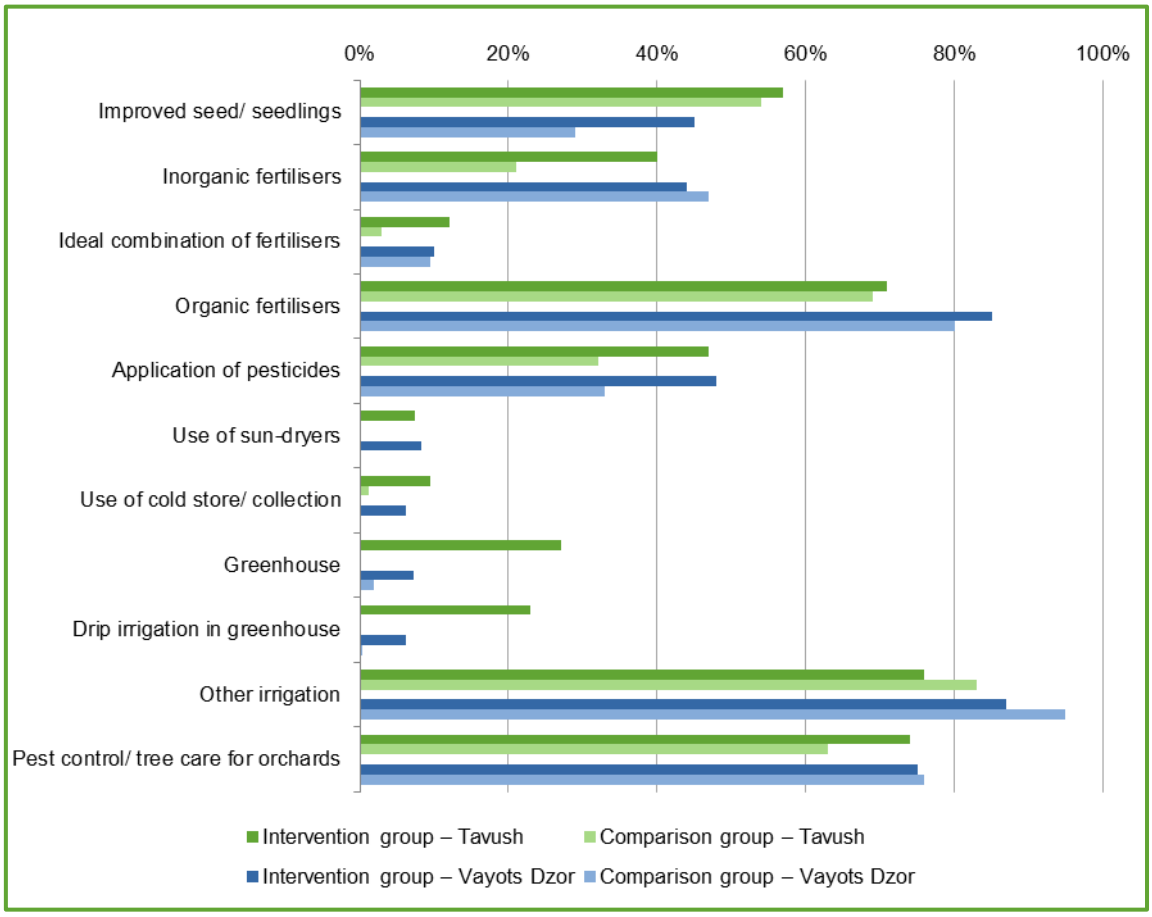
5.3.2 Agricultural practices

Many of the project activities focused on increasing the adoption of modern and improved agricultural practices among the beneficiaries. The rationale is that these improved practices will increase productivity and yields, thus increasing farmers' incomes. The activities included training on these practices, provision of consumable inputs (for example improved seed and seedlings, fertilisers and pesticides) and provision of durable facilities (cold storage/collection centres, sun-dryers and greenhouses). We examine whether there is a difference in adoption of these practices between the intervention and matched comparison communities; the results are illustrated in Figure 5.5 while detailed results are presented in Appendix 2 (Table A2.1).

All measures reported refer to practices in the past year at the time of the survey. It is important to note that the training and consumable inputs were provided to households during the period that the project was active, which concluded in November 2012, so if

an intervention household reports using any of these practices at the time of the survey, it means that they have continued to do so beyond the conclusion of the project, demonstrating a possible sustained impact of the project activities.

Figure 5.5: Improved agricultural practices in last year



Three of the practices, use of organic fertilisers (compost or manure), use of conventional irrigation and pest control and tree care, are widespread in both intervention and comparison communities; the project does not appear to have had any impact on use of these practices. (In fact, in Vayots Dzor region the use of conventional irrigation is significantly less, at the 5 per cent significance level, for the intervention sample. This may reflect local infrastructure availability.)

The project does appear to have had a significant impact on farmers' use of pesticides and inorganic fertilisers. The proportion of farmers using pesticides is 15 percentage points higher in the intervention group than matched comparison group in both Tavush and Vayots Dzor regions (48 per cent in the intervention group versus 33 per cent in the comparison group); overall this difference is highly significant at the 1 per cent level, as well as significant at the 5 per cent level in Vayots Dzor and at the 10 per cent level in Tavush. There is no significant impact on use of fertilisers in Vayots Dzor, but in Tavush there is a significant impact with 40 per cent of the intervention group reporting use of inorganic fertilisers, compared to just 21 per cent of the comparison group (difference significant at 1 per cent level). Similarly, 12 per cent of the intervention group in Tavush report using the recommended combination of three inorganic fertilisers, compared to just 3 per cent of the comparison group (significant at the 5 per cent level).

A significantly higher proportion of farmers in the intervention group in Vayots Dzor report using improved seed or seedlings (45 per cent, compared to 29 per cent in the comparison group; the difference is significant at the 5 per cent level).

Interestingly, despite the fact that more farmers among the intervention group are using these inputs, there is a difference of almost nine percentage points between the proportions of the intervention group and comparison group reporting difficulties finding quality seeds or seedlings, fertilisers or pesticides on the market. The difference is significant at the 10 per cent level (11 percentage points difference in Vayots Dzor, significant at the five per cent level, while the difference of six percentage points in Tavush is not statistically significant). (Results detailed in Table A2.2.) A natural interpretation is that, because they have received trainings and exposure to use of these inputs, there is greater demand for these inputs from the project beneficiaries than the comparison households, but this demand is not being fully met by the local markets.

Across both regions, there is a highly significant difference in the proportion of households using facilities and technologies associated with the project: sun-dryers, cold storage/collection centres and greenhouses[25] (with associated drip irrigation systems). Sun-dryers and cold stores are in use by approximately eight per cent of the intervention group but very few of the comparison group, while greenhouses are in use by 17 per cent of the intervention group, most of whom report using drip irrigation systems, while just one per cent of the comparison group are using greenhouses. This demonstrates that the project has had a persistent impact in adoption of these technologies. Despite the highly significant differences in use of these facilities, the magnitude of the impact is fairly small, as a relatively small proportion of the intervention group is actually using these facilities. To some extent this reflects the fact that not all facilities were provided to all communities (see Table 2.1). It also reflects the fact that within each community the project team developed a variety of different business models with different households.[26] It may also reflect that not all beneficiary households have access to some of the facilities, or some have chosen not to use them.

In the next section we examine in more detail the impact of the project on agricultural input decisions (including area of land cultivated and use of mechanical services), before looking at diversity of crop choice and agricultural outputs in the subsequent section.

5.3.3 Agricultural inputs

As described in Section 2, the pattern of smallholder farms in rural Armenia originated in the de-collectivisation of the agricultural sector in the early 1990s. The Oxfam project team has observed that many smallholder farmers in Armenia do not cultivate all of the land that they own. This may be due to lack of finance for inputs (including the hire of machinery to cultivate larger areas) or lack of labour, especially when family members are migrant labourers. Of course, land may be used for grazing livestock instead of growing crops.

Land use

By supporting agricultural activities as well as facilitating access to credit, it is possible that the project may have relaxed constraints on land use faced by the beneficiary

households. To assess this we examine whether there is any impact on the total area of land used (owned or rented[27]) by the household, the area of that land that is cultivated, and the proportion of the total area that is cultivated. The results are presented in Table 5.2.

Table 5.2: Land utilisation (Year to April 2014)

	Total land area (hectares)	Area of land cultivated (hectares)	Proportion of total land cultivated	Logarithm of total land area	Logarithm of area of land cultivated
Overall					
Intervention group mean:	1.90	1.12	0.78	-0.38	-0.80
Comparison group mean:	1.65	1.12	0.73	-0.42	-0.96
Difference:	0.26 (0.46)	-0.0036 (0.19)	0.058 (0.036)	0.033 (0.16)	0.15 (0.18)
Observations (intervention group):	192	192	192	192	191
Observations (total):	549	549	547	547	544
Tavush Region					
Intervention group mean:	1.09	0.82	0.81	-0.43	-0.80
Comparison group mean:	1.13	0.85	0.72	-0.75	-1.31
Difference:	-0.043 (0.24)	-0.033 (0.21)	0.087* (0.053)	0.33 (0.23)	0.50** (0.26)
Observations (intervention group):	95	95	95	95	94
Observations (total):	278	278	278	278	277
Vayots Dzor Region					
Intervention group mean:	2.70	1.42	0.76	-0.33	-0.80
Comparison group mean:	2.15	1.39	0.73	-0.083	-0.60
Difference:	0.55 (0.88)	0.026 (0.32)	0.030 (0.047)	-0.25 (0.22)	-0.20 (0.24)
Observations (intervention group):	97	97	97	97	97
Observations (total):	271	271	269	269	267

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

There is no clear pattern in these results. While on average intervention households use 0.26 hectares more land than the matched comparison households, the difference is not significant. In fact, looking at the data more closely we find that this difference is due to a couple of households that own considerably more land than is typical. In order to diminish the effect of these high outliers on the results we also take the logarithm of the areas and examine whether there is any impact of the project; no significant impact is found.

Looking at the area of land cultivated, there is no significant impact overall, or when the two regions are examined separately. However, looking at the logarithm of land cultivated, thus focusing less on outlying large values, a significant difference in the area of land cultivated is found for Tavush region (the significant difference in logarithm of 0.50 corresponds to 65 per cent more[28] land cultivated by intervention households than to matched comparison households on average[29]). Conversely in Vayots Dzor the area of land cultivated by intervention households in the sample is 18 per cent less[30] on average than by the matched comparison households, but that difference is not statistically significant. Finally, looking at the proportion of land owned or rented that is

cultivated, we see some suggestion of impact of the project in Tavush region. Overall, intervention households in the sample cultivate six per cent more of their land than the matched comparison households, but the difference is not statistically significant. Examining the regions separately, the difference is nine per cent in Tavush, which is significant at the 10 per cent level, but just three per cent in Vayots Dzor, which is not significant.

Summarising these results, the project does not seem to have had any impact on total land use by beneficiary households. However, there is some evidence that in Tavush region only there is a positive impact on area of land cultivated,.

Mechanical services

Another important agricultural input for smallholder farmers in rural Armenia is the use of mechanical agricultural services, including ploughing, cultivating, sowing and harvesting. These are important for grain crops (grown for own consumption, sale or livestock fodder) and for the cultivation of grapevines. Typically smallholder farmers do not own the required machines, but hire them when needed from a local owner/operator. If the project has encouraged beneficiary households to shift more resources into agriculture, or has relaxed credit constraints preventing use of these services, we may expect to see some impact on utilisation of these services. The results are presented in Table 5.3.

Table 5.3: Utilisation of mechanical services (Year to April 2014)

	Ploughing	Cultivation	Sowing	Harvesting
Overall				
Intervention group mean:	0.53	0.29	0.38	0.47
Comparison group mean:	0.42	0.16	0.27	0.50
Difference:	0.12** (0.053)	0.13*** (0.044)	0.11** (0.050)	-0.031 (0.054)
Observations (intervention group):	192	192	192	192
Observations (total):	549	549	549	549
Tavush Region				
Intervention group mean:	0.65	0.46	0.48	0.44
Comparison group mean:	0.50	0.23	0.31	0.37
Difference:	0.15* (0.076)	0.23*** (0.075)	0.17** (0.077)	0.072 (0.078)
Observations (intervention group):	95	95	95	95
Observations (total):	278	278	278	278
Vayots Dzor Region				
Intervention group mean:	0.41	0.12	0.28	0.49
Comparison group mean:	0.33	0.10	0.23	0.63
Difference:	0.084 (0.069)	0.022 (0.044)	0.049 (0.063)	-0.13* (0.074)
Observations (intervention group):	97	97	97	97
Observations (total):	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

These results suggest that the project has had a significant impact on beneficiary households' use of mechanical ploughing (a difference of 12 percentage points

between the proportion in the intervention sample and the matched comparison sample), cultivation (difference of 13 percentage points) and sowing (difference of 11 percentage points). All of these results are significant at the five per cent level, or lower. These results are driven by the results for Tavush region; there is no significant impact in Vayots Dzor, where in fact the proportion of the intervention group using mechanical harvesting services is 13 percentage points less than the proportion of the comparison group (significant at the 10 per cent level).

However, we should be very cautious when interpreting these results. In particular, it is not clear that they can be ascribed directly to the impact of the project. Use of these services may be driven by local availability and appropriateness for the crops grown in a particular village. Recall data on use of mechanical services in 2009 (before the project started) was collected, but was not used as a matching variable for the analysis because of concerns about its accuracy.[31] It turns out that the intervention and matched comparison samples are not balanced in terms of these recall variables. For this reason we also examine whether there is any impact in *changes* of use of these services (adoption or discontinuation), results given in Table A2.3. It turns out that in fact there is very little change in use of these services, at individual household level, between 2009 and 2014. Two significant differences do, however, emerge: the change in the use of mechanical sowing services was five per cent less for the intervention sample in Tavush than the matched comparison sample (significant at the five per cent level), reflecting a three per cent decrease among the intervention sample and a two per cent increase among the comparison sample. The change in the use of mechanical ploughing services was nine per cent greater for the intervention sample in Vayots Dzor (significant at the 10 per cent level), reflecting a five per cent increase for the intervention sample and a four per cent decrease for the comparison sample.

If we believe that the recall data for use of these services in 2009 is accurate then the results in Table 5.3 cannot be interpreted as an impact of the project, but rather reflect baseline differences between the intervention and matched comparison households. If we are confident that the samples are well-matched and that the recall data is inaccurate, we could interpret the results as an impact of the project.

5.3.4 Agricultural production

Survey respondents were asked about all of the different crops that they produced, harvested and sold in the 12 months preceding the survey. Here we report results about the diversity of crops grown.

Diversity of agricultural production

As described in Section 2, the project activities included training on high-value and climate-risk-resilient crops as well as provision of inputs relevant for these crops. It was anticipated that adoption of these crops would lead to greater diversity in crop production for beneficiary households as well as higher productivity. Here we examine whether the project has had any impact on crop diversity by examining the total number of crops grown, the number of vegetable or grain crops grown and the number of fruit crops grown.[32] We also examine the proportion of households growing non-traditional vegetable crops, a significant focus of the project activities. The results are summarised in Table 5.4.

Table 5.4: Diversity of agricultural production (Year to April 2014)

	Total number of crops grown	Number of vegetable and grain crops	Number of fruit crops grown	Production of non-traditional vegetable crops (indicator)
Overall				
Intervention group mean:	9.76	3.74	5.69	0.068
Comparison group mean:	9.59	3.74	5.48	0.037
Difference:	0.17 (0.36)	0.0044 (0.15)	0.21 (0.28)	0.031 (0.023)
Observations (intervention group):	192	192	192	192
Observations (total):	549	549	549	549
Tavush Region				
Intervention group mean:	10.1	3.47	6.40	0.063
Comparison group mean:	10.0	3.54	6.23	0.039
Difference:	0.054 (0.58)	-0.069 (0.25)	0.17 (0.47)	0.025 (0.033)
Observations (intervention group):	95	95	95	95
Observations (total):	278	278	278	278
Vayots Dzor Region				
Intervention group mean:	9.42	4	5	0.072
Comparison group mean:	9.14	3.92	4.75	0.036
Difference:	0.28 (0.44)	0.076 (0.19)	0.25 (0.32)	0.036 (0.031)
Observations (intervention group):	97	97	97	97
Observations (total):	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

The results in Table 5.5 clearly show that the project has not had an impact on the diversity of agricultural production, whether vegetable/grain crops or fruit crops are examined. In both the intervention and comparison groups, just under 10 different crops are produced on average, including just under four different vegetable or grain crops and five to six different fruit crops. The magnitude of the differences between the intervention and matched comparison samples are very small and not statistically significant. This is the case both overall and looking at the two regions separately.

Furthermore, there is no significant impact on the adoption of non-traditional vegetable crops, a particular focus of project activities, by the beneficiary households. Overall, these crops were cultivated by seven per cent of the intervention sample and four per cent of the matched comparison sample; the difference of three percentage points is not statistically significant. The results are very similar looking at the two regions separately. Anecdotally, during the fieldwork for the survey many beneficiary respondents mentioned that they had cultivated these crops while the project activities supporting these crops (training and provision of inputs) had been ongoing, but they had not continued to do so after these activities had concluded. We understand from the Oxfam project team that after the initial period of implementation, the beneficiary farmers and project team decided to re-focus project activities on the cultivation of traditional, but high value vegetable crops, using greenhouses to extend the growing season and to increase yields, instead of the non-traditional vegetable crops. This is reflected, for one region, in the results below: in Tavush we find that beneficiary households have substantially higher harvests of traditional vegetable crops than the

matched comparison sample and obtain greater income from sale of agricultural produce.

Quantity of agricultural production

We now examine whether the project had any impact on quantities of crops harvested. We first examine the quantity by weight of crops harvested (fruit, non-fruit and total quantity). The results are presented in Table 5.5 and should be interpreted with care, as it may not be meaningful to aggregate by weight over different crop types. (For example, one kilogramme of grapes is quite different from a kilogramme of wheat.) However, the results of this analysis give us an initial sense about the impact of the project, which may then be examined in more detail by considering the different crop types individually as presented in Appendix 2.

Table 5.5: Aggregate (by weight) agricultural produce (Year to April 2014)

	Aggregate quantity in kg			Logarithm of aggregate quantity in kg		
	All agricultural produce	**Non-fruit agricultural produce**	**Fruit**	**All agricultural produce**	**Non-fruit agricultural produce**	**Fruit**
Overall						
Intervention group mean:	6331.1	3613.3	2717.8	7.37	6.42	6.40
Comparison group mean:	3827.3	2630.5	1196.9	7.21	6.43	6.01
Difference:	2503.8 (1973.1)	982.8 (1644.6)	1521.0 (1147.1)	0.15 (0.17)	-0.014 (0.20)	0.38** (0.16)
Observations (intervention group):	192	192	192	191	190	184
Observations (total):	549	549	549	547	544	526
Tavush Region						
Intervention group mean:	5788.3	1182.8	4605.5	7.51	6.14	6.93
Comparison group mean:	2963.8	1390.8	1572.9	7.06	6.02	6.28
Difference:	2824.5 (2339.9)	-208.0 (347.1)	3032.5 (2228.5)	0.44** (0.22)	0.11 (0.30)	0.64*** (0.24)
Observations (intervention group):	95	95	95	94	93	92
Observations (total):	278	278	278	277	274	271
Vayots Dzor Region						
Intervention group mean:	6862.8	5993.7	869.1	7.22	6.69	5.86
Comparison group mean:	4673.1	3844.6	828.6	7.36	6.82	5.75
Difference:	2189.7 (3227.5)	2149.2 (3250.9)	40.5 (346.5)	-0.14 (0.23)	-0.13 (0.27)	0.11 (0.22)
Observations (intervention group):	97	97	97	97	97	92
Observations (total):	271	271	271	270	270	255

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

The distributions of harvested quantities are highly skewed, with many households harvesting relatively small quantities and a few households harvesting substantially larger quantities, so it makes most sense to interpret the logarithm results.

Overall, the total quantity harvested by intervention households is 16 per cent larger on average than the average quantity harvested by households in the matched comparison sample, however this difference is not statistically significant. There is very little difference in non-fruit harvests, but a significant difference in fruit harvests, for which the average quantity harvested by intervention households is 46 per cent larger than that harvested by the matched comparison sample, the difference being significant at the five per cent level.

Looking at the regions separately, in Tavush we see a significant and large impact of the project both overall (55 per cent more harvested by intervention households, significant at the five per cent level) and for fruit (90 per cent more harvested by intervention households, significant at the one per cent level). In Vayots Dzor the average total quantity harvested is actually 13 per cent lower among intervention households, although the difference is not significant; the average amount of fruit harvested is 12 per cent larger but again the difference is not significant.

So, overall we see a significant impact of the project on the total amount of fruit harvested by intervention households. In Tavush we see a large impact for both overall harvest and fruit harvest, but there is no statistically significant impact in Vayots Dzor.

It is possible to gain a fuller understanding by examining the impact of the project on different crops separately; aggregating over different crop types may have obscured important information. The detailed results are presented in Appendix 2 (Tables A2.4 and A2.5). These results should be interpreted with care, however, as the beneficiary and comparison samples were not matched according to particular crop types cultivated.

For vegetable and grain crops a clear pattern emerges of significantly greater harvests for beneficiary households than comparison households for several of the crop types, with smaller harvests for beneficiary households for just one of the ten crops (potatoes, a low-value crop). In Tavush, beneficiary households had significantly greater harvests of grains/cereals other than wheat and barley, pulses and traditional vegetables. In Vayots Dzor beneficiary households had significantly greater harvests of wheat, grains/cereals other than wheat and barley, and pulses (the impact in Vayots Dzor was obscured in the aggregate results reported above).

Of particular note is the substantially greater production of traditional vegetables in Tavush; on average beneficiary households' harvests were approximately four times as much as comparison households'. This is likely to reflect the emphasis of the project under review after its first year, and follow-up projects, on cultivation of traditional vegetable crops using greenhouses to extend their growing season, value and yields (output per square metre of cultivated land).

For fruit crops, a clear pattern emerges of significantly greater harvests for beneficiary households in at least one region for six of the 12 crops, with mixed results for one of the 12 crops. Harvests were not significantly lower overall for beneficiary households for any of the crops. We find a significant positive impact for five fruit crops in Vayots Dzor, which was obscured in the aggregate data.

Agricultural yields

We cannot measure agricultural yields directly because we were not able to gather data on the land area devoted to individual crop types. We have already seen in Section 5.3.3 that the differences in average area of land cultivated are not large, while above we saw a clear pattern of greater harvests for beneficiary households than comparison households, across many crop types. This suggests that beneficiary households may be experiencing higher yields.

We did ask survey respondents about their *perception of changes* in crop yields and tree fruit yields between 2009 and 2014, the results are presented in Table 5.6.

Table 5.6: Perception of changes in yields between 2009 and April 2014

	Perception of change in crop yields (per square metre)			Perception of change in fruit yields (per tree)		
	Increase	**Decrease**	**No Change**	**Increase**	**Decrease**	**No Change**
Overall						
Intervention group mean:	0.18	0.28	0.52	0.32	0.31	0.36
Comparison group mean:	0.11	0.38	0.52	0.19	0.34	0.47
Difference:	0.072* (0.038)	-0.096* (0.051)	0.0043 (0.054)	0.13*** (0.045)	-0.028 (0.052)	-0.11** (0.054)
Observations (intervention group):	192	192	192	192	192	192
Observations (total):	549	549	549	549	549	549
Tavush Region						
Intervention group mean:	0.24	0.21	0.52	0.41	0.24	0.33
Comparison group mean:	0.12	0.31	0.57	0.20	0.34	0.46
Difference:	0.12** (0.062)	-0.098 (0.072)	-0.058 (0.081)	0.21*** (0.070)	-0.097 (0.072)	-0.14* (0.080)
Observations (intervention group):	95	95	95	95	95	95
Observations (total):	278	278	278	278	278	278
Vayots Dzor Region						
Intervention group mean:	0.11	0.35	0.53	0.23	0.38	0.39
Comparison group mean:	0.093	0.44	0.46	0.17	0.34	0.47
Difference:	0.020 (0.041)	-0.093 (0.074)	0.065 (0.075)	0.053 (0.056)	0.039 (0.073)	-0.083 (0.074)
Observations (intervention group):	97	97	97	97	97	97
Observations (total):	271	271	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

For crop yields, overall 18 per cent of the intervention sample reported an increase in yields while just 11 per cent of the matched comparison sample did; the difference of seven percentage points is significant at the 10 per cent level. The difference was greater (12 percentage points) and more significant in Tavush, while there was very little difference (just two percentage points, not significant) in Vayots Dzor. The

proportion of the intervention sample reporting a decrease in crop yields was 10 percentage points less than the proportion of the matched comparison sample (significant at the 10 per cent level), with similar results in both Tavush and Vayots Dzor, although the difference was not significant in either of the regions when assessed separately. There was very little difference in the proportions of the intervention and comparison samples reporting no change in crop yields.

The results are similar for fruit tree yields: overall the proportion of the intervention sample reporting an increase was 13 percentage points more than the proportion of the matched comparison sample, significant at the five per cent level. However, this constitutes a large and highly significant difference of 21 percentage points in Tavush compared with a small and not statistically significant difference of just 5 percentage points in Vayots Dzor. Similar proportions (overall and in both regions) of the intervention and comparison samples reported a decrease in fruit tree yields, while 11 percentage points fewer of the comparison sample (significant at the 5 per cent level) reported no change; again the difference was significant in Tavush but not Vayots Dzor.

In conclusion, for both crop and tree fruit yields, beneficiary households in Tavush region were more likely to report an increase in yields since 2009 than the matched comparison sample. Furthermore, beneficiary households in Tavush were more likely to report an increase than a decrease in yields over the time period.

However, for both crop and tree fruit yields, there was no significant impact of the project for households in Vayots Dzor region. Furthermore, both beneficiary and comparison households in Vayots Dzor were more likely to report a decrease in yields than an increase over the time period.

So it seems that there is some evidence for a positive impact of the project on crop and fruit tree yields in Tavush region. This may well be connected with the positive impact of the project on agricultural practices, in particular the greater use of fertilisers and pesticides by beneficiary households in Tavush region that was demonstrated in Section 5.3.2.

The results from Vayots Dzor are a little hard to interpret. We saw in Section 5.3.3 that there are no significant differences in area cultivated, while we saw above that for several crops beneficiary households report higher harvests, which taken together do suggest that beneficiary households are experiencing higher yields than comparison households. However, this is not reflected in the respondents' perception of changes in yields.

5.3.5 Sale of agricultural produce

We now examine whether the project had any impact on sales of agricultural produce, considering whether or not the households sold any of their produce, the proportion of their produce that was sold and the revenue received from sales of produce.

Any agricultural sales

We first examine whether surveyed households have sold any agricultural produce in the 12 months preceding the survey, considering all crops and then fruit and non-fruit crops separately. The results are presented in Table 5.7.

Table 5.7: Sales of agricultural produce (Year to April 2014)

	Household sold any agricultural produce	Household sold any non-fruit agricultural produce	Household sold any fruit produce
Overall			
Intervention group mean:	0.84	0.67	0.63
Comparison group mean:	0.78	0.53	0.53
Difference:	0.056 (0.039)	0.15*** (0.052)	0.10** (0.047)
Observations (intervention group):	192	192	192
Observations (total):	549	549	549
Tavush Region			
Intervention group mean:	0.88	0.64	0.81
Comparison group mean:	0.71	0.40	0.64
Difference:	0.17*** (0.055)	0.24*** (0.074)	0.17*** (0.062)
Observations (intervention group):	95	95	95
Observations (total):	278	278	278
Vayots Dzor Region			
Intervention group mean:	0.79	0.70	0.45
Comparison group mean:	0.85	0.65	0.42
Difference:	-0.057 (0.050)	0.053 (0.070)	0.031 (0.071)
Observations (intervention group):	97	97	97
Observations (total):	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

The results are quite different for the two regions, so it makes sense to discuss them separately. In Tavush region, 88 per cent of the intervention sample has sold agricultural produce in the past year, compared to 71 per cent of the matched comparison sample, a difference of 17 percentage points which is significant at the one per cent level. A similar pattern is seen when we look at fruit and non-fruit produce separately. In both cases, substantially more of the intervention sample has sold such produce, and the difference is highly significant. This suggests that the project has had a substantial impact on households' decisions or ability to sell agricultural produce in Tavush region.

In Vayots Dzor region, the proportion of the intervention sample that had sold any agricultural produce was six percentage points *less* than the proportion of the matched comparison sample, although this difference is not significant. Conversely, five per cent more of the sample had sold non-fruit produce and three per cent more of the sample[33] had sold fruit, but again the differences are not significant. So, in Vayots Dzor the project does not appear to have had an impact on households' decisions or ability to sell agricultural produce.

Proportion of agricultural produce sold

We now examine whether the project has had any impact on the proportion of agricultural produce that the households sold. Results for the proportion of total produce (by weight), total fruit produce and total non-fruit produce are reported in Table 5.8.

Table 5.8: Proportion of agricultural produce sold (Year to April 2014)

	Proportion of all agricultural produce	Proportion of non-fruit agricultural produce	Proportion of fruit produce
Overall			
Intervention group mean:	0.31	0.23	0.32
Comparison group mean:	0.22	0.14	0.26
Difference:	0.090*** (0.026)	0.093*** (0.028)	0.056* (0.031)
Observations (intervention group):	190	190	183
Observations (total):	546	544	525
Tavush Region			
Intervention group mean:	0.46	0.28	0.51
Comparison group mean:	0.28	0.14	0.36
Difference:	0.18*** (0.043)	0.15*** (0.041)	0.15*** (0.050)
Observations (intervention group):	93	93	91
Observations (total):	276	274	270
Vayots Dzor Region			
Intervention group mean:	0.17	0.17	0.13
Comparison group mean:	0.16	0.13	0.17
Difference:	0.0068 (0.028)	0.039 (0.037)	-0.037 (0.034)
Observations (intervention group):	97	97	92
Observations (total):	270	270	255

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

The project had a clear and substantial impact on the proportion (by weight) of agricultural produce that households sold. Overall, households in the intervention sample sold on average 31 per cent of their agricultural produce by weight, whereas households in the matched comparison sample sold on average 22 per cent. The difference of nine percentage points is highly significant. Similarly, intervention households sold 23 per cent of their non-fruit produce while comparison households sold 14 per cent – again the difference of is highly significant. The difference of six percentage points for fruit produce is also significant, but less so.

The results for the two regions are quite different. In Tavush the impact of the project is a difference of 18 percentage points overall, and 15 percentage points for both fruit and non-fruit crops when considered separately; each of these results is highly significant. However in Vayots Dzor the impact is much smaller; less than one percentage point overall, four percentage points for non-fruit, while intervention households sell four percentage points *less* of their fruit produce than do the matched comparison households. None of these results is significant.

Value of agricultural produce sales

We now examine whether the project has had any impact on the value of sales of agricultural produce, restricting attention to those households that did sell agricultural produce. The results are presented in Table 5.9.

Table 5.9: Value of sales of agricultural produce (Year to April 2014)

	Value of sales in Armenian drams			Logarithm of sales value in drams		
	All agricultural produce	Non-fruit agricultural produce	Fruit	All agricultural produce	Non-fruit agricultural produce	Fruit
Overall						
Intervention group mean:	323527.7	171713.2	247412.9	11.8	11.3	11.4
Comparison group mean:	248403.2	181061.9	187252.5	11.4	11.3	11.0
Difference:	66688.6 (74312.1)	-41417.9 (52530.4)	55946.4 (63302.0)	0.41** (0.18)	0.019 (0.23)	0.32 (0.23)
Observations (intervention group):	161	129	121	161	129	121
Observations (total):	392	283	271	392	283	271
Tavush Region						
Intervention group mean:	441189.3	219655.7	307284.4	12.1	11.3	11.8
Comparison group mean:	374059.6	245498.5	263058.9	11.7	11.2	11.4
Difference:	75686.6 (136339.0)	-88313.4 (108198.3)	48689.7 (94375.2)	0.52* (0.30)	-0.058 (0.44)	0.44 (0.31)
Observations (intervention group):	84	61	77	84	61	77
Observations (total):	189	114	164	189	114	164
Vayots Dzor Region						
Intervention group mean:	195169.7	128705.9	142637.9	11.5	11.3	10.7
Comparison group mean:	145542.6	141900.2	75456.8	11.3	11.3	10.5
Difference:	56872.5 (43630.9)	650.1 (29252.8)	69250.4 (53926.5)	0.29 (0.19)	0.088 (0.19)	0.11 (0.32)
Observations (intervention group):	77	68	44	77	68	44
Observations (total):	203	169	107	203	169	107

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

Looking at the average value of sales among those who sold agricultural produce, we do not see a clear pattern. Overall, households in the intervention sample sold on average produce worth 66,700 AMD (approximately £100) more than households in the matched comparison sample. However, this difference is not significant. Fruit sales were higher and non-fruit sales were lower in the intervention group, but again the differences were not significant. Similarly, no significant differences were found examining the two regions separately.

However, the distributions of value of agricultural produce sales (total, fruit and non-fruit) are highly skewed, with many households selling relatively small amounts and a few households selling substantially more. This means that the results just discussed are dominated by the few higher-producing households, and we can get a better understanding of the patterns in the data by examining the logarithms of the values. These results are also presented in Table 5.9, and may be naturally interpreted in terms of proportional differences between the different groups.

Examining the logarithm of the value of total sales, there is a difference of 0.41, significant at the five per cent level, between the intervention sample and the matched

comparison sample. This means that those households in the intervention sample that sold any agricultural produce sold on average 51 per cent more[34] by value than the households in the matched comparison group that sold any agricultural produce. The difference is positive for both of the regions, although significant (at the 10 per cent level) only in Tavush region, where households in the intervention sample sold on average 68 per cent more than households in the matched comparison sample. There is very little difference in value of non-fruit sales overall or for either region, and any differences are not significant. The differences for fruit sales are large in magnitude (38 per cent overall, 55 per cent in Tavush and 12 per cent in Vayots Dzor) but not statistically significant.

Bringing together the results presented in this section, we can conclude that the project has had a positive impact on the likelihood that a household sells agricultural produce (fruit and non-fruit, in Tavush region only), on the proportion of agricultural produce that is sold (fruit and non-fruit, again Tavush region only) and, conditional on selling produce, on the revenue obtained from sales of agricultural produce, the difference being larger and more significant in Tavush region.

Combining these results with those from the previous section we can see that the intervention households in Tavush region are receiving higher revenue because they are both producing greater quantities and selling a greater proportion of their produce.

5.3.6 Market linkages and access to market

An important aspect of the project's objectives was to improve farmers' position in the marketing supply chain and access to market for their produce. Activities relating to this objective included the dissemination of information about market prices to beneficiaries by SMS, building links with national-level processing companies and provision of storage facilities to give farmers greater choice in when and how to market their produce. In this section we assess whether the project had any impact on perceived difficulties with market access, access to price information, ability to sell produce at the going market rate and channels through which produce was sold.

Reported difficulties

We first examine difficulties reported by survey respondents relating to market access. The results are presented in Table 5.10.

Intervention households were more likely to report difficulties than households in the matched comparison sample across all four issues about which questions were asked: lack of access to wholesale markets; transportation problems; problems with middlemen; and lack of storage facilities. However, the difference was significant overall only for problems with middlemen and, looking at region level, there were no significant differences.

While the project does not appear to have had a significant impact on these issues, it is concerning that beneficiary households are reporting these difficulties at a higher frequency than the matched sample of comparison households. However, as we saw in the previous section beneficiary households, particularly in Tavush region, are significantly more likely to be selling their produce and therefore more likely to face these problems. The market-access difficulties are less likely to be reported by a

household that is not marketing any of their produce (unless the problems are so severe that they prevent a household that would have marketed produce from doing so) so this pattern may in fact simply reflect the fact that more of the beneficiary households are marketing produce.

Table 5.10: Reported market access difficulties during last 12 months (all indicator variables)

	Lack of access to retail/wholesale agricultural markets	Difficulty transporting goods to market	Problems dealing with middlemen	Lack of storage facilities for fresh fruits and vegetables
Overall				
Intervention group mean:	0.41	0.34	0.34	0.18
Comparison group mean:	0.37	0.27	0.24	0.12
Difference:	0.044 (0.053)	0.077 (0.048)	0.098* (0.051)	0.056 (0.036)
Observations (intervention group):	192	192	192	192
Observations (total):	549	549	549	549
Tavush Region				
Intervention group mean:	0.36	0.23	0.28	0.20
Comparison group mean:	0.24	0.15	0.20	0.12
Difference:	0.11 (0.077)	0.086 (0.063)	0.080 (0.073)	0.077 (0.054)
Observations (intervention group):	95	95	95	95
Observations (total):	278	278	278	278
Vayots Dzor Region				
Intervention group mean:	0.46	0.45	0.39	0.15
Comparison group mean:	0.49	0.39	0.28	0.12
Difference:	-0.025 (0.074)	0.068 (0.072)	0.12 (0.070)	0.034 (0.049)
Observations (intervention group):	97	97	97	97
Observations (total):	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

In the subsequent analysis of access to information about market prices, ability to sell at prevailing market prices and location of sales we focus only on those households that are actually selling produce.

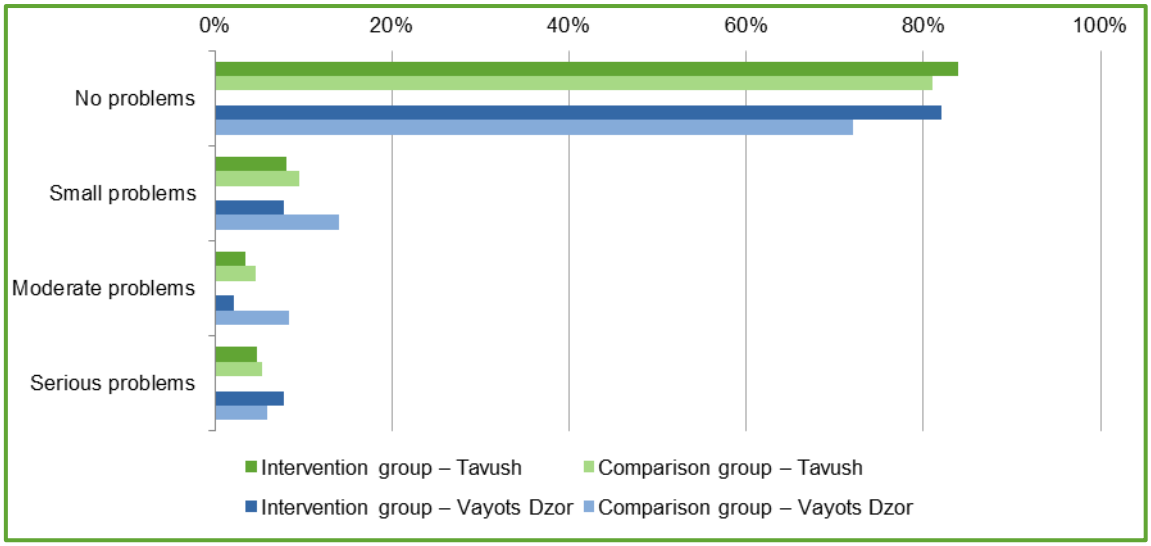
Access to price information

Restricting attention to those households for whom it was relevant, Figure 5.5 illustrates the proportion of households experiencing different degrees of difficulty accessing accurate information about market prices for their produce in the 12 months preceding the survey.

The overwhelming majority of households in both regions, in both the intervention and comparison samples, reported no problems accessing accurate information about market prices. The proportion of the intervention sample reporting no difficulties was eight percentage points greater than the proportion of the matched comparison sample; this difference was significant at the 10 per cent level. In Tavush, any differences between the intervention and comparison samples were very small; in Vayots Dzor the proportion reporting no difficulties was 11 percentage points greater in the intervention

sample, while six percentage points fewer in the intervention sample reported each of small difficulties and moderate difficulties, the last result being significant at the 10 per cent level. In conclusion, there is some evidence to suggest that the project had an impact on beneficiaries' access to accurate information about market prices for their produce.

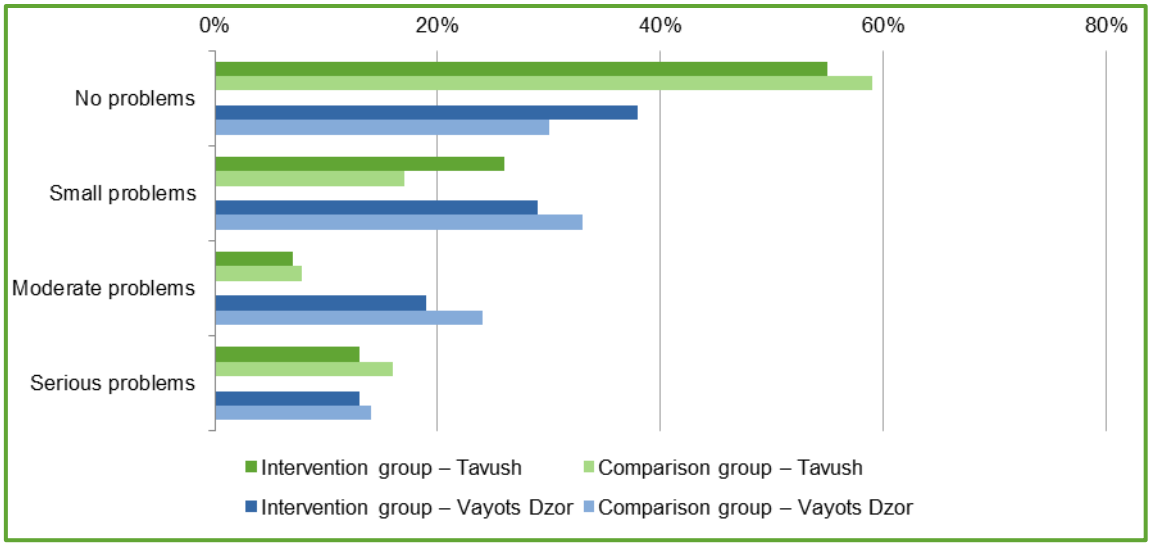
Figure 5.5: Proportion of households reporting problems accessing accurate information about market prices in the last 12 months.



Ability to sell at prevailing market prices

Of course, access to knowledge about market prices is not sufficient for a household to be able to sell their produce at these prices. Again restricting attention to those households for whom it was relevant, Figure 5.6 illustrates the proportion of households experiencing different degrees of difficulty selling their produce at the prevailing market prices.

Figure 5.6: Proportion of households reporting problems selling produce at prevailing market prices in the last 12 months.



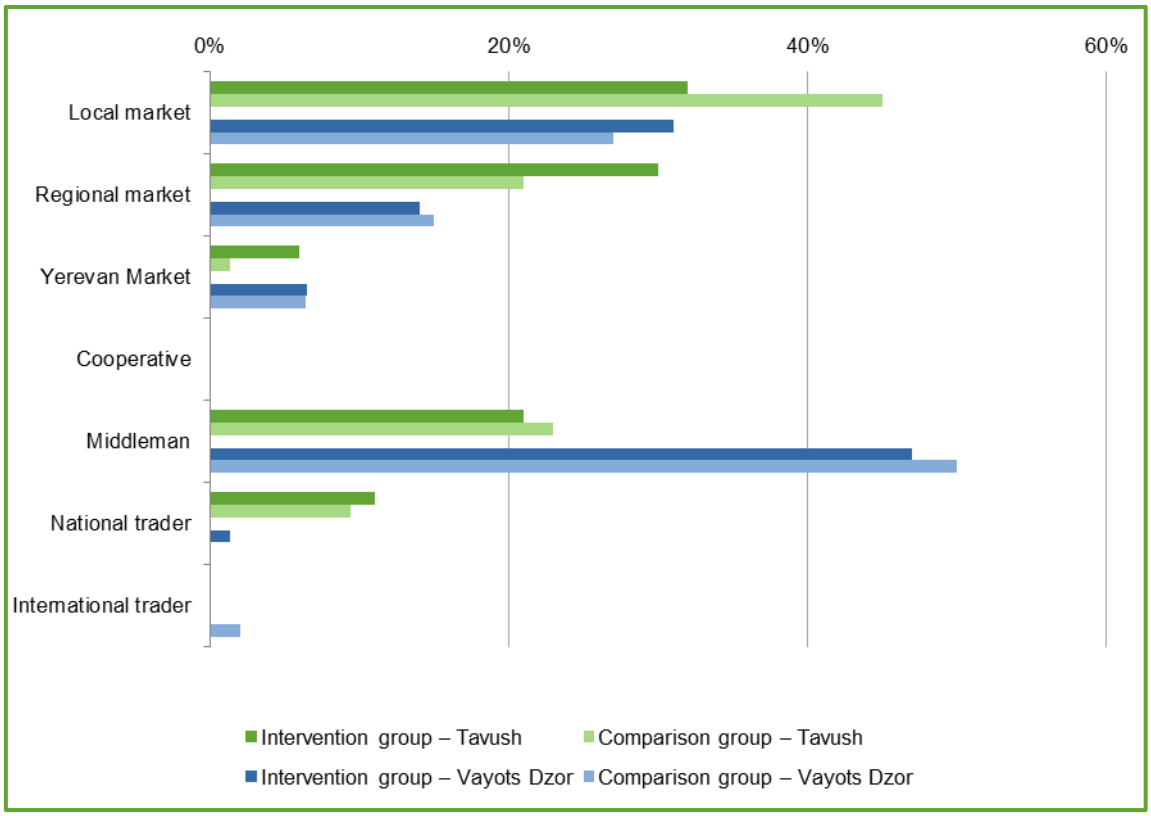
It is clear that a greater proportion of households experience difficulties selling at the prevailing market price than experience difficulties accessing information about the prevailing market price, demonstrating that information may be helpful, but is not sufficient to enable households to sell at the prevailing price. (For example, a household with no access to transport and dependent on selling to a middleman may be in a weak negotiating position and unable to sell at the full market price.)

Interestingly, in Tavush three per cent fewer of the intervention sample than the matched comparison sample reported no problems while seven per cent more reported small problems, one per cent fewer reported moderate problems and three per cent fewer reported serious problems. However, none of these differences is statistically significant. In Vayots Dzor nine per cent more of the intervention sample than the matched comparison sample reported no problems while five per cent fewer reported small problems and four per cent fewer reported moderate problems. However, again, none of these differences is statistically significant.

Primary channel through which produce is sold

Finally, we examine whether the project had any impact on the channels through which produce is sold, again restricting attention to households that sold any produce. Figure 5.7 illustrates the proportion of households selling produce through various channels during the last 12 months.

Figure 5.7: Proportion of households selling produce through various channels in the last 12 months



In Tavush a fairly clear pattern emerges, of intervention households being less likely to sell at local markets (the difference is 12 percentage points) and more likely to sell at a regional or national-level (Yerevan) markets. However, the only one of these

differences that is statistically significant is the likelihood of selling at the Yerevan market (five per cent more of the intervention sample than the matched comparison sample). In Vayots Dzor the differences between the intervention and comparison samples are very small; none is statistically significant.

Note that overall, households in Vayots Dzor are more dependent on middlemen than are households in Tavush. This is likely to reflect the fact that the terrain in Vayots Dzor is more mountainous, with both intervention and comparison villages in that region being less accessible than in Tavush region.

Drawing together the results for this section, we do not see a clear impact of the project on access to market for beneficiary households. There is some evidence of a positive impact on beneficiary households' access to price information in Vayots Dzor region, while in Tavush there is some evidence of a positive impact on beneficiary households' access to regional or national, rather than local markets.

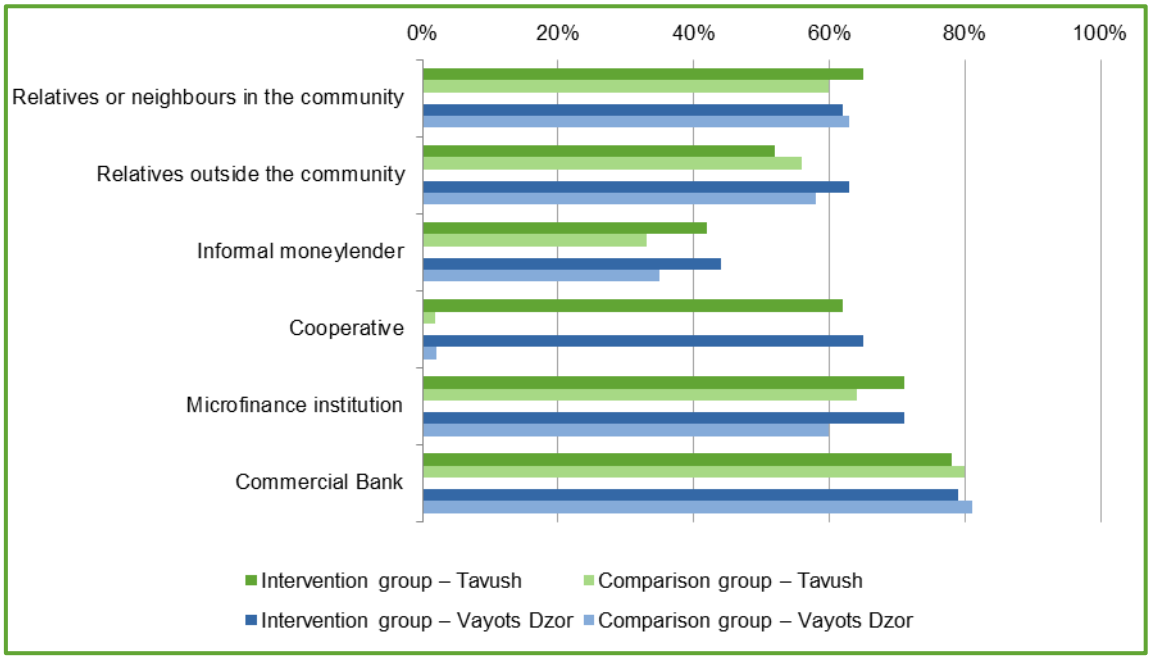
5.3.7 Access to credit

One important objective of the project was to increase farmers' access to financial services, through the provision of financial training and small subsidised (interest-free) microfinance loans to cooperative members. Not only was this anticipated to have a direct impact on access to credit, but by gaining a better understanding of financial services and demonstrating credit-worthiness by repaying the subsidised loans, it was anticipated that beneficiaries would gain better access to commercial financial services.

Potential access to credit

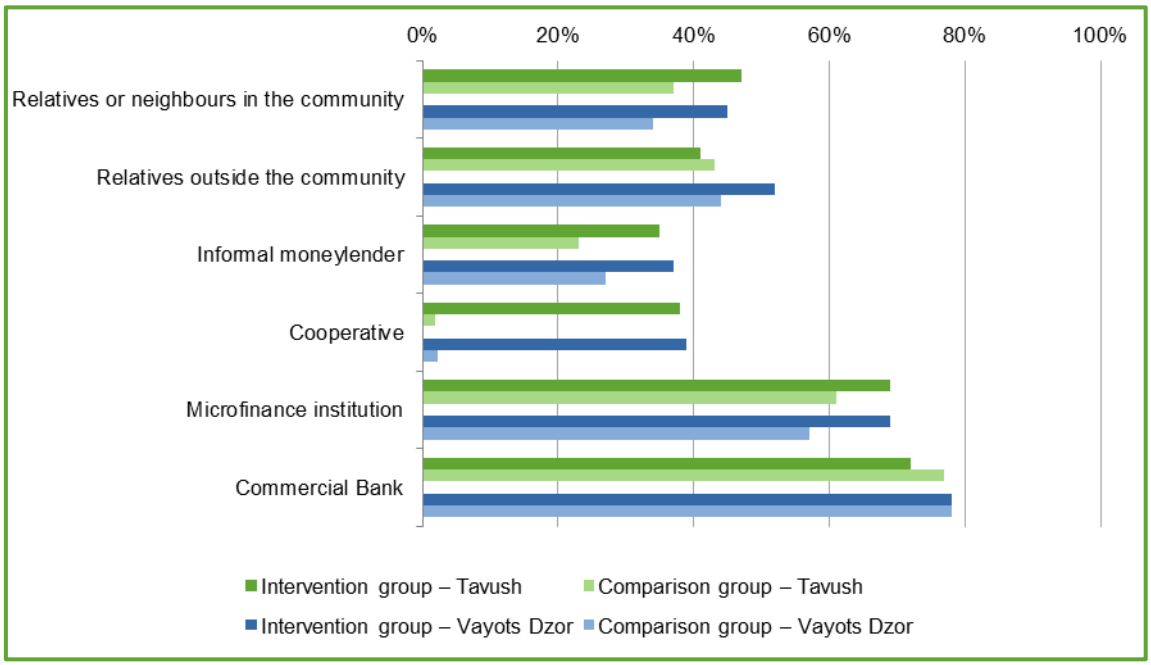
First we examine whether the project had any impact on beneficiaries' perceived potential access to credit. Respondents were asked whether, if they needed to borrow 60,000 or 150,000 AMD (approximately £90 and £220 respectively), they would be able to do so from a variety of sources. Results are illustrated in Figures 5.8 and 5.9.

Figure 5.8: Proportion of households reporting ability to borrow 60,000 AMD from various sources



The proportion of respondents reporting ability to borrow from relatives or neighbours (within or outside the community) and from commercial banks is very similar for the intervention and matched comparison samples. In both regions, a slightly greater proportion of the intervention sample report being able to borrow from informal moneylenders. The difference is nine percentage points overall, which is significant at the 10 per cent level (but not significant in either region separately). Similarly, nine per cent more of the intervention sample than the matched comparison sample report being able to borrow from a microfinance institution; however this is not statistically significant. As would naturally be expected, the proportion reporting the ability to borrow 60,000 AMD from a cooperative is substantially and highly significantly higher for the intervention sample, virtually all of whom are cooperative members. One of the key project activities was the provision of interest-free loans of 60,000 AMD through the cooperatives, and this is reflected in this result.

Figure 5.9: Proportion of households reporting ability to borrow 150,000 AMD from various sources



Examining the potential to borrow the larger amount of 150,000 AMD, the results are similar but slightly more pronounced. The project appears to have had some impact across a greater range of sources, perhaps reflecting greater confidence or better creditworthiness among beneficiary households. The proportion of households in the intervention sample reporting being able to borrow this sum from relatives or neighbours within the community is 11 per cent greater than the proportion of households in the matched comparison sample; this difference is significant at the 10 per cent level overall although not significant when the two regions are examined separately. Overall, 11 per cent more of the intervention sample than matched comparison sample report being able to borrow this sum from an informal moneylender; this is significant at the five per cent level overall, but not in either region separately. As expected, a much greater (and highly significant) proportion of the intervention sample than comparison sample report being able to borrow this sum from a cooperative, although the proportions are smaller than for loans of 60,000 AMD; this reflects the fact that the standard loan size from the cooperatives was 60,000 AMD and it is not clear whether larger loan amounts were in fact ever possible. 10 per cent more

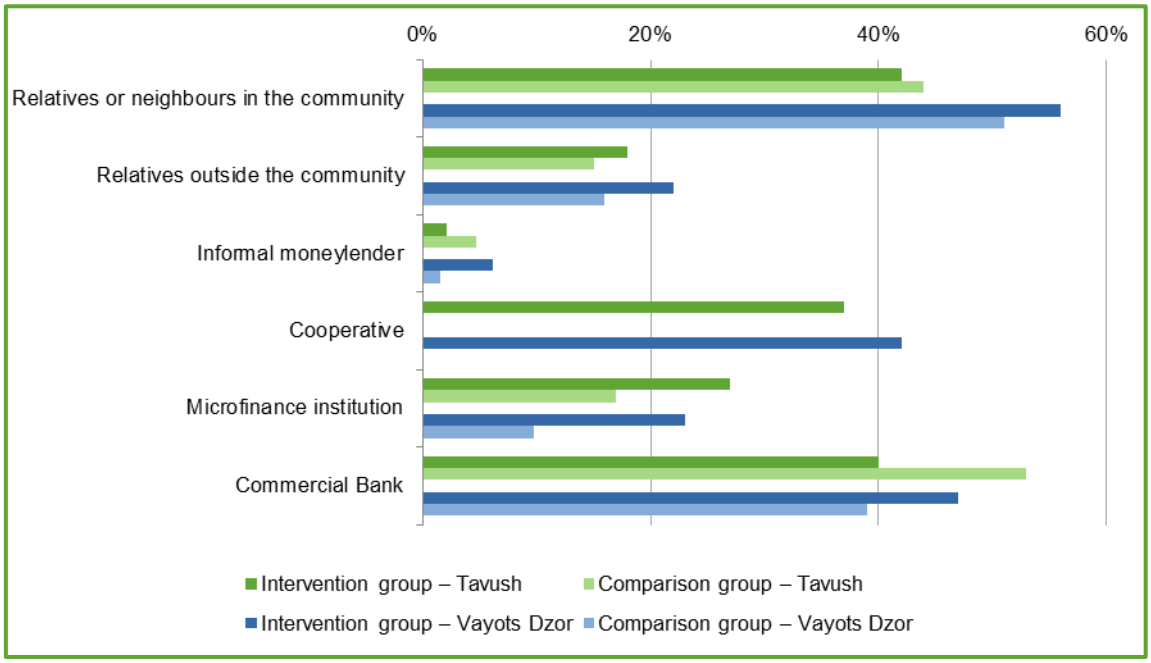
of the intervention sample than the matched comparison sample report being able to borrow 150,000 AMD from a microfinance organisation, the difference being significant at the five per cent level (significant in Vayots Dzor, but not Tavush when the regions are examined separately). There is no significant difference in the proportions reporting being able to borrow this sum from a commercial bank.

In conclusion, the project appears to have had a small impact on beneficiary households' perceived ability to borrow from a variety of sources, including friends and neighbours within the community, informal moneylenders and microfinance institutions.

Actual take-up of credit

Respondents were asked whether they, or any other household member, had actually borrowed money from any of the same potential sources in the last 12 months. These results should be interpreted with care; in a sense they will be more reliable than the potential access to credit results above, as those may reflect misperceptions among the respondents. However, these results reflect demand for credit and choice among potential providers as well as access to credit. The results are illustrated in Figure 5.10.

Figure 5.10: Proportion of households receiving credit from various sources in last 12 months



The results for actual take-up of credit are quite similar to the results for potential access to credit reported above. Any differences in borrowing from friends and family members (within and outside the community) are very small and not statistically significant, in either region or overall. While there is little overall difference in borrowing from an informal moneylender, in Vayots Dzor five per cent more of the intervention sample had done so, a difference which was statistically significant at the 10 per cent level. As to be expected, a significant proportion of the intervention sample had taken up loans from a cooperative, while in fact none of the comparison sample had done so.

A very interesting result emerges when we examine the take-up of loans from microfinance organisations. Overall, 12 per cent more of the intervention sample had

done so, the difference being highly significant (at the one per cent level) overall and significant at the five per cent level in Vayots Dzor, although not significant (but fairly large at 10 per cent) in Tavush. This suggests that participation in the project has had a substantial impact in either demand for credit or ability to access credit from microfinance institutions, or quite possibly both. The results are less clear when we consider commercial banks. Overall there is no significant difference between the intervention and comparison samples, but in fact 13 per cent fewer of the intervention sample than the matched comparison sample had taken a loan from a commercial bank, a difference that is significant at the 10 per cent level.

Amount of credit

Where respondents had borrowed from formal institutions (cooperative, microfinance organisation or commercial bank) during the last 12 months, they were asked about the value of these loans. We examine whether the project had any impact on the total amount borrowed and the amount borrowed from different sources, for those households which had borrowed from each of the formal sources. The results are presented in Table 5.11.

Table 5.11: Amount of credit from formal institutions (Year to April 2014)

	Value in Armenian drams			Logarithm of value in drams		
	Total	**Microfinance organisation**	**Commercial bank**	**Total**	**Microfinance organisation**	**Commercial bank**
Overall						
Intervention group mean:	830202.7	968333.3	834523.8	12.9	13.1	13.2
Comparison group mean:	785903.5	631152.9	652706.6	13.2	13.1	13.0
Difference:	54873.0 (159134.5)	323788.6 (478656.9)	190167.9 (129090.3)	-0.31** (0.16)	-0.11 (0.22)	0.26* (0.16)
Observations (intervention group):	148	48	84	148	48	84
Observations (total):	324	100	241	324	100	241
Tavush Region						
Intervention group mean:	649400	603846.2	714684.2	12.8	13.0	13.3
Comparison group mean:	782563.4	626951.4	612947.6	13.1	13.1	12.9
Difference:	-125744.5 (144208.4)	-51905.4 (160444.2)	105490.8 (122420.8)	-0.32 (0.24)	-0.21 (0.29)	0.30 (0.20)
Observations (intervention group):	70	26	38	70	26	38
Observations (total):	168	61	126	168	61	126
Vayots Dzor Region						
Intervention group mean:	992461.5	1399090.9	933521.7	12.9	13.3	13.2
Comparison group mean:	790157.8	638380.1	706020.5	13.2	13.1	13.1
Difference:	219070.8 (275975.4)	774621.4 (1013576.0)	261673.1 (217533.7)	-0.31 (0.21)	0.017 (0.33)	0.24 (0.24)
Observations (intervention group):	78	22	46	78	22	46
Observations (total):	156	39	115	156	39	115

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

Examining the total amount borrowed and the amounts borrowed from microfinance organisations and commercial banks, no clear pattern emerges; there are some differences but none are significant. However, the distributions of amounts borrowed are highly skewed, with a small number of households borrowing large amounts, which means that it makes more sense to analyse the logarithm of values. Here we see a clearer pattern; overall households in the intervention sample borrow on average 27 per cent less than households in the matched comparison sample, significant at the five per cent level (the difference is similar in magnitude, but not significant in either of the regions when examined separately). This result is easily explained by the high take-up by beneficiary households of relatively small loans (typically 60,000 AMD) through the cooperatives, so it is worth examining average loan amounts from microfinance organisations and commercial banks separately. While loans from microfinance organisations are on average 10 per cent smaller for the intervention sample, the difference is not significant overall or for either district. However, loans taken from commercial banks are on average 30 per cent larger for intervention households, significant at the 10 per cent level, suggesting that the project has some impact either on the beneficiary households' perceived creditworthiness or their demand for credit.

Interest rates

If beneficiary households can demonstrate creditworthiness through a history of repaying loans from the cooperative, they may be perceived as lower risk and thus able to access better interest rates from microfinance organisations or commercial banks. Alternatively, beneficiary households that have participated in the finance training may be more financially literate and thus able to make better decisions or negotiate a better rate. For those households that took up loans from these sources, we examine whether the project has any impact on the interest rates payable. The results are presented in Table 5.12.

The results are very interesting. In Tavush region, households in the intervention sample who take up loans from both microfinance organisations and commercial banks appear to be able to access lower interest rates than households in the matched comparison sample. The average interest rate on loans from microfinance institutions is 4.5 percentage points lower for households in the intervention sample than the matched comparison sample; this is significant at the five per cent level. The difference in average interest rates of 2.5 percentage points for loans from commercial banks is significant at the 10 per cent level. There is no evidence for an impact of the project in Vayots Dzor, however.

Table 5.12: Interest rates (Loans in year to April 2014)

	Microfinance organisation	Commercial bank
Overall		
Intervention group mean:	19.3	17.6
Comparison group mean:	21.0	18.5
Difference:	-2.55* (1.34)	-0.53 (0.85)
Observations (intervention group):	48	84
Observations (total):	100	241
Tavush Region		
Intervention group mean:	17.9	16.4
Comparison group mean:	21.6	19.2
Difference:	-4.45** (1.87)	-2.49* (1.31)
Observations (intervention group):	26	38
Observations (total):	61	126
Vayots Dzor Region		
Intervention group mean:	20.9	18.6
Comparison group mean:	20.0	17.6
Difference:	-0.27 (1.84)	1.12 (1.06)
Observations (intervention group):	22	46
Observations (total):	39	115

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

5.3.8 Household income

We found in previous sections that beneficiary households, particularly in Tavush region, harvested larger quantities of crops, sold a greater proportion of them and obtained higher revenue from agricultural production than did households in the matched comparison sample. This does not by itself imply that there was a corresponding increase in household income: in a context where households generally have multiple livelihoods activities, it is possible that a project that has made agricultural activities more productive could have diverted resources from other livelihoods activities. It is important, therefore, to evaluate the effects of the project household income as a whole. We examine below both a subjective measure of household income and an objective measure based on household expenditure.

Subjective perception of changes in incomes

Survey respondents were asked directly about their perception of changes in household income from agricultural and non-agricultural activities between 2009 and the date of the survey. The results from this perception measure are reported in Table 5.13.

The project appears to have had a highly significant impact on the proportion of households reporting an increase in income from agricultural activities between 2009 and the date of the survey (April 2014). Some 26 per cent of households in the intervention sample report an increase in income from agricultural activities, compared to just 12 per cent of households in the matched comparison group. The difference is significant at the one per cent level. The impact is particularly large in Tavush region,

where 31 per cent of households in the intervention group report an increase in agricultural income compared to just six per cent in the matched comparison group, again significant at the one per cent level. In Vayots Dzor the impact is much smaller (21 per cent in the intervention sample and 17 per cent in the matched comparison sample, the difference is not significant).

Consistent with the above results, we see a smaller proportion of households in the intervention sample reporting a decrease or no change in income from agricultural activities; however these differences are not significant, apart from significantly fewer in Tavush reporting no change. While the impact of the project on the proportion of households reporting an increase in income from agricultural activities is highly significant, it is important to bear in mind that only one quarter of the intervention sample are reporting an increase. Just as many households in the intervention sample report a decrease in income from agricultural activities over the period, while almost half of the sample reports no change. Therefore, we cannot infer from these results any overall increase in average income from agricultural activities for beneficiary households.

Table 5.13: Perception of changes in income between 2009 and April 2014

	Perception of change in income from agricultural and agri-business activities			Perception of change in income from non-agricultural activities		
	Increase	**Decrease**	**No Change**	**Increase**	**Decrease**	**No Change**
Overall						
Intervention group mean:	0.26	0.29	0.45	0.40	0.19	0.42
Comparison group mean:	0.12	0.36	0.53	0.43	0.15	0.43
Difference:	0.14*** (0.041)	-0.066 (0.051)	-0.072 (0.054)	-0.030 (0.053)	0.041 (0.038)	-0.012 (0.054)
Observations (intervention group):	192	192	192	192	192	192
Observations (total):	549	549	549	549	549	549
Tavush Region						
Intervention group mean:	0.31	0.23	0.46	0.43	0.16	0.41
Comparison group mean:	0.063	0.32	0.62	0.44	0.17	0.39
Difference:	0.24*** (0.054)	-0.089 (0.071)	-0.15** (0.077)	-0.0069 (0.080)	-0.015 (0.055)	0.022 (0.078)
Observations (intervention group):	95	95	95	95	95	95
Observations (total):	278	278	278	278	278	278
Vayots Dzor Region						
Intervention group mean:	0.21	0.35	0.44	0.36	0.22	0.42
Comparison group mean:	0.17	0.39	0.43	0.41	0.12	0.47
Difference:	0.036 (0.060)	-0.044 (0.072)	0.0085 (0.075)	-0.052 (0.071)	0.097* (0.053)	-0.045 (0.072)
Observations (intervention group):	97	97	97	97	97	97
Observations (total):	271	271	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

Looking at income from non-agricultural activities, there are no significant differences overall between the intervention and matched comparison samples. Interestingly, approximately 40 per cent of both the intervention and the matched comparison sample report an increase in income from non-agricultural activities, substantially more than those reporting an increase in income from agricultural activities. The general pattern of the results suggests a shift in income from agricultural to non-agricultural activities over the period, which is ameliorated to some extent for beneficiary households by the impact of the project under review.

Objective measure of impact on household income

Measuring household income directly can be problematic: self-reported measures of total income are generally regarded as unreliable, particularly in contexts where households engage in a wide variety of income-generating activities, not all of which are in the formal sector. Most households surveyed for this review reported that they were engaged in several livelihood activities; to construct a direct income measure we would have needed to collect detailed information about the contribution of each of these activities to household income.

For these reasons, we did not attempt to collect data on total household income directly. However, there is a widely recognised and strong association between household income and consumption expenditure.[35] For this Effectiveness Review we therefore followed common practice in micro-level socio-economic analysis, by considering household consumption and expenditure as an indicator of income.

To that end, respondents were asked to provide detailed information about their recent expenditure on both food and non-food items. Firstly, the respondents were asked what types of food they consumed over the previous seven-day period, as well as the particular quantities. We asked about the total consumption of each item, but also about the particular quantities consumed coming from three different sources: purchases, home production and gifts or in-kind payments. The quantities of each food item consumed were then converted into a monetary value. This was done by asking the respondent how much was paid for the food item in question or – if the food item was from the household's own production or from gifts – how much it would have been worth if it had been purchased from the local market. The respondents were also asked how much they spent over the past four weeks on regular non-food items and services from a comprehensive list including soap, toothpaste and transport fares among many others. Finally, they were asked to estimate the value of other occasional and seasonal types of expenditure – including school fees, clothes, medical expenses and home repair – which they had incurred over the last 12 months. The household expenditure measure was calculated by converting each of the expenditure types into a per-day figure and adding them together. This figure was then divided by a factor representing household size, to generate a per-day, per-person expenditure figure.[36]

We examine the impact of the project on this measure of household expenditure. The results are presented in Table 5.14.

Table 5.14: Household consumption measures, April 2014

	Total expenditure per capita per day (AMD)	Logarithm of total expenditure per capita per day	Expenditure per day above median of unmatched comparison sample (indicator)
Overall			
Intervention group mean:	4236.1	8.23	0.69
Comparison group mean:	3807.4	8.12	0.61
Difference:	428.6* (257.8)	0.11** (0.051)	0.078* (0.046)
Observations (intervention group):	192	192	192
Observations (total):	549	549	549
Tavush Region			
Intervention group mean:	4215.4	8.23	0.75
Comparison group mean:	3879.1	8.13	0.65
Difference:	336.3 (386.4)	0.10 (0.079)	0.095 (0.062)
Observations (intervention group):	95	95	95
Observations (total):	278	278	278
Vayots Dzor Region			
Intervention group mean:	4256.3	8.23	0.64
Comparison group mean:	3737.3	8.11	0.58
Difference:	519.0 (320.7)	0.12* (0.071)	0.061 (0.069)
Observations (intervention group):	97	97	97
Observations (total):	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4.000 repetitions; all means are calculated *after* matching.

Average total expenditure per capita per day is higher for households in the intervention sample than the matched comparison sample by 429 AMD. This difference is significant overall at the 10 per cent level, although while a similar impact is found in each of the regions these differences are not statistically significant at regional level.

The household expenditure variable has a skewed distribution with many households consuming relatively little and a few households consuming substantially more, meaning that it makes sense to analyse the impact of the project on the logarithm of expenditure, reported in the second column of Table 5.14. This gives a clearer result that is nevertheless consistent with the result above: households in the intervention sample have expenditures 12 per cent greater on average than households in the matched comparison sample, and the result is significant at the five per cent level. The impact of the project is of similar magnitude in both regions examined individually, significant at the 10 per cent level in Vayots Dzor though not in Tavush.
In the third column of Table 5.14 we report Oxfam GB's 'Global Indicator' for livelihoods Effectiveness Reviews, that is, the proportion of the samples whose daily consumption exceeds the median of the unmatched comparison sample. (These medians were assessed separately for the two regions.) Some 69 per cent of the households in the intervention sample had expenditures exceeding the critical value, while 61 per cent of the matched comparison sample did, giving a difference, attributable to the project, of eight percentage points. This is statistically significant at the 10 per cent level. The

impact is slightly larger in Tavush and slightly smaller in Vayots Dzor, although neither region-level result is statistically significant.

5.3.9 Household asset wealth

In this final section we examine whether the project has had any impact on wealth, as measured by asset ownership.

The respondents were asked about the household's ownership of many different assets, including land, livestock, productive equipment and household goods as well as the material and condition of their dwelling. Instead of examining these different measures individually we created aggregate indices of household wealth from the measures in 2009[37] and at the time of the survey (April 2014), as well as an index created by pooling observations in 2009 and 2014 which may be used to measure changes in wealth between 2009 and 2014. The indices were constructed separately for the two regions, Tavush and Vayots Dzor, to enable us to carry out meaningful within-region analysis.

A total of 64 assets and housing characteristics were considered for inclusion in the wealth indices. If each of these assets and characteristics is an indicator of household wealth, they should be correlated with each other. That is, a household that scores favourably on one particular wealth indicator should be more likely to do so for other wealth indicators. Items that had low correlations with the others were therefore removed from the indices.[38] The final number of indicators retained for the various indices varied between 39 and 49 according to the region and the date.

A data reduction technique, called principal component analysis (PCA), was then used to produce indices of overall wealth. PCA produces a measure that maximises the variation in the asset index by assigning more weight to those assets that are most highly correlated with the inter-item variation. Hence, each household's weighted index score is determined by both the number of assets it owns and by the weight assigned to each asset type. The resulting index enables the relative wealth status of the households to be compared. (A greater value of the index indicates a wealthier household, and a lower value a less wealthy household, but the actual numerical value of the index is not straightforward to interpret. For this reason wealth measured by such an index is often analysed in terms of quantiles, for example quintiles, rather than actual values.)

We examine the impact of the project on the 2014 asset wealth index, changes in wealth (measured by the pooled index) between 2009 and 2014, and changes in wealth measured by quintiles of the pooled index between 2009 and 2014. The results are presented in Table 5.15.

Examining first the results for the 2014 wealth index, we see that intervention households have an index value that is on average 0.19 units greater than the matched comparison sample. (The standard deviation of the wealth index is 2.5, so that is just 0.076 standard deviations.) This is a small impact, and not statistically significant.

Table 5.15: Household asset wealth

	2014 asset wealth index	Difference in pooled wealth index (2009 to 2014)	Difference in quintiles of pooled wealth index (2009 to 2014)
	b	b	b
Overall			
Intervention group mean:	0.19	0.87	0.031
Comparison group mean:	-0.0027	0.60	-0.028
Difference:	0.19 (0.25)	0.27** (0.13)	0.060 (0.090)
Observations (intervention group):	192	192	192
Observations (total):	549	549	549
Tavush Region			
Intervention group mean:	0.44	1.13	0.11
Comparison group mean:	-0.072	0.80	-0.035
Difference:	0.51 (0.35)	0.33 (0.21)	0.14 (0.15)
Observations (intervention group):	95	95	95
Observations (total):	278	278	278
Vayots Dzor Region			
Intervention group mean:	-0.055	0.61	-0.041
Comparison group mean:	0.065	0.41	-0.021
Difference:	-0.12 (0.35)	0.20 (0.17)	-0.020 (0.11)
Observations (intervention group):	97	97	97
Observations (total):	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

However, looking at the change in the pooled wealth index, we see that for intervention households there is on average a 0.87 unit increase while for the matched comparison sample there is on average a 0.60 unit increase; the difference of 0.27 is significant at the 10 per cent level. The impact is similar in each region examined separately, although not statistically significant at regional level. Overall, the project appears to have had a small but statistically significant impact on household wealth accumulation over the project period.

The third column presents the average change in quintiles of the pooled asset index over the project period. The measured impact is very small and not statistically significant; this is not surprising as the impact on the continuous index variable was small, and information is lost when we restrict attention to quintiles.

6 CONCLUSIONS

6.1 CONCLUSIONS

The results of this Effectiveness Review, presented in Section 5, demonstrate that the project ARMA62, 'New Economic Opportunities for Small-Scale Farmers in Tavush and Vayots Dzor Regions in Armenia', has had a positive impact on livelihoods for beneficiary households, as measured through both income and wealth indicators. We have found evidence that beneficiary households have incomes (measured as per capita expenditure) 12 per cent greater on average than households in the matched comparison sample; the impact of the project on income is of similar magnitude in both regions examined individually. Similarly, beneficiary households experienced greater increases in wealth as measured by an asset index, over the time period of the project.

As well as examining the project's impact on household income, this Effectiveness Review investigated the channels through which the project activities may have led to this impact. Clear evidence emerged for Tavush region throughout the steps of the project's theory of change, with increased adoption of technologies and use of fertilisers, greater harvests (particularly of fruit and traditional vegetable crops) and greater revenues from agricultural produce sales; furthermore there is some evidence for increased access to credit. The results for Vayots Dzor are more mixed, with impact evident in some parts of the chain but not others.

Agricultural livelihoods activities

The overall aim of the project was to support agricultural livelihoods for smallholder farmers. It is possible that there could have been an impact on choice of livelihoods activities within the household; however, it appears that the project had little or no impact on the occupation of the household head or reliance on migrant labour.

There is mixed evidence on the share of income from agricultural livelihood activities. No impact is found in response to a question asking respondents to estimate income shares from all sources at baseline and the time of the survey.

However, when asked about their perception of changes in income over this period (between 2009 and 2014), on average 26 per cent of households in the intervention group report an increase in income from agricultural activities, compared to just 12 per cent of households in the matched comparison group. The difference is highly significant and the impact is particularly large in Tavush region; beneficiary households were substantially more likely than matched comparison households to perceive an increase in income from agricultural activities. Similarly, beneficiary households were less likely than comparison households to report a decrease or no change in income from agricultural activities. However, it is important to note that in both the intervention and comparison groups, households were more likely to report a decrease than an increase in income from agricultural activities, and more likely to report an increase in income from non-agricultural activities. This suggests that, while there is considerable

diversity at individual household level, there has been an overall shift away from agricultural livelihoods over the period of the project, which was ameliorated to some extent by the impact of the project for beneficiary households.

Technological adoption

The project activities included training sessions to enhance cooperative members' understanding and knowledge of modern and improved agricultural practices. There is evidence to suggest that the project succeeded in increasing the adoption of such practices among beneficiaries. A significantly higher proportion of farmers in the intervention group reported using improved seed, seedlings and pesticides, compared with the matched comparison group. There is also a significant difference in the proportion of households using facilities and technologies associated with the project, including sun-dryers, cold storage/collection centres and greenhouses (with associated drip irrigation systems). In Tavush region only, the project appears to have had a significant impact on farmers' use of inorganic fertilisers and ideal combination of fertilisers.

Agricultural inputs

The project does not seem to have had impact on total area of land used by beneficiary households; however, in Tavush region only, there is evidence that there is a positive impact on the amount of land cultivated, measured both as a proportion of total land used and by area. There is also some evidence suggesting an increase in the use of mechanical services in the intervention group in Tavush; however these results are not robust and are sensitive to the model employed.

Agricultural production

Despite the project's success in supporting the adoption of improved agricultural technologies, there is no evidence suggesting higher diversity of agricultural production, measured by the number of crops and crop groups grown in the 12 months preceding the review, among beneficiary households. In both the intervention and comparison groups, each household produces almost ten different crops and crop groups on average; the magnitude of the difference between the intervention and matched comparison samples is small and not statistically significant.

There is evidence for significantly greater harvests of several individual crops and crop groups in the 12 months preceding the survey, both fruit and non-fruit, for beneficiary households in both regions. Of particular note is the substantially greater production of traditional vegetable crops in Tavush region; on average beneficiary households' harvests were approximately four times as much as comparison households'. This is likely to reflect the emphasis of the project under review after its first year, and follow-up projects, on cultivation of traditional vegetable crops using greenhouses to extend the growing season and increase yields and value of these vegetable crops. In both regions beneficiary households harvested significantly less potatoes, a relatively low value crop. Conversely, there was no evidence for the sustained adoption, beyond the conclusion of the project activities, of the non-traditional vegetable crops that had been introduced through the project (broccoli, chilli peppers and cherry tomatoes). Their adoption had been noted by the project team and reported in annual reports during the period in which they were actively supported but it appears that beneficiary households

did not choose to continue cultivating these crops after directed support had concluded.[39]

When considering aggregate quantities of fruit and non-fruit crops harvested, there is some evidence suggesting higher aggregate quantity of fruit harvested by beneficiary households for both regions considered together, and a large impact on overall harvest and fruit harvest in Tavush region only. However, this result should be interpreted with care, as it may not be meaningful to add quantities by weight of different crop types.

Beneficiary households in Tavush region only were more likely to perceive an increase in both fruit and non-fruit yields over the period between baseline and the time of the survey; this may reflect the significant impact of the project on the adoption of modern and improved agricultural practices and technologies in that region, in particular the use of fertilisers and greenhouses.

Access to markets

Several project activities aimed to enhance beneficiaries' access to market, including provision of price information by SMS and establishing direct links with national-level agricultural processors. The project appears to have had a positive impact on access to markets in one of the two intervention regions. Beneficiary households in Tavush are on average more likely than comparison households to have sold any fruit and any non-fruit agricultural produce in the 12 months preceding the survey, and they sell a greater proportion of their produce. Furthermore, those beneficiary households in Tavush that are selling produce obtain, on average, 68 per cent greater revenue from their sales than households in the matched comparison group that are selling produce. They were also slightly (but statistically significantly) more likely than comparison households to sell produce at national level rather than in local markets, reflecting the new market linkages with big agricultural processors established with the support of the programme. However, there is no evidence of a difference in the probability of selling produce, selling higher proportion of production, or receiving higher revenues for beneficiary households in Vayots Dzor.

Financial services

Project activities included training on finance (including credit risk) and provision of small interest-free loans through the cooperatives. The project appears to have had some impact on access to financial services. On average, beneficiary households perceived a greater ability to borrow from a variety of sources than did comparison households. Furthermore, a significantly higher proportion of beneficiary households than comparison households actually accessed credit from microfinance organisations in the 12 months preceding the survey; this impact was particularly strong in Vayots Dzor.

On average beneficiary households who take up credit seem to be borrowing smaller amounts than households in the matched comparison sample; this is explained by the fact that a substantial proportion of beneficiary households continue to access relatively small interest-free loans offered by an Oxfam partner (Horizon Fund) through the project cooperatives. Focusing attention on loans from microfinance organisations and commercial banks, beneficiary households in Tavush region only appear to be able to access credit at lower interest rates than households in the matched comparison

sample, suggesting that an impact of the project has been to improve their credit-worthiness.

Income and asset wealth

We assessed the overall impact of the project on household livelihoods by measuring household income and asset wealth.

The project has had a significant impact on household income measured as daily expenditure per capita; average expenditures among beneficiary households are 12 per cent greater than average expenditures among households in the matched comparison sample. Similarly, the proportion of the intervention group experiencing expenditures above the median of the unmatched comparison sample is eight percentage points greater that the proportion of the matched comparison sample (Oxfam GB's 'global indicator' for livelihoods project evaluation).

Finally, household wealth, measured by an asset index, increased significantly more over the period of the project for beneficiary households than households in the matched comparison sample.

6.2 PROGRAMME LEARNING CONSIDERATIONS

The following issues have been identified:

- We would like to encourage the project team to reflect on possible reasons for the more ambiguous impact of the project in Vayots Dzor region and to identify actions to mitigate the risks associated with such issues in future projects. Possible issues may include one or more of the following:
    - Particular vulnerability of this region to climatic shocks. Were there significant problems in the 12 months preceding the survey? (The period over which agricultural production information was collected.)
    - Problems with project implementation: were there particular challenges in specific communities?

- Particularly in Vayots Dzor, beneficiary farmers faced difficulties sourcing inputs, including quality seeds and seedlings, fertilisers and pesticides on the local market. This meant that while beneficiaries were able to make use of these enhanced inputs during the duration of the project, they were not able to continue after the project had concluded, despite a desire to do so. With subsequent projects, when introducing farmers to improved inputs and technologies, we encourage the project team to consider and perhaps take actions to enhance the longer-term viability of these technologies in the communities being supported.

- The introduction of non-traditional vegetable crops (broccoli, chilli peppers and cherry tomatoes) that were perceived to be of high value and resistant to climatic risks was a significant element of the project activities. However, we did not find evidence that the adoption of these non-traditional vegetable crops

had been sustained beyond the period in which their cultivation was directly supported. We also understand that in the subsequent projects the focus of project activities shifted to support for cultivation of traditional high-value vegetable crops, using greenhouses to increase the yields and value of these crops, protect against climatic shocks and extend the growing season. This shift in focus may reflect learning considerations already recognised and acted upon by the project team. We would like to encourage the team to document the reasons for this shift in focus, which may include the following, among others:

- The value or resilience of these crops may not have been as high as anticipated.
- It may have been difficult to source the required inputs.
- It may have been difficult to access markets for these crops.

APPENDIX 1: PROPENSITY SCORE MATCHING

The analysis of outcome variables, presented in Section 5 of this report, involved group mean comparisons using propensity score matching (PSM). The basic intuition of PSM is to match each participant with a non-participant that was observationally similar at baseline and to obtain the programme treatment effect by averaging the differences in outcomes across the intervention group and matched comparison group after project completion. Unsurprisingly, there are several different approaches to matching, that is, to determining whether or not a household is observationally 'similar' to another household. For an overview, we refer to Caliendo and Kopeinig (2008).[40]

The following sections describe and assess the specific matching procedure followed in this Effectiveness Review.

Estimating propensity scores

Given that it is extremely hard to find two individuals with exactly the same characteristics, Rosenbaum and Rubin (1983)[41] demonstrate that it is possible to match individuals using a prior probability for an individual to be in the intervention group, naming it *propensity score*. More specifically, propensity scores are obtained by pooling the units of observation from both the intervention and comparison groups and using a statistical probability model (e.g. a *probit* regression) to estimate the probability of participating in the project, conditional on a set of observed characteristics.

Tables A1.1, A1.2 and A1.3 present the probit regression results used to estimate the propensity scores in our context. Table A1.1 shows the probit results for a non-parsimonious model entering the full set of matching variables considered in this study. To guarantee that none of the matching variables was affected by the intervention, we only considered variables that were measured using recall information from 2009, before project implementation started, or demographic characteristics that are unchanging through time, and only those variables that were unlikely to have been influenced by anticipation of project participation (Caliendo and Kopeinig, 2008).

Note that we have not included recall variables on agricultural practices, use of agricultural services and use of credit. This is because we consider that their values may have been affected by the intervention; the intervention group was more familiar with the terminology used for these practices and so there could have been a systematic difference in responses between the intervention and comparison groups that did not reflect a true difference in practices.

Table A1.1: Estimating the propensity score – non-parsimonious model

Dependent variable: Project participation = 1		Tavush Region			Vayots Dzor Region		
Explanatory variables	**Variable source**	**Coefficient**	**Standard error**	**p-value**	**Coefficient**	**Standard error**	**p-value**
Household size in 2009	Constructed	-0.141	0.070	0.043	0.062	0.061	0.309
HH head female = 1	Current	-0.136	0.292	0.641	0.566	0.344	0.100
Proportion of HH members younger than 6 years in 2009	Constructed	0.027	0.808	0.974	0.760	0.825	0.357
Proportion of HH members older than 60 years in 2009	Constructed	-0.552	0.572	0.334	0.001	0.511	0.998
Proportion of HH members male adults (16 years or older) in 2009	Constructed	-0.022	0.640	0.973	-0.888	0.635	0.162
Age of HH head in 2009	Constructed	0.002	0.009	0.852	-0.009	0.009	0.347
HH head has secondary education = 1	Current	0.115	0.378	0.761	0.341	0.441	0.440
HH head has vocational education = 1	Current	0.271	0.307	0.378	-0.428	0.307	0.163
HH head has university education = 1	Current	0.090	0.465	0.846	-0.374	0.435	0.389
Proportion of adult HH members who have secondary education	Current	-0.178	0.538	0.740	-0.546	0.599	0.363
Proportion of adult HH members who have vocational education	Current	0.083	0.460	0.857	1.056	0.507	0.037
Proportion of adult HH members who have university education	Current	-0.218	0.637	0.732	-0.558	0.638	0.381
HHH principal occupation in 2009 was farming (agriculture/horticulture) = 1	Recall	-0.118	0.358	0.742	-0.156	0.378	0.680
HHH principal occupation in 2009 was processing crops/natural products = 1	Recall	0.582	1.051	0.580	0.000	.	.
HHH principal occupation in 2009 was rearing livestock = 1	Recall	-0.318	0.555	0.567	0.128	0.434	0.769
HHH principal occupation in 2009 was production of livestock or dairy products = 1	Recall	-0.176	0.747	0.814	0.036	0.472	0.939
HHH principal occupation in 2009 was running non-agricultural business = 1	Recall	0.390	0.844	0.644	0.730	1.361	0.592
HHH principal occupation in 2009 was casual labour = 1	Recall	0.335	0.527	0.525	0.505	0.696	0.468
HHH principal occupation in 2009 was private-sector salaried job = 1	Recall	-0.092	0.466	0.844	0.203	0.495	0.681
HHH principal occupation in 2009 was public sector salaried job = 1	Recall	-0.184	0.486	0.706	0.866	0.465	0.062
Share of HH income in 2009 from farming (agriculture/horticulture)	Recall	-0.352	1.340	0.793	2.427	0.687	0.000
Share of HH income in 2009 from processing crops/natural products	Recall	0.065	2.344	0.978	1.566	4.082	0.701
Share of HH income in 2009 from rearing livestock	Recall	-2.348	1.582	0.138	0.474	0.665	0.476
Share of HH income in 2009 from production of livestock or dairy products	Recall	-2.716	1.768	0.124	0.716	0.691	0.300
Share of HH income in 2009 from running non-agricultural business	Recall	-0.985	1.763	0.576	2.774	2.301	0.228
Share of HH income in 2009 from casual labour	Recall	-2.075	1.443	0.150	0.604	0.963	0.530
Share of HH income in 2009 from unskilled private-sector salaried job	Recall	-3.833	1.801	0.033	0.701	0.811	0.387
Share of HH income in 2009 from skilled private-sector salaried job	Recall	-1.126	1.453	0.438	0.604	0.909	0.507
Share of HH income in 2009 from unskilled public sector salaried job	Recall	-1.466	1.536	0.340	0.662	1.101	0.548
Share of HH income in 2009 from skilled public sector salaried job	Recall	-1.390	1.392	0.318	0.510	0.578	0.377
Share of HH income in 2009 from remittances	Recall	-2.428	1.437	0.091	0.899	0.676	0.183
Share of HH income in 2009 from pensions or other social security payments	Recall	-1.998	1.413	0.157	0.000	.	.
Number of fruit crops grown in 2009	Recall	0.101	0.040	0.012	0.152	0.054	0.005
Number of grain/vegetable/other crops grown in 2009	Recall	-0.048	0.074	0.521	-0.104	0.082	0.207
HH grew non-traditional crops (broccoli/chillies/cherry tomatoes) in 2009 = 1	Recall	-1.341	0.965	0.164	0.856	0.492	0.082
HH collected berries in 2009 = 1	Recall	-0.277	0.246	0.259	0.046	0.222	0.835
Area of land owned in 2009 by HH – in hectares	Recall	0.310	0.182	0.087	0.017	0.030	0.575

Dependent variable: Project participation = 1		Tavush Region			Vayots Dzor Region		
Explanatory variables	**Variable source**	**Coefficient**	**Standard error**	**p-value**	**Coefficient**	**Standard error**	**p-value**
Area of land rented or other not owned in 2009 by HH – in hectares	Recall	0.160	0.531	0.763	-0.337	0.281	0.230
Area of land owned AND cultivated in 2009 by HH – in hectares	Recall	-0.272	0.240	0.258	-0.189	0.084	0.025
Area of land rented/other AND cultivated in 2009 by HH – in hectares	Recall	-0.046	0.550	0.933	0.441	0.363	0.225
Number of migrant workers HH relied on for remittances in 2009	Recall	0.402	0.214	0.060	0.204	0.245	0.405
Number of minutes (return on foot) to fetch water from main water source in 2009	Recall	-0.000	0.002	0.962	0.018	0.016	0.264
Number of minutes (on foot) to reach village centre in 2009	Recall	0.008	0.012	0.503	-0.018	0.013	0.153
Number of minutes (on foot) to reach nearest marketplace to sell produce in 2009	Recall	-0.000	0.000	0.362	-0.000	0.000	0.062
HH wealth in second quintile (2009) = 1	Recall	0.541	0.312	0.083	-0.120	0.293	0.681
HH wealth in third quintile (2009) = 1	Recall	1.134	0.320	0.000	-0.441	0.327	0.177
HH wealth in fourth quintile (2009) = 1	Recall	0.673	0.340	0.047	-0.479	0.339	0.158
HH wealth in fifth quintile (2009) = 1	Recall	0.418	0.365	0.252	-0.315	0.346	0.363
Constant		0.676	1.571	0.667	-0.600	0.787	0.446
Number of observations		300			300		

Notes: Probit regression. Explanatory variables expressed as x = 1 represent binary variables taking values of either 0 or 1. The dependent variable is 1 if the household participated in the project, 0 otherwise. The coefficients represent the contribution of each explanatory variable/characteristic to the probability that a household participates in the project.

The final set of variables used in the matching process were identified using a backwards stepwise regression to identify those variables that explain the household being in the intervention group at *p*-values of 0.20 or less. We carried out the matching separately for Tavush and Vayots Dzor regions, so we identified the matching variables separately for the two regions. Table A1.2 shows the results of the probit model restricted to the final (restricted) set of matching variables for Tavush region. The propensity scores for Tavush households are the predicted probabilities of participation obtained from this model.

Table A1.2: Estimating the propensity score – restricted model (Tavush)

Dependent variable: Project participation = 1		**Tavush Region**		
Explanatory variables	**Variable source**	**Coefficient**	**Standard error**	**p-value**
Household size in 2009	Constructed	-0.089	0.050	0.076
HH head has vocational education = 1	Current	0.340	0.183	0.063
Share of HH income in 2009 from rearing livestock	Recall	-1.796	0.600	0.003
Share of HH income in 2009 from production of livestock or dairy products	Recall	-2.565	1.060	0.016
Share of HH income in 2009 from casual labour	Recall	-1.140	0.538	0.034
Share of HH income in 2009 from unskilled private-sector salaried job	Recall	-3.079	1.173	0.009
Share of HH income in 2009 from unskilled public sector salaried job	Recall	-0.996	0.744	0.181
Share of HH income in 2009 from skilled public sector salaried job	Recall	-1.003	0.373	0.007
Share of HH income in 2009 from remittances	Recall	-1.662	0.496	0.001
Share of HH income in 2009 from pensions or other social security payments	Recall	-1.647	0.374	0.000
Number of fruit crops grown in 2009	Recall	0.082	0.032	0.009
HH grew non-traditional crops (broccoli/chillies/cherry tomatoes) in 2009 = 1	Recall	-1.088	0.814	0.181
Area of land owned in 2009 by HH – in hectares	Recall	0.309	0.163	0.059
Area of land owned AND cultivated in 2009 by HH – in hectares	Recall	-0.284	0.208	0.173
Number of migrant workers HH relied on for remittances in 2009	Recall	0.274	0.183	0.133
HH wealth in second quintile (2009) = 1	Recall	0.384	0.245	0.117
HH wealth in third quintile (2009) = 1	Recall	0.853	0.231	0.000
HH wealth in fourth quintile (2009) = 1	Recall	0.371	0.237	0.118
Constant		-0.130	0.361	0.719
Number of observations		300		

Notes: Probit regression. Explanatory variables expressed as x = 1 represent binary variables taking values of either 0 or 1. The dependent variable is 1 if the household participated in the project, 0 otherwise. The coefficients represent the contribution of each explanatory variable/characteristic to the probability that a household participates in the project.

Table A1.2 shows the results of the probit model restricted to the final (restricted) set of matching variables for Vayots Dzor region. The propensity scores for Vayots Dzor households are the predicted probabilities of participation obtained from this model.

Table A1.2: Estimating the propensity score – restricted model (Vayots Dzor)

Dependent variable: Project participation = 1		**Vayots Dzor Region**		
Explanatory variables	**Variable source**	**Coefficient**	**Standard error**	**p-value**
HH head female = 1	Current	0.453	0.292	0.122
Proportion of HH members male adults (16 years or older) in 2009	Constructed	-0.917	0.529	0.083
Age of HH head in 2009	Constructed	-0.011	0.007	0.132
HH head has vocational education = 1	Current	-0.417	0.262	0.111
Proportion of adult HH members who have vocational education	Current	0.825	0.418	0.048
Proportion of adult HH members who have university education	Current	-0.646	0.436	0.138
HHH principal occupation in 2009 was farming (agriculture/horticulture) = 1	Recall	-0.372	0.209	0.075
HHH principal occupation in 2009 was public sector salaried job = 1	Recall	0.539	0.237	0.023
Share of HH income in 2009 from farming (agriculture/horticulture)	Recall	1.899	0.535	0.000
Share of HH income in 2009 from running non-agricultural	Recall	2.689	1.341	0.045

Dependent variable: Project participation = 1		Vayots Dzor Region		
Explanatory variables	**Variable source**	**Coefficient**	**Standard error**	**p-value**
business				
Number of fruit crops grown in 2009	Recall	0.122	0.042	0.004
Number of grain/vegetable/other crops grown in 2009	Recall	-0.100	0.075	0.183
Area of land rented or other not owned in 2009 by HH – in hectares	Recall	-0.352	0.262	0.180
Area of land owned AND cultivated in 2009 by HH – in hectares	Recall	-0.163	0.069	0.018
Area of land rented/other AND cultivated in 2009 by HH – in hectares	Recall	0.474	0.341	0.164
Number of migrant workers HH relied on for remittances in 2009	Recall	0.254	0.159	0.111
Number of minutes (return on foot) to fetch water from main water source in 2009	Recall	0.019	0.014	0.183
Number of minutes (on foot) to reach village centre in 2009	Recall	-0.020	0.012	0.084
Number of minutes (on foot) to reach nearest marketplace to sell produce in 2009	Recall	-0.000	0.000	0.042
Constant		0.351	0.481	0.465
Number of observations		300		

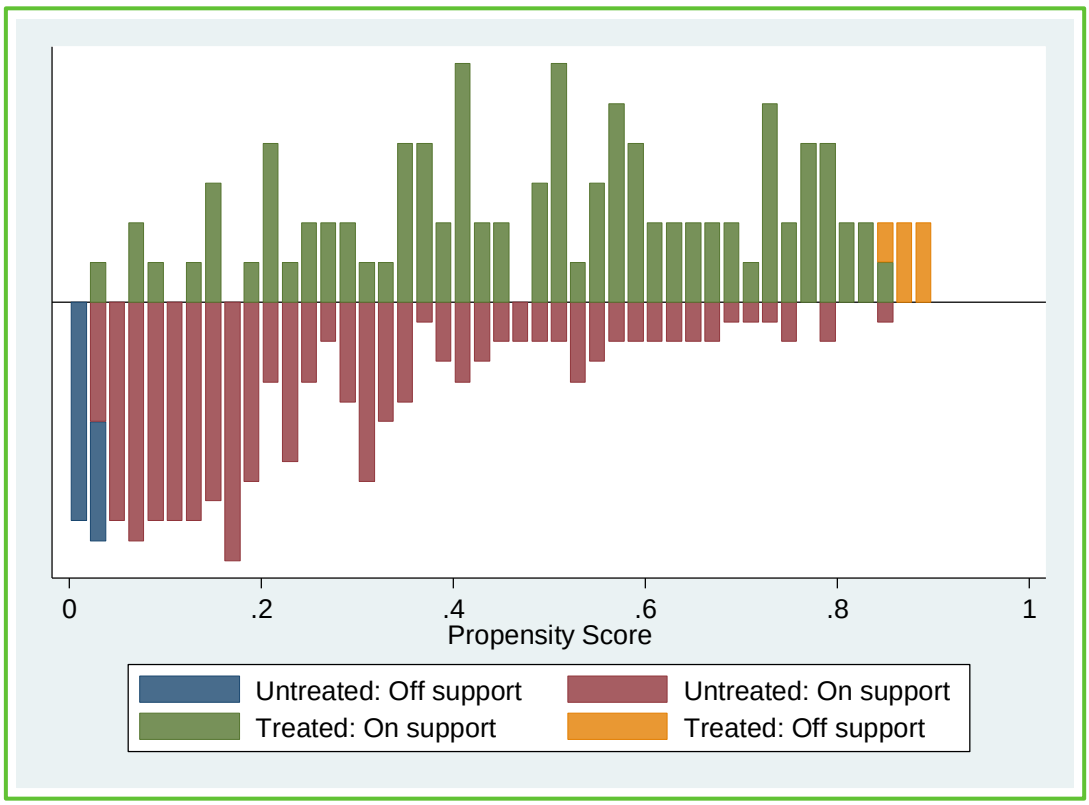
Notes: Probit regression. Explanatory variables expressed as x = 1 represent binary variables taking values of either 0 or 1. The dependent variable is 1 if the household participated in the project, 0 otherwise. The coefficients represent the contribution of each explanatory variable/characteristic to the probability that a household participates in the project.

Defining the region of common support

After estimating the propensity scores, the presence of a good *common support area* needs to be checked. The area of common support is the region where the propensity score distributions of the treatment and comparison groups overlap. The common support assumption ensures that 'treatment observation have a comparison observation "nearby" in the propensity score distribution' (Heckman, LaLonde and Smith, 1999[42]). Since some significant differences were found between the intervention and comparison groups in terms of the baseline and demographic characteristics (as detailed in Section 4.3), some of the households in the intervention group are too different from any of the households in the comparison group to allow for meaningful comparison. We developed a minima and maxima comparison, deleting all observations whose propensity score was smaller than the minimum and larger than the maximum in the opposite group (Caliendo and Kopeinig, 2008). Because some of the households in the intervention group are dropped, this means that the estimates of differences in outcome characteristics between the intervention and comparison groups only apply to those intervention households that were not dropped; that is, they do not represent the surveyed population of beneficiaries as a whole.

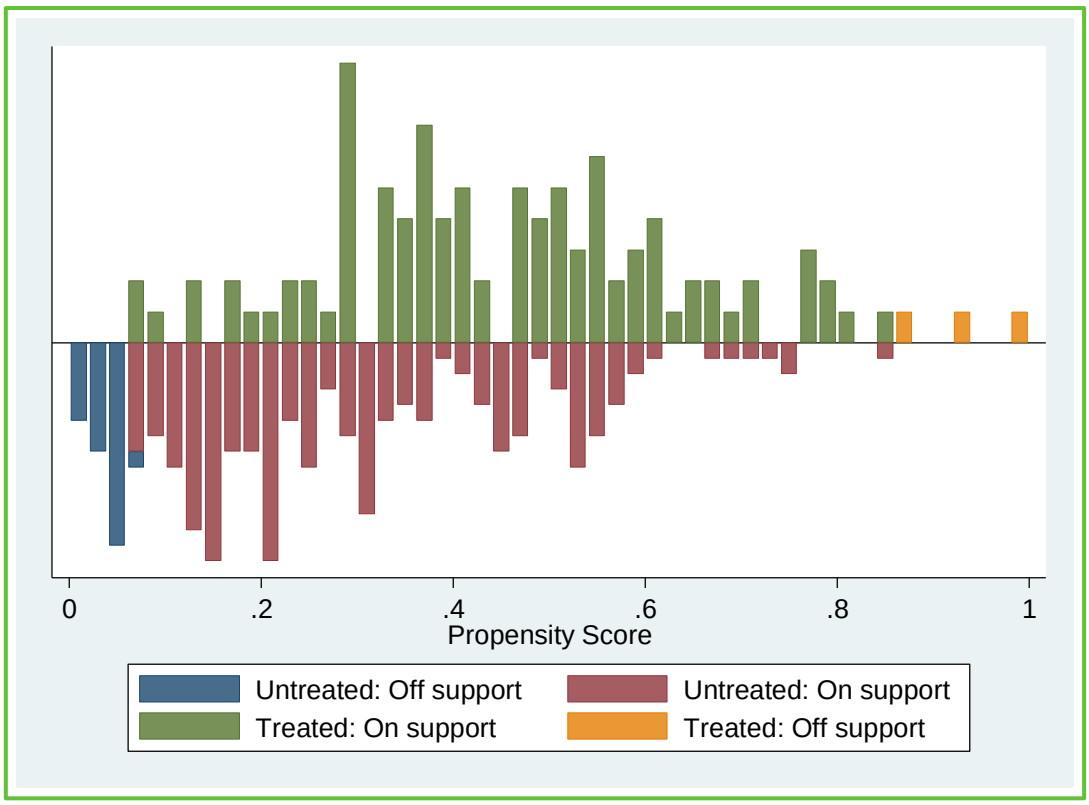
In Tavush region, 17 of the 200 households surveyed in the comparison villages and five of the 100 households surveyed in the intervention villages were dropped because they lie outside the common support area. Figure A1.1 illustrates the area of common support and indicates the proportion of households lying on and off the common support area, by treatment group.

Figure A1.1: Propensity score on and off common support (Tavush)



In Vayots Dzor region, 26 of the 200 households surveyed in the comparison villages and three of the 100 households surveyed in the intervention villages were dropped because they lie outside the common support area. Figure A1.2 illustrates the area of common support and indicates the proportion of households lying on and off the common support area, by treatment group.

Figure A1.2: Propensity score on and off common support (Vayots Dzor)



Matching intervention households to comparison households

Following Rosenbaum and Rubin (1983), after estimating the propensity scores and defining the area of common support, individuals are matched on the basis of their propensity score. The literature has developed a variety of matching procedures. For the main results presented in this Effectiveness Review we chose to employ the method of kernel matching (note that we use alternative matching procedures as a means of robustness checks in Appendix A2). The kernel matching method weights the contribution of each comparison group member, attaching greater weight to those comparison observations that provide a better match with the treatment observations, the kernel function determining the relative weights of better and worse matches. An appropriate kernel function will give 'good' matches a larger weight than 'poor' matches. Various kernel functions have been suggested in the literature; we applied the fairly conventional Epanechnikov function, which has a truncated quadratic form, with a bandwidth of 0.06. (Another common approach is to use the normal distribution with mean zero as the kernel.) The bandwidth determines the 'width' of the kernel weighting function, with a lower bandwidth penalising differences in propensity score more in terms of the weight attached. There is a trade-off between bias introduced due to poor matches (minimised by a narrow bandwidth) and variance or standard error of the resulting estimates (minimised by a wide bandwidth).

We use the *psmatch2* module in Stata to implement the propensity score matching, restricting the analysis to the region of common support. The standard errors of the estimates were obtained by bootstrapping,[43] using 4,000 repetitions for most of the tables presented.[44]

Check balancing

For PSM to be valid, the intervention group and the matched comparison group need to be balanced, meaning that they need to be similar in terms of their observed baseline characteristics. (Recall that the unmatched comparison group was found to be significantly different from the intervention group in terms of some baseline characteristics in Section 4.3.) This should be checked. The most straightforward method to do this is to test whether there are any statistically significant differences in baseline covariates between the intervention and comparison group in the matched sample. Efforts were made to ensure that the covariates were balanced across groups at *p*-values greater than 0.20.

The balance of each of the matching variables before and after kernel matching for Tavush region is shown in Table A1.3. (Note that the unmatched results differ slightly from the results reported in Section 4.3 because here we restrict the analysis to households in the common support region.) In the unmatched sample we can strongly reject the joint hypothesis of no difference in means for any of the variables (p-value of 0.00) whereas in the matched sample we fail to reject the hypothesis (p-value of 1.00). While we cannot draw conclusions about the alternative hypothesis of at least one difference, such a high p-value makes us confident that we have achieved balance for these variables in the matched sample. Similarly the mean and median biases of the variables have reduced from 17.9 and 18.3 to 3.6 and 3.5 respectively, comfortably below the rule-of-thumb value of 5. Furthermore, the means of none of the matching variables are significantly different in the matched comparison and intervention samples, whereas several were significantly different in the unmatched sample.

Table A1.3: Balancing test on the restricted set of matching variables (Tavush)

Matching variable	Sample	Mean		%bias	% reduction |bias|	t-test	
		Intervention	Comparison			t statistic	p-value
Household size in 2009	Unmatched	4.263	4.574	-17.6		-1.39	0.166
	Matched	4.263	4.130	7.5	57.2	0.53	0.594
HH head has vocational education = 1	Unmatched	0.526	0.388	27.9		2.22	0.027
	Matched	0.526	0.488	7.7	72.3	0.53	0.6
Share of HH income in 2009 from rearing livestock	Unmatched	0.063	0.084	-13.2		-1	0.317
	Matched	0.063	0.069	-3.8	70.9	-0.29	0.775
Share of HH income in 2009 from production of livestock or dairy products	Unmatched	0.023	0.040	-19.1		-1.43	0.154
	Matched	0.023	0.023	-0.3	98.6	-0.02	0.982
Share of HH income in 2009 from casual labour	Unmatched	0.035	0.071	-20.6		-1.53	0.126
	Matched	0.035	0.030	3.1	85	0.28	0.777
Share of HH income in 2009 from unskilled private-sector salaried job	Unmatched	0.007	0.018	-16		-1.18	0.239
	Matched	0.007	0.008	-1.5	90.4	-0.15	0.878
Share of HH income in 2009 from unskilled public sector salaried job	Unmatched	0.034	0.025	7.9		0.63	0.531
	Matched	0.034	0.029	4.3	45.8	0.28	0.778
Share of HH income in 2009 from skilled public sector salaried job	Unmatched	0.143	0.120	8.7		0.68	0.495
	Matched	0.143	0.141	0.6	93.3	0.04	0.969
Share of HH income in 2009 from remittances	Unmatched	0.086	0.133	-19.5		-1.48	0.14
	Matched	0.086	0.084	0.9	95.5	0.07	0.942
Share of HH income in 2009 from pensions or other social security payments	Unmatched	0.132	0.242	-41		-3.12	0.002
	Matched	0.132	0.127	1.7	95.8	0.14	0.887
Number of fruit crops grown in 2009	Unmatched	6.084	5.006	37.7		3.04	0.003
	Matched	6.084	6.173	-3.1	91.8	-0.21	0.838
HH grew non-traditional crops (broccoli/ chillies/cherry tomatoes) in 2009 = 1	Unmatched	0.011	0.016	-5.1		-0.39	0.698
	Matched	0.011	0.016	-4.5	11	-0.31	0.754
Area of land owned in 2009 by HH – in hectares	Unmatched	0.817	0.617	25.1		1.98	0.049
	Matched	0.817	0.856	-4.9	80.5	-0.28	0.784
Area of land owned AND cultivated in 2009 by HH – in hectares	Unmatched	0.583	0.451	20.6		1.64	0.103
	Matched	0.583	0.590	-1.1	94.8	-0.07	0.946
Number of migrant workers HH relied on for remittances in 2009	Unmatched	0.284	0.284	0		0	0.999
	Matched	0.284	0.280	0.6	-6693.4	0.04	0.965
HH wealth in second quintile (2009) = 1	Unmatched	0.200	0.208	-1.9		-0.15	0.881
	Matched	0.200	0.181	4.7	-151	0.34	0.738
HH wealth in third quintile (2009) = 1	Unmatched	0.295	0.148	35.9		2.96	0.003
	Matched	0.295	0.262	8	77.6	0.5	0.615
HH wealth in fourth quintile (2009) = 1	Unmatched	0.221	0.202	4.6		0.37	0.715
	Matched	0.221	0.247	-6.3	-36.7	-0.42	0.677
Number of observations	278	95	183				

Notes: The average standardised percentage bias is the % difference of the sample means in the treated and control sub-samples as a percentage of the square root of the average of the sample variances in the treated and control groups. As a rule of thumb, a bias of 5 or less is tolerated.

The balance of each of the matching variables before and after kernel matching for Vayots Dzor region is shown in Table A1.4. (Again, the unmatched results differ slightly from the results reported in Section 4.3 because here we restrict the analysis to households in the common support region.) In the unmatched sample we can strongly reject the joint hypothesis of no difference in means for any of the variables (p-value of 0.01) whereas in the matched sample we fail to reject the hypothesis (p-value of 1.00). While, again, we cannot draw conclusions about the alternative hypothesis of at least one difference, such a high p-value makes us confident that we have achieved balance for these variables in the matched sample. Similarly the mean and median biases of the variables have reduced from 12.2 and 12.8 to 4.4 and 4.2 respectively, again comfortably below the rule-of-thumb value of 5. Furthermore, the means of none of the matching variables are significantly different in the matched comparison and intervention samples, whereas several were significantly different in the unmatched sample.

Table A1.4: Balancing test on the restricted set of matching variables (Vayots Dzor)

Matching variable	Sample	Mean		%bias	% reduction |bias|	t-test	
		Intervention	Comparison			t statistic	p-value
HH head female = 1	Unmatched	0.124	0.132	-2.5		-0.2	0.843
	Matched	0.124	0.122	0.5	81.5	0.03	0.974
Proportion of HH members male adults (16 years or older) in 2009	Unmatched	0.404	0.437	-18.1		-1.38	0.17
	Matched	0.404	0.401	1.3	92.9	0.09	0.929
Age of HH head in 2009	Unmatched	48.897	50.902	-16.9		-1.31	0.193
	Matched	48.897	48.693	1.7	89.8	0.12	0.901
HH head has vocational education = 1	Unmatched	0.526	0.506	4		0.32	0.753
	Matched	0.526	0.536	-2	49.6	-0.14	0.889
Proportion of adult HH members who have vocational education	Unmatched	0.442	0.392	14		1.11	0.269
	Matched	0.442	0.445	-0.8	94.4	-0.05	0.957
Proportion of adult HH members who have university education	Unmatched	0.148	0.126	9.1		0.72	0.47
	Matched	0.148	0.143	2.2	75.5	0.16	0.875
HHH principal occupation in 2009 was farming (agriculture/horticulture) = 1	Unmatched	0.247	0.282	-7.7		-0.61	0.545
	Matched	0.247	0.289	-9.3	-20.3	-0.64	0.52
HHH principal occupation in 2009 was public sector salaried job = 1	Unmatched	0.268	0.172	23.1		1.87	0.063
	Matched	0.268	0.219	11.9	48.5	0.8	0.427
Share of HH income in 2009 from farming (agriculture/horticulture)	Unmatched	0.191	0.147	25.9		2.06	0.04
	Matched	0.191	0.201	-5.9	77.3	-0.38	0.703
Share of HH income in 2009 from running non-agricultural business	Unmatched	0.015	0.007	14.3		1.17	0.243
	Matched	0.015	0.012	5.5	61.5	0.34	0.732
Number of fruit crops grown in 2009	Unmatched	4.660	4.115	23.5		1.88	0.061
	Matched	4.660	4.756	-4.2	82.3	-0.3	0.768
Number of grain/vegetable/other crops grown in 2009	Unmatched	3.979	4.115	-10.1		-0.8	0.427
	Matched	3.979	3.976	0.3	97.4	0.02	0.985
Area of land rented or other not owned in 2009 by HH – in hectares	Unmatched	0.344	0.395	-2.2		-0.16	0.874
	Matched	0.344	0.469	-5.4	-143.7	-0.38	0.704
Area of land owned AND cultivated in 2009 by HH – in hectares	Unmatched	1.010	1.289	-20.2		-1.58	0.116
	Matched	1.010	0.979	2.3	88.7	0.17	0.863
Area of land rented/other AND cultivated in 2009 by HH – in hectares	Unmatched	0.311	0.338	-1.5		-0.11	0.912
	Matched	0.311	0.414	-5.8	-277.3	-0.4	0.686
Number of migrant workers HH relied on for remittances in 2009	Unmatched	0.247	0.213	6.6		0.52	0.604
	Matched	0.247	0.303	-10.6	-60.8	-0.68	0.497
Number of minutes (return on foot) to fetch water from main water source in 2009	Unmatched	1.361	1.017	5.6		0.45	0.655
	Matched	1.361	1.243	1.9	65.8	0.12	0.903
Number of minutes (on foot) to reach village centre in 2009	Unmatched	8.680	9.563	-12.8		-0.98	0.329
	Matched	8.680	9.038	-5.2	59.5	-0.37	0.709
Number of minutes (on foot) to reach nearest marketplace to sell produce in 2009	Unmatched	399.020	505.660	-14.2		-1.15	0.249
	Matched	399.020	444.470	-6.1	57.4	-0.45	0.653
Number of observations	271	97	174				

Notes: The average standardised percentage bias is the % difference of the sample means in the treated and control sub-samples as a percentage of the square root of the average of the sample variances in the treated and control groups. As a rule of thumb, a bias of 5 or less is tolerated.

Recall, however, that we did not use all of the potential matching variables to construct the propensity scores, but just those that were significantly different between intervention and comparison groups with a p-value of less than 0.2 in a stepwise modelling procedure. It is necessary to check that the matched comparison samples are balanced with the intervention samples in terms of all of the potential matching variables. The results for both regions are shown in Table A1.5. (Again, the unmatched results differ slightly from the results reported in Section 4.3 because here we restrict the analysis to households in the common support region.)

In the case of Tavush, in the unmatched sample we can strongly reject the joint hypothesis of no difference in means for any of the variables (p-value of 0.01) whereas in the matched sample we fail to reject the hypothesis (p-value of 1.00). In the case of Vayots Dzor region in the unmatched sample we cannot strongly reject the hypothesis of no difference in means for any of the variables (p-value of 0.26); in the matched sample we again fail to reject the hypothesis (p-value of 1.00). Looking at the variables individually, in almost all cases the difference between the intervention and matched comparison groups is not significant (p-values above 0.2); in three cases (all Vayots Dzor) the p-value is between 0.1 and 0.2; this is quite reasonable with 48 variables.

Table A1.5: Balancing test on the full set of baseline covariates

Baseline variable	Sample	Tavush Region						Vayots Dzor Region					
		Mean			Reduction % bias	t-test		Mean			Reduction % bias	t-test	
		Interven-tion	Compar-ison	% bias		t-stat	p-value	Interven-tion	Compar-ison	% bias		t-stat	p-value
Household size in 2009	Unmatched	4.263	4.574	-17.6		-1.39	0.166	4.278	4.190	5.1		0.39	0.696
	Matched	4.263	4.130	7.5	57.2	0.53	0.594	4.278	4.227	3	42.1	0.21	0.835
HH head female = 1	Unmatched	0.189	0.219	-7.2		-0.56	0.573	0.124	0.132	-2.5		-0.2	0.843
	Matched	0.189	0.201	-2.9	60.1	-0.2	0.841	0.124	0.122	0.5	81.5	0.03	0.974
Proportion of HH members younger than 6 years in 2009	Unmatched	0.074	0.088	-11		-0.86	0.389	0.072	0.051	16.8		1.38	0.168
	Matched	0.074	0.061	10	9.3	0.73	0.469	0.072	0.052	16.1	4.1	1.11	0.268
Proportion of HH members older than 60 years in 2009	Unmatched	0.121	0.188	-28.1		-2.19	0.03	0.104	0.143	-17.3		-1.35	0.18
	Matched	0.121	0.154	-13.7	51.2	-1	0.318	0.104	0.093	4.8	72.1	0.38	0.703
Proportion of HH members male adults (16 years or older) in 2009	Unmatched	0.431	0.438	-3.4		-0.28	0.782	0.404	0.437	-18.1		-1.38	0.17
	Matched	0.431	0.445	-7	-105.5	-0.48	0.635	0.404	0.401	1.3	92.9	0.09	0.929
Age of HH head in 2009	Unmatched	51.084	54.454	-25.6		-1.93	0.055	48.897	50.902	-16.9		-1.31	0.193
	Matched	51.084	52.257	-8.9	65.2	-0.67	0.505	48.897	48.693	1.7	89.8	0.12	0.901
HH head has secondary education = 1	Unmatched	0.895	0.781	31		2.35	0.02	0.897	0.885	3.8		0.3	0.767
	Matched	0.895	0.865	8.1	73.8	0.63	0.532	0.897	0.918	-6.8	-79.7	-0.51	0.611
HH head has vocational education = 1	Unmatched	0.526	0.388	27.9		2.22	0.027	0.526	0.506	4		0.32	0.753
	Matched	0.526	0.488	7.7	72.3	0.53	0.6	0.526	0.536	-2	49.6	-0.14	0.889
HH head has university education = 1	Unmatched	0.126	0.093	10.7		0.86	0.389	0.144	0.132	3.5		0.28	0.781
	Matched	0.126	0.129	-0.9	91.9	-0.06	0.956	0.144	0.164	-5.7	-61.6	-0.38	0.707
Proportion of adult HH members who have secondary education	Unmatched	0.860	0.781	30.1		2.35	0.02	0.874	0.868	2.5		0.2	0.845
	Matched	0.860	0.841	7.1	76.2	0.52	0.606	0.874	0.909	-14.3	-475.7	-1.07	0.286
Proportion of adult HH members who have vocational education	Unmatched	0.486	0.382	28		2.24	0.026	0.442	0.392	14		1.11	0.269
	Matched	0.486	0.470	4.3	84.8	0.29	0.775	0.442	0.445	-0.8	94.4	-0.05	0.957
Proportion of adult HH members who have university education	Unmatched	0.131	0.111	8.7		0.7	0.483	0.148	0.126	9.1		0.72	0.47
	Matched	0.131	0.133	-0.8	90.5	-0.05	0.958	0.148	0.143	2.2	75.5	0.16	0.875
HHH principal occupation in 2009 was farming (agriculture/horticulture) = 1	Unmatched	0.442	0.383	12.1		0.96	0.338	0.247	0.282	-7.7		-0.61	0.545
	Matched	0.442	0.442	0.1	99.4	0.01	0.996	0.247	0.289	-9.3	-20.3	-0.64	0.52
HHH principal occupation in 2009 was processing crops/natural products = 1	Unmatched	0.011	0.005	5.7		0.47	0.637	0.000	0.000	.	.	.	.
	Matched	0.011	0.002	9.7	-71.9	0.76	0.447	0.000	0.000	.	.	.	.
HHH principal occupation in 2009 was rearing livestock = 1	Unmatched	0.032	0.093	-25.5		-1.88	0.061	0.124	0.167	-12.2		-0.94	0.346
	Matched	0.032	0.057	-10.4	59.1	-0.84	0.403	0.124	0.164	-11.4	6.3	-0.8	0.427
HHH principal occupation in 2009 was production of livestock or dairy products = 1	Unmatched	0.011	0.027	-12.3		-0.91	0.363	0.093	0.103	-3.6		-0.28	0.78
	Matched	0.011	0.012	-1	92.2	-0.09	0.932	0.093	0.107	-4.7	-31	-0.32	0.747
HHH principal occupation in 2009 was running non-agricultural business = 1	Unmatched	0.032	0.016	9.9		0.82	0.41	0.021	0.006	13		1.12	0.264
	Matched	0.032	0.024	4.9	50.2	0.32	0.753	0.021	0.009	10	23.4	0.65	0.516
HHH principal occupation in 2009 was casual labour = 1	Unmatched	0.053	0.071	-7.6		-0.59	0.556	0.041	0.023	10.3		0.85	0.397
	Matched	0.053	0.019	13.8	-81.6	1.24	0.218	0.041	0.010	17.9	-73.9	1.41	0.161

Baseline variable	Sample	Tavush Region						Vayots Dzor Region					
		Mean			Reduction % bias	t-test		Mean			Reduction % bias	t-test	
		Interven-tion	Compar-ison	% bias		t-stat	p-value	Interven-tion	Compar-ison	% bias		t-stat	p-value
HHH principal occupation in 2009 was private-sector salaried job = 1	Unmatched	0.158	0.131	7.6		0.61	0.544	0.134	0.149	-4.4		-0.35	0.73
	Matched	0.158	0.184	-7.5	1.6	-0.48	0.632	0.134	0.106	7.9	-79.9	0.59	0.555
HHH principal occupation in 2009 was public sector salaried job = 1	Unmatched	0.189	0.148	11.2		0.9	0.37	0.268	0.172	23.1		1.87	0.063
	Matched	0.189	0.173	4.4	60.4	0.3	0.768	0.268	0.219	11.9	48.5	0.8	0.427
Share of HH income in 2009 from farming (agriculture/horticulture)	Unmatched	0.342	0.188	53.8		4.3	0	0.191	0.147	25.9		2.06	0.04
	Matched	0.342	0.332	3.7	93.1	0.22	0.822	0.191	0.201	-5.9	77.3	-0.38	0.703
Share of HH income in 2009 from processing crops/natural products	Unmatched	0.012	0.007	10.6		0.89	0.376	0.003	0.004	-0.7		-0.05	0.957
	Matched	0.012	0.009	6.6	37.2	0.44	0.659	0.003	0.002	7.8	-971.6	0.72	0.471
Share of HH income in 2009 from rearing livestock	Unmatched	0.063	0.084	-13.2		-1	0.317	0.133	0.164	-17.1		-1.32	0.187
	Matched	0.063	0.069	-3.8	70.9	-0.29	0.775	0.133	0.144	-6.1	64.6	-0.44	0.66
Share of HH income in 2009 from production of livestock or dairy products	Unmatched	0.023	0.040	-19.1		-1.43	0.154	0.123	0.126	-1.6		-0.12	0.902
	Matched	0.023	0.023	-0.3	98.6	-0.02	0.982	0.123	0.122	0.7	52.6	0.06	0.956
Share of HH income in 2009 from running non-agricultural business	Unmatched	0.029	0.017	10.6		0.9	0.368	0.015	0.007	14.3		1.17	0.243
	Matched	0.029	0.024	4.7	55.5	0.31	0.758	0.015	0.012	5.5	61.5	0.34	0.732
Share of HH income in 2009 from casual labour	Unmatched	0.035	0.071	-20.6		-1.53	0.126	0.029	0.029	0.7		0.05	0.956
	Matched	0.035	0.030	3.1	85	0.28	0.777	0.029	0.012	14.8	-1891.1	1.45	0.147
Share of HH income in 2009 from unskilled private-sector salaried job	Unmatched	0.007	0.018	-16		-1.18	0.239	0.029	0.034	-3.8		-0.29	0.775
	Matched	0.007	0.008	-1.5	90.4	-0.15	0.878	0.029	0.022	4.8	-25.6	0.37	0.709
Share of HH income in 2009 from skilled private-sector salaried job	Unmatched	0.076	0.048	15		1.22	0.222	0.032	0.045	-8.9		-0.68	0.495
	Matched	0.076	0.118	-22	-46.1	-1.25	0.214	0.032	0.032	0.5	94.2	0.04	0.968
Share of HH income in 2009 from unskilled public sector salaried job	Unmatched	0.034	0.025	7.9		0.63	0.531	0.026	0.023	2.6		0.2	0.84
	Matched	0.034	0.029	4.3	45.8	0.28	0.778	0.026	0.013	12.8	-386.9	1.05	0.296
Share of HH income in 2009 from skilled public sector salaried job	Unmatched	0.143	0.120	8.7		0.68	0.495	0.182	0.154	10.4		0.82	0.411
	Matched	0.143	0.141	0.6	93.3	0.04	0.969	0.182	0.171	4	61.9	0.27	0.787
Share of HH income in 2009 from remittances	Unmatched	0.086	0.133	-19.5		-1.48	0.14	0.093	0.079	6.2		0.49	0.624
	Matched	0.086	0.084	0.9	95.5	0.07	0.942	0.093	0.093	0	99.6	0	0.999
Share of HH income in 2009 from pensions or other social security payments	Unmatched	0.132	0.242	-41		-3.12	0.002	0.142	0.189	-19		-1.46	0.146
	Matched	0.132	0.127	1.7	95.8	0.14	0.887	0.142	0.175	-13.5	28.8	-1.01	0.314
Number of fruit crops grown in 2009	Unmatched	6.084	5.006	37.7		3.04	0.003	4.660	4.115	23.5		1.88	0.061
	Matched	6.084	6.173	-3.1	91.8	-0.21	0.838	4.660	4.756	-4.2	82.3	-0.3	0.768
Number of grain/vegetable/other crops grown in 2009	Unmatched	3.505	3.328	12.3		1.03	0.306	3.979	4.115	-10.1		-0.8	0.427
	Matched	3.505	3.496	0.7	94.7	0.04	0.967	3.979	3.976	0.3	97.4	0.02	0.985
HH grew non-traditional crops (broccoli/ chillies/cherry tomatoes) in 2009 = 1	Unmatched	0.011	0.016	-5.1		-0.39	0.698	0.052	0.023	15.1		1.26	0.21
	Matched	0.011	0.016	-4.5	11	-0.31	0.754	0.052	0.042	4.9	67.1	0.31	0.758
HH collected berries in 2009 = 1	Unmatched	0.737	0.699	8.3		0.65	0.515	0.474	0.391	16.8		1.33	0.184
	Matched	0.737	0.811	-16.4	-98.4	-1.22	0.224	0.474	0.502	-5.6	66.8	-0.38	0.701
Area of land owned in 2009 by HH – in hectares	Unmatched	0.817	0.617	25.1		1.98	0.049	1.921	2.022	-2.1		-0.19	0.851
	Matched	0.817	0.856	-4.9	80.5	-0.28	0.784	1.921	1.612	6.5	-206.9	0.46	0.647
Area of land rented or other not owned in	Unmatched	0.225	0.134	19.4		1.55	0.121	0.344	0.395	-2.2		-0.16	0.874

Baseline variable	Sample	Tavush Region						Vayots Dzor Region					
		Mean			Reduction % bias	t-test		Mean			Reduction % bias	t-test	
		Interven-tion	Compar-ison	% bias		t-stat	p-value	Interven-tion	Compar-ison	% bias		t-stat	p-value
2009 by HH – in hectares	Matched	0.225	0.191	7.2	63.1	0.42	0.672	0.344	0.469	-5.4	-143.7	-0.38	0.704
Area of land owned AND cultivated in 2009 by HH – in hectares	Unmatched	0.583	0.451	20.6		1.64	0.103	1.010	1.289	-20.2		-1.58	0.116
	Matched	0.583	0.590	-1.1	94.8	-0.07	0.946	1.010	0.979	2.3	88.7	0.17	0.863
Area of land rented/other AND cultivated in 2009 by HH – in hectares	Unmatched	0.183	0.110	16		1.29	0.196	0.311	0.338	-1.5		-0.11	0.912
	Matched	0.183	0.160	5	68.8	0.3	0.767	0.311	0.414	-5.8	-277.3	-0.4	0.686
Number of migrant workers HH relied on for remittances in 2009	Unmatched	0.284	0.284	0		0	0.999	0.247	0.213	6.6		0.52	0.604
	Matched	0.284	0.280	0.6	-6693.4	0.04	0.965	0.247	0.303	-10.6	-60.8	-0.68	0.497
Number of minutes (return on foot) to fetch water from main water source in 2009	Unmatched	19.211	16.820	5.1		0.43	0.666	1.361	1.017	5.6		0.45	0.655
	Matched	19.211	18.635	1.2	75.9	0.09	0.931	1.361	1.243	1.9	65.8	0.12	0.903
Number of minutes (on foot) to reach village centre in 2009	Unmatched	10.768	11.240	-6		-0.47	0.64	8.680	9.563	-12.8		-0.98	0.329
	Matched	10.768	10.405	4.6	23	0.34	0.733	8.680	9.038	-5.2	59.5	-0.37	0.709
Number of minutes (on foot) to reach nearest marketplace to sell produce in 2009	Unmatched	177.140	195.100	-2.6		-0.22	0.828	399.020	505.660	-14.2		-1.15	0.249
	Matched	177.140	215.780	-5.5	-115.1	-0.39	0.697	399.020	444.470	-6.1	57.4	-0.45	0.653
HH wealth in second quintile (2009) = 1	Unmatched	0.200	0.208	-1.9		-0.15	0.881	0.196	0.190	1.6		0.12	0.901
	Matched	0.200	0.181	4.7	-151	0.34	0.738	0.196	0.158	9.5	-504.8	0.68	0.495
HH wealth in third quintile (2009) = 1	Unmatched	0.295	0.148	35.9		2.96	0.003	0.165	0.230	-16.3		-1.26	0.207
	Matched	0.295	0.262	8	77.6	0.5	0.615	0.165	0.243	-19.6	-20.3	-1.35	0.179
HH wealth in fourth quintile (2009) = 1	Unmatched	0.221	0.202	4.6		0.37	0.715	0.216	0.184	8.1		0.65	0.519
	Matched	0.221	0.247	-6.3	-36.7	-0.42	0.677	0.216	0.210	1.6	79.7	0.11	0.911
HH wealth in fifth quintile (2009) = 1	Unmatched	0.168	0.219	-12.7		-0.99	0.324	0.196	0.201	-1.3		-0.1	0.917
	Matched	0.168	0.121	12.1	4.7	0.93	0.351	0.196	0.217	-5.4	-309.7	-0.37	0.712
Number of observations		95	183	Total: 278				97	174	Total: 271			

Notes: The average standardised percentage bias is the % difference of the sample means in the treated and control sub-samples as a percentage of the square root of the average of the sample variances in the treated and control groups. As a rule of thumb, a bias of 5 or less is tolerated.

APPENDIX 2: DETAILED RESULTS

In this appendix we present detailed results and significance tests from some of the analyses presented in Section 5, where there was not enough space to report full results.

The detailed results presented here are as follows:

- Improved agricultural practices (discussed in Section 5.3.2)
- Reported difficulties (discussed in Section 5.3.2 and Section 5.3.6)
- Difference-in-difference results for use of mechanical services (discussed in Section 5.3.3)
- Harvested quantities of individual vegetable and grain crops (discussed in Section 5.3.4)
- Harvested quantities of individual fruit crops (discussed in Section 5.3.4)

Table A2.1: Detailed results for improved agricultural practices during last 12 months (all indicator variables)

	Improved seed/ seedlings	Inorganic fertilisers	Ideal combination of fertilisers	Organic fertilisers	Application of pesticides	Use of sun-dryers	Use of cold store/ collection	Greenhouse	Drip irrigation in greenhouse	Other irrigation	Pest control/ tree care for orchards
Overall											
Intervention group mean:	0.51	0.42	0.11	0.78	0.48	0.078	0.078	0.17	0.15	0.81	0.74
Comparison group mean:	0.42	0.34	0.062	0.75	0.33	0.00050	0.0068	0.0098	0.0015	0.89	0.69
Difference:	0.094* (0.052)	0.079 (0.051)	0.047 (0.029)	0.029 (0.048)	0.15*** (0.053)	0.078*** (0.020)	0.071*** (0.021)	0.16*** (0.029)	0.14*** (0.026)	-0.077** (0.035)	0.051 (0.047)
Observations (intervention group):	192	192	192	192	192	192	192	192	192	192	192
Observations (total):	549	549	549	549	549	549	549	549	549	549	549
Tavush Region											
Intervention group mean:	0.57	0.40	0.12	0.71	0.47	0.074	0.095	0.27	0.23	0.76	0.74
Comparison group mean:	0.54	0.21	0.029	0.69	0.32	0.0010	0.012	0.00084	0	0.83	0.63
Difference:	0.028 (0.081)	0.19*** (0.070)	0.087** (0.037)	0.013 (0.075)	0.15* (0.080)	0.073*** (0.027)	0.083** (0.032)	0.27*** (0.046)	0.23*** (0.043)	-0.068 (0.056)	0.11 (0.071)
Observations (intervention group):	95	95	95	95	95	95	95	95	95	95	95
Observations (total):	278	278	278	278	278	278	278	278	278	278	278
Vayots Dzor Region											
Intervention group mean:	0.45	0.44	0.10	0.85	0.48	0.082	0.062	0.072	0.062	0.87	0.75
Comparison group mean:	0.29	0.47	0.095	0.80	0.33	0	0.0017	0.019	0.0029	0.95	0.76
Difference:	0.16** (0.066)	-0.029 (0.073)	0.0082 (0.045)	0.045 (0.059)	0.15** (0.069)	0.082*** (0.028)	0.060** (0.025)	0.054* (0.029)	0.059** (0.025)	-0.085** (0.040)	-0.0076 (0.061)
Observations (intervention group):	97	97	97	97	97	97	97	97	97	97	97
Observations (total):	271	271	271	271	271	271	271	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

Table A2.2: Detailed results for reported difficulties during last 12 months (all indicator variables)

	Lack of access to retail/ wholesale agricultural markets	Difficulty accessing credit for agricultural activities/ inputs	Shortage of quality seeds/ seedlings/ fertilisers/ pesticides	Difficulty transporting goods to market	Problems dealing with middlemen	Lack of storage facilities for fresh fruits and vegetables	Severe agricultural damage from hail storms	Severe agricultural damage from early/ late frost/ snow	Severe agricultural damage from rainfall/ floods/ landslides	Severe agricultural damage from droughts
Overall										
Intervention group mean:	0.41	0.17	0.23	0.34	0.34	0.18	0.71	0.80	0.28	0.33
Comparison group mean:	0.37	0.11	0.15	0.27	0.24	0.12	0.71	0.76	0.23	0.29
Difference:	0.044 (0.053)	0.055 (0.036)	0.086** (0.042)	0.077 (0.048)	0.098* (0.051)	0.056 (0.036)	-0.0020 (0.048)	0.042 (0.044)	0.050 (0.048)	0.039 (0.047)
Observations (intervention group):	192	192	192	192	192	192	192	192	192	192
Observations (total):	549	549	549	549	549	549	549	549	549	549
Tavush Region										
Intervention group mean:	0.36	0.12	0.25	0.23	0.28	0.20	0.65	0.80	0.28	0.31
Comparison group mean:	0.24	0.074	0.19	0.15	0.20	0.12	0.63	0.75	0.22	0.24
Difference:	0.11 (0.077)	0.042 (0.042)	0.059 (0.065)	0.086 (0.063)	0.080 (0.073)	0.077 (0.054)	0.019 (0.077)	0.048 (0.065)	0.062 (0.071)	0.062 (0.064)
Observations (intervention group):	95	95	95	95	95	95	95	95	95	95
Observations (total):	278	278	278	278	278	278	278	278	278	278
Vayots Dzor Region										
Intervention group mean:	0.46	0.22	0.22	0.45	0.39	0.15	0.76	0.79	0.27	0.36
Comparison group mean:	0.49	0.15	0.10	0.39	0.28	0.12	0.79	0.76	0.23	0.34
Difference:	-0.025 (0.074)	0.068 (0.056)	0.11** (0.051)	0.068 (0.072)	0.12 (0.070)	0.034 (0.049)	-0.022 (0.061)	0.035 (0.060)	0.037 (0.063)	0.017 (0.072)
Observations (intervention group):	97	97	97	97	97	97	97	97	97	97
Observations (total):	271	271	271	271	271	271	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

Table A2.3: Difference-in-difference results for use of mechanical services (difference between 2009 and 'last 12 months')

	Change in proportion using ploughing	Change in proportion using cultivation	Change in proportion using sowing	Change in proportion using harvesting
Overall				
Intervention group mean:	0.021	0	-0.010	-0.016
Comparison group mean:	-0.029	-0.017	0.0049	0.0072
Difference:	0.049 (0.033)	0.017 (0.023)	-0.015 (0.024)	-0.023 (0.022)
Observations (intervention group):	192	192	192	192
Observations (total):	549	549	549	549
Tavush Region				
Intervention group mean:	-0.011	-0.011	-0.032	-0.032
Comparison group mean:	-0.014	-0.0041	0.021	0.0047
Difference:	0.0031 (0.044)	-0.0065 (0.032)	-0.052** (0.025)	-0.036 (0.036)
Observations (intervention group):	95	95	95	95
Observations (total):	278	278	278	278
Vayots Dzor Region				
Intervention group mean:	0.052	0.010	0.010	0
Comparison group mean:	-0.043	-0.029	-0.011	0.0096
Difference:	0.095* (0.050)	0.039 (0.031)	0.021 (0.039)	-0.0096 (0.026)
Observations (intervention group):	97	97	97	97
Observations (total):	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 4,000 repetitions; all means are calculated *after* matching.

Table A2.4: Harvested quantities of vegetable and grain crops (Year to April 2014; all quantities kilogrammes)

	Wheat	Barley	Other grains/ cereals	Pulses (chickpeas, lentils etc.)	Traditional vegetables[45]	Non-traditional vegetables[46]	Nuts	Tobacco	Potatoes	Other non-fruit crop
Overall										
Intervention group mean:	299.9	120.1	156.8	54.6	144.5	2.44	71.9	0	152.6	2610.5
Comparison group mean:	275.9	133.7	36.4	29.1	54.5	0.37	64.4	30.7	233.9	1771.4
Difference:	24.0 (121.0)	-13.6 (58.8)	120.5*** (43.1)	25.5** (11.1)	90.0*** (29.6)	2.07 (1.32)	7.46 (10.1)	-30.7 (29.0)	-81.3*** (27.6)	839.1 (1558.9)
Observations (intervention group):	192	192	192	192	192	192	192	192	192	192
Observations (total):	549	549	549	549	549	549	549	549	549	549
Tavush Region										
Intervention group mean:	301.1	115.3	144.7	96.6	227.1	3.98	37.2	0	134.9	122.0
Comparison group mean:	468.8	173.3	51.4	48.7	59.0	0.53	31.0	62.1	216.4	279.7
Difference:	-167.7 (225.9)	-58.0 (93.0)	93.3 (57.1)	48.0** (22.3)	168.1*** (52.8)	3.45 (2.68)	6.11 (9.77)	-62.1 (61.0)	-81.4** (41.2)	-157.7 (113.5)
Observations (intervention group):	95	95	95	95	95	95	95	95	95	95
Observations (total):	278	278	278	278	278	278	278	278	278	278
Vayots Dzor Region										
Intervention group mean:	298.8	124.8	168.6	13.5	63.7	0.93	105.9	0	169.9	5047.6
Comparison group mean:	87.1	95.1	21.6	9.94	50.1	0.22	97.1	0	251.1	3232.3
Difference:	211.7** (100.2)	29.8 (58.7)	147.0** (59.2)	3.53* (2.03)	13.5 (12.1)	0.71* (0.40)	8.77 (18.0)	0 (0)	-81.2** (35.4)	1815.3 (3337.0)
Observations (intervention group):	97	97	97	97	97	97	97	97	97	97
Observations (total):	271	271	271	271	271	271	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions; all means are calculated *after* matching.

Table A2.5: Harvested quantities of fruit crops (Year to April 2014; all quantities kilogrammes)

	Apples	Grapes	Cherries	Apricots	Peaches	Berries	Figs	Pears	Plums	Pome-granates	Persim-mons	Other tree fruit
Overall												
Intervention group mean:	465.3	203.6	20.4	74.6	1493.7	49.2	84.0	39.3	98.2	7.85	130.6	51.1
Comparison group mean:	211.8	342.9	45.7	31.6	49.5	74.2	39.5	22.9	61.5	18.1	135.6	163.7
Difference:	253.6** (112.5)	-139.3 (132.5)	-25.3 (23.6)	43.0** (17.8)	1444.2 (1115.0)	-25.0 (19.2)	44.5* (24.6)	16.5** (8.19)	36.7 (25.2)	-10.3 (9.94)	-5.07 (68.5)	-112.6 (147.5)
Observations (intervention group):	192	192	192	192	192	192	192	192	192	192	192	192
Observations (total):	549	549	549	549	549	549	549	549	549	549	549	549
Tavush Region												
Intervention group mean:	360.1	400	22	10.8	3009.8	76.6	169.7	26.3	157.3	15.9	263.9	93.1
Comparison group mean:	71.8	680.0	37.6	1.29	96.1	144.3	79.8	17.3	102.1	36.6	274.1	32.0
Difference:	288.3* (172.5)	-280.0 (276.7)	-15.6 (18.8)	9.56 (6.40)	2913.8 (2098.4)	-67.7* (38.5)	89.9* (49.1)	8.93 (8.80)	55.2 (52.4)	-20.7 (20.1)	-10.3 (138.4)	61.1 (45.8)
Observations (intervention group):	95	95	95	95	95	95	95	95	95	95	95	95
Observations (total):	278	278	278	278	278	278	278	278	278	278	278	278
Vayots Dzor Region												
Intervention group mean:	568.4	11.2	18.7	137.1	8.88	22.4	0	52.1	40.4	0	0.010	9.97
Comparison group mean:	348.8	12.7	53.6	61.4	3.95	5.47	0	28.3	21.8	0	0	292.6
Difference:	219.6 (134.5)	-1.54 (8.94)	-34.8 (41.0)	75.7** (35.3)	4.93** (2.03)	16.9*** (4.83)	0 (0)	23.8* (14.1)	18.6** (8.84)	0 (0)	0.010 (0.0081)	-282.7 (285.7)
Observations (intervention group):	97	97	97	97	97	97	97	97	97	97	97	97
Observations (total):	271	271	271	271	271	271	271	271	271	271	271	271

Notes: Standard errors in parentheses; * p<0.1, ** p<0.05, *** p<0.01; PSM estimates are bootstrapped with 1,000 repetitions; all means are calculated *after* matching.

For vegetable crops, the results may be summarised as follows; all statements compare the intervention sample with the matched comparison sample.

- Overall slightly more wheat was harvested by beneficiary households (not significant overall, but significantly more in Vayots Dzor).
- There was no significant difference in barley harvests.
- Overall significantly more of other grains/cereals were harvested by beneficiary households, not significant in Tavush, significant in Vayots Dzor.
- Overall significantly more pulses were harvested by beneficiary households (significant in both regions).
- Overall significantly more traditional vegetables were harvested by beneficiary households (significant in Tavush, but not Vayots Dzor).
- Overall slightly more non-traditional vegetables were harvested by beneficiary households (not significant overall, but significantly more in Vayots Dzor), however average harvests were very low at 2.44kg for intervention households and 0.37kg for comparison households.
- There was no significant difference in nut harvests.
- There was no significant difference in tobacco harvests.
- Significantly less potato was harvested by beneficiary households in both districts.
- There was no significant difference in harvests of other non-fruit crops.

For fruit crops, the results may be summarised as follows; all statements compare the intervention sample with the matched comparison sample.

- Overall significantly more apples were harvested by beneficiary households (significant overall and in Tavush, but not significant in Vayots Dzor).
- There was no significant difference in grape harvests.
- There was no significant difference in cherry harvests.
- Overall significantly more apricots were harvested by beneficiary households (significant overall and in Vayots Dzor, but not significant in Tavush).
- Overall there is no significant difference in peach harvests, although significantly more was harvested by beneficiary households in Vayots Dzor region. (However, the results for peaches in Tavush and overall have some strange characteristics, driven by the presence of some extremely large peach farms among intervention households in Tavush.)
- Overall there is no significant difference in berry harvests, although significantly less was harvested by beneficiary households than comparison households in Tavush while significantly more was harvested by beneficiary households in Vayots Dzor.
- Figs are grown only in Tavush, where harvests are significantly greater among beneficiary households.
- Overall significantly more pears were harvested by beneficiary households (significant overall and in Vayots Dzor, but not significant in Tavush).
- Overall more, but not significantly more, plums were harvested by beneficiary households (significant in Vayots Dzor, but not significant in Tavush).
- Pomegranates were grown only in Tavush, where harvests were lower among beneficiary households, but not significantly so.
- Pomegranates were grown only in Tavush (except for one household in Vayots Dzor) where harvests were lower among beneficiary households, but not significantly so.
- Harvests of other tree fruits were lower among beneficiary households overall, but not significantly so.

NOTES

1 The Oxfam project team explained that the beneficiary farmers had chosen to focus on larger scale cultivation of traditional, but high-value, vegetable crops in greenhouses as the project progressed – as reflected in the results discussed above – and described this as 'their livelihoods shifting to the new level of cooperative community development introduced by the programme'.

2 A mature project has been running for long enough – typically at least 2.5 years – to have a reasonable expectation of impact, with either an expenditure rate of at least 70 per cent or completion of most project activities.

3 ARMA62 Narrative Progress Report, 2011–2012.

4 Glenn E. Curtis, ed. Armenia: A Country Study. Washington: GPO for the Library of Congress, 1995.

5 Discussion with Oxfam country office team.

6 Statistical Yearbook of Armenia, 2001

7 World Bank Databank http://databank.worldbank.org/data/home.aspx

8 Ibid.

9 Discussion with Oxfam project team.

10 ARMA62 Project Proposal FY 2010.

11 ARMA62 Project Proposal FY 2010.

12 Informal farmers' groups had been established in 2008–09 as part of an earlier project in some of the communities in Tavush region; the formal cooperatives established through the present project built on the earlier groups, with expanded membership. Communities were targeted according to remoteness, vulnerability (location close to border with Azerbaijan or post-Soviet economic history) and the potential to benefit from improved positioning in the value chain. Horizon Fund (microfinance NGO, one of the implementing partners) had also been active in Tavush region since 2008. In Vayots Dzor Oxfam had developed local knowledge having been active in the region, particularly in the health sector, over two decades. On the basis of that knowledge as well as poverty statistics from the local authorities, the poorest rural communities were selected for this agricultural livelihoods-focused project.

13 Note that the greenhouses in all communities were funded through different channels: partnership with UNDP, Oxfam project ARMA69 or the Austrian Development Cooperation. It will not be possible to separate the impact of these greenhouses from the impact of activities funded through ARMA62.

14 Note that agro-tourism activities were discontinued after the first year of the project due to inconsistency with Oxfam GB policy.

15 Note that as originally envisaged (ARMA62 Project Proposal FY 2010–11) the Oxfam project team planned to research and implement a pilot micro-insurance scheme for smallholder farmers as well as the micro-credit provision that was actually implemented. Unfortunately, as reported by the Oxfam project team and the microfinance partner NGO (Horizon Fund) it proved impossible to find a commercial insurance provider to act as a partner for this part of the project. The understanding of the Oxfam project team and the Horizon Fund representative was that this was at least in part due to regulatory changes for motor insurance in Armenia which meant that all commercial insurance providers were focusing their activities in the new market for motor insurance and were not interested in creating agricultural insurance products for smallholder farmers. It may also have been the case that the commercial providers did not see agricultural insurance for smallholder farmers as a commercially viable proposition, not least because Armenia is a small country and the climatic risks faced by the farmers are highly correlated, meaning that it would not be possible to pool risks over a sufficiently diverse area.

16 Note that the greenhouses in all communities were funded through different channels: partnership with UNDP, Oxfam project ARMA69 or the Austrian Development Cooperation. It will not be possible to separate the impact of these greenhouses from the impact of activities funded through ARMA62.

17 Note that, as summarised in Table 2.1, there were several funding streams. Project activities in some of the villages were not funded by ARMA62.

18 The preferred respondents were the adult household member who was best informed about agricultural production (for the production sections) and the adult household member who was best informed about consumption (for the consumption sections). When not available, the household head, their spouse, or another adult household member (in that order of preference) was interviewed.

19 A bias may be introduced if participation in the project alters the likelihood of death, migration, non-availability of a respondent or any other reason not to participate in the survey, so that the effects are different between the intervention and comparison group. We cannot control for this, but it seems reasonable to expect that such an effect would be relatively small.

20 Note that both the intervention and comparison samples were restricted to the region of common support, that is, those households for which appropriate comparators exist in the sample. This is explained in detail in Appendix 1.

21 As the sampling frame was Oxfam's list of cooperative members, some must have subsequently left the cooperative. This issue was concentrated in one particular intervention village in Vayots Dzor, where eight of the 25 households sampled did not belong to the cooperative. The Oxfam project team had mentioned that they had encountered community problems in this village, which may explain this

relatively high drop-out rate. Several of these households had clearly formerly been members of the cooperative as they did report having received training and other support.

22 This possibly reflects the Oxfam project team's observation, discussed in Section 2, that typically a subset of the cooperative members participated more actively in project activities.

23 For example, in several communities in Vayots Dzor region, including two of the comparison communities, Oxfam had been running a Disaster Risk Reduction and Climate Change Adaptation programme; some comparison households had received training on some of the topics through this programme.

24 One comparison household head in Tavush region did have a main occupation processing agricultural produce, but the weighting of that household in the PSM analysis was very low, at 0.17.

25 Note that, as detailed in Section 2, the greenhouses were generally funded through different funding streams from ARMA62; however, as their impact cannot be separated from that of the other interventions, and as they were associated with if not funded by this project, we consider them in this analysis.

26 Discussion with project team.

27 No significant difference is found when land owned and land rented (or other use of non-owned land) are examined separately.

28 , thus 65% more.

29 Note that, working with log values, the averages are geometric means rather than the better known arithmetic mean.

30 , thus 18% less.

31 Recall data on agricultural practices and inputs was not used for matching because of concerns that not all respondents clearly understood that 2009 was before the project had started; respondents in intervention communities were much more familiar with the terminology used for practices associated with the project than respondents in comparison communities. There was thus a strong possibility that respondents in intervention households said that they used the practice in 2009 when in fact they had only started using it after the start of the project.

32 Note that, in the survey and for the purposes of this analysis, some crop types are aggregated. For example traditional vegetables (carrots, tomatoes, cucumbers, peppers, greens etc.) count as one crop type, as do pulses (chickpeas, lentils, beans etc.), non-traditional vegetables (broccoli, chillies, cherry tomatoes), nuts (walnuts, almonds, etc.) and wild berries.

33 There is no inconsistency in these results; there must be a greater correlation between selling fruit and non-fruit produce for the intervention households than the comparison households in Vayots Dzor.

34 to three significant figures.

35 See Gujarati, Damodar N. (2003) Basic Econometrics: Fourth Edition. New York: McGraw Hill.

36 To reflect the existence of economies of scale within households and the lower consumption needs of children, the formula used for calculating household size is , where A is number of adults in the household; K is the number of children; is the consumption of a child relative to an adult; and stands for the extent of economies of scale. This Effectiveness Review follows the common practice of setting equal to 0.33 and equal to 0.9, but the findings are not sensitive to reasonable changes in these parameters. See Deaton, A and S. Zaidi. 2002. Guidelines for constructing consumption aggregates for welfare analysis, Working Paper No. 135. The World Bank, Washington, D.C.

37 The indices relating to 2009 were used in the propensity score matching exercise.

38 The correlation of each indicator with the others in the dataset was examined using Cronbach's alpha, a coefficient of reliability. When items are used in a scale or index, they should all measure the same underlying latent construct (e.g. household wealth status). The items, then, must be significantly correlated with one another. Cronbach's alpha is a measure of this inter-item correlation. The more the variables are correlated, the greater is the sum of the common variation they share. If all items are perfectly correlated, alpha would be 1 and 0 if they all were independent from one another. For comparing groups, an alpha of 0.7 or 0.8 is considered satisfactory. See: Bland, M. J. & Altman, D. G. 1997. Statistics notes: Cronbach's alpha. BMJ, 314, 572. The overall alphas for the wealth indices created for this particular Effectiveness Review are 0.838 (Tavush, 2014), 0.829 (Tavush, 2009), 0.834 (Tavush, over period), 0.832 (Vayots Dzor, 2014), 0.822 (Vayots Dzor, 2009), and 0.835 (Vayots Dzor, over time), showing that the various items used to construct the wealth indices are highly correlated.

39 The Oxfam project team explained that the beneficiary farmers had chosen to focus on larger scale cultivation of traditional but high-value vegetable crops in greenhouses as the project progressed – as reflected in the results discussed above – and described this as 'their livelihoods shifting to the new level of cooperative community development introduced by the programme'.

40 Caliendo, M. and Kopeinig, S. 2008. "Some Practical Guidance for the Implementation of Propensity Score Matching", Journal of Economic Surveys, Wiley Blackwell, vol. 22(1), pages 31–72.

41 Rosenbaum, Paul R., and Donald B. Rubin 1983. "The central role of the propensity score in observational studies for causal effects." Biometrika 70.1: 41–55.

42 Heckman, James J., Robert J. LaLonde, and Jeffrey A. Smith 1999. "The economics and econometrics of active labor market programs." Handbook of labor economics 3: 1865–2097.

43 Bootstrapping is a statistical procedure where repeated samples (of the same size) are drawn from the original sample with replacement. This results in a statistical distribution of parameter estimates (the sampling distribution). The bootstrapped standard error is the standard deviation of this sampling distribution and it can be shown that as the number of repeated samples becomes large, provided certain technical conditions are met this is a good estimate for the standard error of the estimate.

44 Note that the psmatch2 module cannot take into account that the propensity scores have been estimated or the restriction to common support when calculating standard errors for the estimates. The bootstrapping procedure applied in this report does not do that, either.

45 Carrots, tomatoes, cucumbers, peppers, greens etc.

46 Broccoli, chillies, cherry tomatoes.

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