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IMPACT ASSESSMENT REPORT

Peru

Strengthening Local Development in the Highlands and High Rainforest Areas Project (PSSA)

Authors:
Aslihan Arslan, Daniel Higgins, Eva-Maria Egger and Emanuele Zucchini

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Table of contents

Contents

List of abbreviations

AGRORURAL	Programa de Desarrollo Productivo Agrario Rural
ATE	Average Treatment Effect
ATET	Average Treatment Effect on the Treated
CENAGRO	Censo Nacional Agropecuario
CLAR	Comités Locales de Asignación de Recursos
HHI	Herfindahl-Hirschman Index
IPWRA	Inverse Probability Weighted Regression Adjustment model
NN	Nearest Neighbour model
PA	Producer Association
PDN	Planes de Negocio (business plan)
PSM	Propensity Score Matching
PSSA	Proyecto Sierra Selva Alta/Strengthening Local Development in the Highlands and High Rainforest Areas Project
SMD	Standardised Mean Difference
TLU	Tropical Livestock Units
ToC	Theory of Change

Executive summary

The Strengthening Local Development in the Highlands and High Rainforest Areas Project (PSSA) was implemented between 2013 and 2019 with financing from IFAD and the Peruvian Ministry of Agriculture and Fisheries. It aimed to unlock rural development and poverty reduction in Peru through supporting the design and implementation of business plans (Planes de Negocio, PDNs) by Producer Associations (PAs), targeting two of the country's poorest regions. This impact assessment (IA) of PSSA was conducted as part of IFAD's impact assessment agenda for its 11th replenishment period, through which IFAD is analysing the impacts of 15 per cent of its portfolio to learn lessons for improved programming as well as to estimate the overall impact of its portfolio through an aggregation analysis.

PSSA aimed to sustainably improve the human, physical, social and financial capital of its beneficiaries through three components: (i) Supporting the formation of producer associations (PAs) and the development and implementation of business plans (PDNs); (ii) Supporting the development of community natural resource management plans; and (iii) Strengthening local governance. This IA focuses on PSSA's support to PAs, which included technical support to producers to form a PA and prepare a PDN, with which they applied to a local committee for financial support. Selected PAs were registered formally and received grant equal to 80 per cent of the cost of their PDN, and the members contributed the remaining 20 per cent. PAs also received training on business management and accounting.

This study rigorously analyses the impact of PSSA on a large set of indicators grouped by IFAD's strategic objectives and overarching goal, as well as other indicators that measure impact pathways and crosscutting themes, as relevant. We investigate direct impacts on beneficiaries as well as indirect ones, because spillover effects were expected in project districts.

Using data from 3,100 households (more or less evenly split between treatment, spillover and control groups) collected in the summer of 2019, we find that the most significant direct impact of the project was related to livestock production. The value of livestock production, input use and input use efficiency all increased for treated compared to control households, by around 60, 50 and 14 per cent, respectively. We do not find a significant impact on crop production, though we find significant increases in total income (21 per cent) and cash income (26 per cent) per capita. The impact channels are twofold: treated households receive a much higher portion of their income from livestock (which also significantly increased at the expense of crop production) and their probability of participating in wage employment significantly increased. We also find that financial inclusion and asset ownership increased significantly for treated households. Project area is characterised by high female participation in decision household making, hence we do not find an impact on this indicator. Nonetheless, we find significant increases in women's participation in local groups and wage employment, as well as in livestock and total income under their ownership and decision-making.

Significant spillover impacts on households that live in PSSA districts materialised primarily through participation in wage employment, which led to an increase in cash income per capita. The project seems to have stimulated the demand for technical assistance and inputs through trainings, as well as local wage employment opportunities. Spillover communities also benefited from increased financial inclusion, as their probability to take a loan and to have a bank account both increased significantly, similar to treated households.

Introduction

The Strengthening Local Development in the Highlands and High Rainforest Areas Project (PSSA) was implemented between 2013 and 2019 with financing from IFAD and the Peruvian Ministry of Agriculture and Fisheries. It aimed to unlock rural development and poverty reduction in Peru through supporting the design and implementation of business plans (Planes de Negocio, PDNs) by Producer Associations (PAs), targeting two of the country's poorest regions. This study of PSSA's impact was conducted as part of IFAD's impact assessment agenda for its 11th replenishment period, through which IFAD will analyse the impacts of 15 per cent of its projects and aggregate the results in order to estimate the overall impact of its portfolio.

Peru has experienced considerable, but unbalanced, growth in rural incomes in recent years. While there has been significant growth and rural poverty reduction in the coastal regions, rural poverty in the "Sierra" highland and "Selva Alta" rainforest regions remains high and rural inequality has even increased during the period leading up to the PSSA implementation (Flachsbarth et al. 2018). The topography of these areas makes access to expanding rural markets difficult and expensive for small-scale producers, which, combined with soil erosion and extreme weather events, severely constrains productivity and income growth (Escobal and Cavero, 2012; INEI, 2013).

PSSA aimed to sustainably improve the human, physical, social and financial capital of beneficiaries through the following three components: (i) Supporting the formation of PAs and the development and implementation of PDNs; (ii) Supporting the development of community natural resource management plans; and (iii) Strengthening local governance.

While all components are relevant for addressing the development challenges in the project areas, this impact assessment focuses on PSSA's support to PAs (Component I). The support for natural resource management (Component II) and local governance (Component III) have longer term scopes, meaning impacts are not likely to be measurable immediately after project completion—and in terms of the strengthening of local governance, would be difficult to quantify at any stage. Component I also accounts for the largest share (68%) of the project budget (see IFAD, 2019) and is expected to have the largest effects on IFAD's strategic objectives as outlined in its 2016-2025 Strategic Framework (IFAD, 2016).

As part of Component I, producers were required to form a PA and prepare a business proposal, with which they applied to gain financial support from the project. Eligible proposals were selected by Comités Locales de Asignación de Recursos (CLARs)—a local committee formed in a participatory manner—who reviewed the proposals according to pre-defined criteria through public competitions. The project also worked through these CLARs to strengthen local governance as part of Component III. If a PA's initial proposal was not accepted, they received technical support to refine their proposal by the project, and all groups were eventually awarded a grant. Once accepted, they were provided with a formal registration of their PA, a first grant payment, and training on business management and accounting. The project financed 80 per cent of the cost of the business plans—which mainly focused on production and processing of crops or livestock—with the remaining 20 per cent contributed by the PA members (in cash or in-kind) to ensure their commitment.

Projects such as PSSA that employ a demand-driven collective action approach are receiving considerable attention and investment across the continent (World Bank, 2008; Wong et al., 2018). This is in response to the low uptake of previous top-down rural development projects caused by low institutional capacity and low trust in regional and national governments (Escobal and Ponce, 2011).

This impact assessment aims to generate much-needed evidence on the effectiveness of this increasingly popular approach so that future projects can be improved (Mansuri and Rao, 2004). The study also aims to generate methodological insights, helping to inform future efforts to capture the impacts of such projects, which is made difficult by their demand-driven implementation.

This assessment generates this evidence by rigorously testing the project's expected impacts and their pathways for direct as well as indirect beneficiaries. Potential indirect impacts that were expected for non-beneficiary households in beneficiary districts included spill-over effects through provision of local services, increased demand for goods or services and positive social-network externalities. The sampling frame, therefore, included three comparison groups consisting of beneficiary, spillover, and non-beneficiary (control) households. In-depth questionnaires at the household, community and producer association levels were conducted between August and November of 2019. We estimate the project's impacts on a set of indicators identified through the project's Theory of Change (ToC) using a rigorous statistical methodology and generate detailed lessons to be taken into account for future projects. In measuring the project's contribution towards IFAD's Strategic Objectives, this analysis also contributes to IFAD's accountability mandate.

The remainder of the report contains the PSSA ToC and the research questions addressed by this study; details of the impact assessment design and data; descriptive statistics of the sample; the results; and finally the conclusions and policy recommendations.

Theory of change and main research questions

In this section, we first detail PSSA's Theory of Change (ToC), focusing on the project's support to PAs. We also explain details of the project's coverage and targeting to add further context. Based on this understanding of the project, we then outline the main research questions around which the impact assessment is based.

PSSA Theory of Change

PSSA's expected impact pathways are outlined in the ToC diagram in Figure 1. A ToC maps the inputs/activities, outputs, outcomes and ultimate expected impacts of a project, highlighting the interlinkages within and across each stage and the assumptions that are required to hold in order for the pathways to function (White, 2009). Considering the assumptions is important as they highlight the factors that may have caused the impact pathways to break down, thus helping to understand the full impact story.

The various types of direct support provided to the PAs are listed as inputs in the ToC. The project first facilitated the formation of the PAs and supported them to develop their PDNs. Once the PDNs were approved, the project aimed to build the capacity of PAs through grants and non-financial support. The grants were used mainly for the purchase of physical capital to improve or start the production of specific goods, for example building a fish pond with constant fresh water supply. The PAs also used the money to hire local experts to provide technical training in the field of their specialization, for example a veterinarian for the healthy raising of guinea pigs. Further improvements in human capital were targeted through training in business management and accounting, as well as through visits to other successful production sites of similar products. The project also coached local champions to provide support to PAs.

All of the project activities aimed to be inclusive of women, and some women formed their own groups and developed successful PDNs (although the project implementation did not specifically target the inclusion of women in PAs or their role as PA leader). The project exclusively targeted women through the provision of financial products (savings accounts and life insurance) to improve their financial capital, which followed financial education workshops that were offered to all members of the PAs. These workshops were focused mostly on household finances rather than on business financing, therefore this activity is considered in the ToC as a separate input from the PA competition and activities. It is, however, expected to influence all outcomes given that beneficiaries with financial education can improve the financial planning of their households and women can increase their savings capacity through the financial instruments, as well as feel empowered to participate stronger in the PAs and their community.

PSSA's inputs were expected to lead to outputs in the form of established and functioning PAs, with their members possessing improved production skills, facilities and knowledge, and more social captial. Women were also expected to have more savings accounts and be enrolled in life insurance schemes. To produce these outputs, it is assumed in the logic of the project design that there is sufficient demand from producers to form PAs and to participate in the training, and that women do not face barriers to their participation. The importance of demand and a lack of other barriers to group formation is highlighted in a study of a similar project that provided grants to producer groups in Mexico, which found that encouraging group formation was a challenge, especially among poorer households (Cord and Wodon, 2001). Participation of women has been found to be a particular problem in past projects in Peru, including for *Juntos*, the country's large-scale rural Conditional Cash

Transfer project (Valente, 2010). Low levels of trust in the government in these regions of Peru could also cause potential beneficiaries not to participate.

Through these inputs and outputs, various household and PA level outcomes were expected. First, the formation of PAs alone was expected to improve the benefits from market participation for members. Past studies have found that membership of such groups can increase bargaining power (Thorpe et al., 2005), encourage mutual support through strengthened social capital (Isham, 2002; Heemskerk and Wennink, 2004), and can reduce transaction costs for production and sales (Barrett et al., 2012; Yang and Liu, 2012). Reducing transaction costs, in particular, has the potential for considerable impacts. Cheaper and easier access to markets, information and new technologies can encourage farmers to participate more in markets, to invest more in their production, and to invest in higher risk-higher return activities based on the prospect of larger profits (de Janvry et al., 1991; Guiso et al., 1996; Stockbridge et al., 2003; Markelova et al., 2009). Increased investment and technology adoption can also be incentivised through risk-spreading within the groups (di Gregorio et al., 2008; Abebaw and Haile, 2013). Based on these benefits, membership of such groups has been found to increase market participation, agricultural productivity and total income, especially for small-scale producers (Verhofstadt and Maertens, 2015; Ma and Abdulai, 2016; Bachke, 2019).

The positive outcomes from forming a PA are then expected to be amplified though the support provided to the groups. At the household level, technical assistance and financial support can further encourage the adoption of new technologies (Shiferaw et al., 2009), whilst improved business management, and better quality and quantity of products, is expected to further improve their selling and buying practices both inside and outside of the PA (Bijman et al., 2007). This is expected to begin a virtuous cycle, through which the success of the group increases the engagement and investment of members, and fuels further increases in the scale of the operations and the demand for their products.

At the level of PAs, formal registration and business management training should ensure that the groups establish sustainable management and planning processes and effective cooperation. In turn, and complemented by the household level outcomes, this is expected to contribute to the growth of the group's membership and assets and its ability to access external finance. These expected impacts are reflected by a previous study in Nepal, that found providing extension support to producer groups led to significant impacts on the growth and income of the groups and significant growth in human, social and financial capital of its members (Bista, 2018). The study also validated the greater inclusion of women in the groups that is expected from the project. These outcomes are expected to contribute to the sustainability of the household level impacts, through their improved management, and an increasing capacity to support their members' livelihood activities in various ways.

With higher productivity and more benefits from market participation, ultimate impacts on PA members are expected in the form of higher incomes, savings and reduced poverty. Savings are also expected to be improved through the project's support to women's financial inclusion. Higher productivity, incomes and savings are then expected to improve food security and nutrition. More robust production practices, and risk-sharing through collective action, are also expected to increase livelihood resilience (Heijman et al., 2019).

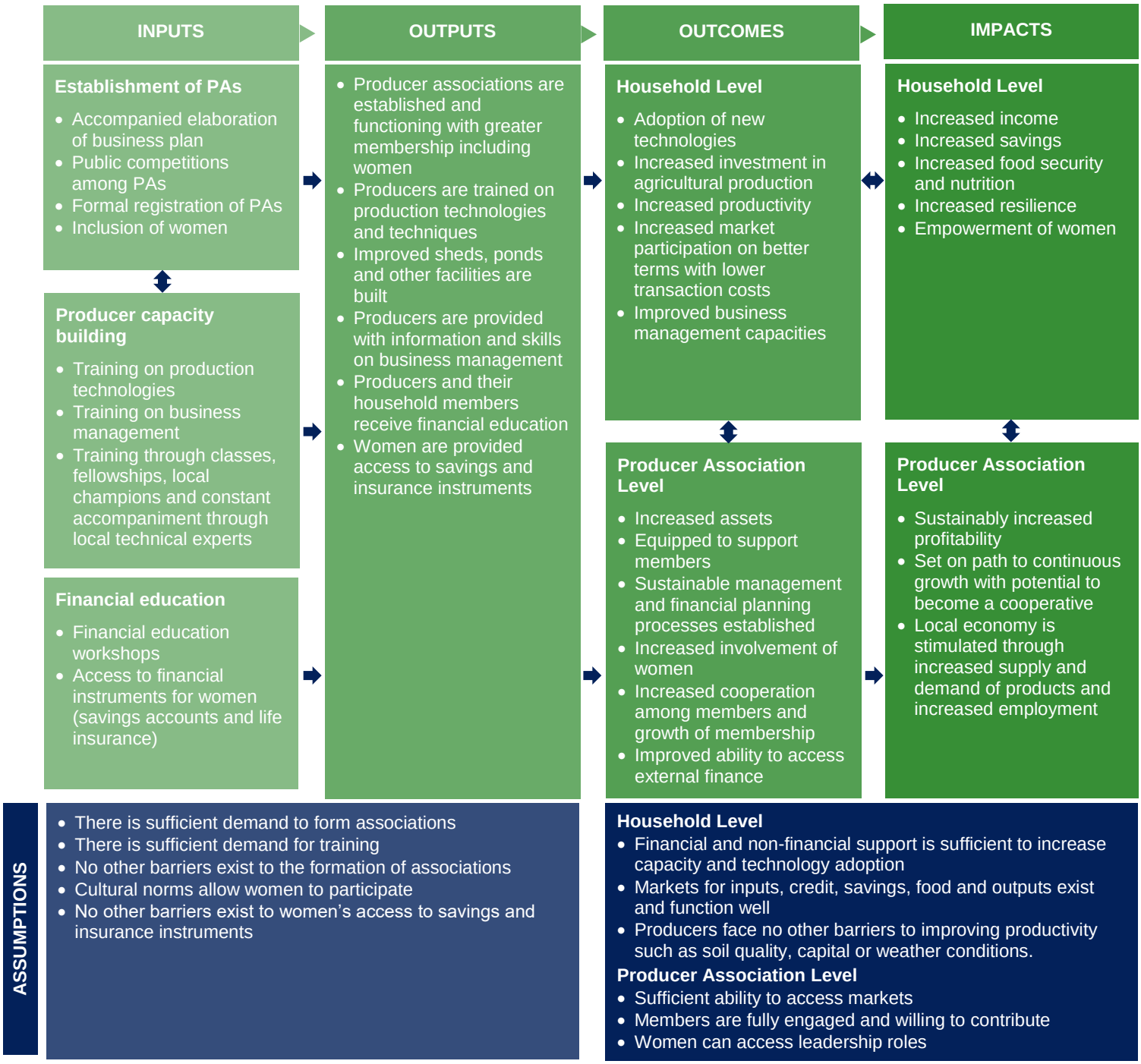
Improved financial inclusion and PA involvement is also expected to impact women's empowerment by enhancing their autonomy, bargaining power and voice. Supporting women's financial inclusion has been found to have a powerful effect on empowerment indicators—demonstrated by projects in East Africa and India (Hendriks, 2019). The positive effects of group membership on women's empowerment has also been confirmed by projects that encouraged women's involvement in producer groups in Ethiopia (Oxfam, 2012) and irrigators' associations in the Philippines (Arslan et al., 2018).

This set of impacts are expected to reinforce each other, and are also expected to feedback to the outcome level by further fuelling investment, productivity and market participation. They should also be mutually complementary with the expected PA level impacts helping to sustainably increase the PA's profitability and growth. If the PAs continue to grow, it is also expected that they could convert to a cooperative and operate on a larger scale, potentially reaching a scale where they can stimulate positive effects on the wider economy.

Achieving these outcomes and impacts also comes with underlying assumptions. Technology adoption and increased productivity is reliant on the project's financial and non-financial support being appropriate, and on appropriate technologies being available. These outcomes are also reliant on well-functioning markets for inputs, credit and outputs. The suitability of the support, and the importance of markets, is highlighted by the study of the grant project in Mexico mentioned above, which found that the grants provided to PAs were sometimes too small for their intended purpose, and that producers were also hindered by insufficient input access (Cord and Wodon, 2001). Improved productivity is also reliant on conducive environmental factors, and improved food security and nutrition also requires well-functioning markets for food. For the PA level outcomes, there must be avenues available for market entry for these groups, and there must be a lack of barriers for women to access leadership roles. The success of the PAs also strongly depends on members' active participation and financial contributions.

Non-participants in the project area are expected to benefit mainly through the transfer of knowledge as beneficiaries apply and share the skills they have acquired. One example provided by the project team was of a PA member who received veterinary training for guinea-pigs and is now being called by other producers to teach them these skills and to deliver veterinary services to them. Past rural development projects have shown that, where the appropriate channels and networks exist, such knowledge transfer mechanisms can have powerful effects, as confirmed by studies of a technology adoption project in the Dominican Republic (Aramburu et al., 2019) and a Farmer Field Schools in Tanzania (Garbero and Chichaibelu, 2018). In addition to knowledge transfer, non-beneficiaries may be inspired to form their own PAs and pursue similar activities by seeing the PAs at work or by observing the public reviewing of their business plans. Although not included in the ToC, which focuses on direct impacts, capturing these indirect spillover effects is a key focus of this impact assessment.

Figure 1: PSSA Theory of Change

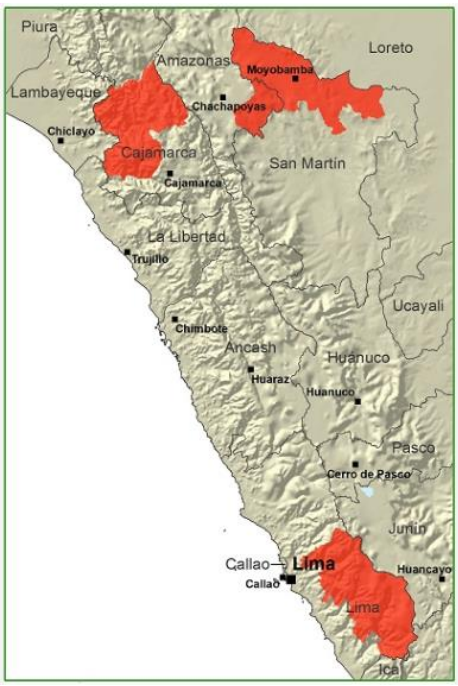


Project coverage and targeting

PSSA was implemented by the government agency AGRORURAL in 85 districts across four departments: Cajamarca, Lima, Amazonas, and San Martín (see Figure 2). Its target population comprised 55,000 rural poor families living in high altitude areas (more than 1,000m above sea level.). The areas were required to meet the following criteria: purely or predominantly rural as defined by the National Statistics Institute; have an extreme poverty rate of at least 10% (at national poverty line); and have not received recent development support from projects by IFAD, the World Bank or other similar agencies.

At project completion, the PSSA had implemented 1,525 initiatives out of which 1,166 were PDNs and 359 PGTs, benefiting 36,053 households in total (PSSA 2019).

Figure 2: Map of project coverage



Research questions

Informed by the PSSA's ToC, this impact assessment adresses six main research questions. Whilst specific to the project, these questions also assess PSSA's contribution to IFAD's overarching strategic goal of reducing poverty and food insecurity; it's guiding strategic objectives of enhanced productive capacity, market participation and climate resilience; and it's cross-cutting themes of gender and nutrition—as outlined in IFAD's 2016-2025 Stategic Framework (IFAD, 2016). The research questions are as follows:

1. Did the project have the intended direct impacts on household income, food security, resilience and women's empowerment? Through which pathways were these achieved?
2. Did the project have the intended spillover effects on households in project districts? Through which pathways were these achieved?
3. How have the PA's progressed since their formation? Are they able to access markets for outputs and finance?
4. To what extent are women involved in the PAs? Did women's contribution to income improve?
5. What are the implications of these findings for similar demand-driven rural development projects implemented in the future?

Table 1 below shows the linkages between the above research questions and IFAD's SOs, overarching goal and cross-cutting themes.

Table 1: Matrix of research questions and IFAD's goal, strategic objectives (SOs) and cross-cutting topics

Question	Goal	SO1	SO2	SO3	Cross-cutting
	Economic Mobility	Productive Capacities	Market Access	Resilience	Gender, youth, nutrition, climate
Did the project have the intended impacts on beneficiary households in terms of increased income, food security, resilience and women's empowerment?	X	X	X	X	X
Did the project have spillover effects on households in project districts?	X	X	X	X	X
How have the PAs progressed since their formation?		X	X		X
Are the PAs able to access markets for outputs and finance?			X	X	X
To what extent are women involved in the PAs? Did their contribution to income improve?					X

Impact assessment design: Data and methodology

Sample design

Household, community and PA level data were collected for this impact assessment between August and November 2019. The household and community questionnaires covered treatment and control groups and a spillover group of indirect beneficiaries.

For the household questionnaire, sample size calculations and discussions with project staff determined that covering 1,000 households per group (treatment, spillover and control) would provide sufficient power to accurately detect impacts.[1] The sample was stratified by the northern and southern project areas due to their fundamentally different agro-ecological conditions and infrastructure. The sample was distributed between the two regions according to the proportion of number of beneficiaries in each area as indicated by project monitoring and evaluation data: 86 per cent of the sample was allocated to the northern area and 14 per cent to the south.[2]

The sample was designed to support a robust causal analysis to quantify the project's impacts. The key to accurately estimating the impact of a development intervention is to compare a group of

[1] See Arslan and Egger (2019) for further details of the sample size calculations that were conducted to ensure sufficient statistical power for impact assessment.

[2] The proportions refer to the sample of PAs after having restricted the PAs to those with at least 10 members and that are located in communities without beneficiaries of the other PSSA project component.

beneficiaries (the treatment group) to a set of non-beneficiaries (the control group), who represent how beneficiaries would have fared in the absence of the project. In this case there are two treatment groups consisting of the direct and spillover beneficiaries of the project. Thus, the samples for the household and community questionnaires were designed to identify representative treatment and spillover communities and households, along with control communities and households that could be compared with both groups. Comparability in this sense refers to the similarity of the three groups at the time of PSSA's initial implementation, allowing us to separate the project's effects from changes that would have occurred anyway if the project never existed.

Based on the project's non-random implementation, the sample frame must ensure that common characteristics among treated and control groups are accounted for. This is usually done by using the same targeting criteria project used to identify beneficiaries. The project was implemented by first selecting eligible communities, and then advertising the project in the communities, whereby producers were required to organise themselves to participate. It is not possible to recreate this selection in control communities, therefore the sample design focused on identifying non-project communities that had a high chance of containing producers who would have engaged with the project if they were given the chance. This was done using project monitoring data combined with the 2012 CENAGRO census, a nationally representative dataset of agricultural producers in Peru from the year the project was implemented.

Using these data, two rounds of Propensity Score Matching (PSM) were used to produce the final set of sample communities. Propensity Scores are essentially used to identify units that are similar based on multiple characteristics. In this case we first wanted to identify similar treatment and control districts, and then communities, based on characteristics linked to the project's targeting criteria and characteristics that may have influenced the main impact indicators (such as productivity or income), thus increasing the probability of sampling households that would allow us to calculate unbiased impact estimates.

Using PSM, each unit is assigned a Propensity Score that represents the probability that the unit is in the treatment group conditional on relevant characteristics. This is done by running a logit or probit model where the dependent variable is the unit's treatment status, and the independent variables are the relevant matching characteristics mentioned above, with the predicted values of the dependent variable used as the Propensity Scores (Caliendo and Kopeinig, 2008). Treatment and control units are then paired based on the proximity of their scores, and units without a match are excluded. This is a common approach to sample design, which has been widely used in a number of past impact assessments of development interventions (Arslan et al., 2018; Garbero et al., 2018; Paolantonio et al. 2018).

The first step of sample design included the identification of suitable treatment and control districts. This was done using the baseline study commissioned by the PMU, which had identified a set of control districts for the PSSA that met the project eligibility criteria using PSM based on various relevant observable characteristics. The eligibility criteria at district level are that they are located within the four *departamentos* of the project area: Amazonas, Cajamarca, Lima, San Martín or in neighbouring *departamentos*: Huancavelica, Junín, Lambayeque. Further, they must be at an altitude of at least 1,000 meters, mostly rural and have an extreme poverty rate (based on the national poverty line) of more than 10 per cent of the population. The set of districts that meet these criteria were reduced using PSM, where Propensity Scores were estimated based on poverty rate, share of small farmers among agricultural producers, share of cultivated land owned by producers, altitude, location, and rural population share. This led to a set of 85 treatment and 56 control districts in the baseline study.

In the second step, the number of districts were further reduced using the CENAGRO data to identify districts with enough households that produce one of the top five products of PDNs in the PSSA monitoring data. These are guinea pigs, pigs, coffee, fruits and large animals (mostly cows) representing 68 per cent of all PAs in the project at the time of sample design. Districts in which more than 60% of producers own more than the median amount of one of these products are kept in the sample This left a final set of 45 treatment and 23 control districts from which to select the treatment, spillover and control communities.

Within the 45 selected treatment districts, all treated communities were eligible for the sample as long as there were at least ten beneficiaries (PA members) residing in the community according to the project's monitoring data.[3] All of the communities without a PA in the treatment districts were eligible for inclusion in the spillover group, while all communities within the control districts were eligible for the control group. A second round of PSM using the CENAGRO data was then used to identify the final set of sample communities, which was conducted separately for the northern and southern regions. First treatment and control communities were matched, and communities without a match were dropped, then the selected treated communities were matched with potential spillover communities to identify spillover communities with a match. In both cases the Propensity Scores for each community were estimated based on data from 2012 on the number of producers in the community, the demographics, education and facilities of households in the community, and the types of external support it had received.[4]

The number of communities that were deemed comparable through this process exceeded the total sample size needed, therefore random selection followed by validation by project staff were used to identify the final set of 100 communities per group (treatment, spillover, and control). The remaining communities in the long list were used as potential replacements during field work should any problems arise with the selected communities.

[3] Where PAs were registered in more than one community, the community with the highest proportion of the members was considered as the treated community.

[4] The specific variables used for the matching were: Number of producers, total land, average dependency ratio and household size, female household head (%), have improved toilet (%), have improved kitchen (%), adults with secondary education (%), owned land (% of all land), irrigation coverage (% of all land), have cement irrigation, beneficiaries of social projects (%), beneficiaries of extension services (%), members of a producer group or cooperative (%), loan applicants in past year (%), involved in off-farm activities (%),

From the selected communities, households were randomly sampled for the household questionnaire. In treated communities, the monitoring data provided the full list of beneficiaries from which households were randomly selected, with no more than five households sampled from a single PA. In both the spillover and control groups, households were first listed during an initial visit, and then randomly selected for the interviews. In a small number of cases, the selected communities were not accessible, either because of the terrain, or in one case because entry was refused by a local leader. Also in some communities the desired number of households could not be obtained, meaning that additional communities had to be added. Some difficulties in locating PA members during field work were addressed by the data collection firm to maintain the total sample size to the extent possible, and the final number of treatment households is slightly lower (by 18 households) than planned. Data from an additional 103 households were collected from the control and spillover communities to buffer against potential data issues during analysis. The distribution of communities is mapped in Figure 3 and the intended and actual number of communities and households for each department are presented in Table 1. The actual values are in parenthesis in cases they differed from the intended numbers.

Figure 3: Map of sampled communities

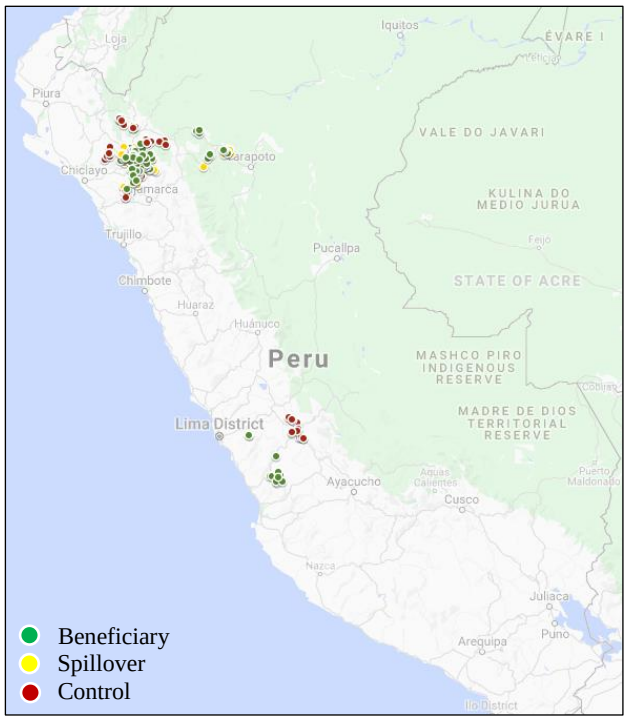


Table 1: Sample distribution across departments

	Treatment		Spillover		Control	
Department	Nr. communities	Nr. households	Nr. communities	Nr. households	Nr. communities	Nr. households
North						
Amazonas	1 (2)	10 (12)	1 (2)	10 (18)	16 (18)	240 (275)
Cajamarca	77 (76)	780 (761)	79 (81)	790 (826)	46 (47)	460 (472)
San Martin	7	60 (59)	7	70	0	0
Lambayeque	0	0	0	0	10	150
North total	***78 (85)***	***850 (832)***	***87 (90)***	***870 (914)***	***72 (75)***	***850 (897)***
South						
Junín	0	0	0	0	15	150
Lima	12	150	13 (16)	130 (160)	0	0
South total	***12***	***150***	***13 (16)***	***130 (160)***	***15***	***150***
Total (all)	**97**	**1,000 (982)**	**100 (106)**	**1,000 (1,074)**	**87 (90)**	**1,000 (1,047)**

Questionnaires and impact indicators

All three of the questionnaires captured data that refer to the 12 month period between August 2018 - July 2019, which covers two agricultural seasons (the main season and a small season utilized only by some households) in the country. The main impact analysis is based on the data from the household questionnaire, while data from the community questionnaire is used for context and to identify factors that may have influenced impacts. As there is no control group for the PA questionnaire by design (PAs were formed and supported in treated communities only), the data from the PA surveys are used for a descriptive analysis only. This analysis provides an overall understanding of the PA's formed through PSSA by project completion, and helps us identify possible linkages with the household level outcomes and impacts.

The impact indicators are drawn from the project's ToC (see Figure 1), and cover the expected outcomes and impacts of the project. These indicators are constructed from the household data, and in all cases represent annual values per household. In terms of outcomes at the household level, we use sets of indicators related to agricultural productivity, and the production of livestock, fish and bees, as farming and livestock rearing are the two main activities of the producers and the PAs. We also assess a set of outcome indicators relating to market participation for these two activities. In terms of impact indicators, we assess sets of indicators relating to income, resilience, food security and nutrition, and women's empowerment. The specific indicators, and details of how they are constructed, are outlined in Table 2. Each indicator is also mapped to IFAD's SOs, overarching goal and relevant cross-cutting themes (i.e. SO1, SO2, SO3, OG and CTs). Note that the impact indicators directly correspond to these categories, while outcome indicators represent channels through which impact is achieved.

Table 2: Description of outcome and impact indicators

Indicator	Description	Impact area
Livestock production (including fish and bees, households who did not own livestock at baseline not included) – SO1		
Value of production	Cash income from selling live or slaughtered livestock, livestock products, fresh fish and fish products, and bee products, plus the value of livestock slaughtered for home consumption, and livestock, fish and bee products consumed at home, valued using the median price for the sample for each species and crop when sold (Carletto et al., 2007).	Effectiveness/efficiency of livestock practices
Land dedicated to grazing	Hectares of land dedicated solely to livestock grazing.	Investment in production
Livestock ownership	Index of livestock owned calculated based on Tropical Livestock Units (Jahnke, 1982)	Livelihood practices; Physical capital.
Expenditure on inputs	Cash expenditure on purchased livestock, and labour, machinery, vaccinations, feed, shelter.	Investment in production
Output per dollar of input	Value of production divided by expenditure on inputs.	Efficiency of livestock practices
Crop Production (households who did not cultivate any land with crops during the study period not included) – SO1		
Value of harvest per ha.	Income from crop sales plus the value of non-sale uses (including home consumption), valued using the median price for the sample for each crop when sold (Carletto et al., 2007).	Effectiveness/efficiency of farming practices
Land cultivated with crops	Sum of land cultivated with annual crops in both seasons and land under trees and perennials.	Investment in agricultural production
Crop diversity	Crop Diversity Index, calculated based on a Herfindahl-Hirschman Index calculation (Hirschman, 1964).	Livelihood practices
Expenditure on inputs per ha.	Cash expenditure on labour, seeds, fertiliser, pesticide, insecticide and transport costs to purchase inputs.	Investment in production
Output per dollar of input	Value of production divided by expenditure on inputs.	Efficiency of farming practices
Livestock and crop market participation – SO2		
Proportion of farm production that was sold	Percent of the value of livestock/crop production that was sold, rather than consumed at home or other for uses.	Market orientation of production.
Sales made at a market	For those who sold any of their produce, did they sell at a local or district market or somewhere other than the farm gate or roadside? (Yes/No indicator)	Sales practices
Sold to trader or business	For those who sold any of their produce, did they sell at to a local trader or business, or to anyone other than individuals? (Yes/No indicator)	Sales practices

Table 2 (continued): Description of outcome and impact indicators

Indicator	Description	Impact area
Income and livelihood resilience (full sample) –OG and SO3		
Total income	Value of livestock and crop production, plus cash income from waged labour, household enterprises, and other sources	Income
Cash income	Cash income from livestock and crop sales, plus cash income from waged labour, household enterprises, and other sources.	Income; Financial capital
Livelihood diversity	Livelihood Diversity Index, calculated based on a Herfindahl-Hirschman Index calculation (Hirschman, 1964).	Livelihood composition; Resilience
In waged employment	At least one household member is in waged employment (Yes/No indicator)	Livelihood composition
Daily wage from employment	Average daily wage from all jobs held by household members	Income; Livelihood composition
Asset ownership	Index of assets, separated by durable and productive items, calculated using Principal Component Analysis (see Filmer and Pritchett, 2001)	Resilience; Physical capital
Shock recovery	For those who experienced a climatic or non-climatic shock, self-reported extent that they were able to recover their livelihoods. The scale is as follows: 1= Did not recover; 2 = Recovered somewhat, but worse; 3 = Recovered to the same level; 4 = Recovered and better off.	Resilience
Food security and nutrition - CT		
Food security	Food Insecurity Experience Scale (0-8 scale): Composite indicator of eight questions regarding food insecurity, also adopted by SDGs (2.1.2) (Ballard et al., 2013).	Food security
Dietary diversity	Household Dietary Diversity Score (0-16 scale): Based on the consumption of 16 food groups in the past week (FAO, 2010).	Nutrition
Women's empowerment - CT		
Gender differentiated values of crop, livestock and total income, and livestock ownership	Calculated using the indicators above by separating the values according to who owned the assets that generated income, or controlled the income sources: female only, male only and joint	Women's control/ ownership of income/assets
Involved in livelihood decisions	Women involved either solely or jointly in household decision-making about at least one of the following areas: farm production; use of income from farming, wage labour, household enterprise (Yes/No indicator).	Women's position in the household
Member of a local group	Number of groups (such as PAs, savings groups, women's groups, etc.) of which at least one female household member is a member.	Women's position in the community; Social capital

In waged employment	A female household member is either a manager of a household enterprise or is in waged employment (Yes/No indicator)	Women’s economic empowerment/autonomy
Life insurance coverage	At least one female household member has life insurance coverage (Yes/No indicator)	Women’s financial inclusion

Impact estimation methodology

We estimate the impact of PSSA attributable to project interventions by using non-experimental econometric analysis methods. As is best practice, we employ two model specifications in order to test whether results are robust across estimation methods. We analyse impacts in two categories: project's direct impacts by comparing households in treatment and control communities, and the spillover/indirect impacts by comparing households in spillover and control communities. All of the steps of the methodology explained in this section are conducted separately for the two impact categories.

The first step is to remove households from the analysis that have potentially incorrect or highly outlying data. We removed 111 households because they had outlying data for income, land size, crop yields or livestock ownership or production —35 from the treatment, 25 from the spillover, and 51 from the control groups. As is best practice, the sample is then trimmed based on the common support (see Heckman et al. 1998). This involves assigning Propensity Scores to each household, in the same way as in the sample design explained above, and removing treatment or spillover households with a Propensity Score above the highest score from the control group, and removing control households with a score below the lowest score from the treatment or spillover group. We estimate the Propensity Scores using matching variables that represent household demographics, education and assets, land access and exposure to climatic shocks.[5]

To know the actual impact of a project on a given impact indicator, one would need to know the exact value of the indicator at the same point in time had the project never existed, i.e. counterfactual. This value could then be subtracted from the actual values for all beneficiaries to give the average treatment effect. As this is impossible, non-experimental impact estimation models estimate this hypothetical counterfactual value based on values from the control group. Ensuring that treatment and control units are well-matched according to characteristics linked to project selection (or self-selection in this case) and characteristics likely to have influenced the impact indicator of interest since the project was implemented is the critical component of this method (Austin and Stuart, 2015).

We estimate PSSA's impact using an Inverse Probability Weighted Regression Adjustment (IPWRA) model, and a Nearest Neighbour (NN) model. These two models were chosen from a number of models that were tested as they prove the most effective in ensuring the treatment and control groups are well-balanced based on relevant characteristics. They also minimise the need to drop households from the analysis because they do not have a match.

The IPWRA approach uses weighting to estimate the with- and without-project values. Based on the method outlined by Wooldridge (2010) and Austin and Stuart (2015), these values are predicted using a regression model that is weighted based on relevant characteristics. In this case, treatment households are all assigned a weight of one, while control households are assigned a weight based on their likelihood of being in the control group. This is calculated in a similar way as the Propensity Scores outline above, except that we are now estimating the probability of being in the control rather than the treatment group. Control households are then weighted by the inverse of this score, meaning that households that are more similar to a treatment household (rather than a control household) are assigned a greater weight. Equation 1 shows how the weights are calculated:

[5] The propensity scores were calculated according to the following variables: Number of adult males and females, dependency ratio, education of household head, average education of household members, number of household members with a disability, gender of household head, pre-project asset ownership (household, productive and livestock assets), hectares of land owned with a title, and the number of weather shocks experienced since 2015.

$$IPW_{ATET} = \mathrm{T} + \frac{P(1-\mathrm{T})}{1-P} \quad (1)$$

where T = the treatment status (1 = treatment or spillover, 0 = control), and P = the probability of receiving the treatment they received given the set of weighting variables.

A weighted regression model is then used to estimate the predicted value of the impact indicator for the treatment (spillover) or control group. The regression model is specified as follows:

$$Y_i = \beta_0 + \beta_1 T_i + \Sigma - X_{ij}\beta_{2j} + e_i \quad (2)$$

Where Y is the outcome for household *i* for the impact indicator, T_i is the treatment status for household *i*, X_{ij} represents an *I* x *J* matrix of control variables used in the model, β_1 is the coefficient of the treatment indicator and β_{2j} is a vector of coefficients to be estimated for each of the control variables, β_o is the constant, and e_i is the error term (see Cameron & Miller, 2015). The control variables are factors that are expected to have influenced the outcome variable, while not having been affected by the project.[6]

The impact (in this case termed as the Average Treatment Effect on the Treated, ATET) is then calculated based on the difference between the predicted value for the treatment (spillover) and control group, as follows:

$$ATET = \hat{Y}_1 - \hat{Y}_o \quad (3)$$

Where $\hat{Y}_1$ is the average expected outcome for the treatment (spillover) households, and $\hat{Y}_o$ is the average expected outcome for control households obtained from Equation 2.

The NN model is a non-parametric, Mahalanobis distance-based radius matching model. The Mahalanobis distance is a matrix-based method of determining the distance between two units based on multiple data points (Hill and Lewicki, 2006). In this case we use this measure to find treatment and control households with the smallest distance according to the relevant matching characteristics, and we match treatment households with all control households within a specified radius. The average difference in the impact indicator for each matched pair provides the Average Treatment Effect (ATE) of the project on that indicator (Abadie et al., 2004). Formally, the ATE from this model for a given impact indicator is calculated as follows:

$$ATE = E(Y_{1i} - Y_{0i}) \quad (4)$$

Where Y_{1i} represents the outcome for treatment household *i*, and Y_{0i} represents the outcome for control household *i*, and the *E* is the expectation operator.

The success of the models in ensuring that the groups are well-balanced is assessed based on the Standardised Mean Differences (SMD) between the matching variables. For the comparison between the treatment and control groups, the average magnitude of the SMD between the two groups across the variables was reduced from 0.06 to 0.01 by the IPWRA model, and to 0.02 by the NN model. For the comparison between the spillover and control groups, the average magnitude was reduced from 0.08 to 0.01 by the IPWRA model, and to 0.04 by the NN model (see Appendix I for the change in the SMD for each matching variable). The threshold SMD for a balanced sample is subject to debate in the literature, but an average SMD of below 0.1 is widely used (Austin, 2009). Our analysis confirms that bias between the comparison groups is reduced to a negligible level by the two

[6] The model was estimated using heteroskedasticity-robust standard errors. Control variables for each impact indicator were selected from the following list: number of adults; dependency ratio; education of household head; average education level in the household; baseline index values of tropical livestock units, productive assets, other household assets and household dwelling characteristics; land area owned with a title; number of exogenous shocks household was exposed to and altitude.

analytical models. As the IPWRA model performs slightly better, this is used as the primary model, and the NN model is used to test for the robustness of the results across models.

Profile of the project area and sample

The purpose of this section is to provide an overview of the project context to support the interpretation of the results. We first discuss descriptive statistics of the sample communities from the community questionnaire, and then statistics of the sample households from the household questionnaire.

Selected characteristics of sample communities

PSSA focused on the "Sierra" highland and "Selva Alta" rainforest regions of Peru, both of which mainly contain small and relatively dispersed community clusters. Within these regions, the project targeted communities with high poverty rates that had not received extensive support from other organisations. This selection criteria is reflected in the data from the community questionnaire, as indicated by key characteristics presented in Table 3 for the three comparison groups.

The average population in the three comparison groups is less than 500 households, although the average for the treatment communities is slightly larger than the others. Market access is poor across the communities, with less than six per cent in any of the groups having a market for trading within their community, a figure that falls to just under two per cent for spillover communities. The majority of treatment and spillover communities have a market within the same district (57 per cent and 64 per cent respectively), but only 40 per cent of control communities do, with 54 per cent reporting that their closest market is located in another district.

In terms of accessibility to other services, the majority of communities reported that they have a primary school that is accessible without a car or bus. To a slightly lesser extent, secondary schools and hospitals are also often accessible. However, across the groups, only around 20 per cent have the same access to a bank or a veterinary, and only around five per cent a post office.

A number of significant challenges were reported in community surveys. Across the groups, access to water for production is the most common challenge, followed by crop pests and diseases and unreliable or extreme weather. Despite the lack of local markets, under ten per cent of the communities in any group reported access to markets for trading or access to inputs to be a main challenge. This may be because road infrastructure is relatively good, with a low proportion of communities in any group reporting road quality to be a challenge.

Challenges related to extreme weather are also reflected in the data on shocks they have recently faced. Across the groups, between 70-84 per cent of communities reported experiencing an extreme weather shock (such as a drought, flood or storm) since 2015. Outbreaks of crop and livestock disease and price spikes were also commonplace everywhere, but with highest incidence in treatment communities.

Table 3: Characteristics of sample communities by treatment group

	Treatment	Control	Spillover
Average population	464.92	319.78	304.48
Closest market (%):			
- Within community	4.04	5.56	1.89
- Outside community (same district)	56.57	40.00	64.15
- Outside community (other district)	39.39	54.44	33.96
Nr. users of closest market in a normal week (%):			
- Less than 50	23.23	30.00	36.79
- 50-100	32.32	35.56	28.30
- 100-500	22.22	14.44	15.09
- Over 500	22.22	20.00	19.81
Services accessible without car/bus (%):			
- Primary school	97.98	96.67	93.40
- Secondary school	78.79	82.22	75.47
- Hospital	82.82	78.89	80.19
- Bank	19.19	20.00	17.92
- Police station	38.38	44.44	28.30
- Post office	5.05	4.44	6.60
- Veterinary	27.27	18.89	21.70
Main livelihood challenge (%):			
- Water access	38.38	32.22	39.62
- Pests and diseases	13.13	17.78	19.81
- Weather	18.18	21.11	5.66
- Access to output markets	5.05	8.89	3.77
- Access to inputs	5.05	3.33	7.54
- Road quality	3.03	4.44	5.66
Shocks experienced since 2015 (%):			
- Extreme weather	83.83	70.00	82.08
- Crop disease	64.65	51.11	60.38
- Livestock disease	38.38	31.11	37.74
- Price spikes	41.41	21.11	33.02

Note: Sample sizes unless specified in parenthesis: Treatment = 99; Control = 90; Spillover = 106

Selected characteristics of sample households

Table 4 presents descriptive statistics from the final household dataset for the three comparison groups after removing outliers and matching to ensure a reliable counterfactual, as described above.

Details of the household members suggests the three groups are relatively similar. The average number of household members and the dependency ratio are both similar, although there is a slightly lower proportion of female headed households in the treatment group (12 per cent) compared to the control (16 per cent) and spillover groups (14 per cent). The percentage of households that have a disabled member, which is defined as having difficulty walking, seeing, hearing, speaking, memory or concentration, or washing and dressing (WG 2018), is slightly smaller in the treatment group.[7] The average education of household heads is slightly lower for the spillover group, averaging six

[7] The questions were adopted from the Washington Group on Disability Statistics, see: http://www.washingtongroup-disability.com/washington-group-question-sets/short-set-of-disability-questions/

years compared to seven years for the treatment and control groups. School enrolment rates are reasonably high across the sample, all around 88 per cent.

Table 4: Characteristics of sample households by treatment group

	Treatment	Control	Spillover
Household composition and education			
Household size	3.50	3.61	3.61
Dependency ratio (%)	33.91	38.12	39.03
Female household head (%)	11.98	15.51	14.10
Household member with a disability (%)	11.77	13.60	13.31
Education of household head (years)	7.31	7.08	6.09
School enrolment rate (% of school-age household members)	86.85 (542)	88.92 (551)	87.96 (577)
Livelihood details			
Total income per capita ($)	1,366	1,120	1,036
Cash income per capita ($)	1,016	847	769
Income diversity (HHI score)	0.55	0.62	0.58
Asset ownership: - Household durables (index score) - Productive (index score) - Livestock (TLU) - Land (ha.)	 1.39 1.61 2.39 1.57	 1.20 1.51 2.36 1.78	 1.11 1.42 1.95 1.53
Value of crop harvest ($)	1,007 (758)	1,391 (763)	1,004 (821)
Value of livestock production ($)	1,817 (876)	1,237 (932)	1,175 (952)
Member of an agricultural collective (%)	100.00	4.03	5.03
Food consumption and women's empowerment			
Food insecurity (0-8 score)	1.98	2.13	2.29
Dietary diversity (0-16 score)	10.87	10.41	10.44
Female member is (%): - Involved in household livelihood decision making - In waged employment	 95.18 (872) 20.07 (872)	 94.74 (932) 15.77 (932)	 95.95 (962) 18.63 (962)

Note: Numbers in parentheses refer to sample sizes for the variable in question. For all other variables sample sizes are: Treatment = 943; Control = 993; Spillover = 1,014

Regarding livelihoods, the wealthiest households in terms of both total income and cash income are in the treatment group. Annual cash income per capita averages $1,016 for the treatment group compared to $847 for the control and $769 for the spillover group. Treatment households also have slightly less diverse livelihoods, although all groups average a diversity score of around 0.6.

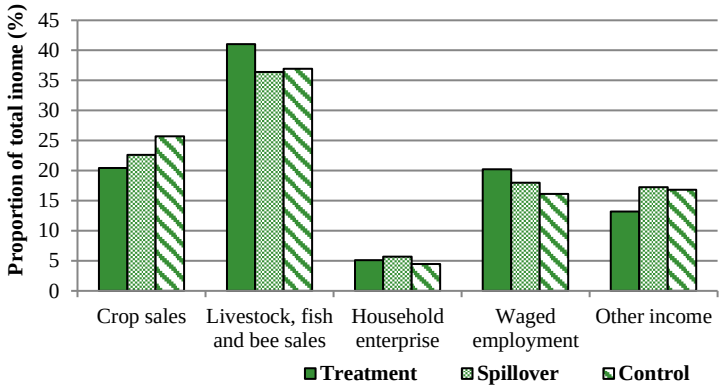
Women's empowerment, in terms of involvement in household decision making is very high across the sample. This characteristic of the project areas was prominent during expert consultations with the PMU, which suggests that it is unlikely that the IA would show impacts on this indicator given the high starting values. Women's economic participation, however, seems to be still constrained given that only around 10 per cent of households in any group has a female member in wage employment.

In order to understand the livelihood compositions of sample households better, figures 1a and 1b show the proportion of the sample participating in and the average income shares coming from different activities, respectively. In terms of participation, livestock production is the most common activity including more than 80 per cent of households in all groups, followed by selling crops. Just over half of the sample obtain income from other sources such as remittances, renting-out property or government transfers, just under half are involved in waged labour, and just over 10 per cent are involved in household enterprises (which mainly involved agro-processing or running a shop).

In terms of the proportion of cash income from these activities, although the relative patterns are broadly proportional to participation shares, figure 1b provides interesting highlights. Overall, although the majority of households are involved in crop sales, this source contributes only one fourth of household income on average, while livestock and livestock products (including fish and bees) contribute 35 to 40 per cent of income on average. The figure also shows some differences across the comparison groups. For instance, the treatment group has the largest proportion of households participating in crop sales, but the average income share from crop sales is the smallest for this group. Similarly, the control group has a slightly lower proportion of households involved in crop sales, but the source provides the highest proportion of income of the three groups. For livestock, fish and beekeeping, a similar proportion of household are involved across the three groups, but this source contributes a much larger proportion of total income for treatment households compared to the other two groups.

Graph 1a: Participation in livelihood activities

Graph 1b: Proportion of income from livelihood activities



Note: Note that each household can have multiple livelihood sources, therefore the sum of shares in panel a exceed 100%.

Results

The Status of Producer Associations

This section provides a descriptive assessment of the status of the PAs that were interviewed in all treatment communities of the sampling frame. We present the results for the overall sample as well as separated by location (given the differences between the northern and southern project interventions areas.

i. Support received

Table 5 presents details of the PSSA support received by PAs in the sample. The average grant size received by the PAs was around $8,200, with little regional variation, and members contributed an average of $287 each to the cost of the business plans. Based on the data in Table 4, this equates to around one fifth of average beneficiary household's annual income. Note that members could also contribute in kind (labour), the value of which is not included in this total. PAs submitted 1.9 applications on average before their PDNs were granted project support, which underlines the importance of the technical support provided by the project to develop and improve business plans.

In terms of how the grants were used, the most common use was related to the purchase or improvement of equipment or infrastructure, including the purchase of new property, and the hiring of services. Using the grants for new equipment has positive implications for the expected impacts of the project on technology adoption, while hiring of services has the potential to create spillover effects and stimulate the local economy. Less common, was the purchase of agricultural and other inputs, which were around 3 percent in the north and 10 per cent in the south; as well as the recruitment and training of new members (4-5 per cent in both regions).

Table 5: Details of PSSA support to PAs in sampled treated communities

	All	North	South
Grant size ($)	8,227	8,213	8,293
Member contribution for business plan ($)	287	297	239
Nr applications before approval	1.90	1.95	1.68
Grant uses (%):			
- Hiring of services	49.36	50.00	46.43
- New Equipment	42.31	40.63	50.00
- Improvement/expansion of property or infrastructure	48.72	52.34	32.14
- New property	33.97	33.59	35.71
- Equipment improvements	10.90	13.28	0.00
- Agricultural inputs	4.49	3.13	10.71
- Other inputs and inventory items	5.13	3.91	10.71
- Recruiting/training new members	5.13	5.47	3.57

Note: Sample sizes: All = 156; North = 128; South = 28

ii. Membership and leadership

Table 6 presents details of the PA's membership and leadership. The average number of members was higher at the point of formation than at project completion, falling from 19 to 16, a trend that applies to both the north and south regions. The main reasons cited for members leaving were "natural" reasons including relocation, illness or death. Other common reasons included expelled members due to a lack of participation or failure to pay membership fees, and members who choose

to leave because they were unhappy with the financial benefits they received from being part of the PA or because they were not happy with the group's organisation. As mentioned, participation challenges have been a problem for previous projects of this type, but despite the reduction in membership amongst PSSA PAs, an average membership of 16 is within the target range of the project, as the PAs are not intended to be very large at this stage of their development.

Around one third of the PA members are women and around 21 per cent are aged between 15-24. The proportion of female members has decreased slightly in both regions since formation, implying that slightly more women have left the groups than men. At the same time, the share of young members has increased, suggesting that young people may have been attracted to the PAs as the project has progressed.

Regarding leadership, almost every PA in the sample has a democratically elected leader with most groups also reporting that all of their leadership positions (president, vice-president, treasurer, secretary, etc.) are filled in this way. A key assumption of the project's ToC is that the groups were well organised and fair, and this is a positive indication that this assumption has held. In both the north and south, around a quarter of the leadership positions of the PAs are held by women. This is positive given past issues with women's participation in such groups, especially given that they were democratically elected as indicated above. The proportion of female members is higher at around one third in both regions.

Table 6: PA membership and leadership

	All	North	South
Current number of members			
- Total	15.99	16.83	12.18
- Male	10.65 (66.6%)	11.28 (67.0%)	7.82 (64.2%)
- Female	5.34 (33.4%)	5.55 (33.0%)	4.36 (35.8%)
- Aged 15-24	3.42 (21.4%)	3.52 (20.9%)	2.96 (24.3%)
Number and % of members at formation:			
- Total	19.37 (100%)	20.34 (100%)	14.96 (100%)
- Male	12.52 (64.6%)	13.18 (64.8%)	9.53 (63.7%)
- Female	6.85 (35.4%)	7.16 (35.2%)	5.43 (36.3%)
- Aged 15-24	2.71 (14.0%)	2.61 (12.8%)	3.18 (21.3%)
Reasons for leaving PA (%):			
- Natural reasons (relocated, passed away, etc.)	30.77	32.81	21.43
- Expelled due lack of participation	12.18	10.94	17.86
- Unhappy with income from group	8.33	5.47	21.43
- Unhappy with group's organisation	10.26	10.94	7.14
- Expelled as unable to pay membership fee	7.69	7.81	7.14
- Wanted to be involved in other activities	5.77	6.25	3.57
- Changed to new group	3.21	3.91	0.00
Democratically elected leader (%)	94.23	92.97	100.00
Leadership roles held by women (%)	25.16	25.11	25.37

Note: Sample sizes: All = 156; North = 128; South = 28

iii. Activities and assets

Table 7 presents details of the activities and assets of the PAs in our sample. The activities are varied, with the most common involving producing and selling live or slaughtered pigs or guinea pigs. There is considerable regional variation in the activities. In the south, for instance, 39 per cent of the PAs are involved in avocado production, but no northern PAs are involved in this activity. Similarly, no southern PAs are involved in coffee or potato production, but ten and five per cent of northern PAs are involved in producing these crops, respectively. Regarding the large assets owned

by the PAs, these are relatively minor, with only 26 per cent of PAs owning their own headquarters—suggesting most PAs are not at a stage in their development where they begin to accrue large physical capital. The other assets that were the most common were livestock shelters, milling machines and storage sheds, but less than ten per cent of PAs owned any of these assets.

A key aim of the project was to improve the PAs capacities to access further sources of finance to fuel their growth. However, that only three per cent of sampled PAs reported having received a loan since 2015 suggests that they have not reached this point yet. This could be partially linked to the limited accessibility of banks in their communities: only one in 5 communities had access to a bank within walking distance (see Table 3). Lack of demand potentially plays a more important role, as liquidity constraints were not mentioned among the main challenges faced by the PAs.

Table 7: PA activities and assets

	All	North	South
Activities (%)			
- Pigs (live or slaughtered)	17.95	20.31	7.14
- Guinea pigs (live or slaughtered)	17.31	17.19	17.86
- Coffee	8.33	10.16	0.00
- Other (bakery, crafts, etc.)	8.33	10.16	0.00
- Other livestock (live or slaughtered)	7.69	8.59	3.57
- Avocado	7.05	0.00	39.29
- Cattle (live or slaughtered)	6.41	7.03	3.57
- Other fruit crops (fresh or processed)	6.41	4.69	14.28
- Other non-fruit crops (fresh or processed)	5.13	3.12	14.29
- Potatoes	4.49	5.47	0.00
- Cattle products (milk, cheese, manure)	3.85	4.69	0.00
- Fresh fish	1.28	0.78	3.57
- Other livestock (products)	1.28	1.56	0.00
Assets (%)			
- Headquarter	25.64	28.13	14.29
- Livestock shelter	8.97	10.16	3.57
- Milling machine	8.33	9.38	3.57
- Galpon (storage shed)	7.05	7.81	3.57
Received loan since 2015 (%)	3.21	2.34	7.14
Main challenges (%)			
- Finding buyers	39.10	41.41	28.57
- Meeting time requirements of buyers	20.51	22.66	10.71
- Meeting quality requirements of buyers	21.15	25.00	3.57
- Weather	42.31	43.75	35.71
- Attracting new members	21.79	17.97	39.29
- Organising members	23.72	22.66	28.57

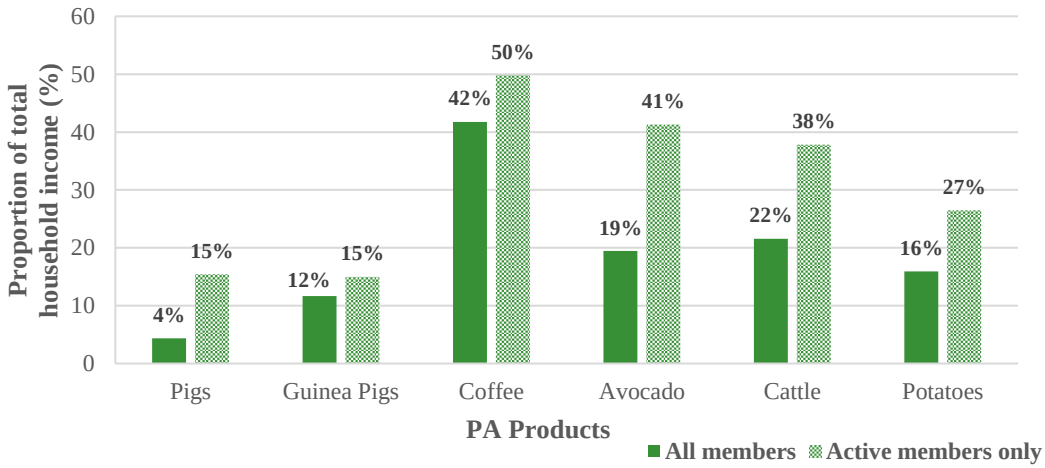
Note: Sample sizes: All = 156; North = 128; South = 28

Weather was the most common challenge in the overall sample, especially in the north, where 44 per cent of PAs mentioned it among their main challenges. Other common challenges included finding buyers and meeting their time and quality requirements, and attracting and organising members. In the north in particular, meeting the time and quality requirements is a particular challenge. Given that most of the grants were used for purchasing equipment, our data suggests that the PA's early focus has been on establishing their basic production practices, and may progress towards addressing the challenges of scale and quality in later stages.

We can gain an understanding of the PAs contributions to income using data from households in the treated communities. Households could generate income from PAs through direct and indirect channels. Directly, they could engage in collective production and marketing of specific products as part of the PAs, and indirectly, they could gain by providing their labour to the group, or by investing money into the group's activities and receiving a share of profits (cash or in kind). Graph 2 below presents the proportion of household income provided directly from some of the most common PA products. In around one third of cases, households registered as PA members did not report producing any of the products of their PA, potentially reflecting the member organisation issues noted in Table 7 above. Although these figures do not consider indirect income from PA activities, this suggests that a lack of direct engagement of all members of the PAs could potentially have curtailed the project's impacts. It also suggests that the financial contribution that was required to join the producer group was not able to incentivise direct engagement in some cases.

The graph separates active members that are involved in producing the PA's product from non-active members that are registered but did not actively produce the PA's product during the 12 months preceding the surveys. It shows that, for active members, direct income through PA activities accounts for a large share of total income for the most common PA products. For active members, who engaged in producing and selling coffee, avocado and cattle, direct income from these products accounts for 50, 41 and 38 per cent of the total income, respectively. Income from pig and guinea pig production provided a slightly lower proportion (around 15 per cent in both cases), suggesting that members of PAs that focus on these products have more diverse livelihoods, or potentially have higher incomes, meaning that although income from the production is high, it accounts for a smaller proportion of the total.

Graph 2: Proportion of total household income from PA activities



Overall household-level impacts

The following two sub-sections present and discuss the estimated impacts that are attributable to PSSA. We present the results from the IPWRA model here and include those from the secondary model to check for robustness in Appendix II. In the majority of cases the results of the two models are qualitatively similar, indicating that the results are generally robust to different specifications. The majority of impacts are estimated in percentages, which are sometimes converted into the equivalent impact in absolute terms to facilitate interpretation. This calculation is made by applying the percentage impact to the average value for the control group, as this would represent the value of the indicator in the absence of the project. All of the impact indicators are annual, aggregated across

the 12 month period covered by the household questionnaires. The average values of all impact indicators for the three comparison groups can be found in Appendix III.

i. Productive capacities (SO1) and market participation (SO2): Livestock and crops

PSSA seemingly had differing impacts on livestock and crop production among PA members. Table 8 presents the estimated impacts of PSSA on livestock production. The value of livestock production, which includes the sale and consumption of livestock and livestock products (including milk, eggs and honey) as well as fish and bee products, increased significantly by 61 per cent compared to the control group, equivalent to an increase of $762 in annual value of production. We estimate a significant increase of 50 per cent in annual input expenditures (equivalent to $468). Graph 3 shows that expenditures for feed are the largest category (42%), followed by services such as veterinary services (32%) and purchasing of livestock (25%). The amount of land dedicated to livestock grazing and the amount of livestock owned have not increased significantly. We find that the value of livestock output produced per dollar of expenditure increased by 14 per cent, which is equivalent to an increase of $0.49 per dollar spent on inputs. These findings combined suggest that the increase in value of production is driven by both higher, and more efficient spending, potentially as a result of lower transaction costs or adoption of better technologies (thanks to the PA's purchasing of improved equipment).

The indicator for land dedicated to grazing in table 8 does not include communal grazing lands. Although the sample was not designed to capture the impacts of the community natural resource management plans, which were another feature of the project (Component II), 33 of the 97 treatment communities included in the sample were located in areas where these plans were implemented. A key feature of these plans was to promote sustainable use of communal lands, including pastures. These plans may have also contributed to the improvements in livestock production and efficiency for treated households.

Regarding spillover effects, the value of livestock production did not increase significantly for the spillover group, and the amount of land dedicated to grazing and the amount of livestock owned by these household both decreased slightly. Expenditure on inputs, and the output per dollar of inputs were also not significantly impacted. In an additional analysis we find that, while the value of production did not increase, the cash income from livestock production of households in the spillover group did increase significantly. This suggests that households in the same districts as PA members were able to gain more benefits from market participation for this livelihood source in the form of cash income, but did not consume more of what they produced through the livestock activities. Based on the expected spillover channels of the project, these benefits likely accrued through successful PAs stimulating a more vibrant local economy and improving the attendance at local markets. PA members may have also passed on their knowledge of how to increase the profitability of livestock production to non-members.

Table 8: PSSA impacts on livestock production

Indicator	Treatment vs Control		Spillover vs Control	
	Impact	**Obs**	**Impact**	**Obs**
SO1 – Productive capacity for livestock				
Value of livestock, fish and bee production (%)	61.28***	1,808	10.91	1,864
Expenditure on inputs (%)	49.95***	1,808	9.58	1,864
Land dedicated to grazing (ha.)	-0.12	1,777	-0.18**	1,836
Livestock ownership (TLU)	0.02	1,805	-0.24**	1,864
Output per dollar of input (%)	14.00*	1,808	-0.33	1,864

Note: *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

Graph 3: Distribution of livestock input expenditures

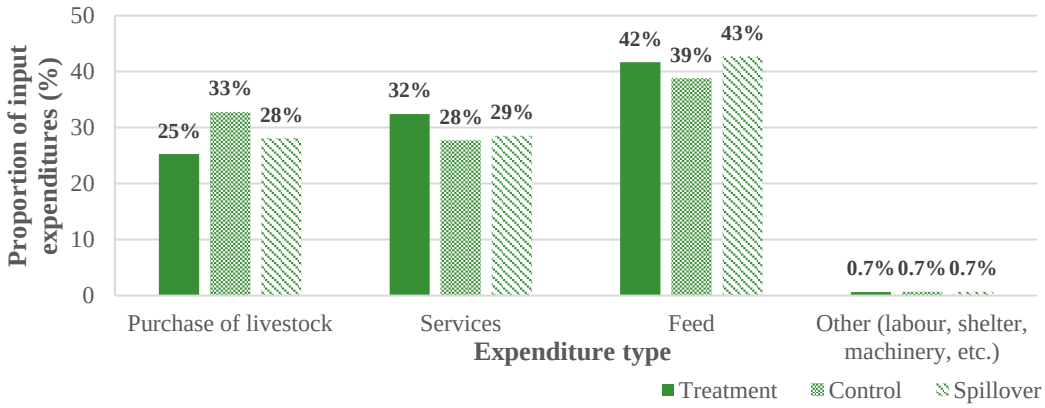


Table 9 presents the results for PSSA's impact on crop production. There was no significant impact on the value of crop production per hectare, crop diversity or input expenditures, and the amount of land dedicated to crop production and output per dollar of inputs were both significantly reduced. Further analysis indicates that there was no change in the share of land dedicated to cash crops (mostly perennials) over staples (mostly annual crops), nor was there an increase in the probability that the majority of harvests (in terms of monetary value) were cash crops.

In most cases, it was not possible to analyse PSSA's impacts on yields from specific crops, as the number of producers were too few. It was only possible for maize and potatoes, and we do not find that yields were affected significantly in both cases. The results suggest that productivity and investment did not increase for this livelihood source for PA members, and that efficiency of overall production was actually reduced compared to the control group. The lack of improvement in this livelihood source is also in evident among spillover households, for whom crop production, land use and expenditure all decreased significantly, while efficiency of expenditure and crop diversity were not impacted.

Table 9: PSSA impacts on crop production

Indicator	Treatment vs Control		Spillover vs Control	
	Impact	Obs	Impact	Obs
SO1 – Productive capacity for crops				
Value of harvest per ha. (%)	-13.19	1,521	-29.73***	1,575
Land cultivated (ha.)	-0.22***	1,521	-0.19***	1,575
Crop diversity index (HHI score)	0.02	1,521	0.02	1,575
Expenditure on inputs per ha. (%)	-19.47	1,521	-43.21*	1,575
Output per dollar of input (%)	-12.17**	1,521	-2.38	1,575

Note: *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

Given that the PAs formed through PSSA more commonly focused on livestock production (see Table 7), one potential explanation for these results is that the project encouraged a shift from crop to livestock production for both PA members and the spillover group. Such a shift may have also been encouraged by the issues with water access and weather shocks (see Table 3), which usually affect crops more than livestock production. To verify this, we assessed whether the project changed the likelihood of livestock and crop production being the main livelihood source for these households. Using the same IPWRA model, we find that PA members were six per cent more likely to have more than 50 per cent of their income provided by livestock activities, and 11 per cent less likely to have more than 50 per cent of their income provided by crop production. For the spillover group, they were seven per cent less likely to have crop production as their main livelihood source, but the likelihood of livestock production being their main source did not change—suggesting that spillover households mainly switched away from crop production to another livelihood source. We also tested whether there was an impact on the share of land dedicated to crops or grazing, and found that the percentage of land dedicated to crops (vs. grazing) decreased significantly by five percentage points among PA members.

Analysing the project's impact on sales practices, presented in Table 10, provides further insights into the dynamics between the two livelihood sources, as well as the influence of the project's business management and marketing training. The proportion of livestock and livestock products that were sold rather than consumed increased significantly by five per centage points, while the proportion of crop harvests that were sold reduced significantly by eight per centage points. This further supports the explanation that crop production became more of a minor livelihood source amongst PA members, used mainly to produce food rather than to generate income. While the likelihood of PA members selling their livestock products at a market (or another location away from the farm gate or roadside) increased by 13 per centage points, more surprisingly, this likelihood also increased by seven per centage points for crops. This implies that, although crop production became less important as a livelihood source, sales practices for crops still improved for the treatment households. We also find that spillover households were more likely to sell their livestock produce at a market, suggesting this may have been a driver of the increased cash income from livestock activities for this group. In order to understand whether the project affected the type of buyers of crops and livestock produce, we ran additional analyses. We found that treated households were more likely to sell to individuals, rather than traders or businesses, which mirrors the increase in market sales finding above.

Data on median prices received by households for their main livestock and crop products (see Appendix IV), show that sales that were not at the farm gate for PA members and the spillover group received much higher prices for the main livestock products (cattle, guinea pigs, and pigs), but less so for the main crop products (avocados, bananas, coffee, green peas, maize and potatoes). This may reflect an improvement in the quality of livestock thanks to the project, but may also be linked to better-developed markets and value chains for livestock compared to crops. Market access is low across the sample, as shown by the community-level data (see Table 3), but given the lack of rewards for selling crops at markets compared to livestock, it may be that access to vibrant crop markets and lucrative, well-integrated value chains may have been particularly limited for PA members, and may have incentivised the apparent reduced involvement in crop production.

Table 10: PSSA impacts on market participation

Indicator	Treatment vs Control		Spillover vs Control	
	Impact	**Obs**	**Impact**	**Obs**
SO2 – Market participation for livestock and crops				
Proportion of harvest that was sold (percentage points):				
- Livestock	5.42***	1,662	-0.55	1,719
- Crops	-7.64***	1,521	-3.37	1,575
Sold at market (percentage points):				
- Livestock	13.49***	1,134	11.20***	1,107
- Crops	7.40**	903	1.47	965

Note: *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

ii. Income (OG), resilience (SO3) and food security (CT)

Table 11 presents the results for PSSA's impacts on indicators from the final stage of PSSA's ToC. The annual total income per capita of PA members increased significantly by 21 per cent, equivalent to $235. Annual cash income per capita also increased, by 26 per cent, equivalent to $220. Although total income did not increase for spillover households, their cash income increased by around 17 per cent. Similar to the impacts on cash income from livestock production reported above, these spillover impacts seem to be driven by improved waged employment opportunities for non-beneficiary households in PSSA districts. Both PA members and the spillover group increased their likelihood of being in waged employment by around nine per centage points. Daily wages from did not increase for the treatment group though they decreased by around 5 per cent for the spillover group. Nonetheless, the share of income from wage labour is highest for the treatment group at around 20 of total income, followed by the spillover group (see Graph 1b).[8]

Livelihood diversity increased for the treatment group and to a lesser extent for the spillover group, which was likely also a result of the employment effect given that crop diversity did not increase (see Table 9). Given the project's impacts on crop production for the spillover group discussed above, these results suggest that spillover households moved away from crop production into waged employment. These impacts on waged employment may have been achieved through the successful PAs stimulating the local economy and thus increasing the demand for paid labour. In addition, given that hiring of services was a common use of the PSSA grants by the PAs, and that household

[8] It is not possible to measure the impact of PSSA on waged labour income given the large proportion of the sample who did not engaged in waged labour activities, which makes accurately comparing treatment and control groups problematic.

expenditures on livestock services increased through the project, PA members as well as spillover households may have benefitted from providing services to their own or other PAs.

Increasing the access of PA's to additional sources of finance was a key aim of PSSA. The unconditional averages presented in Table 7 showed that only three per cent of the PAs in our sample had received a loan since 2015. Nonetheless, we do find that access to credit for PA members' households increased by nine per centage points. Households in the spillover group have also benefited with a higher probability (4 percentage points) of having taken a loan during the reference period. For PA members, this result implies both that members became more eligible for credit through the project, and had increased incentives to invest in their production. This improved access has likely contributed to the positive impacts on livelihoods, such as facilitating the increase expenditure on livestock inputs. We also find that the likelihood of treated households having a bank account increased by 14 per centage points, and that of the spillover households has increased by 12 per centage points. Given that access to formal financial institutions in the project and spillover communities is low (see Table 3), it is likely that these improvements in financial inclusion were driven by increased income amongst these households, which increased their ability and incentives to access credit/open a bank account despite the accesses challenges.

Asset ownership is an indicator of wealth and can be used to measure the impacts of the project on economic mobility. We find that, for treated households only, the increase in income was translated into increased physical capital measured by asset indices for household durables and productive assets. This finding has positive implications for the sustainability of the project's impacts.

We do not find a significant impact on PA members' ability to recover from shocks, however. The average score on the 1-4 scale amongst the groups was around 2.5 in all cases, which corresponds to somewhere in between "recovered somewhat, but worse" and "recovered to the same level."[9] There seem to be some room for improvement in this subjective resilience indicator, though we do not find significant impact on it. As crop production is usually the most vulnerable to weather shocks, which were common in the project areas (see Table 3), the lack of improvement in this resilience indicator may help to explain the lack of impact on crop production. In order to further test the link between resilience to climatic shocks and crop production, we analysed whether the resilience impact for climatic shocks differed by whether the household's main livelihood activity was crop or livestock production, but we found that the lack of impact on resilience to climatic shocks does not depend on the main livelihood activity.

Improved resilience was expected to be achieved both through strengthened livelihoods, and through risk sharing within the PAs. Based on these results, risk sharing does not seem to have been a feature within the PAs established by the project. Nevertheless, resilience is acknowledged to be a longer-term outcome, achieved through multiple cycles of households building their asset base and benefitting from sustainable coping strategies, hence it is best measured over longer periods of time which is not possible in our study. Subjective measures of resilience may also not fully capture the changes to the ability of beneficiaries' livelihoods to withstand and adapt to shocks, something that is notoriously hard to define. Increased livelihood diversification is used as another measure of resilience in the literature (Arslan et al. 2018; Bandyopadhyay and Skoufias, 2013). Given that we find significant increases in livelihood diversity and asset ownership, the project seems to have improved resilience to the extent that these indicators capture components of the notoriously hard to measure concept.

[9] The self reported shock recovery scale is as follows: 1= Did not recover; 2 = Recovered somewhat, but worse; 3 = Recovered to the same level; 4 = Recovered and better off.

Regarding food insecurity, we find that FIES scores did not decrease significantly amongst PA members.[10] This is likely because food insecurity was already very low in the sample (with an average score of two on the 0-8 scale), as discussed in the descriptive statistics section above. The project did improve the dietary diversity of treated households, however, with a significant average effect of 0.4 points on the 0-16 scale. This finding indicates that treatment households consumed an average of 0.4 more of the 16 food groups compared to control households, which – though small – can likely be linked to the increased market participation finding above.

Table 11: PSSA impacts on income, financial inclusion, resilience and food security

Indicator	Treatment vs Control		Spillover vs Control	
	Impact	**Obs**	**Impact**	**Obs**
OG – Economic mobility: Income, employment, financial inclusion and assets				
Total income per capita (%)	21.08***	1,936	3.49	1,979
Cash income per capita (%)	26.34***	1,936	16.60**	1,979
In waged employment (% probability)	9.61***	1,936	9.27***	1,979
Daily wage from employment (%)	1.40	824	-5.06**	826
Took a loan (% probability)	9.12***	1,936	4.05***	1,979
Have a bank account (% probability)	13.86***	1,936	12.22***	1,979
Asset ownership (index score): - Household durables - Productive assets	 0.17*** 0.06**	 1,936 1,936	 0.04 0.01	 1,979 1,979
SO3 – Resilience: Livelihood diversity and subjective ability to recover				
Livelihood diversity index (HHI score)	0.07***	1,936	0.03***	1,979
Ability to recover livelihood after shocks (score on 1-4 scale): - Weather shock - Non-weather shock	 -0.01 0.04	 929 946	 0.07 0.08	 962 1,021
OG: Food security				
Food Insecurity Experience Score	-0.05	1,936	0.09	1,979
Household Dietary Diversity Score	0.37***	1,936	0.15	1,979

Note: *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

iii. Women's empowerment (CT)

Table 12 presents PSSA's impacts on a set of indicators of women's empowerment for treated and spillover households. The first set of indicators are the gender differentiated versions of selected main impact indicators used above: the value of crop production, livestock production, livestock sales and total income that come from female owned parcels or are under female decision making, as well as livestock ownership by gender. These variables were created using the questions on who owns each asset, and who makes the main decisions for the use of each income source for households. As an

[10] Note that higher FIES scores indicate higher food insecurity experience.

indicator of female empowerment, we assess whether solely female owned/controlled assets and incomes have increased more than those under male or joint ownership/control.

We do not find an increase in the value of crop production from female owned parcels in the treatment or spillover groups compared to the control group. The value of livestock, fish and bee production owned/controlled by women, however, increased by 28 per cent in the treatment group. The increase is 41 per cent in the case of joint ownership/control (male and female). The spillover group does not show a similar improvement. While we do not find a gender differentiated impact on livestock ownership measured by TLU the value of livestock sales under female decision making strongly increased (21 per cent) for the treatment group. The value of livestock sales under joint decision making has increased significantly for both treatment and spillover groups. Specifically, the increase in sales income under joint decision-making is 128 per cent in the treatment group and 72 per cent in the spillover group.

The total income per capita under female decision-making increased for both treatment and spillover groups, by 45 and 32 per cent, respectively. This positive impact occurs mainly through the livestock, bee and fishing activities. This is expected considering that most of PA activities in our sample relate to livestock.

Regarding the last set of women's empowerment indicators in Table 12, we do not find an impact on the likelihood that a female household member is involved in decisions about livelihood activities within the household. This needs to be interpreted in light of the fact that around 95 per cent of households in all groups reported that women are involved in household decisions (see Table 4), leaving very small room for improvement in this context. Also given the above findings that livestock income and total income under female decision making significantly improved, indicates that PSSA improved women's income generating capacity even though it did not increase their existing already high involvement in livelihood decision making.

At the same time, improving social capital was among the project's goals and we find that women in PA households 28 per centage points more likely to be member of a local group. Regarding women's economic empowerment related to wage employment, we find that women in PA households are three per centage points more likely be in waged employment.

One activity under component 2 of the project was specifically targeted to women and encouraged them to obtain micro life insurance through trainings and incentives. The project closing report documents that 4,674 micro life insurances were facilitated by the project (PSSA 2019). Only 1.4 per cent of households have a life insurance in our sample, and we do not find an impact on the likelihood of a female member having life insurance amongst treated households. The project's closing report also reports only 1 per cent coverage in terms of health insurance in both treated and control areas they collected data from. The low coverage and lack of impact may be due to a lack of demand for this type of coverage, or potentially a lack of access to institutions that provide life insurance, as reflected by the limited access to banks reported in the community questionnaire (see Table 3). Another potential reason could be that the micro life insurances PSSA facilitated by paying the first premiums have expired and households were not be able to continue paying the premiums without subsidy. The real reasons cannot be established here without detailed information analysis on this activity.

Table 12: PSSA impacts on women's empowerment

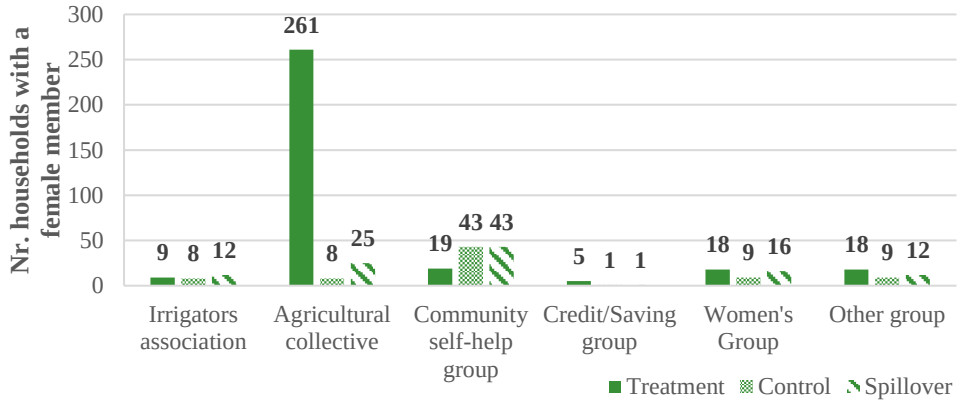
Indicator	Treatment vs Control		Spillover vs Control	
	Impact	Obs	Impact	Obs
CT – Women's Empowerment				
Value of harvest per ha. (%)				
- parcels owned by men	- 35.21 *	1,548	-31.68*	1,602
- parcels owned by women	- 2.23	1,548	7.16	1,602
- parcels owned by both	10.40	1,548	28.40	1,602
Value of livestock, fish and bee production (%)				
- owned/controlled by men	20.12	1,808	0.01	1,864
- owned/controlled by women	28.14 *	1,808	19.83	1,864
- owned/controlled by both	40.92 **	1,808	1.99	1,864
Livestock ownership (TLU)				
- owned by men	-0.05	1,777	-0.02	1,836
- owned by women	0.02	1,777	-0.00	1,836
- owned by both	0.07	1,777	19.19 **	1,836
Value of livestock sales (%)				
- under male decision-making	15.64	1,777	1.46	1,836
- under female decision-making	20.58**	1,777	5.75	1,836
- under joint decision-making	127.80***	1,777	72.13***	1,836
Total income per capita (%)				
- under male decision-making	24.69	1,936	-20.90	1,979
- under female decision-making	44.91***	1,936	31.94**	1,979
- under joint decision-making	14.01	1,936	14.07	1,979
At least one female household member is (%):				
- Involved in livelihood decisions	0.55	1,811	0.92	1,870
- A member of a local group	26.68***	1,811	2.74**	1,870
- In waged employment	3.38**	1,811	1.07	1,870
- Covered with life insurance	-0.16	1,811	0.19	1,870

Note: *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

The positive impacts on women's group participation—a key indicator of their social capital and voice within their communities— and increased income contribution results above seem to be driven by their involvement in PAs (especially as improved financial inclusion does not seem to have been a driver). This is confirmed in Graph 4 that presents the different types of groups that women from the treatment, control and spillover groups are involved in. While there are 261 households in the treatment group with at least one female member of an agricultural collective (which includes PAs,

cooperatives, etc.), there are just eight control households. A slight spillover effect is also evident as 25 households from the spillover group have a woman who is a member of this type of group, suggesting these households may have been inspired to start their own agricultural collectives by observing and interacting with the PAs. Seemingly, women became slightly less involved in community groups (also known as *ronda de campesinos)*—most likely to devote more time to the agricultural/livestock production groups—but they retained their membership of women's groups and other groups.

Graph 4: Women's group membership by group type.



The improvement in women's waged employment seemingly reflects the overall improvement in employment opportunities across the PA households. As PAs have stimulated the local economy, and used their grants to hire local services, this has seemingly opened new economic opportunities for women. There may have also been a mutually reinforcing relationship between their increased group membership and their autonomous income generating activities. Moreover, this improvement in women's employment likely contributed to the increase in livelihood diversity in their households, which was significant for both the treated and spillover groups.

Household-level impacts by sub-groups

PSSA targeted two distinct regions of Peru, separated by north and south. Given the differing contexts of these regions, we run separate analyses by region to test for potentially different impacts. Based on the literature on past projects similar to PSSA, the impacts may also vary according to the education level of the household head and land ownership. We also assess impacts separately by these covariates in this section in order to determine whether households with initial advantages have benefited differently from the project.

i. By location

Different impacts on beneficiaries in the north and south of the country are likely, due to considerable contextual differences (Escobal and Torero, 2003). Within the sample, households located in the south are wealthier (potentially due to their proximity to the capital city, Lima), more focused on crop production over livestock activities, live at higher altitudes and receive more rainfall compared to those in the north. Interviews with the project team also highlighted that there were also some implementation issues in the south, related to considerable issues with accessing communities and encouraging households to participate.

The sample was designed to be representative of the beneficiary population, therefore a much larger proportion (86 per cent) of the sample was allocated to the northern region (based on the percentage distribution of number of beneficiaries between regions). This means it is not possible to reliably analyse impacts in the south due to small sample size. We thus analyse the impacts on households located in the north, and compare them with the impacts for the full sample, based on which we can infer whether impacts were higher in the north compared to the south. Table 13 presents the impacts for key indicators only for households located in the north.

Table 13: PSSA impacts on households located in the northern region

Indicator	Treatment vs Control		Spillover vs Control	
	Impact	Obs	Impact	Obs
Total income per capita (%)	29.65***	1,647	17.83***	1,699
Value of livestock production (%)	68.29***	1,568	27.94*	1,619
Value of harvest per ha. (%)	4.78	1,282	-14.50	1,327
In waged employment (% probability)	9.93***	1,647	11.81***	1,699
At least one female household member is (% probability):				
- A member of a local group	24.18***	1,539	1.37	1,611
- In waged employment	2.56*	1,539	1.65	1,611

Note: *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

Total income per capita increased by 30 per cent for PA members located in the north, a larger impact than the 21 per cent increase for the full sample. While the estimated impact on participation in waged employment is similar to the full sample, the impact on the value of livestock production is larger in the north (68 per cent vs 61 per cent for the full sample), suggesting this was the main driver of the larger impact on total income. While still not statistically significant, the size of the impact on the value of crop production is larger for households in the north (5 per cent vs -13 per cent). These more positive impacts for northern compared to southern beneficiaries implies that the project was able to improve the livelihoods of poorer households in the north. Given the greater focus on livestock activities in the north and crop activities in the south, the higher impacts for the former group may also help to explain the different impacts on livestock and crop production for the full sample.

Despite these differences in the economic impacts of the project, the impacts on women's empowerment seem to be more equally distributed across the sample. Both in terms of group membership and involvement in waged employment, the impacts for households in the north are similar to those for the full sample, thus implying they are similar to those in the south. This indicates that these outcomes for women were not solely driven by improved livelihoods (otherwise the impacts would have been higher in the north), but affected through other channels, such as the increased social capital and autonomy provided by being a member of a PA.

In terms of spillover effects, there is a much larger impact on total income per capita for those in the north (18 per cent) compared to the full sample (3 per cent). This was seemingly driven by larger spillover effects on livestock production, but also on involvement in waged employment, the impacts for both of which are higher for households in the north compared to the full sample. However, the

spillover impact on women's group participation is not significant in the north, again supporting the insight that non-economic factors contributed to the project's impacts on women's empowerment.

The generally more favourable results in the north suggest that the project's impacts were pro-poor, given that the average income is lower in this region compared to the south. However, the implementation issues encountered by the project in the south probably also contributed to these differences in estimated impacts.

ii. By land ownership

Table 14 presents impacts on the same key impact indicators by dividing the sample between landed and functionally landless households (those who own less than 0.1 hectares of land) in order to investigate whether the estimated impacts vary along this dimension. Using land holdings as a variable for heterogeneity analysis is a useful distinction as it is relatively static in the short-term, so would not have been affected by the project.

There was a similarly large statistically significant improvement in total income for both landed and landless households (21 vs 20 per cent), while the impact on livestock production was actually larger for landless households (62 vs 57 per cent). However, the project's impact on waged employment seems to have been specific to landed households, for both men and women, while the social capital impact is slightly larger for landless households. Regarding the spillover group, the impacts are similar across most indicators (except for the impacts on women's waged employment and group membership, which are preferable for landed households), suggesting that wealth (as proxied by access to land) was not as much of a determining factor in terms of spillover effects.

The concern for projects like PSSA, which require households to mobilise themselves and contribute a share of the cost of their business plans to establish a producer's group (which corresponded to an average annual contribution of $287 for PSSA as in Table 5), is that poorer households would either exclude themselves or be excluded by other group members who may doubt their capacity to contribute. In order to address this concern to a certain extent, PSSA also allowed in-kind contributions in the form of labour or other inputs. The preferable impacts of the project for the generally poorer households in the north, and the similar impacts for landed and landless households, indicate that the project was able to promote inclusive PAs within which the benefits were shared. This positive outcome could be linked to the democratic organisation of the PAs (see Table 6), and potentially the option of providing contributions through in-kind payments.

Table 14: PSSA impacts by land ownership

Indicator	Treatment vs Control				Spillover vs Control			
	Landed	Obs	Landless	Obs	Landed	Obs	Landless	Obs
Total income per capita (%)	20.59***	1,498	19.73**	438	6.47	1,504	-1.42	475
Value of livestock (%)	56.76***	1,427	62.05*	381	9.90	1,436	19.15	428
Value of harvest per ha. (%)	-8.20	1,285	-33.73	236	-26.56**	1,317	-16.78	258
In waged employment (% probability)	11.07***	1,498	2.82	438	8.97***	1,504	8.43*	475
At least one female household member is (% probability):								
- A member of a local group	25.80***	1,399	30.22***	405	3.40**	1,423	-0.43	447
- In waged employment	3.79***	1,399	2.02	405	2.28*	1,423	-3.17	447

Note: Landless defined as owning less than 0.1 ha. of land; *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

iii. By gender of the household head

Female headed households often face more economic and social challenges compared to male headed households. This is reflected in the sample as average incomes are higher for male headed households. Analysing whether the project's impacts differed across these two groups can thus provide further insights into the inclusivity and pro-poor impacts of PSSA. As with the analysis by location, we compare impacts for the full sample with the sub-sample of male-headed households, because the number of female headed households is too low to allow a separate analysis for this group.

The 17 per cent impact on total income for male headed households is slightly smaller than the 21 per cent impact for the full sample, suggesting that there was a larger impact on the incomes of female headed households. Given that the impacts on waged employment are similar, this seems to have been achieved through a larger impact on livestock production as also indicated in the women's empowerment indicators analysed above, indicated by the smaller impact on livestock value for male headed households compared to the full sample (53 per cent vs 61 per cent). The impacts are also similar for the indicators of women's empowerment, suggesting that this factor did not influence the project's impacts in this area. The differences in the spillover effects between the full sample and male-headed households are minor, suggesting that the gender of the household head did not influence spillover impacts significantly.

Table 13: PSSA impacts on male-headed households

Indicator	Treatment vs Control		Spillover vs Control	
	Impact	Obs	Impact	Obs
Total income per capita (%)	17.09***	1,669	3.84	1,692
Value of livestock production (%)	53.25***	1,568	10.29	1,596
Value of harvest per ha. (%)	-22.57**	1,350	-34.36***	1,378
In waged employment (% probability)	9.97***	1,669	8.89***	1,692
At least one female household member is (% probability):				
- A member of a local group	24.06***	1,537	2.15*	1,583
- In waged employment	2.86**	1,537	-0.37	1,583

Note: *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

Conclusions and recommendations

PSSA aimed to sustainably increase the incomes of low-income rural households in Peru by improving their financial, human, physical and social capital. This involved encouraging producers to form PAs, and then providing them with financial and non-financial support to implement business plans. As part of the IFAD11 Impact Assessment Agenda, this report presents the results of the rigorous impact assessment (IA) that analysed project's expected impacts and impact pathways, in order to generate lessons for future projects. It presents impacts on a large set of indicators based on the project's theory of change, specifically (but not limited to) to determine the project's contributions to IFAD's Strategic Objectives.

We find that PA members increased their income, asset ownership and financial inclusion, mainly through enhanced production and sales of livestock and increased involvement in waged employment. The livestock impacts were seemingly achieved as PAs used financial support to increase their physical capital and hire services to improve the efficiency of their production, and improved their sales practices thanks to business management training. The higher demand for services by PAs, and the positive effects on the local economy of successful PAs, in-turn, likely contributed to an increase in income from waged employment, which particularly helped to increase women's employment opportunities and livelihood diversity. Women's contributions to income and social capital were also improved through the project, increasing their involvement in local groups and their voice in the community. This impact is complementary to the improvement in livestock and total income under their control, as well as in their waged employment.

At the PA level, we find that they spent the majority of their grants were spent on new and improved equipment in order to establish the group's activities. At this stage, most PAs have not begun to accumulate large assets or access additional sources of finance, and finding new buyers and meeting their time and quality requirements remain a challenge. Based on this, there is room for improvement to increase impacts for PA members as the groups consolidate and move to the next stage of their development. A new project is precisely aiming to achieve this by supporting the consolidation and scaling up of the PAs established by the PSSA.[11]

The sampling frame was designed to allow an analysis of the potential spillover impacts of PSSA, as local interactions in project districts were expected to generate benefits (e.g. economic or technical knowhow) for non-beneficiaries as well. We find that the project had a positive impact on the incomes of non-PA members located in project districts, also driven by improved sales practices related to livestock and more waged employment opportunities. A particularly interesting finding is the improved financial inclusion amongst these households, seemingly as a result of increased cash income. Women in spillover areas also increased their involvement in local groups, seemingly inspired by PA members to start their own agricultural producer organisations.

Our assessments of impacts on specific groups within the sample reveal that impacts generally did not vary based on whether PA members owned land (a proxy for wealth), implying that PSSA's benefits were inclusive. PAs were generally democratically organised, which may have contributed to the inclusivity of the project's impacts. Moreover, most impacts were higher for households in the north, and the income effect was larger for female-headed households, which further indicate that impacts were inclusive given that incomes are lower on average for these two sub-groups. It should be kept in

[11] Project Title: Proyecto de Ampliación de los Servicios Públicos para el Desarrollo Productivo Local en el Ámbito de la Sierra y la Selva del Perú. IFAD Project Identifiction Number: 2000002257

mind that the geographic differences also reflect implementation issues that were encountered in the southern project areas.

There are two main caveats to these positive impacts. The first is that crop production was not improved for PA members or the spillover group. This was seemingly driven by a shift towards livestock production and waged employment, potentially as a result of markets and value chains for crop products being less well-developed in the project areas, and due to prevalent weather shocks. Second, we documented a general reduction in PA membership after formation, and some suggestion that not all members were fully engaged in PA activities in our sample. While the required financial contribution to the business plans was not too high so as to disincentivise members to join the PAs, the engagement issue suggests that the amount was insufficient to ensure participation in some cases and other constraints prevented some beneficiaries from actively participating in the PA activities.

Based on these findings, four main lessons for the future can be drawn from this impact assessment:

1. **Support to rural producers through PAs can have powerful effects on livestock production and waged employment.** Rural producers in these contexts often have their livestock production hindered by a lack of access to sufficient services and information. The project seems to have addressed this barrier through a combination of financial support (which was often used to hire local services) and training on production and business management, and had a powerful impact on livestock production as well as participation in wage employment as a result. Moreover, the way PAs were formed and organised (through broadly advertised public competitions and with the option of providing in-kind contributions), seems to have ensured that the potential risk of marginalised members of the community being excluded has been avoided. Future projects may seek to replicate these activities in similar contexts where livestock production is constrained by similar barriers, and take advantage of the apparent synergies between enhanced livestock production and opportunities for waged employment. Building upon the linkages observed through this project, future projects could devise ways to not only increase local employment opportunities, but also to increase wages (something that was not observed in PSSA areas) by providing additional training for specific skills relevant for local labour markets, for instance.
2. **Encouraging inclusive group membership can bring considerable rewards.** Encouraging inclusive formulation and organisation of the PAs has contributed to pro-poor economic impacts and significant gains for women. PAs were formed through broad advertisements, local competitions and continuing technical support that encouraged democratic decision making. Combined with the potential to contribute in-kind instead of cash by the members, these initiatives seem to have overcome the common risk faced by such projects of marginalised members of the community being excluded. Such a model can be replicated in similar contexts where exclusion is a risk. Future project should be weary, however, that membership and member engagement does not erode once the groups are formed. This can be achieved through regular monitoring of the groups, and open discussions as to why members are leaving or not engaging in group activities, so that these issues can proactively be addressed.
3. **Significant spillover impacts can be generated by unleashing the demand for and supply of technical services and inputs:** Significant increases in cash income from livestock activities, waged employment as well as financial inclusion were observed for non-beneficiary households in project districts (i.e. spillover households). By identifying and targeting the locally demanded technical capacity and input provision needs, projects can create benefits that go beyond the beneficiary households.

4. **Impacts can be increased by addressing relevant constraints in access to infrastructure and financial innovations.** The estimated project's impacts indicated limited improvements in crop production and women's financial inclusion. These were linked to limited access to local markets, value chains, water and financial institutions, as well as problems faced by the project team in accessing communities and encouraging participation in the south of the country. Future projects may therefore benefit from providing targeted support to improve access where this poses a challenge, potentially mapping local buyers and value chains beforehand and devising ways to connect beneficiaries to them, improving water delivery infrastructure, or devising incentives to connect producers with financial institutions.

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Appendices

Appendix I: Balance tests for impact estimation models

	Treated vs Control			Spillover vs Control		
	Raw	IPWRA	NN	Raw	IPWRA	NN
Number of adults	-0.04	-0.00	-0.05	0.01	0.00	0.05
Dependency ratio	-0.16	0.00	-0.04	0.03	0.00	0.02
Education of household head	0.06	0.01	0.02	-0.25	0.01	0.09
Mean education of household members	0.12	0.01	0.03	-0.26	0.01	0.11
Nr. household members with a disability	-0.07	0.00	0.00	-0.02	0.02	0.00
Household head is female	-0.10	-0.00	0.00	-0.02	0.02	0.01
Pre-project asset ownership: - Household durables - Homestead materials/ facilities - Productive assets - Livestock	 -0.02 0.13 0.03 -0.01	 0.00 0.01 0.01 0.01	 -0.03 0.05 -0.01 -0.00	 -0.14 0.09 -0.12 -0.07	 0.01 0.02 0.00 0.01	 0.06 0.06 0.06 0.05
Land owned with a title	0.00	-0.01	-0.01	-0.01	0.01	0.01
Nr. weather shocks experienced since 2015	0.01	-0.02	0.01	0.03	0.00	0.02
Altitude	-0.04	0.02	-0.06	-0.03	0.04	0.02
Average magnitude	**0.06**	**0.01**	**0.02**	**0.08**	**0.01**	**0.04**

Appendix II: Results from secondary nearest neighbour matching model

Table II.A. Secondary model results for livestock and crop production and market participation

	Treatment vs Control		Spillover vs Control	
	Impact	Obs	Impact	Obs
Livestock production				
Land dedicated to grazing	-0.19	1,777	-0.27***	1,836
Livestock ownership (TLU)	-0.03	1,805	-0.37***	1,864
Value of livestock, fish and bee production	48.08***	1,808	-0.81	1,864
Expenditure on inputs	45.07**	1,808	-26.15	1,864
Output per dollar of input	14.08*	1,808	0.15	1,864
Crop production				
Land cultivated (ha.)	-0.19***	1,521	-0.27***	1,575
Value of harvest per ha.	-21.29**	1,521	-9.15	1,575
Expenditure on inputs per ha.	1.76	1,521	-36.91	1,575
Output per dollar of input	-10.22	1,521	1.00	1,575
Crop diversity index	0.01	1,521	0.02	1,575
Market participation				
Proportion of harvest that was sold:				
- Livestock	2.23	1,662	0.00	1,719
- Crops	5.84	903	-1.26	1,575
Sold at market:				
- Livestock	14.94***	1,134	11.07***	1,107
- Crops	2.65	1,521	-0.33	965
Sold to trader or business (not individuals):				
- Livestock	-12.19***	1,134	-10.28***	1,107
- Crops	-16.42***	903	-12.65***	965

Note: *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

Table II.B. Secondary model results for income, financial inclusion, food consumption and resilience

	Treatment vs Control		Spillover vs Control	
	Impact	Obs	Impact	Obs
Total income per capita (%)	26.32***	1,936	5.12	1,979
Cash income per capita (%)	41.56***	1,936	21.18**	1,979
Livelihood diversity index (HHI score)	-0.05***	1,936	-0.04***	1,979
In waged employment (% probability)	12.84***	1,936	10.81***	1,979
Daily wage from employment (%)	0.13	824	-3.59	826
Took loan (% probability)	9.12***	1,936	4.03**	1,979
Have a bank account (% probability)	13.86***	1,936	11.76***	1,979
Asset ownership (index score): - Household durables - Productive assets	 0.14*** 0.07**	 1,936 1,936	 0.06* 0.04	 1,979 1,979
Food Insecurity Experience Score (0-8 score)	-0.12	1,936	0.21*	1,979
Household Dietary Diversity Score (0-16 score)	0.26*	1,936	0.13	1,979
Ability to to recover livelihood after shocks (1-4 scale): - Weather shock - Non-weather shock	 -0.02 0.06	 946 997	 0.03 0.07	 962 1,021

Note: *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

Table II.C. Secondary model results for women's empowerment

	Treatment vs Control		Spillover vs Control	
	Impact	Obs	Impact	Obs
Value of harvest per ha. (%)				
- parcels owned by men	- 21.23	1,548	- 6.97	1,602
- parcels owned by women	- 6.99	1,548	9.46	1,602
- parcels owned by both	- 2.43	1,548	44.64 *	1,602
Value of livestock, fish and bee production (%)				
- owned/controlled by men	17.77	1,808	- 7.53	1,864
- owned/controlled by women	4.27	1,808	- 3.30	1,864
- owned/controlled by both	52.94 **	1,808	12.07	1,864
Livestock ownership (TLU)				

- owned by men	- 9.40 *	1,777	- 6.17	1,836
- owned by women	- 1.23	1,777	- 2.44	1,836
- owned by both	8.58	1,777	- 25.40 **	1,836
Value of livestock sales (%)				
- under male decision-making	15.81	1,777	- 0.67	1,836
- under female decision-making	15.12	1,777	4.40	1,836
- under joint decision-making	103.55 ***	1,777	84.22 ***	1,836
Total income per capita (%)				
- under male decision-making	37.45 *	1,936	- 0.25	1,979
- under female decision-making	18.59	1,936	16.32	1,979
- under joint decision-making	28.21 *	1,936	17.41	1,979
At least one female household member is (% probability):				
- Involved in livelihood decisions	1.38	1,804	1.04	1,870
- A member of a local group	25.53***	1,804	2.63*	1,870
- In waged employment	1.58	1,804	0.89	1,870
- Covered with life insurance	0.53	1,804	-0.00	1,870

Note: *,** and *** indicate the statistical significance of coefficients at the 10, 5 and 1% levels, respectively.

Appendix III: Average values for impact indicators

Outcome indicators	Treatment	Control	Spillover	Control
Value of livestock production ($)	1,817	1,237	1,175	1,242
Land dedicated to grazing (ha.)	1.04	1.13	0.84	1.14
Livestock ownership (TLU)	2.58	2.52	2.08	2.51
Expenditure on livestock inputs ($)	189.55	146.50	128.91	147.56
Livestock output per dollar of input ($)	22.83	26.69	19.89	26.88
Value of crop harvest per ha. ($)	1,896	1,893	1,990	1,899
Land cultivated with crops (ha.)	0.98	1.17	1.00	1.17
Crop diversity index (HHI score)	0.65	0.65	0.67	
Expenditure on crop inputs per ha. ($)	292.85	280.74	304.64	283.95
Crop output per dollar of input ($)	2.52	3.52	3.09	3.53
Proportion of harvest sold (%):				
- Livestock	35.47	30.13	27.73	29.96
- Crops	50.60	56.21	53.53	56.47
Sold at market (Yes/No, %):				
- Livestock	30.21	17.62	29.11	17.64
- Crops	62.12	55.96	55.80	56.13
Total income per capita ($)	1,366	1,120	1,036	1,120
Cash income per capita ($)	1,016	846.52	769.10	843.63
Livelihood diversity index (HHI score)	0.55	0.61	0.58	0.61
In waged employment (Yes/No, %)	46.77	35.65	42.90	36.06
Daily wage from employment ($)	10.28	10.61	8.78	10.52
Took loan (%)	19.72	9.97	12.72	10.16
Have bank account (%)	8.06	3.93	4.83	3.94
Asset ownership (index score):				
- Household durables	1.39	1.20	1.11	1.18
- Productive assets	1.61	1.51	1.42	1.50
Food Insecurity Experience Score (0-8)	1.98	2.13	2.29	2.14
Household Dietary Diversity Score (0-16)	10.87	10.41	10.44	10.43
Ability to recover livelihood after shocks (1-4):				
- Weather shock	3.35	3.33	3.41	3.33
- Non-weather shock	2.59	2.52	2.59	2.53

At least one female is (Yes/No, %):				
- Involved in livelihood decisions	95.18	94.74	95.95	94.93
- A member of a local group	33.26	7.40	9.36	07.60
- In waged employment	11.35	8.15	8.63	08.04
- Covered with life insurance	0.11	0.32	0.31	0.33
Value of harvest per ha. ($)				
- parcels owned by men	208.05	460.01	342.71	461.12
- parcels owned by women	120.93	149.75	200.40	149.18
- parcels owned by both	579.22	680.48	677.87	689.40
Value of livestock, fish and bee production ($)				
- owned/controlled by men	213.81	134.66	95.77	121.51
- owned/controlled by women	359.97	312.77	262.07	315.02
- owned/controlled by both	1,221.54	785.44	816.51	801.34
Livestock ownership (TLU)				
- owned by men	0.36	0.37	0.28	0.33
- owned by women	0.32	0.36	0.32	0.35
- owned by both	1.95	1.81	1.52	1.85
Value of livestock sales ($)				
- under male decision-making	111.00	93.91	29.17	82.58
- under female decision-making	57.96	47.72	48.25	46.69
- under joint decision-making	635.92	344.18	368.48	350.94
Total income per capita ($)				
- under male decision-making	416.71	346.19	291.34	341.45
- under female decision-making	256.07	271.56	196.95	272.91
- under joint decision-making	962.67	856.18	813.84	869.73

Appendix IV: Median prices for main livestock and crop products

Table IV.A. Median prices for main livestock products by comparison group and sales location

	Treatment	Control	Spillover
Farm gate sales:			
Livestock			
- Cattle	$390.00	$300.00	$360.00
- Guinea Pigs	$6.00	$7.50	$6.60
- Pigs	$105.00	$60.00	$90.00
Crops			
- Avocado	$0.90	-	$0.90
- Banana	$0.30	$0.26	$0.30
- Coffee	$1.80	$1.80	$1.88
- Green pea	$0.55	$0.45	$0.60
- Maize	$0.60	$0.45	$0.34
- Potato	$0.48	$0.30	$0.43
Non-farm gate:			
Livestock			
- Cattle	$450.00	$330.00	$450.00
- Guinea Pigs	$6.90	$7.50	$6.60
- Pigs	$120.00	$60.00	$105.00
Crops			
- Avocado	$0.75	$0.48	$0.75
- Banana	$0.30	$0.24	$0.30
- Coffee	$1.88	$1.77	$1.83
- Green pea	$0.53	$0.39	$0.50
- Maize	$0.48	$0.30	$0.48
- Potato	$0.45	$0.30	$0.43

Note: non-farm gate sales include sales at local or district markets and or the location of the buyer.

International Fund for Agricultural Development
Via Paolo di Dono, 44 - 00142 Rome, Italy
Tel: +39 06 54591 - Fax: +39 06 5043463
Email: ifad@ifad.org
www.ifad.org

ifad-un.blogspot.com
www.facebook.com/ifad
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