IMPACT ASSESSMENT REPORT

Democratic Republic of São Tomé e Príncipe

Smallholder Commercial Agriculture Project (PAPAC) and Participatory Smallholder Agriculture and Artisanal Fisheries Development Programme (PAPAFPA)

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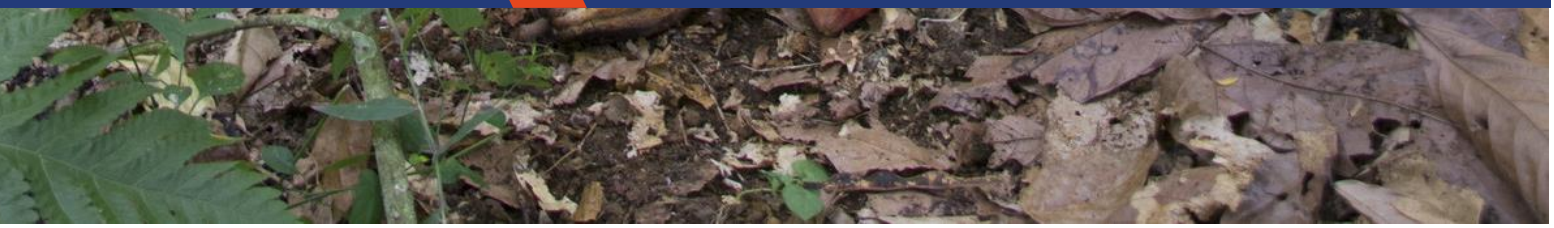

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Executive summary

Despite the progress made over the last decades across several socio-economic indicators, poverty incidence remains persistently high in São Tomé e Príncipe, with over two-thirds of the population living below the poverty line of US$3.2 (World Bank 2018). A set of constraints imposed by the country's insularity, small market size and agroecological conditions make the country extremely vulnerable to market and climate shocks. Its economy relies heavily on imports, which are counterbalanced by a narrow set of exports, with cacao taking the lion share (approximately 70% of total exports, World Bank 2018). Agricultural production, however, has declined since the country's independence in 1975 and productivity has remained consistently low, hindering economic wellbeing and progress of rural livelihoods, particularly of those relying on small-scale farming as a key source of income.

The two projects evaluated in this report - the Participatory Smallholder Agriculture and Artisanal Fisheries Development Programme (PAPAFPA; implemented 2003-15) and, its successor, the Smallholder Commercial Agriculture Project (PAPAC; 2015-2020) – focus on this group of farmers and on three value chains: cacao, coffee and pepper. The projects interventions revolve around the promotion of certified organic farming and the creation of export-oriented cooperatives in each value chain, together with the investment in rural infrastructure. The projects' cooperatives play a key role in the implementation of the interventions in the field, by working closely with the farmers and their associations, providing professional training, productive assets and facilitating linkages to the market. The interventions aim at increasing agricultural production in a sustainable manner via organic farming, enhancing market access and resilience to shocks, thereby promoting small farmers' income stability and food security.

Organic certification labels have been increasingly used across the world to pursue social and environmental sustainability in supply chains for agricultural products. However, there is still considerable debate surrounding their effectiveness in achieving those goals. Robust quantitative evidence of their impact on crop prices, productivity and overall welfare of rural livelihoods is scarce, and for São Tomé e Príncipe inexistent. Thus, the current impact assessment fills a gap in this literature by using a mixed-methods approach to assess and quantitatively estimate the impact of a project centred around certification schemes through rigorous counterfactual-based methods. Given the fundamental role played by the value-chain cooperatives in the project, it also contributes to a growing literature on the impact of associativism and cooperativism on the economic mobility of farmers and rural households.

The findings of this study, both arising from the qualitative and the quantitative evidence gathered, are in general positive. Project beneficiaries exhibit, as expected, significantly higher rates of organic certification than non-beneficiaries. Critically, they also appear to enjoy higher levels of crop productivity, crop sales revenues and market participation, income and asset ownership (particularly durables, productive assets and livestock), as well as greater dietary diversity and food security. These estimated effects are robust in magnitude and statistical significance to a suite of estimation approaches. It is also important to note that, with respect to the projects' impact on crop harvests, productivity and sales values, there is evidence that the effects are not exclusive to the projects value chains, but also extend to other cash-crops (sugar cane and tobacco) as well as fruit and tubers crops and livestock. This is consonant with the fact that some of the critical project interventions (e.g. professional development, access to productive assets) were not crop-specific but rather farmer-specific and can, therefore, generate positive effects on a broader range of agricultural

outputs.

More mixed results are found with regards to poverty reduction and vulnerability, though. For poverty reduction, the impacts of the project appear positive but, for the most part, deprived of statistical significance (in other words, there is no sufficient evidence that beneficiary households perform better than non-beneficiary households). There is, however, evidence of an increase in the probability of moving out of poverty by 8.9 percentage points among beneficiary households when a productive assets-based poverty line at the 60% percentile is considered. Concerning vulnerability, the interventions appear to have resulted in a smaller exposure to shocks for the treated households. However, this estimated effect is not statistically significant. On the other hand, there is evidence that the interventions did lead to a lower level income diversity. This is consistent with the fact that treated households were more likely to allocated efforts and resources to agriculture in general and to the project value chains, thus increasing the contribution of these activities to total household income.

Lastly, the projects' impact on women's empowerment was also assessed, since female farmers have been proposedly targeted by the interventions. The quantitative analysis did not find a statistically significant effect on this variable, which was proxied by the extent of women's control over household income. This contrasted with the very positive findings from the qualitative analysis, though, which reported higher levels of satisfaction with the programs among the participants in general, and in particular, among female farmers, who, among other things, praised the capacitation and professional development training received, which allows them to have a more prominent voice in the producers' associations and in their communities.

In terms of implications for development policy and practice, it is possible to state that organic farming appears to be highly valued by the project beneficiaries, who stress the fact that is better for their land, the farmer and the final consumers, at the same time it allows them to get higher prices for their products in the markets. Through a combination of integrated interventions, ranging from training in production techniques, to rural infrastructure and facilitating access to the market, beneficiary households appear to have achieved statistically significant gains in a realm of key indicators compared to their non-treated counterparts. Many of these gains appear connected to the role played by the project cooperatives in providing targeted mentoring and training, access to productive assets and market linkages. It is thus critical to guarantee that all the cooperatives are equipped with the tools necessary for financial, administrative and technical autonomy by the time the project PAPAC reaches completion, in 2020, and are sustainable in the long run.

1. Introduction

Ending poverty and hunger as well as ensuring a responsible use of land are two of the Sustainable Development Goals (SDGs) that the United Nations has committed to achieve by 2030. Smallholder farmers and labourers in rural areas in the tropics constitute most part of the world's poor (Cruz et al. 2015). Most of the world's biodiversity is in the humid tropics and there is growing evidence that organic farming increases both agrobiodiversity and the diversity of wild species (Borron 2006).

As a result, multiple interventions deployed to achieve these SDGs target rural areas, focusing on improving rural people's living standards and resilience to external shocks, and are often paired with the promotion of more sustainable land use via organic farming.

São Tomé and Príncipe (STP), a small island state in the Gulf of Guinea, has been a recipient of such interventions. As of latest estimates (WB, UNDP 2015), 35% of its population lives in rural areas, and agricultural goods, especially cacao beans (raw and roasted), constitute the bulk of the country's exports.[1] Although STP performs better than the Sub-Saharan Africa average on the UNDP Human Development index, poverty incidence has remained persistently high for the past two decades, with two thirds of its population and 68% of its smallholders living below the poverty line of US$3.2 a day.

STP main development challenges are linked to its insularity, small market size, limited human capital resources, and are compounded by a weak business environment and infrastructure (AfDB 2015). Its economy is insufficiently diversified and vulnerable to external shocks given its narrow export base and high dependence on imports. The agroecological conditions of STP make it almost impossible to grow cereals, legumes and food oils (except for palm oil). The country needs to rely on imported commodities which often are not accessible to poor smallholders, limiting their access to nutritious food (IFAD 2014). As a result, in-country food security policies typically aim at promoting the accessibility dimension by creating income opportunities for poorer households and supporting national production and exports.

The two interventions evaluated in this report - the Participatory Smallholder Agriculture and Artisanal Fisheries Development Programme (PAPAFPA) and the Smallholder Commercial Agriculture Project (PAPAC) - are fully aligned with the national strategies for poverty reduction, rural development and food security as stated in the Second National Poverty Reduction Strategy 2012-2016 and have been integrated in the national policies for the rural sector. Both interventions revolve around the development of certified organic family plantations and the support of four export cooperatives (two in the cacao value chain, one in the coffee and one in the pepper value chain) through the provision of trainings, financial and managerial education to farmers and small infrastructure projects. The programs' objectives are manifold but at their core they aim at increasing agricultural production in a sustainable manner, enhancing market access and resilience to external shocks thereby promoting small farmers' income stability and food security.

In more detail, the Participatory Smallholder Agriculture and Artisanal Fisheries Development Programme (PAPAFPA), implemented between 2003 and 2015, supported the development of a sustainable smallholders' agriculture of export value-chains in selected organic and quality cacao, coffee and pepper market segments. Among other things, this project's interventions, through the

[1] There is considerable overlap in the literature regarding the terms cacao and cocoa (which, in Potuguese, are both referred to generally as "cacau"). Cacao refers to the cacao plant itself and the products made from non-roasted seeds, whicle cocoa and cocoa products are made from roasted cacao beans. In this report, the term "cacao" will be adopted throughout.

proposedly created cooperatives and their articulations with local producers' associations, facilitated access to export markets and ensured higher and more stable free on board prices (as compared with the ones obtained by other operators in the country) for participant farmers, while also fomenting natural resources conservation and sustainability (via the promotion of organic farming) in STP.

Following the encouraging initial results of this program, IFAD and the government of STP agreed to consolidate its activities and extend its reach to a larger number of smallholders and producers' organizations in the selected value chains through the Smallholder Commercial Agriculture Project (PAPAC). PAPAC entered into force in 2015 with an IFAD amount of US$6 million and is expected to be completed by 2020. It aims at integrating and training 950 new farmers while continuing to provide technical support to the original farmers and producers organizations supported by PAPAFPA.

Considering this, this document lays out the strategy and the results of an ex-post impact assessment of both the PAPAFPA and PAPAC projects and carefully assesses their impact on rural livelihoods. The objective is to report on key outcome indicators identified within in the projects' logical frameworks and rigorously examine the impact of the interventions against these indicators.
The impact assessment presented in the following sections used a mixed-method approach in order to gauge the full range of tangible and non-tangible impacts. The data collection started with the identification of treated and non-treated (control) communities (villages) in STP through expert knowledge and validation. Control communities were defined as the ones that would meet the projects' cooperatives eligibility criteria and had characteristics similar to the beneficiary communities at the baseline (i.e. by the start of the projects).

A rigorous listing exercise then took place in 144 communities where 5.107 full enumeration interviews were conducted in order to identify a sample of (i) households treated by both projects (PAPAFPA-PAPAC), (ii) households treated only by the second project (PAPAC only) and (iii) households non-treated by either project. This resulted on a final sample of approximately 1,500 households for which a wide range of data on agricultural production, biographic and income characteristics, food consumption, and project participation among others was collected, guided by the findings from the qualitative study with farmers, community and producers' associations key members as well as technical experts.
Matching algorithms were then implemented to draw a valid counterfactual from the sample of non-beneficiary households. The project's effects on a range of outcomes were estimated from the comparison between this control group and the beneficiary famers.
A suite of estimation approaches was implemented to test the robustness of the estimates, including inverse probability-weighted regression adjustment, propensity score matching, nearest-neighbor matching and treatment effects with regression adjustment. The estimated results, arising from both the quantitative and the qualitative studies, find positive and statistically significant evidence of the projects' effects on crop productivity and sales revenues; income and asset ownership, suggesting considerable impacts on economics mobility; dietary diversity and food security. There is also evidence of increased resilience and women's empowerment (the latter mostly from the qualitative findings).

This study contributes to the literature that assesses the impact of organic certification programmes on rural livelihoods. STP has today the highest share of organic land in Africa (13.8% of total agricultural land, according to FiBL and IFOAM 2018). Certification labels have been increasingly utilized across the world by both the civil society and the private sector to pursue social and environmental sustainability in supply chains for agricultural products. They can also be a way to achieve more favourable terms of trade: organic producers often receive a premium for following

sustainability criteria as consumers and/or retailers are willing to pay higher prices to be assured of a certified organic origin (DeFries et al. 2017). The belief on the merits of organic certification is not universally shared though. Jacobi et al. (2015) or Kleemann et al. (2014), for instance, argue that voluntary certification programs are often mere marketing tools and can rarely play a role towards sustainable development. In effect, robust quantitative evidence of the causal link between organic certification and socio-economic or agroecological outcomes is not abundant or conclusive. Hence, the current study fills a gap in this literature by estimating the impact of a project centered around certification schemes on a range of key indicators through rigorous counterfactual-based methods.

Given the role played by the value-chain cooperatives in these projects, which will be fully described in the following sections, this study also contributes to the increasing body of literature on social capital and, in particular, cooperativism on the livelihoods of small-scale farmers (see Chagwiza et al. 2016; Ma and Abdulai 2016; Mojo et al. 2017 for recent examples of such literature).

The document is organized as follows: in the next section PAPAFPA and PAPAC theory of change is presented including the project background, targeting criteria, research questions, and relevance to the existing literature. In section 3 we discuss the impact assessment design, including a description of the data collection instruments, the indicators and the estimation strategy employed. This is followed by a description of the project area and sample collected. Section 5 presents the projects' results and section 6 concludes.

2. Theory of change and main research questions

Prior to assessing the impact of PAPAFPA and PAPAC projects in São Tomé e Príncipe, it is vital to first examine the projects' theory of change, which refers to how their activities and investments are supposed to bring forward the intended impacts. Also, important to be addressed are the relevant research questions for this impact assessment as they directly relate with the specificities of the projects.

2.1. PAPAFPA and PAPAC Theory of Change

The agriculture sector employs approximately 17% of STP's workforce (ILO 2017)[2] and contributes to close to 19.3% of its GDP (AfDB 2013). The country's economy is dependent on exports of a narrow set of cash crops of which cacao takes the lion share (over 70% of total exports in 2016 and 2017, World Bank 2018). Overall, and despite the progress made in several human development indicators in the past decades since independence, poverty remains widespread, particularly in the rural areas where it affects 65% of households (compared to 45% of the households in urban areas).

The agrarian reform undertaken in STP through the 1990s parcelled the existent state-owned farms (*roças* in Portuguese) and redistributed their most part to small farmers (typically former workers in the state *roças).* Smallholders agriculture in STP is characterised by low levels of productivity as a consequence the small size and/or lower quality of the cultivation areas, little mastery of farming techniques, inadequate access to water and general rural infrastructure, and by high levels of land abandonment.

On the commercial level, smallholder farmers and their producers' organizations face low demand and often declining prices for their crops in the formal market, intense competition in the informal market, and a series of constraints related to the lack of rural infrastructure, particularly with respect to irrigation, storage and processing facilities. The knowledge and level of cooperativism and associativism is the sector is incipient as it is the regulation of cooperatives at national level. In addition, STP's farmers must deal with an increasing exposure to natural shocks and disasters because of climate change, which is known to particularly affect the tropics. Small scale farmers are the most vulnerable to these changes given their limited adaptation capabilities (Borron 2006; Verchot et al. 2007).

The government of STP aimed to address part of the country's vulnerabilities and development constraints in this front by developing and strengthening producers' through the PAPAFPA and the PAPAC projects. PAPAFPA and PAPAC's were designed with the primary objective of improving rural people's lives, assuring them greater revenues from their products and greater food security. The projects main line of operations rest on developing and strengthening producers' associations within four cooperatives. These cooperatives promote the inclusive value chain development of certified organic market products as well as the professional development of smallholder farmers.

Existing evidence suggests that organic agriculture can contribute not only to an ecological dimension of resilience – by protecting the soil, biodiversity and the climate overall -, but also to a social dimension – by enhancing social and human capital through endogenous agricultural knowledge (Speranza 2010). Aligned with the latter, PAPAFPA and PAPAC have pursued an increase in smallholders' production and productivity levels through quality enhancement related to organic farming, thereby improving resilience to climatic and monetary shocks.

[2] This figure includes employment in forestry and fishing activities as well.

Specifically, PAPAFPA was implemented between 2003 and 2015 and its objectives revolved around three main axes:

(i) Building vulnerable rural people's capacities to develop economic activities by improving their access to new markets through the development of new products and the support to niche and sustainable value chains;
(ii) Strengthening rural services by financing productive infrastructure through dedicated funds, the *Fonds d'Infrasructure Communitaires* (FIC); and
(iii) Supporting rural areas by reinforcing farmers' organizations and their representation within governmental institutions, through the formation of value chain cooperatives and the strengthening of FENAPA, the National Federation of Smallholder Farmers.

As part of the first component, PAPAFPA supported the creation and legalization of three value chains crops through four cooperatives: CECAB for organic cacao, CECAQ11 for quality cacao, CECAFEB for coffee and CEPIBA for pepper. Each of these cooperatives, in turn, supported a number of producers organized in producers' associations/organizations.

All the crops supported were organic and fair trade certified by ECOCERT, a recognized control and certification body. For each cooperative a partnership with an international buyer was signed: CECAB established a partnership with KAOKA, CECAQ11 with Café Direct, CEPIBA with Hom&Ter/Agrisud and CECAFEB with Malongo. PAPAFPA also strengthening links with international organizations by signing an expertise agreement with CIAT, the International Center for Tropical Agriculture. The approach followed is backed by the existing literature in this field, which has shown that cooperatives can facilitate farmers' access to vertically integrated food supply chains (Wollini and Zeller 2007) and that market linkages interventions are more likely to succeed if enough support is provided through all stages in the value chain (Ashraf et al. 2009; Cavatassi et al. 2011).

In addition, under the same component, PAPAFPA rehabilitated and densified the cultivated areas of cocoa, coffee and pepper; installed transformation and storage infrastructure; and provided the producers (of which 30% were women) with trainings on agricultural production techniques as well as post-production, transformation and commercialization.

Under the second component, the programme was responsible of reinforcing the availability of services to the rural areas through the operationalization of the *Fonds d'Infrastructure communautaires* (FIC), a fund that was started by PNAPAF, another IFAD-supported project which closed in 2002. The aim of FIC was to address part of the needs of STP's rural population in terms of socio-economic infrastructure by providing rural areas with drinkable water installations, latrines, construction or rehabilitation of rural roads, agricultural irrigation, driers and storage facilities. Interventions of this sort, related to investment in rural infrastructure and road networks, are usually associated with a positive impact on agricultural productivity and on rural GDP and poverty reduction (Knox and Hess 2013).

Finally, under the last component, FENAPA was reinforced and supported by increasing membership of PAPAFPA producers' associations and cooperatives. FENAPA plays an important role with the dialogue with the government, and in the professional development of small-scale farmers by organizing workshops, providing market information to producers and exchanging programs to foster their skills.

Given the encouraging results achieved by PAPAFPA, PAPAC (2015-2020) was conceived and designed to consolidate the former project activities towards reducing rural poverty and food insecurity. As part of the inclusive value chain development, PAPAC aims at integrating and training

950 new farmers while continuing to provide technical support to old producers (i.e. those supported originally by PAPAFPA). The project focuses both on the support of family plantations development and on strengthening the producer's organizations and the cooperatives created under PAPAFPA.

The substantial innovation that PAPAC introduced was to enter in a contractual partnership with the cooperatives and to have them directly carry out the activities necessary to develop family plantations. In the context of family plantations development, similarly to PAPAFPA, PAPAC provided the creation, rehabilitation (through pruning, grafting and replanting) and densification of plantations (cacao, coffee, pepper). It also supplied smallholders with equipment and organic materials as well as technical trainings on improved and organic techniques and financial management. According to the literature, the introduction and extension of organic farming are often associated with higher tree and crop diversity, larger yields and incomes, as well as an increased participation in trainings and overall social connectedness (Jacobi et al. 2015).

In the context of producers' organizations specifically, PAPAC aims to consolidate the activities started under PAPAFPA in terms of strengthening the four cooperatives and their producers' organizations. It does so through capacity and skills development trainings on financial and administrative management, strategic planning, trade strategies, international exchanges, juridical and commercial support. In addition, the project also provides rural infrastructure and equipment such as driers, storages with fermentation boxes, irrigation structures and tracked vehicles.

These inputs and activities are expected to impact project beneficiaries in the following ways. First, new and old producers are professionalised on a technical and economic basis and, therefore, the production capacity of rural actors is reinforced. Second, as a result of the producers' organization strengthening and the upgraded rural infrastructure the quality of the produce can improve, which facilitates commercialization and higher prices. In addition, the contractual agreements between buyers and cooperatives, which are expected to be managed in an efficient and transparent manner, establishes a minimum guaranteed price for the agricultural products. These minimum prices allow for greater flexibility and loss minimization in case of commodity price shocks. In effect, at the beginning of 2017 there was a major drop in international cacao prices. However, because of the minimum guaranteed price for organic and Fair-Trade commodities, organic producers suffered the market shock to a lesser extent than the other cacao producers.

Ultimately, these interventions (through PAPAFPA and PAPAC) are expected to lead to increased and/or more stable agricultural production, income and food security for producers' households, while improving their resilience to market and climate related shocks. These expected results conform with some of the key existing literature in this field, which shows that organic farmers, who use agroecological farming methods, are expected to be more food secure, eat more diversified diets, have higher crops diversity and experience better health outcomes (Altieri, Funes-Monzote, and Petersen 2012). At the producers' associations and cooperatives level, on the other hand, the interventions are expected to have strengthen institutionally and financially the four cooperatives and their member producers' associations, and to contribute to the development of sustainable contractual relationships with individual producers and international partners.

Even though at the time of the agrarian reform land was distributed to previous workers of the state owned *roças* regardless of their gender (and thus many parcels ended up in the hands of women), female farmers in STP still face disadvantages consequent of historically persistent gender inequality. For instance, female producers have not only to manage all farming activities like their male counterparts. They are also often responsible for most household chores and children education on top of that. To counteract this disadvantage, the projects had a strong focus vis a vis the inclusion of

women producers in through specific targeting. Thus, gender empowerment impacts associated with the projects are expected both within the household and within the producers' associations.

2.1.1. Unintended consequences and assumptions

During the inception mission in March 2018, cooperatives members raised concerns that an increase in production might entail a decrease in quality, if it is not backed up by the adequate and timely improvement in storage, processing and quality control. This possible effect will be tested in the analysis by taking into account average sale prices and sales revenues for each project crop.

It is also a possibility that the projects' interventions had spillover effects, either positive or negative, to nearby non-beneficiary farmers and communities. For example, considering PAPAC's activities regarding training in organic production techniques, it is possible that this knowledge was shared with producers outside the cooperatives and project areas (this is a known effect in the agricultural extension literature - see for instance Witt, Pemsl and Weibel (2008) which discusses information diffusion effects based on a Farmer Field School study in Senegal). Other possible spillovers may arise from the fact that the interventions led to a better organization at the community level and increased business opportunities that benefitted also farmers that did not belong to the cooperatives. In addition, according to the perceptions of beneficiaries assessed during the qualitative stage of this study, the rehabilitation of abandoned land resulted in a reduction of rural to urban migration. This is, the projects are likely to have impacts beyond those originally intended regarding agricultural production and rural households wellbeing. The possibility of these spillover effects, in special those concerning the outcome variables of interest, will be taken into account in the identification strategy used in this impact assessment. The approach followed to address them will be discussed in the methodology section.

Critical to the success of PAPAFPA and PAPAC interventions are the assumptions that the activities and inputs supplied were appropriate for the context of the country, there was demand for them and both farmers and producers' associations were effectively targeted by the projects and willing to participate in their activities. The findings from the qualitative and quantitative analysis offered support to these assumptions.

Figure 1 below summarizes the theory of change described above for both projects by illustrating the causal mechanisms through which project impacts emerge from inputs and activities, and its key assumptions.

The projects' inputs and activities considered in this assessment comprise two components: (i) family plantation development and (ii) producers' associations strengthening; and projects' impacts will be discussed both at household and producers' associations level.

Figure 1: PAPAFPA and PAPAC Theory of Change

2.2. Project coverage and targeting

PAPAFPA and PAPAC have been implemented nationwide in São Tomé and in the independent region of Príncipe.

The immediate project beneficiaries were the four cooperatives formed at the inception of PAPAFPA. These four cooperatives, as of September 2018, have in turn supported 3926 producers, grouped in 86 producers' associations spread over 108 communities nationwide.

The selection of the beneficiary communities and respective producers was undertaken by the projects' cooperatives and followed a similar approach for all value-chains. Producers in STP were informed about the existence of PAPAFPA (and then PAPAC) and the possibility to apply to one (or more) of the cooperatives in order to receive the projects' interventions. After receiving the application, cooperative leaders would conduct a needs assessment and check the producers' eligibility criteria.

Through the assessment of program documents, discussions with experts and field visits, it was understood that the selection of eligible communities followed a mixed approach: both based on an objective assessment of needs and capacities of the producers within the community, and also demand-driven, particularly as the programs' popularity spread, with interested farmers and/ producers' associations directly requesting inclusion in the program.

Each cooperative set its exact standards for selection as presented in the table below. Generally speaking, communities were selected on the basis of showing interest in participating the program as expressed by a number of local producers who (i) had space to build infrastructure, (ii) showed good social conduct, (iii) had not applied toxic products in the previous years and, very important, (iv) were smallholders. Furthermore, the creation of associations of producers was a precondition to all communities to join both projects.

Table 1: Cooperatives Eligibility Criteria

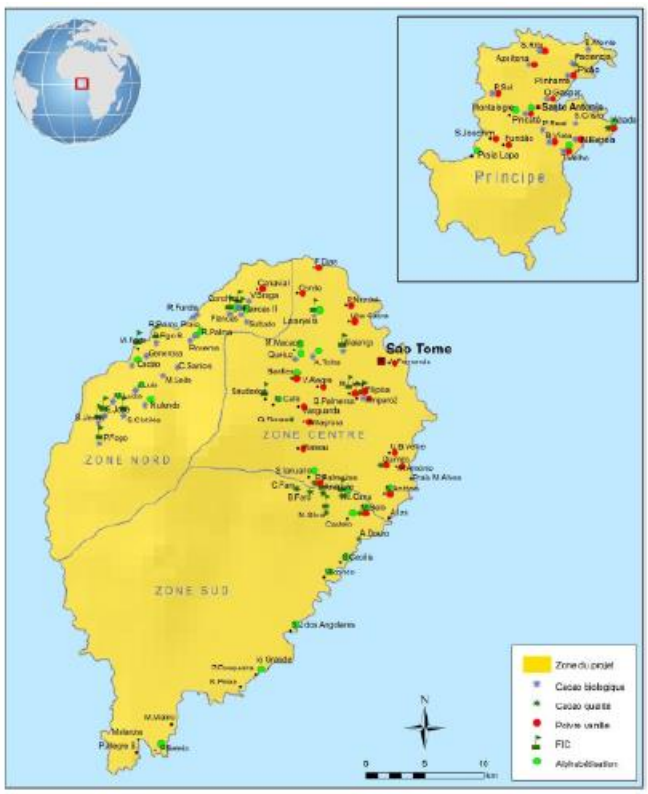
Cooperative	Eligibility Criteria
CECAB	- Having a plot in the community - Plot must be cultivated - Space to build infrastructure at the association level - Good social conduct - Not having applied toxic products in the last 3 years - Priority given to poor households
CECAQ11	- Having a plot in the community - Plot must be cultivated - Space to build infrastructure at the association level - Farmer must have access to the community - Not having applied toxic products in the last 3 years - For associations: minimum 11-15 producers in order to join cooperative - Membership must be approved by the cooperative's general assembly
CECAFEB	- Producers must be smallholders with interest in growing organic coffee

CEPIBA	- Qualify as a poor rural farmer (priority to women and young farmers given) - Qualify as owner of a plot (either cultivated or not) - Be a motivated farmer - Cooperative supports and distributes material corresponding to an area of 0.25ha through PAPAC (previously 1.25ha with PAPAFPA) -

PAPAC was designed to target an estimated 18,500 individuals (this is, including the beneficiaries' whole household), of which 1/3 were supposed to be women household heads and 1/3 young people. However, the project failed to include the latter group as planned due to a basic structural reason – their limited access to land in STP, which was a requisite for project eligibility.

Figure 2 below illustrates the geographical distribution of the beneficiary communities as of 2014.

Figure 2: Project map – Beneficiary communities



Source: IFAD (2014)

2.2.1. Cooperatives coverage

The four project cooperatives vary greatly in terms of size, number of producers, production and geographical coverage. Table 2 below illustrates the number of producers within each cooperative who received support from 1) PAPAFPA and continued to receive support under PAPAC and 2) new producers that were included in the project starting from 2015 under PAPAC (PAPAC-only), and 3) beneficiaries that received support from two program cooperatives, based on the M&E data.

PAPAC is currently supporting 3929 farmers. Unfortunately, it is not possible to know the total number of producers supported since the inception of PAPAFPA since some of the cooperatives did not keep a record of producers that exited the cooperative and hence the program.

Table 2: Number of beneficiaries by cooperative

Cooperative	PAPAFPA & PAPAC	PAPAC only	Beneficiaries with double support
CECAB (organic cacao)	2139	214	51
CECAQ11 (quality cacao)	1135	228	41
CECAFEB (coffee)	420	205	52
CEPIBA (pepper)	358	187	20
TOTAL[1]	4052	834	164

[1] The total includes beneficiaries that are supported by more than 1 cooperative.

Table 3 provides a counting of the number of beneficiaries receiving support from two program cooperatives. As shown the most common scenario is combining support from a cacao cooperative (CECAB or CECAQ11) and CECAFEB. The number of producers falling in this situation is, however, relatively small compared to the whole treatment group.

Table 3: Number beneficiaries supported by two cooperatives

Cooperative	CECAB	CECAQ11	CECAFEB	CEPIBA	TOTAL
CECAB	0	10	25	16	51
CECAQ11	10	0	27	4	41
CECAFEB	25	27	0	0	52
CEPIBA	16	4	0	0	20

Regarding female inclusion, the average share of female producers across cooperatives is 36%. The cooperative with the highest proportion of female producers is CECAFEB with 38% of women, while the cooperative with the lowest proportion is CECAB with still 33% of female representation. Producers' associations within the cooperatives have all mixed composition in terms of gender.

Unfortunately, most cooperatives do not have records of the age or birthdate of their producers, and this prevented assessing the inclusion of young people or age differentials. Only CECAQ11, and to some extent CEPIBA, were able to provide this information. According to the data, the average producer is 50 years old – 50 for CECAQ11 producers (1134 observations) and 46 for CEPIBA (99 observations).

Table 4: Number of female beneficiaries by cooperative

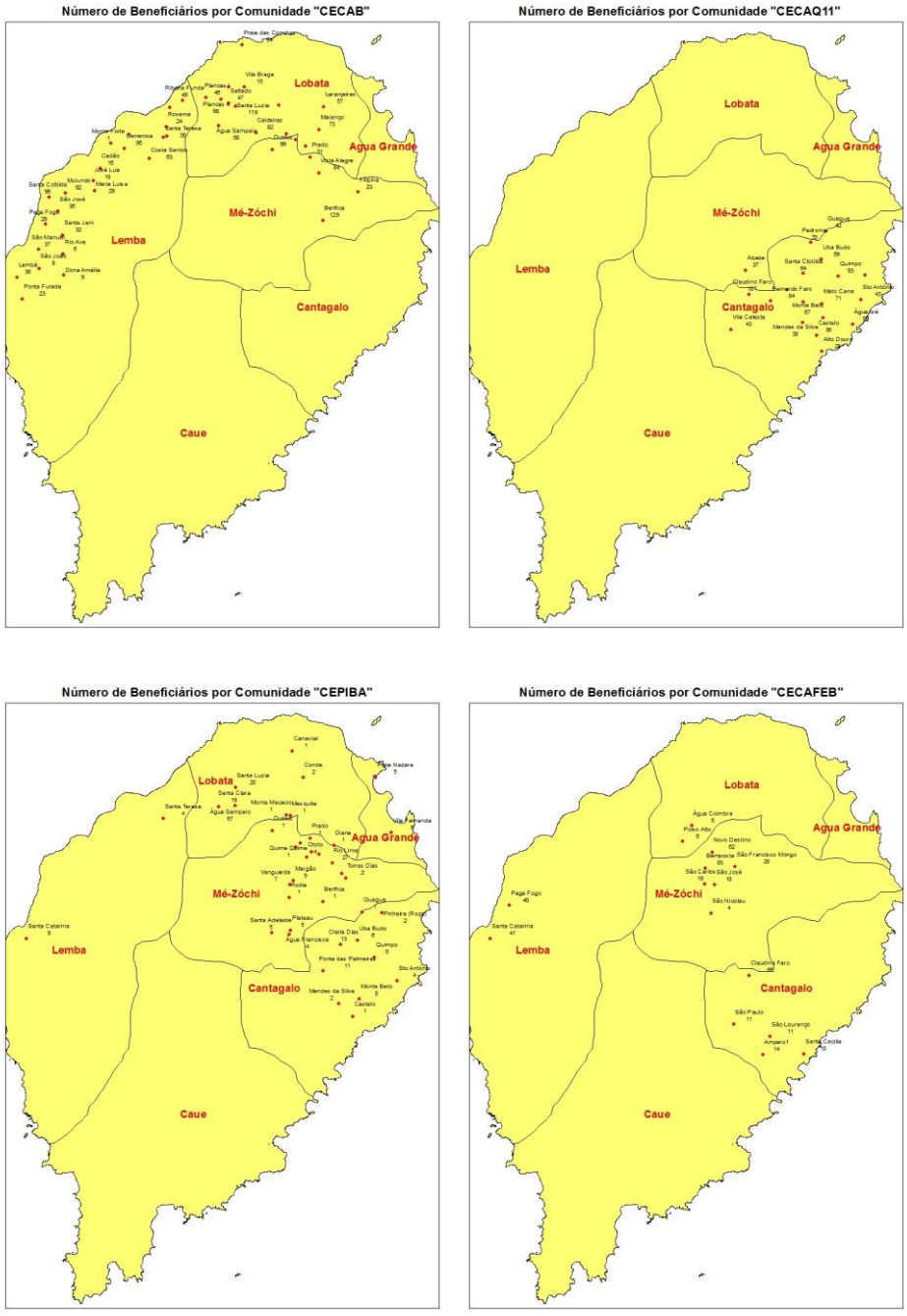
Cooperative	Total producers	Female producers	Percentage of Female
CECAB	2139	715	33%

CECAQ11	1135	393	35%
CECAFEB	420	160	38%
CEPIBA	358	130	36%

2.2.2. Geographic coverage

The cooperatives cover different areas of the country. CECAB is in the north, north-west, CECAQ11 in the center-east, CEPIBA in the center and north-east as well as in Principe, and CECAFEB is spread in the center-north. Some communities received supported from more than one cooperative. Figure 2 displays the cooperatives geographical coverage.

Figure 2: Cooperatives geographical coverage



Overall, the number of communities that benefited from the two projects is 108, including Príncipe, and the average number of beneficiaries in each community is 34, ranging from a minimum of one to a maximum of 129 producers. Table 5 illustrates the number of communities covered by each cooperative.

Table 5: Number of communities by cooperative

Cooperative	Producers	Communities	Average N producers by community	Min	Max
CECAB	2139	44	49	1	129
CECAQ11	1135	21	54	28	107
CECAFEB	420	15	28	4	93
CEPIBA	358	52	7	1	57

Cooperatives have struggled to provide production data disaggregated at farmers' level. However, based on the information supplied it is estimated that the average plot size of project beneficiaries is about 1.8 ha for cacao producers and 0.2 ha for pepper and coffee producers. Table 6 illustrates the most recent production estimates for each cooperative.

Table 6: Production levels and yields by cooperative

Cooperative	Productions (Tons)	Surface (ha)	Surface per capita (avg. ha)	Yield (Kg/ha)
CECAB (2018)	1200	4560	2.1	263
CECAQ11 (2017)	350	1800	1.6	194
CECAFEB (2017)	8.4	384 (of which 94 are productive)	1.1 / 0.2	246
CEPIBA (2017)	15	81	0.2	239

2.3. Research questions

A number of testable hypotheses can be derived from the projects' TOC outlined in Figure 1. Based on those hypotheses, this impact assessment aims at answering the following research questions:

1) Do beneficiary households experience greater and more stable incomes, food diversification, greater access to markets and increased agricultural productivity?

2) Is there any evidence of gender empowerment in beneficiary households, namely are women more involved in the productive workforce and households' decision-making? Do they have larger control over their income and production?

3) Are beneficiary households more resilient to climatic and commodities price shocks?

4) What is the impact of organic certification on production levels and household well-being?

5) Are producers' associations and the cooperatives resilient, financially and administratively viable and self-sufficient?

3. Impact assessment design: Data and methodology

3.1. Data

The ex-post impact assessment of PAPAFPA and PAPAC required an extensive process of data collection and relied on a mixed-method strategy, consisting of both qualitative and quantitative data collection and analysis, in order to seize the full range of tangible and intangible project impacts.

The qualitative study relied on a representative sample of producers, producers' associations, as well as cooperative leaders and technical experts.[3] This study was primarily designed to inform the development of the quantitative questionnaires by delving into the understanding of the targeting and inclusion criteria of the projects, implementation approaches, main challenges faced by producers and the different value chain actors. The information collected from this study was also used to triangulate the findings of the quantitative research and to obtain a deeper understanding of the projects' results.

Overall, the qualitative study revealed a generalized positive outlook regarding the projects' interventions and their benefits to the communities. All or almost all producer participants reported having benefited from some working material support (e.g. production kits, machetes, buckets) and demonstrated high levels of satisfaction with organic farming. Female producers, in particular, reviewed the interventions very positively, emphasizing the professional and capacitation received and how it contributed to a greater sense of knowledge and equality vis-à-vis their male counterparts in the producers' associations.

The quantitative data, on the other hand, consisted of two separate questionnaires: one administered to a sample of 1,404 households and another to a sample of 126 leaders/key member of communities and/or producers' associations. The household survey collected information mainly on household level indicators related to agricultural production, consumption, wealth, income, vulnerability and social capital. The producer' associations survey, on the other hand, focused mainly on indicators related to community level agricultural markets, infrastructure, associativism and resilience.

A common challenge in conducting an ex-post impact assessment is establishing a valid counterfactual, i.e. determining what would have happened to the beneficiaries in the absence of the project. Ideally, one would like to compare the state of the beneficiaries with and without the project interventions. But that is obviously not possible. Therefore, a group of non-beneficiary units which mirror the state of the beneficiaries had they not received the projects' interventions must be identified. The observed difference in the outcomes of interest between the beneficiaries and the selected counterfactual (control) group can then be taken as the impact of the project (Winters et al. 2010), provided a set of identification assumption is met. The quality of the identification strategy is therefore extremely dependent on the identification of a control group that can serve a valid

[3] In particular, two gender-specific focus group discussions (FGD) in each value chain were conducted, in a total of 14 focus groups organized with old (PAPAFPA + PAPAC) and new (PAPAC only) producer's associations members involving a total of 52 individuals. In addition, the sudty also included 13 Key Informant Interviews (KII), with producers that do not belong to any of the supported cooperatives, producers' associations leaders supported by the cooperative and cooperative's technical specialists – one per cooperative included in the process (CECAFEB, CEPIBA, CECAB and CECAQ11). Finally, for a better understanding of the impacts unleashed by the interventions, three interviews were conducted also with private sector partners (buyers) of the cacao, coffee and pepper value chains.

counterfactual. This is a challenging task, especially in ex-post assessments with no or limited baseline data such as in this case.

In this impact assessment three main data-related challenges were faced. First, not all cooperatives were able to provide the full list of projects' beneficiaries, nor the extent of support received by them. Second, a list of communities with similar characteristics to the treated communities was not available.[4] And neither was a list of producers, by community, from which the control group could be drawn since there is no national farmers registry in the country. Third, there was no baseline survey data, i.e. prior to or at the inception of PAPFPA, that could have informed power calculations and help identify the adequate control group of producers.

Given these constraints, the quantitative data collection was approached in three stages. The first stage consisted of the identification of possible counterfactual communities through expert-based knowledge and validation. Counterfactual communities were defined as the ones that would meet the cooperatives inclusion criteria and were similar to the beneficiary communities prior to the start of the projects. This exercise identified a list of 36 communities which had never benefitted from either PAPAFPA and PAPAC and could therefore be considered as "pure" control communities.[5]

Second, following the identification of treated and non-treated communities, an enumeration or listing of the producers' households was conducted within the relevant communities. This exercise consisted of an inventory of producers' households in the 108 communities where the projects took place (PAPAC and PAPAFPA) and in the 36 (control) communities that were not targeted by either project but that qualified, according the experts and cooperatives' assessment, as being eligible. It served as the starting point for sampling producers' households across these communities of interest. This was a fundamental step prior to the main household survey because it allowed to randomly select the required number of households from the eligible populations of interest.

The listing questionnaire captured mostly eligibility criteria and treatment intensity. More precisely, information on the following variables was collected: (1) whether the producer was a smallholder, (2) her/his age and sex, (3) cooperative membership status and membership duration if applicable, (4) main value chain (cacao, coffee and pepper), year when it started and other crops grown in the previous 5 years; (5) whether there was parcel rehabilitation; (6) number of plantations (by grafting status); (7) location through geo-referencing (GPS), and a series of dummy variables indicating the producer status vis a vis (7) whether the producer had ever benefited from the support of a cooperative; (8) whether the producer ever left the projects 'cooperative; (9) whether s/he was member of FENAPA; (10) willingness to join a cooperative; (11) willingness to join a producer association; (12) whether they were members of producers associations (formal or informal); (13) whether they were part of producers groups (informal); and (14) whether they submitted a request to join treated cooperatives. To assess treatment distribution, questions were also asked on whether the producer benefitted from PAPAFPA-PAPAC, PAPAC only or none of these projects at all.

Lastly, in the third stage, the data resulting from the enumeration was used as a sampling frame for randomly selecting a sample of producer households who received the final questionnaire. This sample included: (i) beneficiaries of PAPAFPA and PAPAC, (ii) new beneficiaries of PAPAC only, and (iii) non-beneficiaries to be used as counterfactual.

In absence of random assignment, the counterfactual is normally mimicked statistically. In this case, the appropriate counterfactual identification required both a sound understanding of the projects'

[4] For clarification, as explained in the previous section, not all communities in the country received the project interventions. And within the treated communities, not all producers were treated.

[5] In addition to the non-beneficiary "pure control" communities, 26 other communities were also identified as "low intensity" communities. These consisted of communities where 20 or less producers benefited from the projects, and was made of new CEPIBA communities that entered the project only in 2015, with PAPAC, on which any impact of the project is expected to be minimal, especcially because, different from cacao and coffee, pepper plantations take many years to become productive.

implementation, as informed by experts and the qualitative study and, crucially, of their eligibility criteria. Recall that the selection (into treatment) was not only based on objective eligibility criteria (e.g. being a smallholder, not having used toxic products previously or committing to organic farming, etc.) but also demand-driven. Discussions were held with project staff, as well as with a range of beneficiaries and non-beneficiaries through the qualitative study, to ensure that the determination of the counterfactual mimicked as close as possible the targeting and selection into treatment strategy. Using this information, matching algorithms based on fixed characteristics of the farmers (e.g. biographic and geography-related), their productive profile (crops farmed, plants and yields) and eligibility criteria[6] at the baseline (which, in the questionnaires, was set in at 2008) were used to find a valid counterfactual group of producers' households. The exact list of variables used in this exercise is listed in Table 9. The key assumption in this approach is that conditional on the above-mentioned observables selection intro treatment is as if random, and thus there are no systematic differences between the two groups of treated and non-treated households, and, therefore, no selection bias.

It remains to be noted that the setup of the projects' interventions, which revolved around farmers professionalization in organic cultures and cooperatives financial and administrative strengthening, can produce large spillover effects among households within the communities that were supported by PAPAFPA and PAPAC. This was a clear finding of the qualitative study. Spillovers beyond the treatment communities are also possible, although less expected, with the 'contamination' effect likely to decrease with distance. Producers might share the knowledge obtained through trainings to their neighbor and peer farmers, who would be considered as spillovers farmers. In addition, beneficiaries can share the benefits of belonging to a cooperative, therefore encouraging other farmers to meet the requirements to access a cooperative and apply for it. This being the case the identification strategy outline above will lead to a likely underestimation of the projects' impacts as it will not factor in the fact that (at least) some of the control households were also affects by the projects, albeit indirectly. To address this concern, a neighborhood effects model, which directly models the 'neighborhood' (proximity) effect of the program and the likely contamination to non-beneficiaries, was also estimated. Further details of this approach are given in the methodology section.

3.2. Questionnaires and impact indicators

The household's questionnaires for the PAPAFPA and PAPAC impact assessment were designed to collect detailed information on household socio-demographic characteristics, agricultural and livestock production, asset ownership, adoption of certified and organic agricultural practices, food security, resilience, sustainability, access to markets, associativism, and women's empowerment. The questionnaires conducted with the community leaders and producers' associations, on the other hand, focused on infrastructure and public goods availability, resilience, access to market and associativism.

The detailed household and producers' associations information derived from these questionnaires was used to put together the following key impact indicators, previously identified in the theory of change section of this report.

i. Agricultural production, productivity and diversification

Given the projects' focus on the farmers' professional development, a good starting point to measure the effectiveness of the projects is to assess whether the productive capacity of the beneficiary farmers was reinforced. A key component of the projects is the promotion of certified and organic

[6] See Table 1 for the elegibility criteria.

agricultural techniques and products across three main crops: cacao, coffee and pepper. Thus, to test whether the projects are associated with increased or more stable agricultural production and productivity this impact assessment will use yields per crop, defined as the output per unit of land (kg/ha), comparing project value-chains with other crops cultivated by farmers.

For livestock production, household livestock ownership, the number of livestock units owned, and the amount of animal products produced (based on the number of animals slaughtered, milked or laying and on the quantity of meat, milk or eggs produced) by the household are used.

To measure productivity, the rate of production for given inputs (such as seeds) will be applied, again by crop and comparing organic vs. non-organic and certified vs. uncertified farming.

Lastly, the extent of agricultural diversification was also considered. Agricultural diversification is a concept of allocating resources to an increasing number of agriculture activities. It can be measured using different indices ranging from a simple count index to more complex indices such as the Shannon index. In this impact assessment, a range of measures including a crop diversification count and crop diversity indices are used. The Margaleff and Berger Parker index was computed to measure livestock diversification.

All agricultural-related variables used for this purpose cover a full agricultural season (12 months) preceding the time of the survey, covering wet season (September 2017 to May 2018) and dry season (June to August 2018).

ii. Income and household wealth

Rural household income and asset-ownership indicators are key in assessing the impact of development policies. In the context of this study, agricultural income, household income indicators and asset-based indices were used to evaluate the impact of the projects on household welfare and economic mobility. Asset ownership data, on the other hand, also relied on recall data (more precisely, 10 years prior to the data collection date). Thus, while changes in income are assessed exclusively based on the differences between the beneficiaries and the control group, for asset ownership this study also considers a longitudinal perspective, by considering the (recalled) change in asset ownership between 2008 and 2018 at household level. This longitudinal data was used to compute the poverty reduction indicator discussed in item 3 below.

The aggregate household (gross) income indicator was computed as the sum of the total value of crop production, the total income from livestock and livestock products, the total income from wage employment (agricultural and non-agricultural), self-employment activities and transfers (private and public). Total net income was also computed by discounting from the above the relevant input and costs, such as expenditures on seeds, fertilizers, pesticides and labor (for crop income), or on feed, vaccination and veterinaries, and labor (for livestock income) or other costs associated with the self-employment activities.

Income from agriculture was computed as the sum of crop income (total value of crop sales, sales of by-products and own consumption), livestock income (total value of livestock, carcasses and by-products sales as well as own consumption of livestock and its by-products) and agricultural wages (total cash and in-kind wages from agricultural employments).

To capture household income diversification, which is often inversely associated with economic vulnerability, several measures were considered: a simple count of the number of household income sources, and three diversity indices (Gini -Simpson, Barger-Parker and Shannon).

Lastly, to measure the long-term impact on households' wealth, asset ownership indicators were also considered. Hence, asset indices were constructed by household, by assigning weights to the counts of each asset item based on their distributions in the dataset, for the following: (i) durables; (ii)

livestock, (iii) productive assets, and (iv) housing assets. These asset indices aggregate household stocks with different units into a single measure using weights from principal components analysis (PCA) or multiple correspondence analysis (MCA) depending on whether the original variables were continuous or discrete, respectively. An overall asset index was then also computed using the polychoric factor analysis methodology as it is recommended when aggregating different indices (Kolenikov and Angeles 2004).

For the livestock, an additional measure of livestock units owned was computed - the tropical livestock unit (TLU) - by assigning weights to each livestock type owned according to the FAO TLU conversion factors for tropical Africa.

iii. Poverty reduction and vulnerability

Poverty metrics were also constructed based on the above-mentioned asset-based indicators to measure the probability of moving out of poverty. Asset-based poverty lines are the relative poverty lines calculated using asset information from households' recalled responses at baseline (set at 2008 in this study as explained above). These lines were set at the 40th and the 60th percentiles of the baseline asset index distribution (Booysen et al. 2008).

Indicator variables measuring whether a household is below or above the relevant poverty line were constructed based on the distribution of the asset index at the baseline and at the time of the survey. Based on these indicator variables households were then classified into four possible states: either moving out of poverty (if they were below the poverty line at the baseline and above it at the time of the survey); remaining poor (if they were below the relevant poverty lines in both periods); remaining out of poverty (if they were above the relevant poverty lines in both periods); and last, moving into poverty (if households were above the poverty line at baseline but moved below the poverty line at the time of survey).

In this assessment, household exposure to shocks is used as a measure of vulnerability. This measure is a weighted average of the incidence of experience of a shock in the five-year period prior to the survey multiplied by the perceived severity of the respective shock. A range of climate, economic, conflict and family (e.g. illness, death) related shocks were considered in the survey.
In addition, measures of income diversification, as described above, will also be presented to assess the project's impact on vulnerability.

iv. Dietary diversity and food security

Dietary diversity is a qualitative measure of food consumption that proxies the nutrient adequacy of an individual's diet by revealing household access to a variety of foods. To measure dietary diversity a household dietary diversity score (HDDS) was used. This consists of a simple count of food groups that a household or an individual has consumed over the preceding 24 hours.

To measure food security the Food Insecurity Experience Scale (FIES) was used. The FIES is a measure of severity of food insecurity at the household or individual level that relies on people's direct yes/no responses to eight brief questions regarding their access to adequate food, each of them referring to a different level of severity in food security. Being an experience-based food insecurity type of index, the FIES captures not only any compromised diet quality and reduced food quantity, but also psychosocial elements associated with anxiety or uncertainty related to the ability to procure food.

v. Resilience

Household resilience was proxied by the household ability to manage or recover from shocks and stresses. To this end two measures were computed: the household ability to recover from shocks, and the Pastoralist Areas Resilience Improvement and Market Expansion (PRIME) resilience index (Smith and Frankenberger 2015).

The ability to recover from shocks index was calculated based on the households perceived ability to recover from typical shocks adjusted by their respective severity and frequency in the project area in the year prior to the survey.

The PRIME resilience index, on the other hand, is based on the combinarion of different indices, via polychoric factor analysis (PFA), to capture an household's absorbtive, adoptive, and transformative capacity in face of a shock, in other words, their ability to mitigate, adapt to and recover from schocks and stresses.

vi. Market access and commercialization

Improving smallholder farmers market access was a key objective of these projects. Given its multiple facets market access was evaluated using both quantitative and qualitative data obtained from focus group discussions and experts interviews. The measures evaluated included: the time to transport produce to the market (considering the largest transaction made); the sales value of crops and by products; the sales value of live animals, meat and associated by products (milk, honey and eggs in this case); and the number of buyers of agricultural produce (considering the month before the survey).

At the producers' associations level access to markets and infrastructure (fundamental for adequate access to market) was also assessed based on the (i) distance of the association to the closest paved road, and (ii) on the availability and distance to a daily and a weekly market.

vii. Women's and youth empowerment

Drawing on the household questionnaire the projects' impact on women's empowerment was assessed based on three indicator variables measuring whether any woman in the household had control over day to day money management decisions.

As explained above, "young households" (i.e. those where the household head was 32 years old or younger at the time of the survey) were not specifically targeted by the projects or in the sampling design used for this impact assessment. However, the final sample of treated and control households did include a number of youths, which allowed to explore the project's impact on youth empowerment. For that purpose, as indicator variable analogous to the one described above to proxy women's empowerment was computed to proxy youth control over income within the household (more precisely, whether anyone in the household under 32 years of age had control over household income management decisions).

3.3. Impact estimation

As explained above, in order to estimate the projects' impact a simple comparison between beneficiaries (treatment) and non-beneficiaries (control) households leads to unreliable estimates due to the presence of selection bias. Systematic observable and unobservable differences might exist between the two groups, making the latter an invalid counterfactual. For example, farmers with higher levels of social capital, more informed or more entrepreneurial might be more likely to join the projects' cooperatives, but equally more likely to obtain higher agricultural productivity even in the absence of the project's interventions. Thus, observed differences in productivity between

project beneficiaries and the control group might not be entirely (or at all) due to the project but rather arise from pre-existing differences between the two groups of farmers (i.e. beneficiaries and non-beneficiaries).

More formally, under the potential outcome framework (Roy 1951; Rubin 1974), the treatment effect and the selection bias introduced by the use of a control group can be expressed as follows. Consider a treatment indicator D_i which is equal to 1 if the individual i receives the treatment and equal to 0 otherwise, with i=1, …, n. The potential outcomes are defined as $Y_i(D_i)$.

The most common parameters of interest in the evaluation literatures are the average treatment effect on the treated (ATT) and the average treatment effect (ATE), defined as follows:

$\tau_{ATT} = E[Y(1) \mid D = 1] - E[Y(0) \mid D = 1]$ (1)

$\tau_{ATE} = E[Y(1) – Y(0)]$ (2)

The counterfactual mean for beneficiaries $E[Y(0) \mid D = 1]$ should be observed for the ATT estimation (as in equation (1) above), while both the counterfactual means for beneficiaries $E[Y(0) \mid D = 1]$ and non-beneficiaries $E[Y(1) \mid D = 0]$ should be observed for the ATE estimation. As these are obviously not available, adequate and feasible substitutes for these counterfactuals must be obtained.

In non-experimental studies, such as this impact assessment, using the mean outcome of non-beneficiaries $E[Y(0) \mid D = 0]$ as a substitute for $E[Y(0) \mid D = 1]$ is most likely going to lead to biased and inconsistent estimates of the ATT due to selection bias, given by the difference $E[Y(0) \mid D = 1] - E[Y(0) \mid D = 0]$ as follows from the equation below:

$$E[Y(1) \mid D = 1] - E[Y(0) \mid D = 0] = \tau \text{ ATT} + \underline{E[Y(0) \mid D = 1] - E[Y(0) \mid D = 0]} \quad (3)$$

To address this selection bias and obtain reliable estimates of the ATT and ATE of the projects, identification assumptions are required. The approach in this assessment is to employ a propensity score matching (PSM) based on the 5 nearest neighbors as a starting estimator, followed by the Inverse Probability-Weighted Regression Adjustment (IPWRA) estimator, which is the reference method for this study. Both methods and their identification assumptions are discussed in greater detail below.

3.3.1. Propensity Score Matching

Propensity score matching relies on two key conditions in order to produce reliable ATE estimates: the conditional independence assumption (CIA) and the common support assumption.

The common support assumption requires that for each treatment observation there is at least one comparison control observation with the same probability of being treated conditional on a set of observables, and analogously for each control observation. The probability of being treated given a set of observables (X) is given by the propensity score – p(X). The ATT and ATE can be identified only on the area of the common support – observations off this common support will be dropped for estimation purposes.

This condition rules out the possibility of perfect predictability of receiving/not receiving treatment given X. It ensures that persons with the same X values have a positive probability of being both participants and non-participants (Heckman, LaLonde, and Smith, 1999).

The CIA, on the other hand, requires that, conditional on the propensity scores, the potential outcomes are independent of treatment assignment. This in practice means that if the decision to

take the treatment is purely random for individuals with similar values of the pre-treatment variables (scores), then the average outcome of some similar individuals who were not exposed to the treatment can be used as a valid counterfactual.

If these two conditions are satisfied, the ATT can be estimated as follows:

$$\tau_{ATT} = E\{E[Y(1) \mid p(X), D = 1] - E[Y(0) \mid p(X), D = 0]\} \quad (4)$$

In practice and, considering the above, the estimation strategy employed in this impact assessment is structured in the following way. First, the quality of the counterfactual was examined by looking at the t-test on the equality of means for selected control variables between the beneficiaries and non-beneficiaries prior to matching. This checks whether the selected control variables, which should not be affected by project participation, are balanced between the two groups.

Second, the propensity score was computed using a probit regression model to examine whether the common support condition is met. Kernel densities of the estimated propensity scores were used to visually assess the distribution of scores across the treatment and control groups and the quality of the counterfactual. The common support region was determined by dropping all observations whose propensity score is below the minimum or above the maximum value in the opposite group ("minima and maxima comparison"), and it was further trimmed at the lowest and highest 2% of the propensity scores.

The propensity score matching (PSM) based on the 5 nearest neighbors was assessed based on the Rosenbaum and Rubin (1985) bias reduction statistics. With this regard, and in line with most of the empirical literature, a bias reduction below 5% was considered sufficient.

3.3.2. Inverse Probability Weighting Regression Adjustment

In this impact assessment IPWRA is the reference estimation approach to assess the effect of PAPAFPA and PAPAC on the outcome variables of choice (the key indicators described in the previous section).

In brief, IPWRA estimators are suitable for observational studies where the selection into treatment is not random, but rather a choice made by the subjects under study. IPWRA addresses the endogeneity associated with this self-selection (into treatment) by modelling both the outcome and the treatment to account for the non-random treatment assignment. For this reason, it is said to be "doubly robust", which means that only one of the two models must be correctly specified to consistently estimate the treatment effects (in other words, the impact of the program) (Bang and Robins, 2005). Due to this property, this estimator generates the most reliable and accurate results and is thus used as the preferred approach in the final discussion.

The IPWRA estimator uses the inverse of the estimated treatment-probability weights to estimate missing-data-corrected regression coefficients that are subsequently used to compute the potential outcome means.

The estimates reported are average treatment effect on the treated (ATT). Mathematically, the weighted-least squares regression equation to estimate ATT with the addition of covariates can be written as follows:

$$Y_i = \alpha_0 + \tau T_i + \alpha_1 X_i + \alpha_2 (Xi - \bar{X}) T_i + \varepsilon_i \quad (5)$$

where Y_i is the outcome variable of interest, T_i is the indicator for treatment, X_i is a vector of co-variates in the outcome equation, $\bar{X}$ is the sample average of X for the subsample of treated households, ε_i is the error term, and τ, α_1, and α_2 are parameters to be estimated. The matrix

containing the weights assigned to observations in the sample to estimate the ATT effects can be specified as follows:

$$\omega(t,x)=t+(1-t)\hat{P}(X)/(1-\hat{P}(X))$$

where $\omega(t,x)$ is the weight applied, t represents $Ti=1$, $\hat{P}(X)$ is the estimated propensity score, and X is a vector of covariates (Lee, 2005).

The estimated ATT, or the beneficiary households can be expressed as follows:

$$ATT=E(\delta_i|T=1)=E(Y_{i1/mi}-Y_{i0/mi}|T=1)$$

3.3.3. Further Robustness Checks

To detect the presence of hidden bias, or selection on unobservables a sensitivity test was conducted. This is a key test since if unobserved characteristics influence both assignment into treatment and the projects' outcomes the matching strategy will fail (i.e. the CIA assumption is not met). For this purpose, the Rosenbaum (2002) bounds approach for the ATT in presence of unobserved heterogeneity was used, more specifically, the Mantel and Haenszel (1959) test-statistic.

As mentioned before in this report, the projects being assessed in this report were likely to have generated impacts beyond the group of beneficiaries. Particularly within the treated communities, it is very plausible that the projects have had (unintended) consequences also on non-beneficiary households – in other words, the projects likely had "spillover effects". The matching and the IPWRA approaches are not per se robust to this problem.

This problem is addressed by considering a neighborhood-effects treatment model. This model estimates ATEs when neighborhood interactions may be present and provides an attempt to relax the stable unit treatment assumption (SUTVA, i.e. the assumption that treatment received by one unit do not affect outcomes for another unit) that is made in observational studies.

In short, the neighborhood-effect treatment model will estimate the ATEs considering neighborhood interactions (ATE_{with_neigh}) by relying on a weighting matrix measuring the distance between each untreated and treated unit in the sample.

By comparing this with the ATE estimated ignoring the existence of neighborhood contamination (i.e. ATE_{with_neigh}), a neighborhood-effect bias can be calculated as follows:

Bias (%) = (ATE_{no_neigh} – ATE_{with_neigh}) / ATE_{no_neigh}

This bias may be positive or negative, depending on the type of externalities generated by the projects (i.e. whether it affects non-treated units negatively or positively). The estimation of this bias and its statistically significance are of policy relevance, as ignoring might lead to an overestimation or underestimation of the projects' true impact.

4. Profile of the project area and sample

This section presents a description of the sample collected, in order to understand the distribution and the main characteristics of the communities and households analysed.

The community survey was conducted with community and producers' associations leaders in 124 communities, of which 63 were beneficiary communities and 61 were control (non-beneficiary) communities. Overall, the information from the community survey shows that the two groups of communities are well balanced across several measures of infrastructure and public goods availability, asset ownership (among its residents) and exposure to shocks. Treated communities appeared to have more limited access to (concrete) road both currently and at baseline (in 2008), and less access to electricity at baseline than control communities. There is, however, no statistically significant difference in size (as measured by the number of households), distance to markets, assets ownership within the community[7] or exposure to shocks either currently or at baseline.
The table below presents summary statistics across a range of indicators between the two groups of communities as well as the p-value for the test of difference in means.

Table 7: Summary statistics for treated and control communities

	Treatment communities		p-value	Control communities	
	N	Mean / SE		N	Mean / SE
Number of HH in the community	63	101.78 19.40	0.49	61	122.54 22.99
Share of female headed HH	63	26.00 3.10	0.31	61	21.75 2.73
Infrastructure and public goods					
Road to access community is made of concrete (baseline)	63	0.03 0.02	0.04**	61	0.13 0.04
Road to access community is made of concrete	63	0.03 0.02	0.08*	61	0.11 0.04
Distance to daily market (km, baseline)	63	6.75 0.91	0.69	61	6.17 1.11
Distance to daily market (km)	63	6.74 0.91	0.71	61	6.20 1.11
Distance to nearest primary school (km, baseline)	63	2.19 0.28	0.58	61	2.41 0.26
Distance to nearest primary school (km)	63	2.28 0.30	0.31	61	17.01 14.72
Distance to nearest commercial bank (km, baseline)	63	4.35 0.62	0.14	61	5.65 0.62

[7] Cellphones ownership is the exception here: treated communities have a statisticall significant higer percentage of households with a cellphone than control communities. No difference, however, is found regarding radio or TV ownership between the two groups of communities.

Distance to nearest commercial bank (km)	63	8.37 0.71	0.51	61	9.25 1.14
Availability of electricity lines (baseline)	63	0.21 0.05	0.09*	61	0.34 0.06
Availability of electricity lines	63	0.70 0.06	0.76	61	0.67 0.06
Asset ownership					
Share of HH owning a cellphone (baseline)	63	2.00 0.12	0.54	61	2.11 0.15
Share of HH owning a cellphone	63	4.19 0.13	0.03**	61	3.72 0.16
Share of HH owning a TV (baseline)	63	1.60 0.12	0.40	61	1.75 0.14
Share of HH owning a TV	63	3.24 0.20	0.88	61	3.20 0.20
Shocks					
Number of shocks experienced 5 years ago	63	1.86 0.24	0.37	61	2.18 0.27
Number of shocks experienced in the last 12 months	63	1.48 0.20	0.35	61	1.21 0.20

Notes: Asterisks represent level of statistical significance of t-test/chi-squared test of difference in means.

Table 8 , in turn, displays the sample distribution for the household survey. As it can be seen, a total sample of 1404 households, spread across 7 districts and 116 communities, was collected for this impact assessment. The number of communities sampled was proportional to district size in the two islands of São Tomé and Príncipe.

Table 8: Sample distribution by district and number of communities

Island	District	Number of communities sampled	Treatment	Control	Total
			Number of HHs	Number of HHs	
São Tomé	Agua Grande	1	0	1	1
	Cantagalo	27	211	168	379
	Lemba	18	94	131	225
	Lobata	27	194	171	365
	Me Zochi	27	124	178	302
	Caue	2	0	17	17
	Total	**102**	**623**	**666**	**1289**
Príncipe	Pague	14	37	78	115
	Total	**14**	**37**	**78**	**115**
Total		**116**	**660**	**744**	**1404**

The table below displays a selection of socio-economic and geographic variables used in the matching exercise, for the treatment and the control group of households (the full range of variables used in the matching exercise can be found in the Appendix 1). As it can be seen, before matching

treated households presented some statistically significant differences with respect to the control group of households. For instance, treatment households were on average more educated (as measured by the proportion of respondents who attended school), had better housing infrastructure (electricity, access to toilet facilities or to canalized drinking water) and owned more cacao plants at baseline (set 10 years before the survey, i.e. as of 2008). However, any statistically significant differences that existed between these two groups of households disappeared after the matching. Thus, matching exercise generated a more balanced sample and a more robust counterfactual, consisting of 627 treated households and 713 non-treated (control) households.

Table 9: Summary statistics before and after matching and bias reduction

	Before matching				After matching				Reduction in Bias (%)
	Treat. Mean/ SE	Control Mean/ SE	p-value	Bias	Treat Mean/ SE	Control Mean/ SE	p-value	Bias	
Husehold head (1=male)	0.78 0.02	0.72 0.02	0.012**	12.51	0.77 0.02	0.77 0.02	0.88	0.90	92.77
Age	46.97 0.52	46.88 0.55	0.914	0.53	46.64 0.54	46.50 0.56	0.87	0.99	-87.51
Attended school (1=yes)	0.93 0.01	0.89 0.01	0.004***	12.97	0..93 0.01	0.92 0.01	0.77	1.58	87.84
Basic education (1=yes)	0.48 0.02	0.42 0.02	0.025**	9.19	0.47 0.02	0.46 0.02	0.68	2.67	70.90
Household size	4.48 0.09	4.14 0.08	0.005***	12.19	4.38 0.09	4.32 0.10	0.72	2.64	78.32
HH experienced any shock in last 5 years	0.43 0.02	0.48 0.02	0.072*	7.67	0.44 0.02	0.43 0.02	0.70	2.48	67.61
Number of shocks in last 5 years	0.90 0.06	0.99 0.05	0.24	3.95	0.91 0.06	0.89 0.06	0.81	1.52	61.65
Household has electricity (baseline)	0.21 0.02	0.28 0.02	0.005***	12.23	0.22 0.02	0.26 0.02	0.16	9.19	24.80
Source of drinking water: 0- canalized or 1 - natural source (baseline)	0.16 0.01	0.21 0.02	0.009***	14.44	0.15 0.01	0.14 0.01	0.64	2.63	81.78
Householse has TV (baseline)	0.29 0.02	0.32 0.02	0.203	8.77	0.28 0.02	0.32 0.02	0.17	8.98	-2.42
Household has pickaxe (baseline)	0.46 0.02	0.36 0.02	0.000***	16.41	0.44 0.02	0.44 0.02	0.95	0.40	97.58
HH owned any livestock (baseline)	0.60 0.02	0.58 0.02	0.458	0.12	0.59 0.02	0.58 0.02	0.76	2.01	-1585.95
Household grows cacao (binary)	0.86 0.01	0.86 0.01	0.908	2.54	0.86 0.01	0.85 0.01	0.68	2.78	-9.57
Household grows coffee (binary)	0.48 0.02	0.52 0.02	0.127	5.45	0.50 0.02	0,51 0.02	0,57	3.69	32.37
Household grows pepper (binary)	0.12 0.01	0.08 0.01	0.019**	6.74	0.11 0.01	0.10 0.01	0.87	1.14	83.05

Household started to cultivate cacao after 2004	0.34 0.02	0.40 0.02	0.014**	8.89	0.35 0.02	0.36 0.02	0.77	1.90	78.68
In lowest two quintiles of number of cocoa plants	0.43 0.02	0.56 0.02	0.000***	20.06	0.45 0.02	0.43 0.02	0.48	4.48	77.66
Community had daily market (binary) (baseline)	0.12 0.01	0.0 0.01	0.299	4.97	0.12 0.01	0.12 0.01	0.86	1.23	75.20
No. of observations	660	744			627	713			

Notes:
1. *, **, & *** represent statistical significance at the 10%, 5%, & 1% level respectively.
2. Point estimates are sample means. Standard errors are reported below.
3. Asterisks represent level of statistical significance of t-test/chi-squared test of difference in means.

The table below displays the final distribution of treatment and control households after matching. A (small) number of observations was discarded, as compared to the figures in sample in Table 9 above, since not all treated households could be matched with an adequate counterfactual. As explained in the previous section, only the observations in the common support are considered for the estimation of the projects' treatment effects.

Table 10: Sample distribution by district, number of communities and treatment and control groups after matching

Island	District	Number of communities	Treatment	Control	Total
			Number of HHs	Number of HHs	
São Tomé	Cantagalo	27	165	199	364
	Lemba	18	130	93	223
	Lobata	27	170	175	345
	Me Zochi	27	175	123	298
	Total	**99**	**640**	**590**	**1230**
Príncipe	Pague	14	73	37	110
	Total	**14**	**73**	**37**	**110**
Total		**113**	**713**	**627**	**1340**

As noted earlier, PAPAFPA was implemented in STP between 2003 and 2015. It was estimated it covered over 3,000 smallholder farmers during that period through the four project cooperatives. PAPAC was introduced following that, in 2015, as a consolidation of PAPAFPA. It continued to provide support to all previous PAPAFPA beneficiaries and enlarged the coverage of the interventions to a further 700-800 farmers (figure as of 2018). The sample design for the final household's questionnaire took this information into account, so that a representative sample of PAPAFPA-PAPAC and PAPAC only beneficiaries could be surveyed. That way the presence of heterogenous project impacts conditional on the exposure to the two projects could be assessed. However, during the data collection stage it became apparent that respondents had difficulty in clearly distinguishing PAPAFPA from PAPAC, with a disproportionately large number (as compared to the cooperatives records and the data collected during the enumeration exercise) of them reporting having received only the PAPAC interventions. This problem was also flagged by the qualitative study, which reported a lack of identification of the producers with the projects' names. A considerable part of the producers was not able to identify the name of the projects or to distinguish them. As expected, this caused concerns regarding the correct measurement of the treatment variables (i.e. whether the farmer benefitted from PAPFPA and PAPAC, or PAPAC only, i.e. only after 2015). This problem was compounded by the fact that the projects' cooperatives do

not hold updated records of its members (i.e. start and eventual end of membership). As a result, it was decided to treat the projects together. (See the table below for a comparison of the % of beneficiaries covered by each program as reported by the cooperatives vs. as informed by respondents at the time of the survey.)

This impact assessment will thus focus on the joint impact of PAPAFPA and PAPAC on the outcome variables of interest. Considering that there was no substantial difference in the type of interventions undertaken during the two projects (with PAPAC being in effect a consolidation and continuation of PAPFPA) looking at the joint impact does not substantially affect the assessment and interpretation of the estimated effects discussed in Section 5. It should be borne in mind, however, that it is likely that the estimated coefficients for the joint impact of PAPFPA-PAPAC will be downward-biased with respect to the "true" impacts of PAPFPA, had it been possible to differentiate PAPFPA-PAPAC beneficiaries from PAPAC-only beneficiaries (i.e. those who benefitted from the interventions only after 2015). This is because PAPAC was only introduced in 2015 and, thus, for those who only joined the program at that time or since then it might be too soon to observe any project impacts.

Table 11: Beneficiaries by program (PAPAFPA vs. PAPAC)

	% of beneficiaries (cooperatives records)	% of beneficiaries in the sample for analysis (primary data collection)
PAPAFPA - PAPAC (joined any time between 2003-15)	83%	66%
PAPAC only (joined since 2015)	17%	34%

PAPFPA and PAPAC focused on three value chains: cacao, coffee and pepper. As expected, given its preponderance in the country's primary sector, cacao is the value chain cultivated by the largest number of farmers in the sample (86%). Pepper, which has been cultivated in São Tomé e Príncipe mostly following PAPFPA, is the least prevalent value chain, cultivated by less than 10% of the households in the sample.

Table 12: Distribution of the sample by value chain

Value chain	Treatment HH	Control HH	Total	% of Total Sample
Cacao	537	618	1155	86%
Coffee	311	373	684	51%
Pepper	67	62	129	9.6%

Note that at the time of survey most of the famers sampled had cultivated more than one of the projects' value chains in the previous 12 months, with the most common "mix" being cacao and coffee farming. Table 13 below displays the number of treatment and control households that exclusively cultivated one of the projects' value chains in that period.

Table 13: Distribution of the sample by value chain (exclusive cultivation)

Value chain	Treatment HH	Control HH	Total	% of Total Sample
Cacao only	265	285	550	41%
Coffee only	57	54	111	8%
Pepper only	15	15	30	2%

5. Results

This section presents the impact estimation results on the outcome and impact indicators described above. The results are presented for the overall joint impact of PAPAFPA and PAPAC using the full sample of treated and control households. As explained in the previous section, given the concerns around the distinction between the two programs by the survey respondents, this appears as the most methodologically reliable approach.

Whenever applicable the results are presented separately for each of the three value chains covered by the programs: cacao, coffee and pepper, as well for the other most common agricultural crops in the sample (i.e. sugar cane and tobacco, which are identified as "non-program cash crops" in the results tables below, fruits, vegetables and tubers) for comparison.

Results from four different estimators are presented. The reference estimation approach is the inverse probability weighting with regression adjustment (IPWRA in the results tables below). To verify the robustness of the results, propensity score matching based on the five nearest neighbours (PSMATCH), covariate matching (NN) and regression adjusted (RA) estimates are also displayed.
To address the concerns regarding projects' spillover effects, a neighbourhood treatment effects model was also estimated to assess the existence and extent to possible bias in the ATEs arising from the neighbourhood contamination. As explained earlier, this bias can be either positive (over-estimation) or negative (under-estimation) depending on the ability of the project in generating a negative or positive externality in the non-treated neighbours. The results from the neighbourhood treatment effects model and the estimated neighbourhood bias (vis-à-vis the ATEs obtained via a general model with no neighbourhood effects) are displayed in Appendix 2, and will be mentioned throughout the discussion below whenever relevant.

Lastly, it remains to be said that based on the specific definitions of the indicators, the magnitudes of the impact estimates are either expressed in levels or in percentages. Whenever convenient, however, the discussion of the results may convert impact estimates from percentages to levels in order to illustrate the magnitude of the effects relative to the control group means (which are presented in, in levels, the last column of the results tables).

5.1. Intermediate outcomes: organic certification

A key element of PAPAFPA and PAPAC is the adoption and use of organic farming practices, as a pre-requisite to obtain organic certification. This in turn is expected to lead to more sustainable value chains both socially and environmentally, as well as higher trading prices to the extent that buyers value organically certified products and are willing to pay a premium for them. It is, thus, important to start by looking at the projects impact on organic certification. The results presented in the table below show that the projects did increase the probability of having a certified parcel by more than 42 percentage points for the treated relative to the control sample (estimated impact of 0.423 statistically significant at 1%, as in column (1), as compared to a control sample mean of 0.31).

Table 14: Organic certification

	(1)	(2)	(3)	(4)	(5)	Control sample mean
	IPWRA	PSMATCH	NN	RA	NTREATREG	
Parcel certification (binary; 1 = certified)	0.423***	0.433***	0.425***	0.417***	-3.485	0.31
	(0.026)	(0.034)	(0.029)	(0.026)		
No. of observations	1336	1336	1336	1336	1336	

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Standard errors are presented in parentheses.

5.2. IFAD10 Indicators

5.2.1. Agricultural production, productivity and diversification

Table 15 presents the results on the impact of the projects on quantities harvested, areas cultivated and crop yields. For cacao, the most prevalent crop in the sample, the impacts on harvest, crop area and yields are computed from the sample of cacao producers only (i.e. excluding those households who do not produce cacao). Coffee and pepper, on the other hand, are not as frequently cultivated (at the time of the survey they were cultivated by approximately 50% and 10% of the households in the sample, respectively), and some households might have started cultivating them as a response to the projects. Thus, the projects' impacts on harvests, crop areas and yields of coffee and pepper are computed from the whole sample of treated and control households.

As can be seen from the table below the harvests of the three value chains covered by the projects are significantly higher for the project beneficiaries than the control group of farmers. Interestingly, project beneficiaries also appear to produce significantly more fruits, tubers and other cash-crops (sugar cane and tobacco). This may result from the fact that some of the project interventions professional development, farmer training, access to productive assets) are farmer (not crop) specific and can therefore extend and generate positive impacts on other crops.

The increase in the quantities harvest for the treated farmers does not seem to arise from differences in the size of the cultivated areas for most of the crops analyzed. As displayed under item 2 below (crop areas) there is no evidence of a significant difference in crop areas between the treated and control farmers. The exception is the area dedicated to the cultivation of pepper, which is significantly higher among the treated farmers. This is not surprising given that, contrary to cacao and coffee, pepper has been cultivated in STP mostly since the implementation of PAPAFPA, as confirmed by experts and the qualitative study.

As expected, given the results just discussed, treated households have significantly higher crop yields than their control counterparts, by approximately 26%, 37% and 16% for cacao, coffee and pepper respectively considering the results in column (1). These estimated effects are of considerable magnitude being approximately equivalent to an average difference in yields of 488.5 kg/ha, 27 kg/ha and 3.8 kg/ha between the treated and the control group of farmers, respectively for cacao, coffee and pepper.

Similar effects are observed for non-project cash crops, fruits and tubers for which the average yield is, respectively, 45%, 74% and 37% higher for project beneficiaries.

All the results discussed are consistent and remain highly statistically significant across the 4 estimation approaches shown. Furthermore, they are also robust to the consideration of neighborhood effects (see Appendix 2: Neighborhood Treatment Effects). The estimated bias arising from possible contamination to neighboring non-treated households is low and mostly within the

bounds given by the four estimation approaches displayed in the table below, and in no instance undermines the statistical significance of the results.

Table 15: Production and productivity by crop

	(1)	(2)	(3)	(4)	Control sample mean
	IPWRA	PSMATCH	NN	RA	
1. Crop harvest					
Production quantity cacao (kg, log)[3]	0.422***	0.448***	0.424***	0.408***	808.3
	(0.067)	(0.084)	(0.077)	(0.068)	
Production quantity cofee (kg, log)	0.350***	0.466***	0.475***	0.369***	24.88
	(0.099)	(0.118)	(0.105)	(0.099)	
Production quantity pepper (kg, log)	0.178***	0.145*	0.202***	0.170***	7.56
	(0.064)	(0.08)	(0.065)	(0.065)	
Production quantity program crops (kg, log)	0.743***	0.582***	0.943***	0.767***	911.21
	(0.122)	(0.163)	(0.151)	(0.124)	
Production quantity fruit crops (kg, log)	0.859***	1.055***	0.966***	0.868***	2 26
	(0.165)	(0.249)	(0.188)	(0.165)	
Production quantity vegetables crops (kg, log)	-0.107	-0.050	-0.293***	-0.100	264.26
	(0.091)	(0.117)	(0.112)	(0.0893)	
Production quantity tubers crops (kg, log)	0.398***	0.323	0.392**	0.380**	150
	(0.152)	(0.201)	(0.157)	(0.152)	
Production quantity non-program cash crops (kg, log)	0.714***	0.548***	0.924***	0.734***	964
	(0.122)	(0.160)	(0.150)	(0.124)	
2. Crop areas					
Area of cacao production (ha, log)[3]	0.037	0.010	0.075***	0.037	0.87
	(0.025)	(0.033)	(0.027)	(0.025)	
Area of coffee production (ha, log)	0.021	0.0232	0.036***	0.023	0.11
	(0.015)	(0.021)	(0.014)	(0.014)	
Area of pepper production (ha, log)	0.028***	0.030**	0.028***	0.027***	0.04
	(0.009)	(0.010)	(0.009)	(0.009)	
Area of fruit production (ha, log)	0.032	0.037	0.045*	0.023	0.66
	(0.025)	(0.034)	(0.027)	(0.025)	
Area of vegetables production (ha, log)	-0.011	-0.010	-0.026**	-0.011	0.04
	(0.010)	(0.009)	(0.012)	(0.009)	
3. Crop productivity					
Cacao productivity (kg/ha, log)[3]	0.262***	0.339***	0.255***	0.275***	1879
	(0.085)	(0.116)	(0.098)	(0.088)	
Coffee productivity (kg/ha, log)	0.374***	0.474***	0.500***	0.389***	74.18
	(0.109)	(0.132)	(0.118)	(0.110)	
Pepper productivity (kg/ha, log)	0.162**	0.095	0.183**	0.152**	24.01
	(0.071)	(0.0100)	(0.074)	(0.073)	
Program crops	0.491***	0.197	0.758***	0.582***	3149

productivity (kg/ha, log)	(0.157)	(0.22)	(0.1)	(0.159)	
Non-program cash crops (sugar cane, tobacco) productivity (kg/ha, log)	0.457***	0.159	0.732***	0.487***	3701
	(0.158)	(0.221)	(0.192)	(0.160)	
Fruit crop productivity (lk/ha, log)	0.747***	0.848***	0.801***	0.765***	22338
	(0.204)	(0.295)	(0.226)	(0.203)	
Tubers crop productivity (lk/ha, log)	0.372**	0.317	0.368*	0.354**	1311
	(0.178)	(0.235)	(0.190)	(0.178)	
No. observations	1340	1340	1340	1340	1340

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Standard errors are presented in parentheses.
3. For these variables results are estimated from a sample of 1,112 households.

As far as inputs are concerned, there is no robust evidence of statistically significant differences between treated and control households. Project beneficiaries appear to spend on average less than the control group on non-organic fertilizers and pesticides (as it would be expected given the projects' focus on organic farming) as well as on plant nurseries, but in most of the estimation approaches these impacts are imprecisely estimated (hence, the hypothesis of no significant difference between the two groups cannot be rejected). These results are consistent with facts arising from the qualitative study which noted that several non-project farmers (i.e. not treated by PAPAPFA or PAPAC initiatives) may have also adopted organic farming techniques, without necessarily acquiring certification. This may, in part, be a response to PAPAFPA-PAPAC (via contagion from treated peers or as a pre-requisite to join the project's cooperatives). In effect, when neighborhood effects are considered (Appendix 2), there is evidence that the projects' effects on this group of indicators may be slightly underestimated.

Table 16: Input use

	(1)	(2)	(3)	(4)	Control sample mean
	IPWRA	PSMATCH	NN	RA	
1. Input use and expenditure					
Organic fertilizers used (kg, log)	-0.105	-0.097	-0.143	-0.94	265
	(0.116)	(0.135)	(0.134)	(0.112)	
Expenditure with non-organic fertilizers (STN, log)	-0.096	-0.123	-0.282***	-0.0967	88
	(0.061)	(0.085)	(0.109)	(0.061)	
Expenditure with pesticides (STN, log)	-0.198	-0.235	-0.307**	-0.197	229.78
	(0.138)	(0.174)	(0.156)	(0.136)	
Expenditure with nurseries (STN, log)	-0.214	-0.258	-0.351**	-0.209	224.86
	(0.131)	(0.175)	(0.152)	(0.128)	
Total expenditure with inputs (STN, log)	-0.224	-0.266	-0.356**	-0.222	542.94
	(0.152)	(0.193)	(0.173)	(0.149)	

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Standard errors are presented in parentheses. 3. Number of observations differs accroding to the outcome variable under analysis.

Lastly, Table 17 displays the estimated project impacts regarding crop diversification. Besides being a characteristic of the agricultural production undertaken, crop diversification can be associated with

vulnerability (i.e. greater crop diversity being associated with lower vulnerability). The estimated results concerning the projects' impact on crop diversity are muted overall. The number of crops appears to be higher among treated than control households, but the difference between the two groups is not statistically significant. Similarly, the projects' impacts on crop diversity as assessed by the Gini-Simpson and Berger-Parker diversity indices are not statistically significant. The positive estimated coefficients associated with the Shannon diversity index, on the other hand, suggest that crop diversity may have increased for project beneficiaries. However, even though this effect is statistically significant, its estimated magnitude, and hence economic relevance, is minimal (it estimates that the projects resulted in a 0.10% increase in this index for treated households as compared to control households).

Table 17: Crop diversification

	(1)	(2)	(3)	(4)	Control sample mean
	IPWRA	PSMATCH	NN	RA	
Number of crops	1.043	3.431	4.029*	1.430	27.43
	(1.995)	(2.780)	(2.139)	(2.021)	
Gini-Simpson diversity index	0.001	0.000	-0.005	-0.000	0.85
	(0.008)	(0.010)	(0.009)	(0.008)	
Berger-Parker diversity index	-2.688	-0.002	-2.148*	-2.874	4.13
	(2.164)	(0.141)	(1.280)	(2.438)	
Shannon divesity index	0.0104*	0.002	0.015**	0.009	0.24
	(0.005)	(0.007)	(0.007)	(0.005)	
Livestock diversification index (Margaleff)	0.037	0.027	0.0341	0.0378	0.31
	(0.024)	(0.032)	(0.039)	(0.378)	

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Standard errors are presented in parentheses. 3. Number of observations ranges between 1277 and 1340, depending on the outcome variable under analysis.

5.2.2. Economic mobility

Table 18 presents the projects' estimated results on households' income and income distribution. Total annual household income was calculated taking the sum of value of crop production, livestock and livestock products income, wage employment income (agricultural and non-agricultural) and transfer income (pensions, remittances, etc.). As shown, the projects had a statistically significant impact on both gross and net income (i.e. gross income discounted of input and other costs), with the treated households having on average an estimated net income approximately 45% higher than the control group (as per column (1)), corresponding to an additional STN 13,573 per year (equivalent to USD 627 as of February 2019). Per capita household income is estimated to be equally higher for treated households – more precisely, 52% higher than that of the control sample. Total income obtained from agriculture appears to be one key point of difference between the two groups of households (treated and control), as it is estimated to be approximately 82% higher for the treatment group. It is also interesting to note that the share of household income coming from agricultural activities is estimated to be higher for the treated group. In particular, the share of income originating from crops revenues (which is estimated to be 7.3% higher for treated sample as per column (1)), at expenses of the percentage of income coming from self-employment or agricultural employment. All the income effects discussed are highly statistically significant, including when

neighborhood effects are taken into account (see Appendix 2), and suggestive of a considerable impact of the projects on economic mobility, in all the econometric specifications used.

Table 18: Income

	(1)	(2)	(3)	(4)	Control sample mean
	IPWRA	PSMATCH	NN	RA	
1. Income					
Gross income (STN, log)	0.564***	0.498***	0.770***	0.576***	29 456
	(0.106)	(0.126)	(0.147)	(0.105)	
Net income (STN, log)	0.449***	0.459***	0.446***	0.463***	30 230
	(0.104)	(0.127)	(0.114)	(0.103)	
Household income per capita (STN, log)	0.524***	0.459***	0.671***	0.536***	10 009
	(0.0.097)	(0.127)	(0.136)	(0.097)	
Income from agriculture (STN, log)	0.819***	0.873***	1.122***	0.841***	22 038
	(0.125)	(0.183)	(0.164)	(0.126)	
2. **Share of income**					
Agriculture (crops and livestock; %)	0.072***	0.060***	0.091***	0.073***	0.77
	(0.018)	(0.025)	(0.021)	(0.018)	
Crops (%)	0.078***	0.074***	0.079***	0.077***	0.67
	(0.019)	(0.026)	(0.022)	(0.019)	
Livestock (%)	-0.015	-0.024*	0.004	-0.013	0.10
	(0.010)	(0.013)	(0.010)	(0.010)	
Self Employment (%)	-0.026**	-0.018	-0.038***	-0.024**	0.06
	(0.010)	(0.012)	(0.012)	(0.010)	
Transfers (%)	-0.009	0.013	-0.003	-0.008	0.04
	(0.007)	(0.012)	(0.008)	(0.007)	
Agricultural employment (%)	-0.015**	-0.028***	-0.016*	-0.016**	0.01
	(0.006)	(0.010)	(0.010)	(0.007)	
Non agricultural employment (%)	0.001	-0.000	0.005	-0.000	0.04
	(0.010)	(0.013)	(0.009)	(0.010)	
Other income (%)	0.001	0.000	0.000	0.001	0.05
	(0.003)	(0.004)	(0.004)	(0.003)	

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Standard errors are presented in parentheses. 3. Number of observations depends on the outcome variable under analysis.

Turning to an analysis of asset-based indicators, Table 19 reports the estimated treatment effects on asset ownership. The results on productive asset-based and livestock-based indices are positive and highly significant across all specifications used. There is also strong evidence that treated households have also more durable assets as well as overall assets than their non-treated counterparts. The difference on productive assets is to be expected as one of the project interventions consisted of distributing or facilitating access to this sort of assets to beneficiaries. Regarding livestock, results are also shown disaggregated for the three most common species farmed in STP: goats, pigs and chickens. As shown, there is strong evidence in favour of treated households owning a larger number of goats and pigs than the control group.

On the other hand, there does not appear to be robust evidence in favour of significant differences in housing assets between the two groups.

As with the previous indicators, the results displayed below are robust to the consideration of neighborhood effects - the estimated magnitude and statistical significance of the projects' impacts remains in line with those presented in Table 19.

Taken overall, the results on assets confirm the previous evidence of a positive impact of the projects on economic mobility.

Table 19: Asset indices and livestock ownership

	(1)	(2)	(3)	(4)	Control sample mean
	IPWRA	PSMATCH	NN	RA	
Housing asset index (MCA)	0.002	0.022	0.041***	0.002	0.48
	(0.012)	(0.019)	(0.015)	(0.012)	
Durable assets index (PCA)	0.135**	0.123	0.392***	0.128*	2.04
	(0.068)	(0.100)	(0.078)	(0.068)	
Productive assets index (PCA)	0.270***	0.257***	0.444***	0.273***	1.39
	(0.062)	(0.087)	(0.0653)	(0.062)	
Livestock assets index (PCA)	0.046	0.0253	0.093***	0.045	0.26
	(0.029)	(0.041)	(0.026)	(0.029)	
Overall assets index (Polychloric factor analysis)	0.139***	0.132***	0.304***	0.138***	1.33
	(0.040)	(0.057)	(0.044)	(0.040)	
Tropical livestock units	0.254***	0.266***	0.351***	0.245***	0.78
	(0.077)	(0.086)	(0.083)	(0.077)	
Number of goats owned	0.368***	0.262	0.576***	0.360**	0.48
	(0.137)	(0.184)	(0.125)	(0.140)	
Number of pigs owned	0.720***	0.607***	0.896***	0.697***	1.31
	(0.183)	(0.220)	(0.181)	(0.183)	
Number of chickens owned	0.953	-0.243	2.145**	0.984	8.22
	(0.976)	(1.351)	(0.863)	(0.967)	

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Standard errors are presented in parentheses. 3. Number of observations depends on the outcome variable under analysis.

5.2.3. Poverty reduction and vulnerability

As far as asset-based poverty indicators are concerned, there is evidence of statistically significant results mostly when the higher poverty line is considered (based on the 60th percentile) for durable and productive assets as displayed in the table below. Considering productive assets, treated households are, on average, most likely to move out of poverty by approximately 9% points than their control counterparts (as given by the estimated coefficient equal to 0.089). This is consistent with the estimated impacts on income and asset ownership discussed above.

Table 20 also includes the estimated effects on income diversification. The results offer evidence that treated household on average have lower income diversification than non-treated households (note that all the indices have been computed such that a higher number represents greater diversity). This apparent lower diversification does not appear to come from differences in the number of income sources between the two groups, but rather from a more uneven contribution of different sources of income, with the share of income from agriculture (and from the program crops in

particular) in the total household income becoming significantly larger for treated households (as shown in Table 18).

Table 20: Poverty reduction and income diversification

	(1) IPWRA	(2) PSMATCH	(3) NN	(4) RA	Control sample mean
1. Poverty reduction					
Moving out of poverty based on 40th PL - overall	0.062	0.068	0.121**	0.0717	0.54
	(0.046)	(0.064)	(0.0519)	(0.0460)	
Moving out of poverty based on 60th PL - overall	0.044	0.050	0.0796*	0.0552	0.27
	(0.044)	(0.064)	(0.046)	(0.0429)	
Moving out of poverty based on 40th PL - durables	0.062	0.121**	0.0770	0.0489	0.58
	(0.043)	(0.059)	(0.0507)	(0.0439)	
Moving out of poverty based on 60th PL - durables	0.061*	0.088**	0.103**	0.0558	0.42
	(0.035)	(0.042)	(0.0401)	(0.0353)	
Moving out of poverty based on 40th PL - productive	0.004	0.040	0.0222	0.0141	0.45
	(0.051)	(0.059)	(0.0567)	(0.0501)	
Moving out of poverty based on 60th PL - productive	0.086**	0.0536	0.107***	0.0952**	0.30
	(0.039)	(0.051)	(0.0414)	(0.0380)	
2. Income diversification					
Income diversification index (Simpson-Gini)	-0.041*	-0.0355**	-0.035*	-0.039**	0.26
	(0.021)	(0.020)	(0.020)	(0.017)	
Income diversification index (Berger-Parker)	-0.001	-0.036	-0.036	-0.031	1.44
	(0.145)	(0.119)	(0.119)	(0.111)	
Income diversification index (Shannon)	-0.011*	-0.011*	-0.11*	-0.012**	0.02
	(0.006)	(0.007)	(0.007)	(0.005)	
Number of income sources	0.012	0.162**	0.162**	0.039	2.06
	(0.083)	(0.063)	(0.064)	(0.05)	

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Standard errors are presented in parentheses. 3. Number of observations depends on the outcome variable under analysis.

5.2.4. Food security, dietary diversity and resilience

Considering food security indicators, Table 21 presents evidence of the project's effects on dietary diversity, as proxied by the household dietary diversity score, and on the experience of food insecurity as measured by FIES (Food Insecurity Experience Scale). The results suggest positive and statistically significant effects on dietary diversity and food security: it is estimated that treated households on average enjoy a gain of about 5% in their HDDS relative to the control group, while their food insecurity score is approximately 13% lower.[8]

Regarding vulnerability and resilience, the results show that, on average, the number, the average perceived severity, and the exposure to shocks were all smaller for the group of treated households than for the control group. However, the differences between the groups across these indications are not statistically significant.

The results are less positive with regards to the ability to recover from shocks, in which treated households exhibit a poorer performance than the control group. It must be said, however, that when

[8] For reference, the HDDS score ranges from 0 to 12 (maximum diversity) and the FIES score from 0 to 8 (maximum insecurity).

neighborhood effects are considered, there is no evidence of a statistically significant difference in the ability to recover from shocks between the two groups of households (see Table A 8 in the Appendix).

Importantly, however, when the PRIME resilience index is used as the outcome variable, the results offer strong evidence of the projects' positive impact on resilience (estimated coefficient 0.55, statistically significant at 1% in column (1)).

Table 21: Food security, vulnerability and resilience

	(1)	(2)	(3)	(4)	Control mean sample
	IPWRA	PSMATCH	NN	RA	
1. Dietary diversity					
Household dietary diversity score (HDDS)	0.488***	0.296*	0.593***	0.500***	9.26
	(0.135)	(0.169)	(0.160)	(0.136)	
2. Food security					
Food Insecurity Experience Scale (FIES, HH)	-0.563***	-0.63***	-0.625***	-0.587***	4.35
	(0.144)	(0.205)	(0.172)	(0.146)	
3. Vulnerability and Resilience					
All shocks					
Number of shocks experienced by the HH	-0.054	-0.039	-0.007	-0.066	0.97
	(0.064)	(0.100)	(0.078)	(0.066)	
Severity of shocks experienced (mean)	-0.080	-0.073	-0.032	-0.082	3.36
	(0.067)	(0.089)	(0.077)	(0.068)	
Exposure to shocks	-0.080	-0.072	-0.031	-0.081	3.37
	(0.067)	(0.080)	(0.078)	(0.068)	
Ability to recover from shocks	-0.173*	-0.025	-0.047	-0.190*	1.77
	(0.101)	(0.155)	(0.118)	(0.103)	
Ability to recover from GASOLINE PRICE shocks	-	-0.195	-0.108	-0.195	3.73
		(0.147)	(0.161)	(0.155)	
Ability to recover from FOOD PRICE shocks	-	-0.055	-0.952	-0.188	3.78
		(0.102)	(0.250)	(0.416)	
Ability to recover from THEFT shocks	-	-0.532***	0.419	-0.181	4.20
		(0.182)	(0.361)	(0.252)	
Resilience index (PRIME)	0.550***	0.618***	0.532***	0.532***	3.96
	(0.101)	(0.119)	(0.106)	(0.101)	

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Standard errors are presented in parentheses. 3. Number of observations depends on the outcome variable under analysis.

5.2.5. Access to market and commercialization

Market participation is defined in terms of probability of selling the product or produce in question to the nearest market. As per the results displayed in the table below the projects have, on average, a positive impact on market participation. The estimated effects are statistically significant for coffee and pepper, as well as for livestock market participation, offering strong evidence of an increased market participation among treated households. For cacao, which was pre- and post-projects

interventions the most cultivated crop (as indicated by the control group mean participation), there is no strong statistical evidence of a difference in market participation between treated and control households.

Other relevant commercialization indicators include the time to transport produce to market (for the largest transaction) and the number of buyers of agricultural products accessed in the month before the survey. The results indicate that the projects may have had a positive impact on the last indicator (number of buyers), although the statistical significance of this estimated impact is not robust to different estimation approaches. Interestingly, the results also suggest that treated households spend a significantly larger time to take their agricultural products (for the largest transaction at least) to the market than their control counterparts. Albeit this effect may appear counterintuitive, it results from the fact that treated households must transport their produce to collection points set up by the project cooperatives (for the projects' value chains) while non-beneficiaries are more likely to rely on sales to local hawkers or nearby street markets. This interpretation is supported by the results arising from the qualitative study and information from local experts.

Lastly, Table 22 also provides evidence of the projects' impact on the value of agricultural crops and livestock sales. There is strong evidence in favor of increased sales values for project beneficiaries for the three value-chains covered by PAPAFPA and PAPAC, as well as for livestock. More precisely, the estimates suggest that treated households enjoyed sales revenues, on average, 34%, 44% and 28% higher respectively for cacao, coffee and pepper than the control households (statistically significant at conventional levels, 5% and 1%). The value of total agricultural sales is estimated to be 86% higher for the treated households (statistically significant at 1%), which converts to over 16,401 Dobras (STN) more than the respective sales revenues of the control group (sample mean STN 19,072). These results are robust to the consideration of project spillovers (see Table A 9 in appendix).

Table 22: Access to market, participation and value of sales

	(1)	(2)	(3)	(4)	Control sample mean
	IPWRA	PSMATCH	NN	RA	
1. Market participation					
Cacao (binary; 1=participation)	0.008	-0.0128	0.030	0.010	0.81
	(0.021)	(0.026)	(0.0238)	(0.020)	
Coffee (binary; 1=participation)	0.054***	0.084***	0.082***	0.054***	0.10
	(0.018)	(0.021)	(0.017)	(0.018)	
Pepper (binary; 1=participation)	0.027**	0.024	0.038***	0.027**	0.04
	(0.013)	(0.0175)	(0.012)	(0.012)	
Livestock (binary; 1=participation)	0.0778***	0.083**	0.120***	0.076***	0.59
	(0.0273)	(0.038)	(0.031)	(0.027)	
Time to output market for the largest transaction (hours, log)	0.081***	0.086**	0.095***	0.084***	1.62
	(0.026)	(0.035)	(0.030)	(0.026)	
Time to output market largest transaction – cacao (hours, log)	0.047	0.041	0.083**	0.056*	1.52
	(0.034)	(0.045)	(0.038)	(0.033)	
Number of buyers accessed in the past month	0.207	0.232	0.246*	0.201	1.39
	(0.135)	(0.146)	(0.201)	(0.235)	
2. Value of crop and					

livestock sales					
Value of cacao sales (STN, log)	0.340***	0.336***	0.362***	0.330***	11332
	(0.075)	(0.114)	(0.0915)	(0.075)	
Value of coffee sales (STN, log)	0.446***	0.707***	0.669***	0.477***	321.85
	(0.140)	(0.155)	(0.134)	(0.140)	
Value of pepper sales (STN, log)	0.288**	0.256	0.371***	0.278**	749.5
	(0.113)	(0.159)	(0.110)	(0.116)	
Value of agricultural sales (STN, log)	0.864***	0.823***	1.171***	0.879***	19072.
	(0.134)	(0.202	(0.167)	(0.136)	
Value of livestock sales (log)	0.469**	0.454	0.905***	0.486**	2 063
	(0.213)	(0.290)	(0.233)	(0.211)	
Gross Margin	0.671***	0.664***	0.775***	0.681***	21080
	(0.113)	(0.151)	(0.135)	(0.113)	

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Standard errors are presented in parentheses. 3. Number of observations depends on the outcome variable under analysis.

5.2.6. Women's and youth empowerment

Table 23 reports the project's impact on empowerment. Women have been specifically targeted by the project with the aim to promote their empowerment within their households and their communities. The project took an overall egalitarian approach in the interventions implemented for male and female participants regarding training opportunities, access to the cooperative's resources, prices paid, and quantities bought by the cooperatives. The only significant difference in the interventions between male and female participants was/is the fact that the project cooperatives offer additional support to female farmers for the more physical demanding tasks in the field, such as pruning or carrying heavy loads, when help for those tasks is not available at home (husband or grown-up son).

The indicator used to assess the project's impact on women's empowerment is based on the extent of women's youth control over income within the household. More precisely, it measures whether in the household any women had control over income.

In an analogous fashion, and given the data availability, the projects' impact on youth control over income is also considered – this is, if any young person (someone who is 32 years of age or younger at the time of the survey) had control over income within the household. As it can be seen, the estimated effects are positive when assessing women's empowerment across the four approaches, but not statistically significant. Notwithstanding this lack of sufficient statistical evidence on women's empowerment, it must be noted that the qualitative study reported high levels of satisfaction among women beneficiaries, particularly those treated by PAPAFPA, who stressed the gender egalitarian approach of the project and the ability its interventions, namely on professional development, gave them to have a voice, to be listened and to compete for leadership positions in producers' associations in the future. Thus, even though actual impact on women empowerment could not be observed quantitatively, there is evidence of a sense of empowerment among female participants.

Last, regarding youth empowerment, there is also limited evidence of statistically significant differences between the two groups of households. The estimated coefficients for this indicator are negative in all four estimation approaches but deprived of statistical significance.

Table 23: Women's and youth empowerment

	(1)	(2)	(3)	(4)	Control sample mean
	IPWRA	PSMATCH	NN	RA	
1. Women's empowerment					
Women's control of income (binary)	0.003	0.031	0.006	0.000	0.34
	(0.016)	(0.034)	(0.022)	(0.016)	
2. Youth empowerment					
Youth control of income (binary)	-0.003	0.00	-0.007	0.023*	0.18
	(0.009)	(0.023)	(0.019)	(0.013)	
No. of observations	1340	1340	1340	1340	

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Standard errors are presented in parentheses.

5.2.7. Additional robustness checks: neighborhood effects

As mentioned above, an additional check to the robustness of the estimated results was made through the consideration of neighborhood effects models for each of the outcome variables under analysis. These models address the concerns around the possible contamination or spillovers from treated to non-treated households. As explained earlier, in the context under study, characterized by small communities, it is possible that some of the projects' effects may have extended beyond the group of beneficiaries. Overlooking this fact, may result in over or under-estimation of the projects impacts.

The robustness checks shown in Appendix 2 estimate the bias due to the neighborhood effects by comparing the projects' average treatment effects estimated through a neighborhood effects model to those estimated via a benchmark treatment effects model with no spillovers. As noted throughout the previous sections, the results from this robustness check remain highly consistent with the ones presented in tables 14 to Table **23**: the estimated neighborhood bias are generally small and the statistical significance of the results (or lack thereof) remains unaffected. Among the most significant results there is a suggestion that the estimated increase in cacao productivity and in net income for the project beneficiaries may be overestimated (by 14% and 11%, respectively, when compared to a benchmark no-neighborhood effects model), even though the estimated effects remain highly significant and of considerable magnitude for these outcome variables. On the other hand, the results in appendix suggest that the decline in the use and expenditure with non-organic inputs may be underestimated for project beneficiaries (by approximately, 19% and 58% respectively), consistent with the discussion in section 5.2.1 regarding Table 16.

5.2.8. Internal and external validity

This impact assessment relied on a mixed-method approach consisting on both quantitative and qualitative data collection and analysis, in order to seize the full range of impacts. To address potential selection bias, driven by the non-random selection of program beneficiaries, a rigorous approach was followed for the selection of the treatment and the control groups of households used in the quantitative analysis. The results from the quantitative analysis are robust to a battery of estimation approaches and checks, and in line with the qualitative findings. It must also be noted that no evidence of differential impact of shocks, government or NGOs interventions between treated

and non-treated households and communities was found for the period under analysis that could undermine the internal validity of the results presented.

Regarding external validity, it was apparent that there is demand in STP for the projects' interventions. However, the projects' design, consisting of multiple interventions, together with data availability constraints, impose limits in the external validity of the results presented. The results presented in the assessment are estimated treated effects for the overall "bundle" of PAPAFPA-PAPAC interventions. It is impossible to disentangle and to predict the impact of specific project interventions on a different context or population.

6. Conclusion

The projects analyzed in this ex post impact assessment, PAPAFPA and PAPAC are an example of the greater efforts made to reduce rural poverty and increase economic mobility among small scale farmers in São Tomé e Príncipe (STP). The projects focused on strengthening community infrastructure, producers' organizations and their representation within the national Government, as well as on developing farmers' professionalization and agricultural production, focusing on three value chains: cacao, coffee and pepper. The adoption of organic farming techniques and the organization of farmers within relevant value-chain cooperatives were critical elements of the interventions implemented. Strong quantitative evidence of the impact of cooperativism or organic farming and certification on the livelihoods of rural households is still limited and, for São Tomé e Príncipe non-existent. Recent studies have shown that cooperativism can facilitate farmers' access to markets and technological transformations (Chagwiza et al. 2016) and is positively associated with household income and assets (Mojo et al. 2017), particularly for small scale farmers (Ma and Abdulai 2016). The discussion on the role of organic certification programs on rural people's welfare, on the other hand, remains highly polarized between those who credit its contribution to environmental, social and economic resilience (e.g. Kleemann at al. 2014; Speranza 2010) and those who sustain it has limited or no real impact on sustainability (e.g. Beuchelt & Zeller 2011; Lynbk et al., 2001; Valkila, 2009) and dismiss it as a mere marketing strategy. This impact assessment can thus offer an important contribution to the literature by providing evidence of the impact PAPAFPA and PAPAC in STP.

This study provides evaluative evidence in an ex-post framework and makes used of a mixed-methods approach. Given its non-experimental design, its methodological robustness relies on the identification of a valid comparison group of non-beneficiary households to be used as a counterfactual. To this end a range of geographic and socio-economics characteristics expected to drive both the selection to treatment and the outcomes of interest were measured across the samples of treated and non-treated households. By balancing the two groups across these characteristics, a final treatment and control group was identified. This group consisted of 1,340 households (627 treated and 713 controls) across 113 communities, from which the joint average treatment effects of PAPAFPA and PAPAC were estimated for a range of key indicators, including crop production, income and assets, market access, poverty reduction, food security and resilience, and women's empowerment.

The findings of this study are in general positive. The qualitative study revealed a quite high level of satisfaction among the project participants interviewed/ heard during the focus groups discussions. The cooperatives created and supported by the project are close to full operational and financial autonomy, despite recent fluctuations in market prices, thus demonstrating resilience and sustainability. In effect, one of the cocoa cooperatives exited the project in 2017 and it is now completely self-sufficient.

The quantitative analysis substantiates this and provides robust evidence of a positive and statistically significant impact of the project on crop productivity (for cacao, coffee, pepper as well as other cash-crops not covered by the project), household income (net, gross income and income from agriculture), ownership of productive assets, dietary diversity, food security and commercialization (market participation for coffee and pepper, and sales revenues for all project value chains). Many of these positive agricultural impacts extend to livestock and crops beyond those directly supported by the project (most notably other cash crops such as sugar cane and tobacco, and fruit and tubers production). This is not surprising given that many of the project's interventions were not crop specific but rather focused on the professional development of the farmers or on the development of local infrastructure.

On the other hand, there is no evidence of statistically significant differences in input use (organic or inorganic inputs) between treated and control households, even though the level of organic certification is, as expected, significantly higher among the treated households. A plausible explanation for this effect (or lack thereof) in this context of small-scale farming may be that the use of organic inputs by treated households might have originated spillovers to non-treated community peers. In effect, the use of inorganic inputs by neighbor farmers would likely endanger the organic certification of the treated farmers.

The project's effects on poverty reduction and resilience merit further inspection: notwithstanding the reported positive impact on income and assets ownership, there is only evidence of the project's ability in helping to move farmers' out of poverty when a higher poverty line is considered (60^{th} percentile) for productive assets and durables. Concerning resilience, the results suggest that there is no evidence that either the number of shocks experienced in the 12 months before the survey or their perceived severity differs significantly between the two groups of households. However, the resilience index (PRIME) is statistically significantly higher for the group of treated households, offering support to the hypothesis that the project did increase the resilience of the treated households. Lastly, even though no statistically significant impacts could be observed on the measures of women's empowerment available for this study, it must be noted that the qualitative study reported high level of satisfaction among female beneficiaries, particularly those treated by PAPFPA, who commended the egalitarian approach of the project and the tools its interventions allowed them to develop.
As supported by the qualitative evidence and inferred during the quantitative analysis, it is quite likely that the projects originated spillover effects to non-treated (control) households. This is, an unintended contamination to neighboring farmers is likely to have occurred, particularly given the small size of the communities analyzed. It was estimated that this led to (mostly small) biases in the magnitude of some of the estimated impacts without affecting their direction and statistical significance.

Relative to potential implications for development policy in practice, this assessment provides strong evidence regarding the benefit of organic certification on agricultural productivity, prices and welfare of rural livelihoods in STP in general. This is demonstrated by the quantitative analysis and corroborated by the findings from the qualitative study. Overall, beneficiary farmers appear confident that organic production is the best for their land, their consumers, the environment, and their finances as it allows them to get higher prices for their products. Crucial for these positive results appear to be the role played by the cooperatives in providing professional training and support, promoting organic inputs and supporting the access to markets. It is thus critical to ensure that all the cooperatives have the tools to be financially and administratively autonomous by the closure of the project and sustainable in the long run.

Lastly, some general recommendations can be put forward as part of this impact assessment. The projects' multiple and interconnected interventions, together with the lack of adequate records of which beneficiaries received what and when, make it difficult to distinguish the separate impact of specific interventions. In the future, it would ideal to consider phasing out some of the interventions and/or targeting differing communities at different points in time in order to disentangle and properly assess the impact of the different interventions, as this could lead to more precise policy recommendations.

Granular project level data at the level of the beneficiaries remains a key prerogative for the successful design of impact assessments. As part of this impact assessment a huge challenge was encountered while trying to reconstruct lists of PAPAFPA and PAPAC beneficiaries. In effect, the lack of adequate records about beneficiaries compounded by the difficulty demonstrated by beneficiaries in distinguishing the two projects, made it impossible to explore the existence of

heterogenous effects conditional on the length of exposure to the interventions. Future projects of such kind need to establish adequate databases of beneficiaries.

With respect to specific project interventions, access to adequate infrastructure, particularly related to irrigation, remains a challenge in STP, and it is possibly the most (and only) negative element reported by participants during the qualitative study. Given the current climate change threats it is likely that this problem will accentuate in the future as rainfall in the country is reduced or becomes more uncertain, hindering any project impact on agricultural production. Similar projects should accommodate for this problem adequately. Last, a medium to long term issue in STP is access to land. It is understood that there is a shortage of available portions of land for the new generations to do agriculture and enrol in the cooperatives. In this regard, it is critical that the State, the main landowner, continues their efforts in promoting land rehabilitation in order to ensure that youngsters can access this sector of activity.

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Appendix 1: Matching quality statistics

Table 24: Summary statistics before and after matching and bias reduction

	Before matching				After matching				Reduction in Bias (%)
	Treat. Mean/ SE	Control Mean/ SE	p-value	Bias	Treat Mean/ SE	Control Mean/ SE	p-value	Bias	
Island (1 = Sao Tome)	0.94 0.01	0.90 0.01	0.001***	16.64	0.04 0.01	0.95 0.01	0.57	2.79	83.22
Catagalo District (1 = yes)	0.32 0.02	0.23 0.02	0.000***	19.37	0.32 0.02	0.35 0.02	0.38	6.36	67.15
Lemba District	0.14 0.01	0.18 0.01	0.086*	9.16	0.15 0.01	0.16 0.02	0.52	3.88	57.63
Lobata District	0.29 0.02	0.23 0.02	0.006***	9.31	0.28 0.02	0.28 0.02	0.96	96.43	
Me Zochi District	0.19 0.02	0.24 0.02	0.019**	11.56	0.20 0.02	0.16 0.02	0.11	8.84	23.55
Husehold head (1=male)	0.78 0.02	0.72 0.02	0.012**	12.51	0.77 0.02	0.77 0.02	0.88	0.90	92.77
Age	46.97 0.52	46.88 0.55	0.914	0.53	46.64 0.54	46.50 0.56	0.87	0.99	-87.51
Attended school (1=yes)	0.93 0.01	0.89 0.01	0.004***	12.97	0..93 0.01	0.92 0.01	0.77	1.58	87.84
Basic education (1=yes)	0.48 0.02	0.42 0.02	0.025**	9.19	0.47 0.02	0.46 0.02	0.68	2.67	70.90
Secondary education (1=yes)	0.19 0.02	0.19 0.01	0.884	2.46	0.20 0.02	0.19 0.02	0.92	0.69	71.77
Head civil status (1=non-formal union)	0.61 0.02	0.59 0.02	0.58	3.45	0.61 0.02	0.60 0.02	0.93	0.57	83.56
Household size	4.48 0.09	4.14 0.08	0.005***	12.19	4.38 0.09	4.32 0.10	0.72	2.64	78.32
Dependency ratio	0.88 0.03	0.91 0.03	0.592	0.74	0.89 0.02	0.88 0.02	0.96	0.29	61.60
HH experienced any shock in last 5 years	0.43 0.02	0.48 0.02	0.072*	7.67	0.44 0.02	0.43 0.02	0.70	2.48	67.61
Number of shocks in last 5 years	0.90 0.06	0.99 0.05	0.24	3.95	0.91 0.06	0.89 0.06	0.81	1.52	61.65
Type of house walls: 1 - wood; 2- improved wood; 3 - mixed or 4- bricks (baseline)	3.20 0.04	2.92 0.04	0.000***	20.95	3.19 0.04	3.18 0.04	0.87	1.03	95.09
Type of house roof: 0 –	0.34	0.30	0.11	8.12	0.35	0.35	0.93	0.55	93.19

natural, 1- improved (baseline)	0.02	0.02			0.02	0.02			
Type of house floor: 0 - natural, 1- improved (baseline)	0.68	0.56	0.000***	22.06	0.68	0.67	0.67	2.64	88.04
	0.02	0.02			0.02	0.02			
Type of house toilet: 1- no toilet; 2- latrine or 3- toilet (baseline)	1.49	1.43	0.064*	8.30	1.47	1.49	0.69	2.74	66.96
	0.02	0.02			0.02	0.03			
Household has electricity (baseline)	0.21	0.28	0.005***	12.23	0.22	0.26	0.16	9.19	24.80
	0.02	0.02			0.02	0.02			
Type of fuel used for cooking (baseline)	0.05	0.07	0.173	3.91	0.05	0.06	0.76	1.80	53.84
	0.01	0.01			0.01	0.01			
Source of drinking water: 0- canalized or 1 - natural source (baseline)	0.16	0.21	0.009***	14.44	0.15	0.14	0.64	2.63	81.78
	0.01	0.02			0.01	0.01			
Householse has TV (baseline)	0.29	0.32	0.203	8.77	0.28	0.32	0.17	8.98	-2.42
	0.02	0.02			0.02	0.02			
Household has pickaxe (baseline)	0.46	0.36	0.000***	16.41	0.44	0.44	0.95	0.40	97.58
	0.02	0.02			0.02	0.02			
HH owns radio (baseline)	0.24	0.23	0.504	1.27	0.23	0.25	0.43	5.37	-323.95
	0.02	0.02			0.02	0.02			
In lowest quintile in number of rooms (baseline)	0.76	0.76	0.899	3.69	0.78	0.75	0.37	5.99	-62.20
	0.02	0.02			0.02	0.02			
Quantity TVs owned (baseline)	0.34	0.35	0.573	6.17	0.32	0.36	0.24	7.81	-26.68
	0.02	0.02			0.02	0.02			
Quantity beds owned (baseline)	1.54	1.53	0.824	0.52	1.52	1.53	0.81	1.46	-182.30
	0.02	0.02			0.02	0.02			
HH owned any livestock (baseline)	0.60	0.58	0.458	0.12	0.59	0.58	0.76	2.01	-1585.95
	0.02	0.02			0.02	0.02			
Household grows cacao (binary)	0.86	0.86	0.908	2.54	0.86	0.85	0.68	2.78	-9.57
	0.01	0.01			0.01	0.01			
Household grows coffee (binary)	0.48	0.52	0.127	5.45	0.50	0,51	0,57	3.69	32.37
	0.02	0.02			0.02	0.02			
Household grows pepper (binary)	0.12	0.08	0.019**	6.74	0.11	0.10	0.87	1.14	83.05
	0.01	0.01			0.01	0.01			
HH owned chickens (binary) (baseline)	0.43	0.45	0.337	6.76	0.42	0.40	0.64	2.98	55.96
	0.02	0.02			0.02	0.02			
HH owned goats (binary) (baseline)	0.15	0.12	0.131	4.55	0.14	0.13	0.75	2.11	53.58
	0.01	0.01			0.01	0.01			
Household started to cultivate cacao after 2004	0.34	0.40	0.014**	8.89	0.35	0.36	0.77	1.90	78.68
	0.02	0.02			0.02	0.02			
In lowest two quintiles of number of cocoa plants	0.43	0.56	0.000***	20.06	0.45	0.43	0.48	4.48	77.66
	0.02	0.02			0.02	0.02			
Number pigs owned (baseline)	3.89	3.71	0.701	0.35	3.73	3.75	0.96	0.26	25.79
	0.02	0.02			0.02	0.02			
Number goats owned (baseline)	1.34	1.24	0.690	0.15	1.28	1.26	0.94	0.52	-240.14
	0.02	0.02			0.02	0.02			
Community had daily market (binary) (baseline)	0.12	0.0	0.299	4.97	0.12	0.12	0.86	1.23	75.20
	0.01	0.01			0.01	0.01			
No. of observations	660	744			627	713			

Notes:

1. *, **, & *** represent statistical significance at the 10%, 5%, & 1% level respectively.
2. Point estimates are sample means. Standard errors are reported below.
3. Asterisks represent level of statistical significance of t-test/chi-squared test of difference in means.

Figure A 1: Balance between treatment and control groups

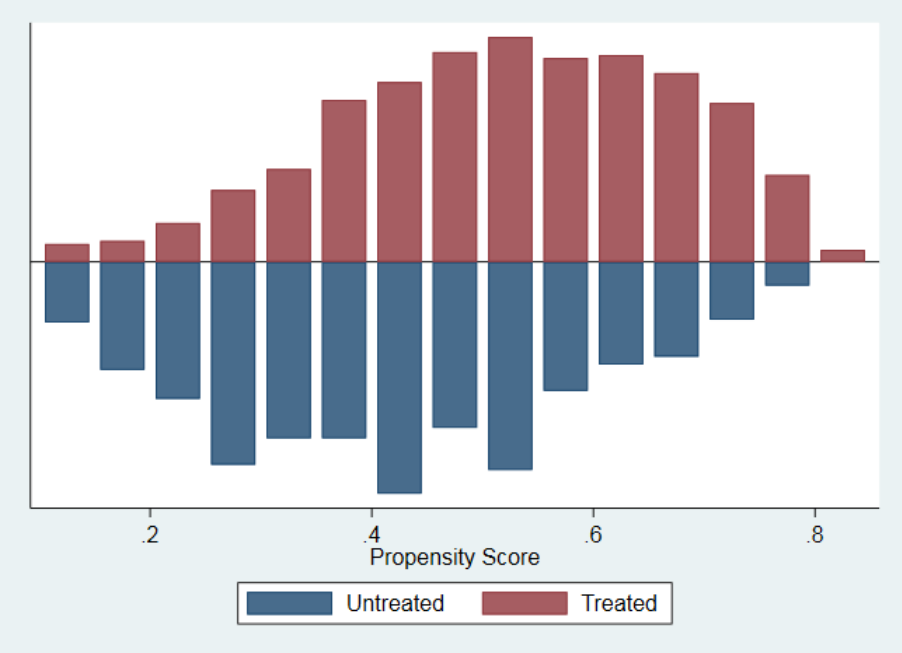
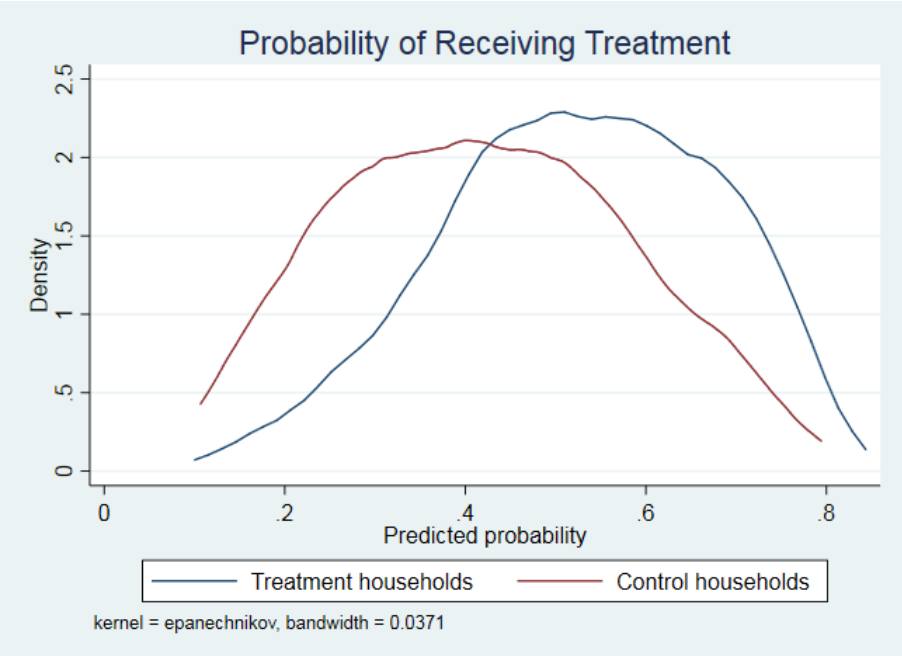


Figure A 2: Common support between treatment and control groups



Appendix 2: Neighborhood Treatment Effects

Table A 1: Parcel certification - neighborhood treatment effects

	ATE with neighborhood effect (1)	ATE without neighborhood effect (2)	Bias	Percent bias
Parcel certification (binary; 1 = certified)	.41***	.40***	-.01	-3.24
No. observations	1335	1335	1335	1335

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Bias = (2) – (1); Percent bias = $\frac{(2)-(1)}{(2)}$ *100

Table A 2: Production and Productivity - neighborhood treatment effects

	ATE with neighborhood effect	ATE without neighborhood effect	Bias	Percent bias
Crop harvest				
Production quantity cacao (kg, log)[3]	.39***	.39***	-.00	-.23
Production quantity cofee (kg, log)	.36***	.36***	-.00	-1.64
Production quantity pepper (kg, log)	.17**	.17***	-.00	-1.22
Production quantity program crops (kg, log)	.77***	.73***	-.04	-5.9
Production quantity fruit crops (kg, log)	.76***	.81***	.05	6.5
Production quantity vegetables crops (kg, log)	-.12	-.07	.04	-71.5
Production quantity tubers crops (kg, log)	.23	.36**	.12	34.4
Production quantity non-program cash crops (kg, log)	.74***	.70***	-.03	-5.3
Crop areas				
Area of cacao production (ha, log)[3]	.03	.02	-.00	-23.7
Area of coffee production (ha, log)	.02*	.02	-.00	-21.0
Area of pepper production (ha, log)	.03***	.03***	.00	1.2

Area of fruit production (ha, log)	.03	.02	-.00	-49.1
Area of vegetables production (ha, log)	-.01	-.01	.00	-70.6
Area of tubers production (ha, log)				
Crop productivity				
Cacao productivity (kg/ha, log)[3]	.25***	.29***	.04	14.0
Coffee productivity (kg/ha, log)	.33***	.34***	.00	1.6
Pepper productivity (kg/ha, log)	.13*	.13*	.00	.01
Program crops productivity (kg/ha, log)	.46***	.44***	-.02	-5.64
Non-program cash crops (sugar cane, tobacco) productivity (kg/ha, log)	.41**	.40**	-.00	-2.4
Fruit productivity (kg/ha, log)	.62***	.68***	.07	9.78
Vegetables productivity (kg/ha, log)	.20	.34**	.14	41.10
No. observations	1339	1339	1339	1339

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Bias = (2) – (1); Percent bias = $\frac{(2)-(1)}{(2)}$ *100

Table A 3: Input use - neighbourhood treatment effects

	ATE with neighborhood effect	ATE without neighborhood effect	Bias	Percent bias
Input use and expenditure				
Organic fertilizers used (kg, log)	-.08	-.04	.04	-108.8
Inorganic fertilizers used (kg, log)	-.10*	-.08*	0.02	-18.74
Expenditure with non-organic fertilizers (STN, log)	-.11*	-.07	.04	-58.00
Expenditure with pesticides (STN, log)	-.12	-.12	.00	-3.04
Expenditure with nurseries (STN, log)	-.13	-.13	0.007	-5.5

Total expenditure with inputs (STN, log)	-.14	-.14	.00	-3.1

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Bias = (2) – (1); Percent bias = $\frac{(2)-(1)}{(2)}$ *100

Table A 4: Crop diversification - neighbourhood treatment effects

	ATE with neighborhood effect	ATE without neighborhood effect	Bias	Percent bias
Crop diversity (no. of crops)	.66	.68	.03	4.4
Simpson diversity index	.27	-.14	-.41	295.8
Berger-Parker diversity index	-.18**	-.17**	.00	-5.8
Shannon divesity index	-.81	-.98	.17	17.8

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Bias = (2) – (1); Percent bias = $\frac{(2)-(1)}{(2)}$ *100

Table A 5: Income - neighborhood treatment effects

	ATE with neighborhood effect	ATE without neighborhood effect	Bias	Percent bias
Income				
Gross income (STN, log)	.50***	.52***	.01	3.7
Net income (STN, log)	.38***	.42***	.04	11.1
Household income per capita (STN, log)	.47***	.49***	.02	4.2
Income from agriculture (STN, log)	.70***	.71***	.00	1.2
Share of income				
Agriculture (crops and livestock; %)	.04***	.04***	.00	1.66
Crops (%)	.07***	.07***	-.00	-.94
Livestock (%)	-.02*	-.02*	-.01	-.01
Self Employment (%)	-.02**	-.02**	.00	-7.4

Transfers (%)	-.00	-.00	-.00	9.7
Agricultural employment (%)	-.02**	-.02**	.00	-2.2
Non agricultural employment (%)	.00	.00	-.00	-48.4
Other income (%)	.00	.00	.00	36.1

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Bias = (2) – (1); Percent bias = $\frac{(2)-(1)}{(2)}$ *100

Table A 6: Asset indices - beighbourhood treatment effects

	ATE with neighborhood effect	ATE without neighborhood effect	Bias	Percent bias
Housing asset index (MCA)	.00	-.00	-.00	496.7
Durable assets index (PCA)	.16**	.15**	-.00	-6.3
Productive assets index (PCA)	.29***	.30***	.01	3.6
Livestock assets index (PCA)	.04*	.05**	.00	12.92
Overall assets index (Polychloric factor analysis)	.15***	.15***	.00	.08
Tropical livestock Units	.22***	.25***	.03	13.4
Number of goats owned	.36***	.36***	-.00	-.10
Number of pigs owned	.65***	.66***	.00	.97
Number of chickens owned	1.31	1.40	.08	6.1

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Bias = (2) – (1); Percent bias = $\frac{(2)-(1)}{(2)}$ *100

Table A 7: Poverty reduction and income diversification – neighborhood treatment effects

Table 19	ATE with neighborhood effect	ATE without neighborhood effect	Bias	Percent bias
Poverty reduction				
Moving out of poverty based on 40th PL - overall	.05	.067	.01	21.0

Moving out of poverty based on 60th PL - overall	.08**	.09**	.00	2.0
Moving out of poverty based on 40th PL - durables	.03	.06	.02	41.2
Moving out of poverty based on 60th PL - durables	.06*	.06*	-.00	-1.9
Moving out of poverty based on 40th PL - productive	.03	.03	-.00	-19.3
Moving out of poverty based on 60th PL - productive	.10***	.11***	.00	6.2
Income diversification				
Income diversification index (Simpson-Gini)	-.03*	-.02*	.00	-3.1
Income diversification index (Berger-Parker)	-.06	-.03	.02	-85.0
Income diversification index (Shannon)	-.01*	-.01**	.00	3.5
Number of income sources	.03	.04	.01	26.8

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Bias = (2) – (1); Percent bias = $\frac{(2)-(1)}{(2)}$ *100

Table A 8: Food security, vulnerability and resilience - neighborhood treatment effects

	ATE with neighborhood effect	ATE without neighborhood effect	Bias	Percent bias
Dietary diversity				
Household dietary diversity score (HDDS)	.54***	.60***	.06	10.2
Food security				
Food Insecurity Experience Scale (FIES, HH)	-.56***	-.52***	.04	-8.9
Resilience				
Number of shocks experienced by the HH	-.04	-.06	-.01	34.2
Severity of shocks experienced (mean)	-.04	-.06	-.02	41.1
Ability to recover from shocks	-.15	-.16	-.01	7.83
Resilience index (PRIME)	.46***	.49***	.03	6.5

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Bias = (2) – (1); Percent bias = $\frac{(2)-(1)}{(2)}$ *100

Table A 9: Access to market - neighborhood treatment effects

	ATE with neighborhood effect	ATE without neighborhood effect	Bias	Percent bias
1 Market participation				
Cacao (binary; 1=participation)	.01	.00	-.00	-66.7
Coffee (binary; 1=participation)	.05***	.05***	-.00	-4.34
Pepper (binary; 1=participation)	.03**	.03**	-.00	-4.9
Livestock (binary; 1=participation)	.08***	.08***	-.00	-5.7
Time to output market for the largest transaction (hours, log)	.06**	.07***	.00	6.83
Time to output market largest transaction – cacao (hours, log)	.05	.04	-.00	-8.9
Number of buyers accessed in the past month	.42*	.40*	-.01	-3.8
Value of crop and livestock sales				
Value of cacao sales (STN, log)	.32***	.32***	.00	.07
Value of coffee sales (STN, log)	.45***	.43***	-0.0	-2.9
Value of pepper sales (STN, log)	.28**	.27**	-.01	-3.8
Value of agricultural sales (STN, log)	.84***	.84***	.00	.82
Value of livestock sales (log)	.48**	.54***	.053	9.8

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Bias = (2) – (1); Percent bias = $\frac{(2)-(1)}{(2)}$ *100

Table A 10: Women's and youth empowerment - neighborhood treatment effects

	ATE with neighborhood effect	ATE without neighborhood effect	Bias	Percent bias
Women's empowerment				
Women's control of income (binary)	.01	.00	-.00	-126.3

Youth empowerment				
Youth control of income (binary)	.02*	.02*	-.00	-15.2

Notes:
1. *, ** & *** represent significance at 10%, 5% and 1% levels respectively.
2. Bias = (2) – (1); Percent bias = $\frac{(2)-(1)}{(2)}$ *100

Appendix 3: Producers' Associations descriptive statistics

Table A3.1: Producers' Associations structure

	Producers' Organizations	
	N	Mean / SE
Cooperative membership		
CECAB	61	0.54 0.06
CECAQ11	61	0.31 0.06
CECAFEB	61	0.07 0.03
CEBIBA	61	0.11 0.04
Crops		
Cocoa	61	0.89 0.04
Coffee	61	0.07 0.03
Pepper	61	0.11 0.04
PO composition		
N of Members	61	55 4.57
N of Active Members	61	42 3.76
N of Female Members	61	34 16.19
N of Members With Disabilities	61	1 0.21
Services offered		
The PO buys crops	61	0.87 0.04
The PO offers formation	61	0.54 0.06
The PO offer supply of inputs	61	0.33 0.06
Governance		

The President Of The Association Is Female	61	0.08 0.12
The President Of The Association Is Young	61	0.18 0.04
At Least One Female Member In The Leadership Of Association	61	0.70 0.06
At Least One Young Member (<32) In The Leadership Of Association	61	0.52 0.06
Organic Farming		
Size Of Land That Is Currently Organic Certified (hectares)	61	83.9 7.96
What are the most important benefits from organic farming and certifications?		
Higher income for farmers	61	0.70 0.06
Greater environmental sustainability	61	0.51 0.06
Higher yeilds	61	0.52 0.06
Greater food security	61	0.56 0.06

Table A3.2: Producers' Associations commercialization

	Producers' Organizations	
	N	Mean / SE
Commercialization		
Number Of People That Delivered In The Last 12 Months	60	47.4 4.27
Quantity Delivered From Farmers To Pa In The Last 12 Months (Ton)	61	25.79 2.96
Price Farmer Received For 1 Kg Of Crop (all) (STN)	60	22.6 3.56
Price Farmer Received For 1 Kg Of Crop – COCOA (STN)	52	19.21 0.04
Price Farmer Received For 1 Kg Of Crop – COFFEE (STN)	4	14.25 0.75
Price Farmer Received For 1 Kg Of Crop – PEPPER (STN)	4	75.00 43.3
Quantity PO Delivered To Coop In The Last 12 Months (Ton)	61	25.07 2.81
Quantity PO Delivered To Coop In 2008 (Ton)	61	8.79 2.19

Price Coop Paid For 1 Kg Of Crop	61	36.93 8.14
Association Is Committed To Deliver A Minimum Quantity	61	0.72 0.06
Minum Quantity The Pa Is Committed To Deliver (Ton)	42	32.56 3.43
Price		
The PO thinks that the price operated by the cooperative was:		
Higher than the market one	61	0.56 0.06
Same as the market price	61	0.23 0.06
Lower than the market price	61	0.21 0.05
Infrastructure and Equipment		
Warehouse	61	0.69 0.06
Office	58	0.57 0.07
Office Forniture	59	0.47 0.07
Fermentation boxes	59	0.69 0.06
Solar drier	60	0.8 0.05
Electric drier	58	0.02 0.02
Equipment for transformation	58	0.07 0.03
Tractor	59	0.05 0.03
Motorbike	58	0.82 0.05
Telephone	58	0.07 0.03
Solar panel	58	0.02 0.02

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