Public private partnerships: only for the well-off? Evidence from the rural productive partnership project in Colombia

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Abstract

This paper focuses on assessing the evidence that Public-Private Partnerships (PPPs) work well for producers from vulnerable backgrounds and/or located in post conflict zones. Looking at data from the Rural Productive Partnership Project (PAAP), a decade long program designed to overcome market barriers in Colombia, and using a combination of statistical and econometric techniques such as principal component analysis, survival models and impact assessment methods, results reveal that partnerships with vulnerable populations perform similar to others with better off participants. Partnerships in post-conflict zones perform slightly worse than those in other areas. Additionally, there is no difference in the duration of agribusiness contracts, regardless of producers' backgrounds and location in a post-conflict zone or not. The impact assessment exercise confirms an increase in households' sales of the PAAP product. These findings suggest that market access PPPs such as the PAAP can be inclusive, helping to link marginalized smallholder farmers to modern agricultural value chains.

Keywords: agricultural markets and marketing, agricultural policy, smallholder farmers, vulnerable populations.

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1. Introduction

In the developing world, farmers' investment levels, technology adoption and productivity remain low. Often the presence of market failures, asymmetric information and high transaction costs make it difficult for smallholder farmers to access high value agricultural value chains. The literature generally highlights several approaches in linking farmers to markets such as investing in infrastructure as well as building institutions that help to reduce the risk and transaction costs in the buyer-producer relationship (Torero, 2011, Casaburi et al., 2012, Svensson and Yanagizawa, 2009; Aker, 2010). In building institutions, governments and international development agencies increasingly promote innovative partnerships with the private sector to bridge gaps between resources and expertise. These are referred to as Public-Private Partnerships (PPPs). Commonly stated PPPs' objectives are rural employment, income generation, food security and increased agricultural competitiveness (FAO, 2013). The private sector benefits on the supply side, while farmers profit from linkages with markets, technologies and knowledge that contribute to improved income. Under the right conditions this leads to pro-poor development and sustainable agribusiness creation (IFAD, 2013).

The Colombian Rural Productive Partnership program was developed to increase the income and employment of smallholder producers, while at the same time providing buyers with a reliable supply of high quality products (Collion and Friedman, 2012). Within this framework, a Productive Alliance (PA) is defined as a commercial agreement that brings Commercial Partners (CP) together with a Producer Organizations (PO) with explicit marketing goals. It involves public grants to upgrade the PO through technical assistance, infrastructure and equipment. Despite the model's widespread implementation in around 10 Latin American countries[1] with funds from the World Bank, there is little empirical evidence on its effectiveness in facilitating competitive and sustainable agribusiness or its impact on the welfare of participating rural households. Critics often voice the concern that PPPs exclude marginalized and disadvantaged groups who might find themselves in unequal relationships with a more powerful corporate partner (Reed and Reed, 2009; Utting and Zammit, 2009; IFAD, 2013).

This study assesses Colombia's 'Rural Productive Partnerships Project' (PAAP according to its Spanish acronym), which has been operating since 2002, has reached 49,000 households and established 802 PAs in 2014. Evidence from Colombia's experience is used to assess the effectiveness of agribusiness PPPs, with a focus on whether the model works for producers from vulnerable populations and those located in post-conflict zones. Vulnerable populations are defined as households from ethnic

[1] The first project started in Colombia in 2002, and it was followed by Bolivia, Honduras, Panama, Guatemala, Peru, and Jamaica. Other projects in Brazil, Mexico and Haiti also share some of the key elements of the productive alliance model.

minorities such as Afro-Colombians and indigenous populations, the internally displaced and victims of violence. The participation of marginal populations grew over the two phases of PAAP reaching 29.7% in 2014. The Colombian government defines post-conflict zones as municipalities that have been affected by the armed conflict, the cultivation of illicit crops and weak institutional presence. The Department of Social Prosperity (Departamiento para la Prosperidad Social) estimates that one and a half million Colombians live in these zones.

Using the PAAP Monitoring and Evaluation (M&E) database as well as an original household survey, two of the model's features are evaluated: i) the performance and survival of the PAs; and ii) their impact on poverty reduction for participating agricultural households. To measure the performance and survival rates of the PAs, we used Principal Component Analysis (PCA) to construct a Productive Partnership Performance Index (PPPI). The latter is used to compare the performance of PAs with vulnerable populations and those located in post-conflict zones to other PAs. In addition, a duration model is estimated to assess differences in the hazard rates of PAs with and without vulnerable populations and PAs in post-conflict zones and the other zones.

The second part of the study involved an impact assessment, employing data from a household survey designed for the evaluation of the PAAP. The households surveyed were deliberately chosen to be located in post-conflict zones, or originating from vulnerable populations. In particular, a propensity score matching (PSM) model is employed to evaluate the impact of household participation in the PAAP on household income, sales of the product sold through PAAP, poverty and food security levels of producers of sugar cane in the Risaralda and of dairy in the Cauca departments.

This study is in line with the literature, which demonstrates that institutions can reduce transaction costs and credit constraints by transferring management and production skills, and even grants for technical assistance to POs. This can have a positive impact on agricultural households' well-being. (Nankhuni and Paniagua, 2013).

For example, there are a number of qualitative case studies, which assessed the outcomes of PPPs in the agricultural sector. Thorpe and Maestre's (2015) research, based on semi-structured interviews, field visits and focus group discussions with groups of farmers in Ghana, Indonesia, Rwanda and Uganda who participated in agribusiness PPPs, shows positive effects of PPPs on household's income and productivity. In addition, Abdulsamad et al. (2015) analyse three case studies from Indonesia, Kenya and Rwanda. They find that while PPPs positively impact economic growth at industry level, the smallholder households do not benefit. Francescutti-Motis et al. (2010) conducted interviews and workshops with producers from 23 PAs in Colombia. Most producers reported improvements in product sales, quality, input availability and access to credit. However, producers did not note any changes in terms of productivity and product prices. Quintero (2010), based on 12 PAs, reveals that their survival depends on the capacity of the POs to maintain the agribusiness contract (volume and quality), CPs agreement benefits and project POs' support. Finally,

Galeano et al. (2010) analysed six PAs to assess whether the PAAP could be transformed into a regional development policy. Using Porter's diamond model[2] to analyse agricultural clusters' competitiveness and PAs' role, they find that the PAAP delivers positive results for the participating smallholders, but only two out of six PAs could be scaled up to a regional development strategy.

This study is a relevant contribution to the literature. To our knowledge, there are currently few quantitative studies that empirically assess the effectiveness of agribusiness PPPs with respect to its effect on producers from vulnerable groups or located in post-conflict zones. In addition, the combined use of PCA, survival models and impact assessment methodologies is novel in assessing PPP programs.

The rest of the paper is structured as follows: The second section provides an overview of the model of rural PAs and its application in Colombia; the third section discusses the data, methodology and findings on the performance and survival rates of the PAs; the fourth section presents the data, methodology and findings of the impact assessment at household level. Finally, the last section offers some concluding remarks.

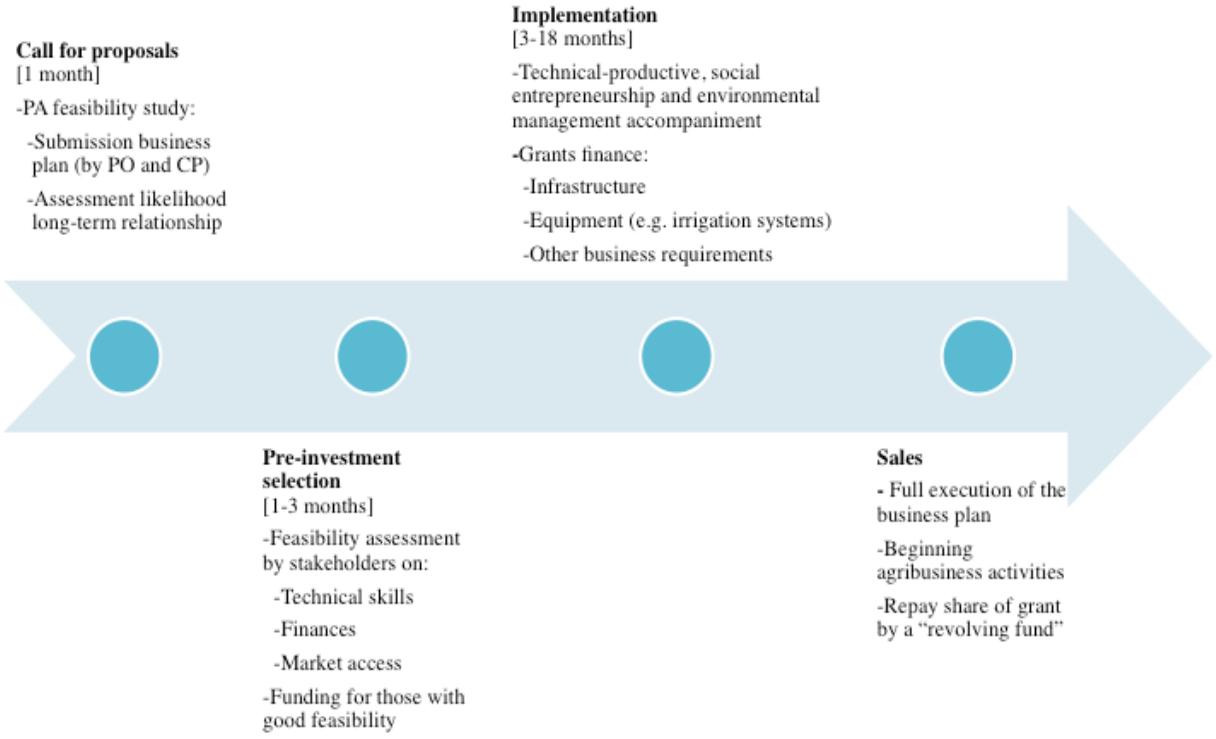
2. Background

Rural Productive Partnerships' Framework

The rural productive partnerships' framework is based on the notion that rural development can be achieved by providing the right incentives to the private sector to establish commercial ties with small-scale producers (Collion and Friedman, 2012). This framework has been designed to help farmers overcome problems in market access. A PA is defined as an agribusiness contract between a PO and one or more Commercial Partners (CP), also called 'buyers', such as wholesalers or processing industries. The contract normally defines the products' characteristics, price, quantity and quality to be produced, delivery and the packaging requirements. In addition, these contracts establish the CP's contribution such as technical assistance. Figure 1 visualizes the stages in which a PA is shaped: i) a call for proposal; ii) a pre-investment selection; iii) implementation (the project support) stage; and iv) sales (the agribusiness is operating).

[2] The Porter diamond model is a key tool for the analysis of competitiveness and allows determining the comparative advantage, industry dynamics, and factors, which can be improved upon. It analyses four important factors of competitiveness: i) firm strategy, structure and rivalry, ii) factor conditions, ii) demand conditions and iv) related and supporting industries.

Figure 1:
Time line PA stages

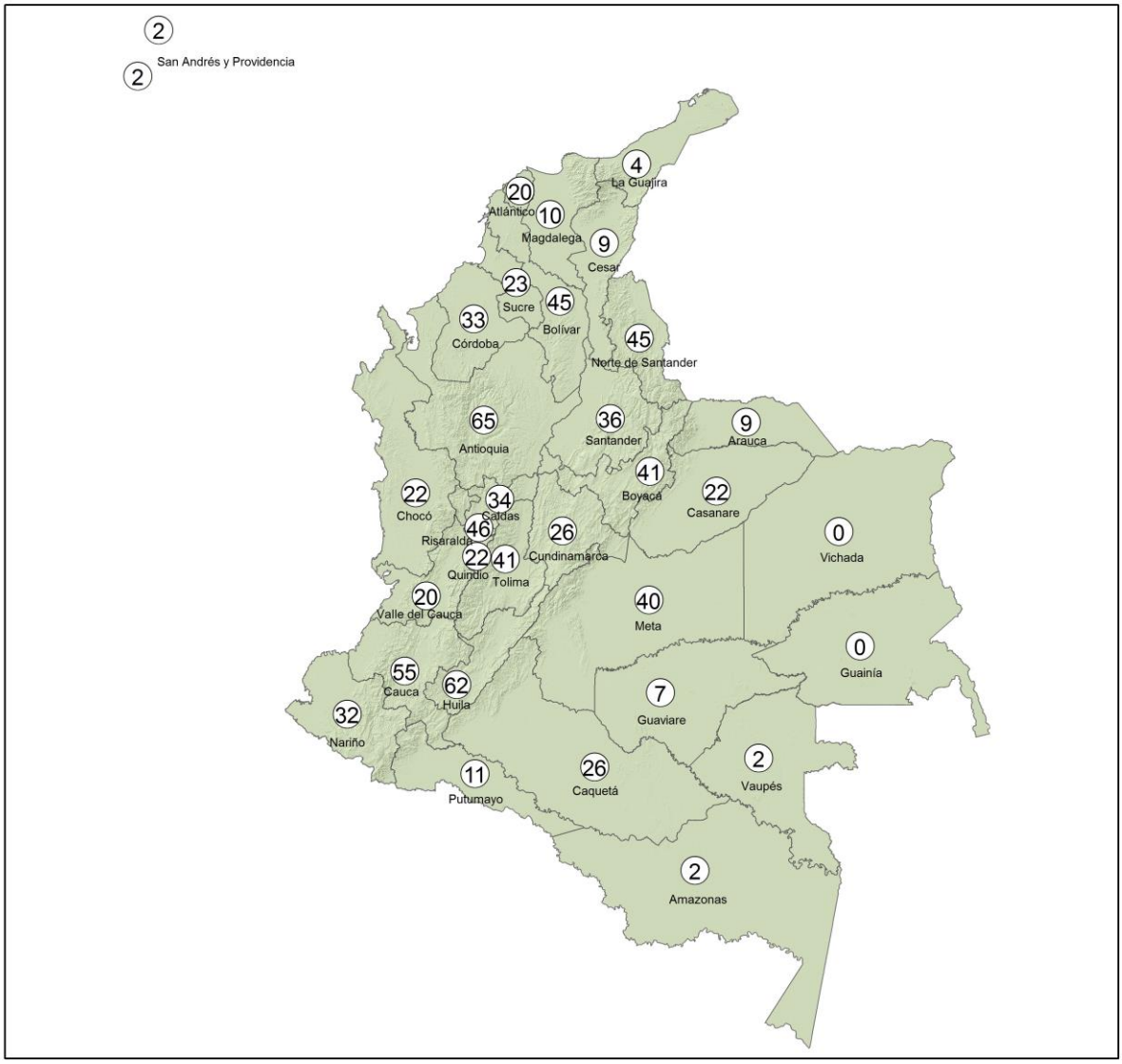


The 'Rural Productive Partnerships Project' in Colombia

Colombia's PAAP is one of the oldest of the productive partnerships projects in Latin America. Between 2002 and 2008, the first phase of the PAAP was funded by the World Bank and implemented by Colombia's Ministry of Agriculture and Rural Development (MADR, according to the Spanish acronym). Initially, the project focused on business development and facilitating market access for medium scale producers. From 2008 onwards, the second phase was co-funded by the Colombian government and changed its focus to improving the competitiveness of poor smallholder farmers, including the most vulnerable populations. Producers are only eligible to participate in the PAAP if their monthly income does not exceed two monthly minimum salaries (USD 2*307.73 = 615.46[3]) and their plot size remains below two Family Agricultural Units (UAF[4], according to the Spanish acronym).

[3] According to the World Bank exchange rate in 2014 (1 USD = 2,001.78 COP)
[4] UAF: it is usually devoted to subsistence and whose production is sufficient to meet the basic needs of the family. The size of UAFs varies according to the municipality.

Figure 2
Number of PAs by department 2014

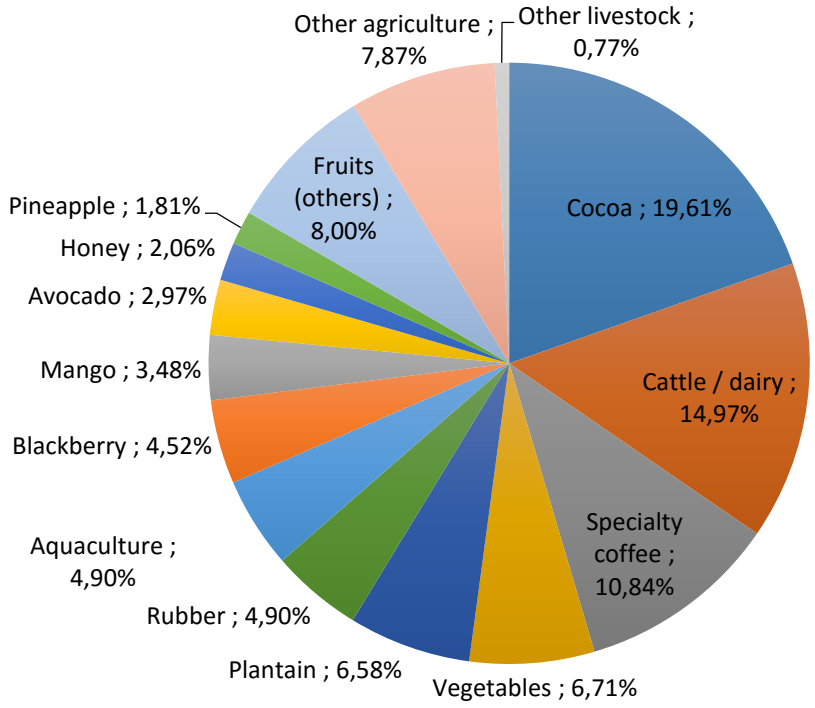


Source: MADR (2014)

Between 2002 and 2014, the PAAP established 802 PAs[5] (figure 2), including over 49,000 households and involving 430 CPs. Approximately 92% of all partnerships are still operating[6] today.

[5] The figure includes 812 PAs whereas the analysis counts 802. This difference can be explained by the need to drop some observations because of incompleteness or inconsistency.
[6] Doing business with one or more active commercial partners.

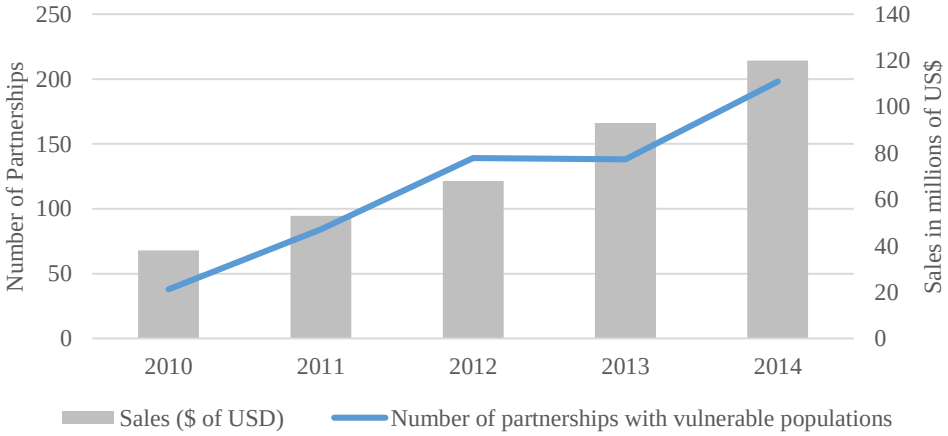
Figure 3:
Product lines within the PAAP



Source: MADR (2014)

PAAP has supported a wide range of agricultural activities including short-term and long-term crops as well as cattle ranching and aquaculture (Figure 3).

Figure 4:
Number of partnerships with vulnerable groups



Source: MADR (2014) [7]

Between 2010 and 2014 the number of PAs with vulnerable groups rose sharply from 38 to 198 (figure 4) In fact, in 2014 the share of producers from vulnerable populations is larger than their share in the total Colombian population. For example, while indigenous populations constitute around 3.4% of the overall Colombian population, they make up almost 10% of PAAP beneficiaries (table 1). Effectively, PAAP

[7] Sales in US$ were obtained using official annual exchange rates: http://data.worldbank.org/indicator/PA.NUS.FCRF

constitutes a large-scale natural experiment in which the relative performance of PPPs with marginal and non-marginal populations against those with better off populations can be assessed.

Table 1
Share of vulnerable populations in the PAAP in 2014

Type of Population	% in PAAP	% in Colombia
Indigenous	9.9	3.4
Internally Displaced	8.8	7.3
Afro-Colombians	8.5	10.6
Others	72.8	78.7
Total	**100**	**100**

Source: MARD (2014)

3. Performance and survival of productive alliances

Data

The M&E database from the MADR has information on 802 partnerships in 2014, established since 2002. This database was created in 2010 and is updated every six months after field visits by monitors of eight Regional Management Organisations (Organizaciones Gestoras Regionales – OGR), which operate in all departments with active PAs. Table 2 shows the PAs' 2014 summary statistics.

Table 2
Summary statistics – PAs 2014

Variables	Mean	Std. dev.	Min	Max
PA				
Sales (in thousands of dollars)	112.7	220.7	0	2,975
No. of beneficiaries	62.1	36.6	15	400
Sales stage (1=yes; 0=no)	0.62	0.48	0	1
Phase I (1=yes; 0=no)	0.11	0.31	0	1
Phase II (1=yes; 0=no)	0.89	0.31	0	1
Age (in years)	3.56	2.52	0.5	13.5
Percentage of female beneficiaries	0.24	0.17	0	1
With vulnerable population (1=yes; 0=no)	0.25	0.43	0	1
In post-conflict zone (1=yes; 0=no)	0.19	0.4	0	1
CP				
Exporter (1=yes; 0=no)	0.57	0.5	0	1
Type				
Processing industry	0.42	0.49	0	1
Wholesalers	0.45	0.5	0	1
Retailers and supermarkets	0.13	0.28	0	1
Size				
Large	0.43	0.5	0	1
Medium	0.39	0.49	0	1
Small	0.19	0.39	0	1
Product				
Temporary crops (1=yes; 0=no)	0.06	0.32	0	1
Permanent crops (1=yes; 0=no)	0.68	0.5	0	1
Others (1=yes; 0=no)	0.26	0.45	0	1

Notes: i) Statistics based on a total of 802 partnerships; ii) other products include: Livestock, dairy, raw sugar cane, aquaculture, eggs, forestry products, honey from bee-keeping and silk thread
Source: PAAP M&E unit, MADR

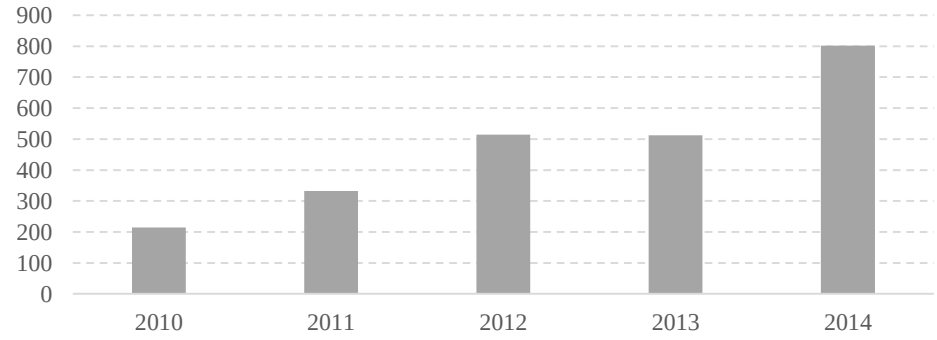
In 2014, the POs enrolled in the PAAP had on average 62.1 members; over half of the partnerships were in the commercial stage (62%), meaning that the PAAP supported agribusiness is operating; the annual sales were worth on average USD 112,700 per PA; 11% of PAs were formed during phase I (2002-2008), while 89% originated in phase II (2008-2014). The average age of a PA is around 3.5 years. In addition, 25% of all PAs include beneficiaries from vulnerable populations and 19% are located in post-conflict areas. 24% of the project's beneficiaries are women (table 2).

In terms of the CPs, 42% are from processing industries. 45% are wholesalers and the rest (13%) are smaller retailers or supermarkets. Most CPs are large (43%) or medium-scale (39%) companies. Only 19% of all buyers are small enterprises. Finally, 57% of all CPs participate in export markets, while the rest sell domestically.

The majority (74%) of all products traded by the POs of the PAAP are crops: 68% are permanent crops and 6% are temporary crops.[8] The rest of the products (26%) are other animal-based products such as livestock, milk and fish.

Between 2010 and 2014, the PAAP increased the number of PAs supported in Colombia by almost 400%, from 214 to 802 PAs (figure 5).

Figure 5
Number of PAs



Source: PAAP M&E unit

Productive Partnership Performance Index (PPPI)

In order to assess the performance of the PA, an index was constructed. The PPPI measures the PA's performance based on three dimensions: competitiveness, efficiency in business management and sustainability. These three conceptual dimensions give support to the notion that a PA is successful when it creates added value for the POs and the CPs involved in the agribusiness. The PAs with the highest performance are the ones that offer value to both the PO and the CP in that they constitute competitive, efficient and sustained business linkages. The index also indicates whether PAs with vulnerable populations and in post-conflict zones perform better or worse than others.

[8] Permanent crops are sown or planted once, and then occupy the land for some years and need not be replanted after each annual harvest. Temporary crops are planted and harvested usually within the same year (FAO Stat).

Empirical Strategy

Each dimension is composed of a number of variables. The variables were calculated using the PAAP M&E database[9]. Performance in competitiveness is judged by the PA's commercial success. Four variables comprise this dimension:

Table 1
PPPI Competitiveness variables

Variable		Definition
Achievement of PA's sales target	=	$\frac{Sales\ of\ PP\ delivered\ to\ buyer}{Target\ agreed\ with\ buyer \times (\%\ of\ sales\ to\ buyer)}$
Sales per beneficiary	=	$\frac{Sales\ of\ PP\ delivered\ to\ the\ buyer}{Active\ members\ in\ the\ PP}$
Achievement of PA's sales target per beneficiary	=	$\frac{Sales\ per\ beneficiary}{Target\ per\ beneficiary}$
Creation of externalities	=	$\frac{Other\ PO\ members\ that\ benefit\ from\ PP\ activities}{Active\ members\ in\ the\ PP}$

Efficiency in business management relates to the managerial capacities and the financial performance of the POs. The following variables comprise this dimension:

Table 2
PPPI Efficiency in Business Management variables

Variable		Definition
Recovery of the Government's Financial Incentive (GFI)	=	$\frac{Recovery\ of\ the\ GFI}{Set\ value\ of\ the\ recovery}$
Recovery of the GFI per beneficiary	=	$\frac{Recovery\ of\ the\ GFI}{Active\ members\ in\ the\ PP}$
Net capitalization of the revolving fund	=	$\frac{Recovery\ of\ the\ GFI}{Net\ capital\ of\ the\ revolving\ fund}$
Average business rating by the Regional Management Organization (OGR)[10]	=	$\frac{\sum scores\ in\ all\ categories}{number\ of\ categories}$

Sustainability refers to those characteristics that ensure that the value created persists over time. Moreover, it includes the PO's engagement in strengthening the partnership. The variables that measure sustainability are:

Table 3
PPPI Sustainability variables

Variable		Definition
Share of sales delivered to the buyer	=	$\frac{Sales\ delivered\ to\ the\ buyer}{Total\ sales\ of\ the\ PP}$
Share of PO's collective sales	=	$\frac{Sales\ delivered\ to\ the\ buyer}{Total\ collective\ sales\ of\ the\ PO}$
Capacity to reimburse the resources of the PA	=	$\frac{Achievement\ of\ sales\ target}{Recovery\ of\ GFI}$

Principle Component Analysis (PCA) is employed to construct the PPPI. The idea behind PCA is to exploit the relationship between the variables constituting each dimension. Within each dimension, the variables are highly correlated with each other, and PCA uses their correlation matrices to calculate a group of factors, summarizing their variance (Jolliffe, 2002). PCA allows

[9]Available here: **http://alianzasproductivas.minagricultura.gov.co**
[10] POs are graded on a scale from 1 to 10 regarding the level of implementation of the social and environmental plan; transfer of managerial competencies; effectiveness of the Business Steering Committee; adoption of technology; and the capitalization of the revolving fund.

estimating a linear functional form of the dimensions in which the weight of each variable is taken into consideration. For each dimension, the first factor is the one that explains most of the variance. These are placed on a scale from 1-100 where the maximum represents the PA with the best performance for each dimension. To obtain the PPPI, each dimension is weighed by 0.33 and summed, and once again, for interpretation purposes, the sum results are placed on a scale from 1-100; where for this case 100 represents the PA with the best performance in the PPPI

Results

Younger partnerships lack the organizational structure necessary for high performance levels and naturally score lower on the PPPI. As time passes the accumulation of knowledge drives improvements in performance. Table 6 displays that in 2014 over 70% of all PAs were younger than 3 years. It also shows that PA's mean and median PPPI scores increase with the age ranges of the partnerships. PAs older than ten years have performance scores that are on average 37% higher than those of PAs younger than two years old.

Table 4
PPPI score by age of the partnerships (2014)

Phase	**Age in years**	**No of Obs (%)**	**PPPI**		
			Mean	**Median**	**Maximum**
II	Less than 2	303 (37.8%)	28.2	20.8	53.8
(2008-2014)	2-3	268 (33.4%)	34.3	34.4	100
	4-5	99 (12.3%)	34.8	35.1	82.1
I	6-7	63 (7.9%)	32.9	32.6	54.8
(2002-2008)	8-9	50 (6.2%)	35.7	37.7	60.2
	More than 10	19 (2.4%)	38.6	37.9	74.6

Partnerships, which originated in phase I of the project, display better performance. However, while the mean score of PAs between 6 and 7 years old is higher than that of the youngest PAs, it is lower than that of PAs between 2 and 5 years old. This cohort of PAs was initiated right around the time that phase II began and therefore, their lower score might stem from initial difficulties brought about by a structural change in the PAAP implementation. Figure 6 shows graphically that PPPI scores of older PAs are significantly higher than those of younger PAs.

Figure 6:
PPPI scores by dimension and age of the PA

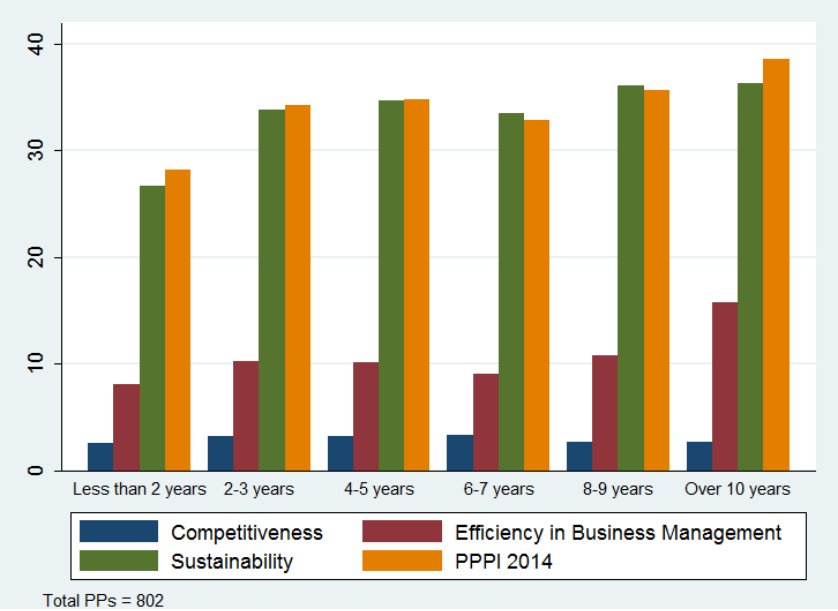


Table 7 displays the PPPI scores for each dimension by vulnerable populations, location in post-conflict zone, both and neither. In 2014, 24% of all PAs involved producers from vulnerable populations, 20% were located in post-conflict zones, 6% were characterized by both of these factors and 63% were part of neither two populations.

The PAs that include vulnerable populations perform similarly to those that do not. The difference is negligible. While their scores in efficiency in business management and sustainability are around the same compared to the PAs without vulnerable populations, they slightly under-performed in competitiveness. PAs in post-conflict zones perform worse than those in other areas. This is mainly driven by differences in the sustainability dimension.

Table 5
PPPI scores and dimensions by population type in 2014

	Vulnerable	Post-Conflict	Both	Neither
Competitiveness	2.50	2.84	2.67	3.13
Efficiency	9.28	8.26	8.90	10.04
Sustainability	31.86	28.38	28.77	31.96
PPPI	31.68	29.06	29.39	33.29
% of PAs	**24%**	**20%**	**6%**	**63%**

The results are also presented graphically in Figures 7 and 8. Figure 7 compares PPPI scores and Figure 8 shows the frequency distributions of the PPPI. In both cases, it demonstrates that the PAs without vulnerable populations (vulnerable=0) and those not located in post-conflict zones (post-conflict=0) perform slightly better compared to the others (vulnerable=1 and post-conflict=1). However, the difference is negligible.

Figure 7:
PPPI scores by dimension and population type (2014)

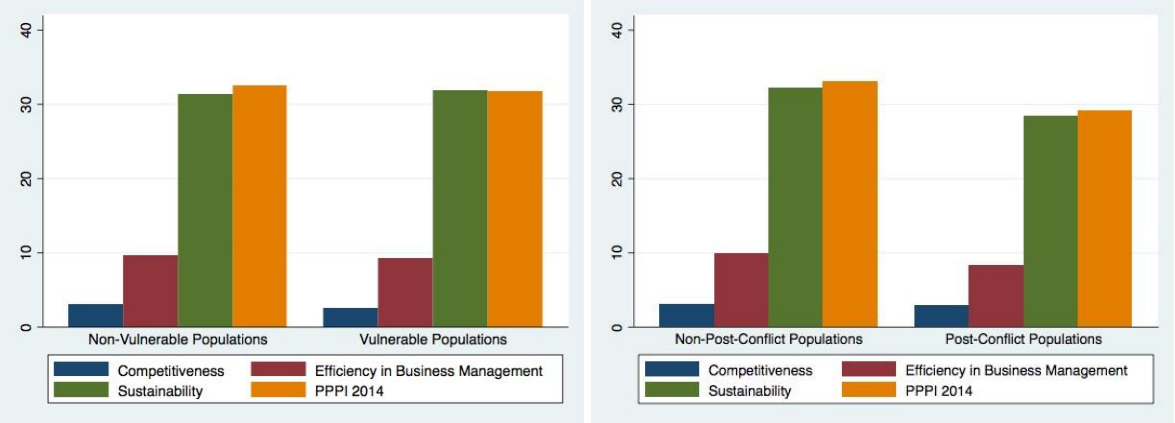
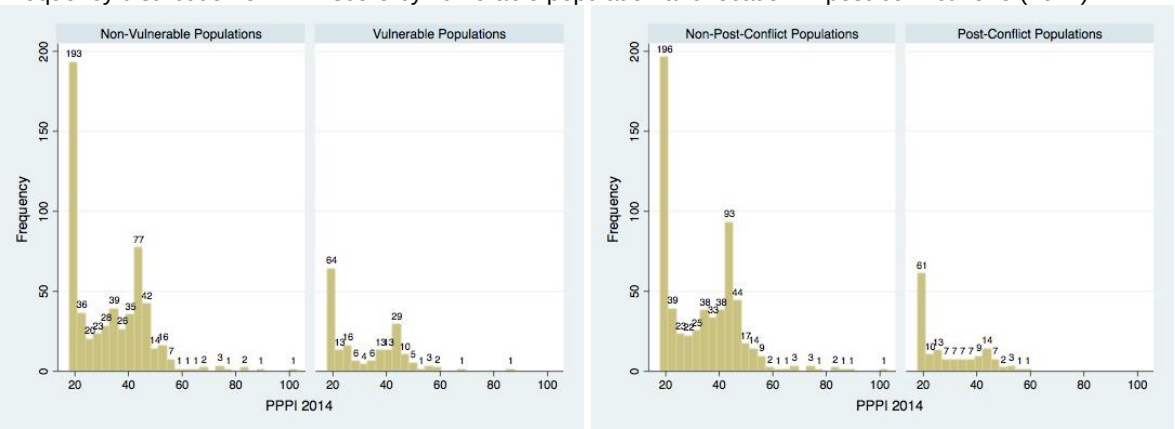


Figure 8:
Frequency distribution of PPPI score by vulnerable population and location in post-conflict zone (2014)



Note: The frequency distribution of the PAs is on the y-axis and the PPPI score is on the x-axis. The number on top of the bars is the number of PAs.

The survival of the PAAP agribusiness contracts

A second analysis was conducted to test whether agribusiness contracts formed with producers from post-conflict areas or vulnerable populations differ in their duration from contracts formed with producers with more stable backgrounds. The data come from the PAAP M&E unit of the MADR. The analysis is restricted to the information of 444 PAs registered between January 2005 and December 2012[11].

Empirical Strategy

Duration models explain how long an individual remains in a given state before there is a change in status. The time that an individual lasts in a particular state is known as a "spell" (Jenkins, 2005).

[11] This sample was used due to information restrictions regarding PAs durations

It is important to define the duration of the spell with the help of clear origin and failure points. In the context of the PAAP, the point of origin is defined as the date on which the PAAP agribusiness contract was signed. To determine the failure point, the PAAP inspectors determine whether there is "at least one active commercial tie with a CP"; the information is limited to a default on the original commercial tie with the initial CP. Field visits are done every six months, so the semester of failure is determined. A limitation to this approach is that field visits started from 2010 onwards; therefore, failure before 2010 cannot be determined. In the dataset of 444 PAs evaluated, 119 experienced a default of the original contract.

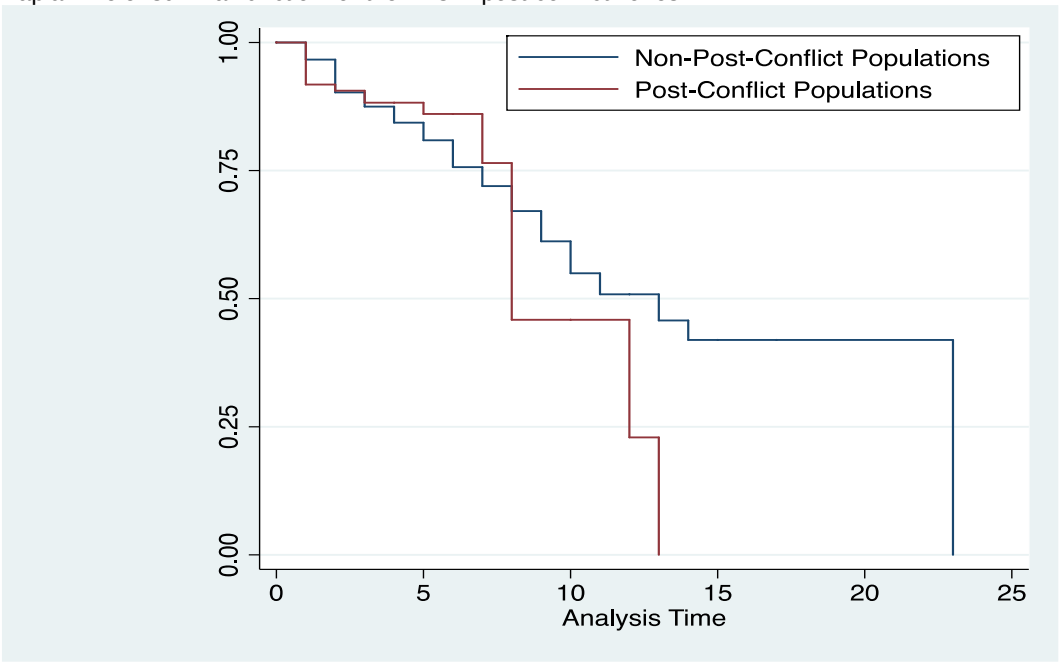
Non-parametric model (Kaplan-Meier)

The simplest version of a duration model is the non-parametric Kaplan-Meier function in which the survival function is obtained by dividing the survival rate (total agribusiness contracts minus broken contracts, $n_k - h_k$) by the total number of agribusiness contracts, n_k:

$$S\,(T_k) = \frac{n_k - h_k}{n_k}$$

Figure 9 shows the survival functions of PAs located in post-conflict zones and those located elsewhere. While the horizontal axis represents the duration in semesters, the vertical axis displays the survival function values, which range between 0 and 1. As time passes, PAs' probability of default on the original commercial link with the CP increases. Hence, the survival rate decreases.

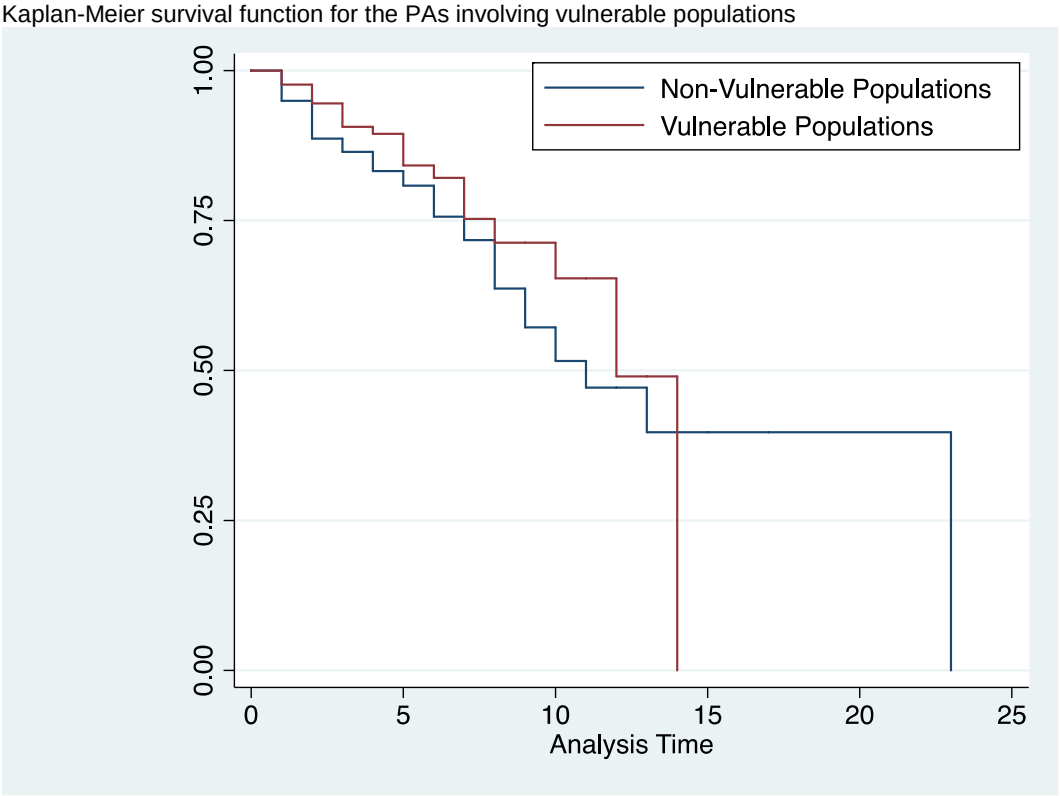
Figure 9:
Kaplan-Meier survival function for the PAs in post-conflict zones



Between semesters 2 and 8 the probability that an agribusiness contract remains active is higher for PAs located in post conflict zones. Thereafter, the survival functions cross and those not located in post-conflict zones have a higher probability of survival. A log-rank test is performed to detect whether this difference is statistically significant. A p-value of 0.72 provides evidence that there is no significant difference in the duration of agribusiness contracts between PAs in post-conflict zones and PAs elsewhere.[12]

Similar survival functions are estimated to compare the duration of agribusiness contracts between PAs involving vulnerable groups and PAs that do not. Figure 10 reveals that for the first years, the probability for PAs with vulnerable populations to sustain the original agribusiness contract is consistently higher. Right around the 7-year mark (14 semesters), the PAs without vulnerable populations have a higher probability to survive. The log-rank test yields a p-value of 0.21. Therefore, the difference between the survival of agribusiness contracts involving vulnerable populations and those with other populations is not statistically significant.

Figure 10:
Kaplan-Meier survival function for the PAs involving vulnerable populations



Capacity to re-establish commercial ties

The duration model described above assesses the failure of the initial contract. While important, this does not allow us to evaluate the capacity of the PO to re-establish a commercial relationship when the initial contract fails. A truly successful program should contribute to the capacity of the PO to establish commercial relationships. The

[12] Null hypothesis (Ho): no significant difference between the two Kaplan-Meier survival functions.

capacity of the PO to rebound from a failed relationship was chosen as a proxy to assess business capacity developed by PAAP. Out of the 119 failures, 82 (69%) PAs managed to re-establish a link with a CP by entering a new or recovering their original agribusiness contract (table 8). In fact, PAs in post-conflict zones and/or with vulnerable populations were faster than the average in finding new commercial contracts.

Table 6
PAs' recovery of commercial ties by vulnerable populations and location in post-conflict zones.

PAs	**Partnerships with broken contracts**	**Partnerships which managed to recover commercial ties**
Vulnerable population	24 (20%)[a]	18 (75%)[b]
Post-conflict zone	19 (16%)[a]	15 (79%)[b]
Both	6 (5%)[a]	6 (100%)[b]
Total	**119**	**82 (69%)**

[a]percentages of total partnerships with broken contracts
[b] percentages of total recoveries

With respect to the velocity of re-establishing commercial ties, 85% of the PAs managed to recover within the first semester after failure, 98% within one year and 99% within two years.

On average, PAs located in post-conflict zones and involving vulnerable populations are faster at recovering commercial ties. 89% of the PAs with vulnerable populations, and 87% of those located in post-conflict zones, which lost their contract, found a new one within one semester.

In Appendix A, a semi-parametric specification is used for illustrative purposes to highlight some of the time-invariant determinants of the duration of the PAs.

4. PAAP impact assessment at the household level

Data

To assess whether the PAAP is an "inclusive" market access project that goes beyond establishing competitive and long-lasting agribusiness relationships by also benefiting farmers from poor and vulnerable backgrounds, an impact assessment was conducted at the household level. Between 2014 and 2015 the Linking Farmers to Markets team of the International Center for Tropical Agriculture (CIAT) conducted a household survey covering 709 households from 10 PAs in 9 departments across Colombia. Most of these PAs are either located in post-conflict zones or involved people from vulnerable populations. For two PAs a control group of households that did not participate in any PA were surveyed. In the Department of Cauca, the treatment group included all 159 milk-producing households that participated in the PA "Paletará" and the control group included 222 non-participating milk-producing households. In the Department of Risaralda, the treatment group is composed of all 84 raw sugar cane

producing households that are part of the PA “Asopri” and the control group includes 119 raw sugar cane producing households that do not benefit from any PA. The households in the control group have similar characteristics to the treatment group such as household income and farm size (table 9).

Table 9
PAs and Households Surveyed

PA name	Product traded	Vulnerable population	Post-conflict zone	Treatment households	Control households	Impact assessment
Agroaguadas	Blackberry			40		
Asprocamm	Cocoa	Yes	Yes	65		
Paletará Cauca	Milk	Yes		159	222	Yes
Aprocoleda I	Milk		Yes	58		
Asomacafe	Coffee	Yes		33		
Arpa	Honey		Yes	70		
Activa G10	Cocoa		Yes	60		
Asopri	Raw Sugar Cane	Yes		84	119	Yes
Coogrupar	Plantain	Yes		69		
Coopcacao	Cocoa		Yes	71		
Total				709	341	

The impact of participation in a PA is evaluated on four outcome variables at the household level: i) annual household income (in Colombian pesos: COP); ii) sales of the product traded through the PAAP (in COP); iii) poverty levels, and; iv) food security levels. Questions from the household survey are used to construct the two indices of poverty and food security levels.

Poverty is measured by constructing the Grameen Foundation’s Progress out of Poverty Index (PPI). This index is based on 10 questions concerning the households’ ownership of basic assets, access to public services and members’ employment situation. The questions are customised for each country and assign points on a scale from 0 to 100. The higher a household’s score in the PPI, the less likely it is to be poor. The PPI includes tables comparing it to different poverty lines (e.g. $1.25 a day international poverty line, the national poverty line or the USAID extreme poverty line) and households are given a percentage likelihood of being below a given poverty line (Boucher 2014).

The household’s food security index is defined by the Escala Latinoamericana y Caribena de Seguridad Alimentaria (ELCSA) from FAO (2012). This is a discrete scale, based on 15 survey questions, classifying food security in four categories between 0

and 3. The higher the score the more insecure a household's food situation (secure=0, slightly insecure=1, moderately insecure=2, severely insecure=3).

Summary statistics of 709 households participating in 10 different PAs are presented in table 10. The average annual household income is equivalent to COP$ 19,600,000 (US$ 9791), where around 31% came from the sales of the product supported by the PAAP.

The mean household PPI score in the sample is 37.04, which indicates that 45% of the households in the sample have the probability of living below Colombia's national poverty line. The mean food security index is just under 1, which translates into 'mild food insecurity'. Regarding the household heads; 87% are male, they are around 49 years old and have an average of 5.85 years of schooling. In addition, households have on average 4.6 members, 46% of which are female. Just over half of the households (56%) list agriculture as their main source of income, and a bit over a quarter (28%) also own livestock. 75% of all households are accessible by road but only 15% have running water for the irrigation of their farm.

Table 10
Summary statistics of PAAP beneficiary households from the 10 PAs selected

Variables	Mean	Std. dev.	Min	Max
Outcome variables				
Annual household income (millions of COP)	19.60	50.90	0	739.00
Sales of PAAP product (millions of COP)	6.11	15.80	0	262.00
Household PPI score	37.04	12.74	3	77
Household food security index	0.91	0.86	0	3
Explanatory variables				
Gender of household head (1=male; 0=female)	0.87	0.34	0	1
Age of household head	49.21	11.88	25	88
Years of schooling of household head	5.85	4.57	0	21
Number of household members	4.59	2.01	1	13
Proportion of females in household [0-1]	0.46	0.19	0	1
Agriculture main source of income in household (1=yes; 0=no)	0.56	0.50	0	1
Animal breeding (1=yes; 0=no)	0.28	0.45	0	1
Farm size (hectares)	19.45	26.74	0.08	200
Access by paved road (1=yes; 0=no)	0.75	0.43	0	1
Irrigation with running water (1=yes; 0=no)	0.15	0.35	0	1
PAAP variables				
Proportion of area used for PAAP crop [0-1]	0.44	0.36	0	1
Tech assistance received (1=yes; 0=no)	0.83	0.38	0	1
Training received (1=yes; 0=no)	0.49	0.50	0	1
Production inputs received (1=yes; 0=no)	0.32	0.47	0	1
PA older than 3 years (1=yes; 0=no)	0.70	0.46	0	1
Satisfied with price received (1=yes; 0=no)	0.58	0.49	0	1
Benefit from other social project (1=yes; 0=no)	0.17	0.38	0	1

Summary statistics of PAAP beneficiary households from the 10 PAs selected

The average proportion of land dedicated to the production of the PAAP product is 44%. 83% of all producers received technical assistance through the project, 49% received production and business training through their PO, and 32% received production inputs and transport services. Furthermore, 70% of all producers are part

of a PA that is already older than 3 years. 58% are satisfied with the price that their PO negotiated for their product and 17% currently also benefit from another social project besides the PAAP.

Estimation Method and Results

In order to examine the correlation between participation in the PAAP and household outcomes, the following model is estimated using ordinary least squares (OLS):

$$\ln(y_{ij}) = \beta_0 + \beta_1 PAAP_{ij} + \beta_2 X_{ij} + \beta_3 Z_{ij} + \beta_4 M_{ij} + w_j + e_{ij}, \quad (2)$$

where $\ln(y_{ik})$ is the log of the annual income of household *i* selling product *j* through the PAAP. Eq. (2) is also estimated using OLS, replacing the log of total annual income of the household with the log of household's sales of the PAAP product and the PPI score as dependent variables.

$PAAP_{ij}$ is a vector of variables capturing the scale of participation of household *i* selling product *j* in the PA. This vector of variables includes the proportion of the farm's area household *i* dedicates to the production of the PAAP product *j* and four dummy variables indicating whether the household received technical assistance, training in production and/or business techniques, production inputs including transportation services through this project and whether the household has been part of the PA for more than three years.

In addition, three vectors of covariates are included in the model. Firstly, X_{ij} is a vector of socioeconomic variables of household *i* selling product *j*, including years of schooling by the household head, age of the household head, average household age, gender of the household head, number of household members, proportion of females, number of people working on the farm, and dummies capturing whether the household has members of an ethnic minority, and if it has at least one person employed in a public or private company. To allow for non-linearity, it also includes the squared value of the age of the household head and the average household age.

Secondly, Z'_{ij} is a vector of variables capturing the agricultural production characteristics of household *i* selling product *j.* It includes the total farm size (in hectares), and two dummies indicating if agriculture is the household's main source of income, or if the main income comes from livestock and/or aquaculture.

Thirdly, M'_{ij} controls for the degree of market access of household *i* selling product *j* by including a dummy for whether the farm can be accessed via a paved road or not.

w_j represents product fixed effects, which must be included in the model because the dataset contains producers from various PAs selling various products (blackberry, cocoa, plantain, coffee, sugar cane, milk and honey). Eq. (2) controls for (time-invariant) characteristics of each product such as the average area needed for its production. Finally, e_{ij} is the error term.

Furthermore, in order to evaluate the effect of households' participation in the PAAP on the food security index, the following ordered logit model is estimated:

$$P(Food_{ij} = k) = F(\gamma_1 PAAP_{ij} + \gamma_2 X_{ij} + \gamma_3 Z_{ij} + \gamma_4 M_{ij} + a_j + v_{ij}), \quad (3)$$

where k = 0, 1, 2 and 3 refers to the four categories of food security according to the ELCSA from FAO. The model estimates the probability of a household *i,* selling product *j,* to fall in each of these categories and F(.) denotes the logistic cumulative distribution function. The explanatory variables remain the same as in Eq. (2).

While the estimation results for Eq. (2) are shown in table 11, the results from Eq. (3) are presented in table 12. The annual household income does not appear to be statistically affected by the household's participation in the PAAP (table 11). However, the values of the sales the PAAP product, the PPI score, and food security index (table 12) are statistically positively related to participation in the PAAP.

In particular, the value of the sales from the product sold through the PAs also responds positively to the proportion of farmland dedicated to its production relative to the production of other products. A 10% increase of the area used for the production of the PAAP product increases the household's sales by 5.82%. Additionally, households, which received training in production and business methods, increase their sales of the PAAP product by 42.19%.

The PPI levels also respond positively to some PAAP participation measures. The households that received technical assistance and production inputs and/or transportation services, through the PA, score 1.6 and 1.36 points more on the PPI, respectively, on average and ceteris paribus. Thus, they are less likely to be below the national poverty line.

While the impact of the PAAP measures on food security are not statistically significant, there is a positive and statistically significant impact of long-term participation on food security. A household, which sells its product through a PA for longer than 3 years, is 9.9% more likely to be "food secure", on average and ceteris paribus. Its food security situation is also 2.8% less likely to be "slightly insecure"; 5.3% less likely to be "moderately insecure"; and 2% less likely to be "severely insecure", on average and ceteris paribus.

Table 11
OLS estimation of PAAP participation on household income, sales from the PAAP product and household poverty levels

Variables	(1) Ln (Annual income)	(2) Ln (Sales of PAAP product)	(3) PPI
Proportion of area used for PAAP crop [0-1]	0.243	0.582***	1.018
	(0.189)	(0.256)	(0.997)
Tech assistance received (1=yes; 0=no)	-0.019	0.076	1.595**
	(0.110)	(0.131)	(0.809)
Training received (1=yes; 0=no)	0.129	0.352***	0.350
	(0.109)	(0.123)	(0.641)
Production inputs received (1=yes; 0=no)	0.045	0.107	1.359***
	(0.109)	(0.117)	(0.628)
PA older than 3 years (1=yes; 0=no)	-0.081	-0.109	-0.924
	(0.133)	(0.143)	(0.689)
Satisfied with price received (1=yes; 0=no)		-0.083	
		(0.101)	
Socioeconomic controls	YES	YES	YES
Agricultural production controls	YES	YES	YES
Market access controls	YES	YES	YES
Product fixed effects	YES	YES	YES
Constant	13.70***	11.06***	12.753***
	(0.874)	(1.242)	(3.21)
Observations	603	369	693
R^2	0.227	0.527	0.677

For all reported outcomes, standard significance levels were used of * 10%, ** 5% and *** 1 %.
Standard errors are shown in parenthesis.

Table 12
Ordered logit estimation results of PAAP participation on households' food security categories

Variables	(1) Secure	(2) Slightly insecure	(3) Moderately insecure	(4) Severely insecure
Proportion of area used for PAAP crop [0-1]	0.105	-0.038	-0.052	-0.015
	(0.079)	(0.029)	(0.039)	(0.01)
Tech assistance received (1=yes; 0=no)	-0.038	-0.025	0.018	-0.054
	(0.063)	(0.187)	(0.028)	(0.06)
Training received (1=yes; 0=no)	0.072	-0.028	-0:035	-0.011
	(0.049)	(0.014)	(0.025)	(0.01)
Production inputs received (1=yes; 0=no)	-0.009	-0.003	-0:005	-0.001
	(0.049)	(0.018)	(0.022)	(0.01)
PA older than 3 years (1=yes; 0=no)	0.099**	-0.028**	-0.053*	-0.020*
	(0.053)	(0.014)	(0.032)	(0.01)
Benefit from other social project (1=yes; 0=no)	0.186***	-0.088***	-0.076***	-0.022***
	(0.065)	(0.039)	(0.023)	(0.01)
Socioeconomic controls	YES	YES	YES	YES
Household production controls	YES	YES	YES	YES
Market access controls	YES	YES	YES	YES
Product fixed effects	YES	YES	YES	YES
Predicted probability	0.33	0.49	0.14	0.04
Observations		414		
Pseudo-R^2		0.107		

For all reported outcomes, standard significance levels were used of * 10%, ** 5% and *** 1 %.
Standard errors are shown in parenthesis.

Impact Assessment

The results from the previous section have a limitation: They do not allow for a counterfactual. While they establish the relationship of participation in the PAAP with some household outcomes, these estimations do not reflect the causal impact of the project. To solve this problem, this section uses data from two control groups of households that were surveyed among the milk producers in the Department of Cauca and the raw sugar cane producers in the Department of Risaralda (see table 9). Summary statistics for both treatment and control groups of these producers can be found in the appendix (tables A.2 and A.3).

For these two PAs, based on Rosenbaum and Rubin (1983), a propensity-matching model[13] is employed to establish the impact of the PAAP on the total annual household income, the annual sales from the PAAP product, the households' PPI and food security indices. The PSM method creates the missing counterfactual by finding a group of non-treated households which are similar to the treated households in all relevant observable characteristics except for their treatment status. The two groups are matched and their outcomes are compared. The average treatment effect on the treated (ATT) is estimated for the households from those two PAs.

The following logit model is used to estimate the propensity score, which is the probability that a household with a certain set of characteristics belongs to the treatment group.

$$P(PAAP_i = 1) = F(\pi_1 X_i + \pi_2 Z_i + v_i) \quad (4)$$

where X_i is a vector of socioeconomic treatment confounders of household *i,* including years of schooling, age and gender of the household head, the average years of schooling in the household and the number of household members. When using the model to estimate the propensity score of the milk producers from the PA in Cauca department, the vector X_i also includes the proportion of women in household *i* and two dummy variables capturing whether the household's ethnic background is indigenous and whether its members have to cook without electricity.

Z_i is a vector of farm characteristics of household *i,* including the farm size in hectares and the number of farms owned. For the milk producers, this vector also includes two dummy variables capturing whether the household is accessible by paved road and uses running water for its irrigation.

The reason why the two specifications have a slightly different combination of control variables is because using the data from each of these two PAs, the best estimation is selected (according to the overall significance F-test). This means that the model avoids over-specification and possibly has a higher number of observations in common to do the matching (Khandker et al., 2010). In addition, the models rely on the

[13] The **Propensity Score Matching** (**PSM**) is a statistical matching technique that attempts to estimate the effect of a treatment, policy, or other intervention by accounting for the covariates that predict receiving the treatment.

assumption that participation in the PAAP is not related to unobservable characteristics.

The estimated propensity score from the logit model forms the basis for the matching procedure. As the control group is larger than the treatment group, trimming is used to improve common support. This implies that observations in the control group with propensity scores that are lower than the lowest propensity score in the treatment group are dropped (Dehejia and Wahba, 1999). Before matching beneficiaries and non-beneficiaries, a balance test is performed which confirms that the data are balanced. The matching procedure employed is Kernel matching. A Kernel function gives more weight to observations closer to the propensity score of the treated household (the PAAP households) and is a standard method to use in impact evaluations (Khandker et al., 2010).

The estimation of the marginal effects of Eq. (4) for the probability of belonging to both PAs from the PAAP (milk in Cauca and raw sugar cane in Risaralda departments) is presented in Table 13. The coefficients from the logit regression can be found in the appendix (table A.4).

Table 13
Marginal Effects - Predicting the probability of PAAP participation for milk and sugar cane producers.

Variables	**Marginal Effects**	
	Milk	**Raw Sugar Cane**
Years of schooling of household head	-0.059***	-0.053*
	(0.018)	(0.028)
Average years of schooling in household	-0.004	0.026
	(0.022)	(0.026)
Gender of household head (1=male; 0=female)	0.132	0.402
	(0.087)	(0.096)
Age of household head	-0.009***	-0.010*
	(0.003)	(0.006)
Proportion of women in household [0-1]	0.183	
	(0.181)	
Household members	0.068***	0.071**
	(0.020)	(0.028)
Farm size (hectares)	0.028***	0.036**
	(0.006)	(0.015)
Access by paved road (1=yes; 0=no)	0.249***	
	(0.078)	
Irrigation by running water (yes=1; 0=no)	-0.192**	
	(0.077)	
Household has indigenous members (1=yes; 0=no)	0.671***	
	(0.053)	
Cook without electricity (1=yes; 0=no)	-0.346***	
	(0.078)	
Number of farms	-0.247**	-0.499**
	(0.106)	(0.225)
Constant		
Estimated probability of treatment	0.515	0.443
Observations	405	173

For all reported outcomes, standard significance levels were used of * 10%, ** 5% and *** 1 %.
Standard errors are shown in parenthesis.

For producers from both PAs, their probability of being a PAAP beneficiary decreases in relation to years of schooling and the age of the household head, and in the number of farms owned. On the other hand, the propensity of being a PAAP beneficiary increases in relation to the number of household members and the size of the farm. In particular, in the case of the milk producers in Cauca department, the estimations also reveal that households with an indigenous background and which are accessible by paved road are more likely to be PAAP beneficiaries. Additionally, households, which use running water for irrigation and which do not use electricity for cooking, are less likely to be beneficiaries of the PAAP.

Table 14 and 15 present the PSM results and show the average impact of the PAAP on the four outcome variables for the milk and raw sugar cane producers in Cauca and Risaralda departments, respectively. In the case of the milk producers, the project has a statistically significant and positive impact on the households' sales of the PAAP product. Per year, an average PAAP beneficiary household's milk sales are 38.4% (COP 904,592)[14] higher than those of a non-treated household. Since this comparison of means is from matched pairs with very similar propensities to participate in the program, we can conclude that this is a causal effect of the project.

On the other hand, there is no statistically significant impact of the PAAP on households' total annual income, poverty and food security levels. This is the case because of the highly diversified nature of livelihood strategies and the relatively decreasing importance of agricultural activities to overall household income. Nevertheless, the PPI of beneficiary households is slightly higher than that of non-beneficiary households, suggesting that there might still be some households that have improved upon this indicator. Furthermore, as the PPI is defined through factors such as the ownership of assets and access to public services, the treated households might not have had enough time yet to materialize the higher revenue from sales of the PAAP product into improvements. For all four outcomes, the nearest-neighbour matching method (nearest 5 neighbours) in addition to Kernel matching was performed as a robustness check. All results remained robust (see appendix table A.5).

Table 14
Average Treatment Effect on the Treated of the PAAP on household outcomes – Milk producers in Cauca.

	Total annual income	**Sales of the PAAP product (milk)**	**PPI**	**Food Security**
Treatment	$ 12,492,752	$ 3,260,372	33.20	0.76
Control	$ 12,381,708	$ 2,355,780	33.00	0.56
ATT	$ 111,044	$ 904,592**	0.20	0.20
Matched observations	366	366	364	220

(1) For all reported outcomes, standard significance levels were used of * 10%, ** 5% and *** 1%;
(2) Kernel matching with trimming; and
(3) Income and sales in COP

[14] Equivalent to USD 452 - using the average 2014 exchange rate from the World Bank: http://data.worldbank.org/indicator/PA.NUS.FCRF

For the PA involving sugar cane producers from Risaralda department, there is a statistically significant and large positive effect of the PAAP on both total annual household income and its sales of the PAAP supported product. The PAAP increases the total annual income of an average beneficiary household by 98.8% (COP 10,676,918)[15] and their sales of the PAAP product by 57.9% (COP 6,207,480)[16]. However, similarly to the milk producers in Cauca department, there is no statistically significant effect of the PAAP on the PPI scores and the food security index. Again, these results are similar when employing the nearest-neighbour matching method (nearest 5 neighbours) instead of Kernel matching (see appendix table A.6).

Table 15
Average Treatment Effect on the Treated of the PAAP on household outcomes – Raw sugar cane producers in Risaralda.

	Total annual income	**Sales of the PAAP product (sugar cane)**	**PPI**	**Food Security**
Treatment	$21,482,461	$16,936,342	35.70	0.47
Control	$10,805,543	$10,728,861	38.57	0.68
ATT	$10,676,918*	$6,207,480*	-2.87	-0.21
Matched observations	159	133	159	52

(1) For all reported outcomes, standard significance levels were used of * 10%, ** 5% and *** 1%;
(2) Kernel matching with trimming; and
(3) Income and sales in COP

5. Conclusions

This study has revealed that PPPs in the agribusiness sector in Colombia can work well for producers from vulnerable backgrounds and those living in post-conflict zones. They have the potential to boost both income and competitiveness. Although the PAAP was originally not designed to target vulnerable populations or post-conflict zones, the data demonstrate that participation of producers with these characteristics in the project is strong. The performance of PAs with these particular features is similar or only slightly worse than with better off populations. Statistically, the difference is negligible. The same conclusion applies for the survival of the PAs. Furthermore, levels of resilience to the loss of a CP by POs with vulnerable populations or located in post-conflict zones are very strong.

At the household level, an impact assessment has revealed that agribusiness PPPs, such as the PAAP, are successful at generating income gains for participating producers. However, this was not found to translate into changes in poverty and food security levels, which might stem from the way these concepts are measured or from the fact that the data do not capture long-term effects.

Interestingly, despite the considerable participation of vulnerable populations and post-conflict zones in the project, the PAAP did not make any significant adjustments in its instruments to accommodate for these groups. In the light of the findings of this study,

[15] Equivalent to USD 5,336 (2014)
[16] Equivalent to USD 3,102 (2014)

this suggests that marginal populations can successfully compete in open calls for funding with appropriate support. Since the fact that within the PAAP design no special preference was given to marginal populations, formal buyers can be found who are willing to engage with these populations in profitable commercial relationships. Indeed, instruments, such as the revolving credit fund, business training and the project management committees, work for these populations. It has also been demonstrated that time tends to improve the performance of PAs and therefore, policy makers should focus on strengthening the competitiveness of younger PAs in order to give them time to mature and improve their performance.

Finally, the lessons from the PAAP show that PPPs do not exclusively work in favour of larger commercial entities and already moderately competitive producers but that when given the opportunity, vulnerable and smallholder producers can also build lasting business relationships while increasing their own income. Due to this potential, policy should support PPPs involving vulnerable populations and POs in post-conflict zones.

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7. Appendix

Appendix A: The Cox PH model

$$\lambda(x_i, t) = \lambda_0(t)\exp(\beta_1 post\_conflict_{i,t=0} + \beta_2 vuln\_pop_{i,t=0} + \beta_3 X'_{i,t=0}), \quad (1)$$

where $\lambda(x_i, t)$ is the hazard rate of agribusiness contract failure, $\lambda_0(t)$ is the baseline hazard rate common to all units - it does not vary across observations and is therefore left un-parameterized -, $post\_conflict_{i,t=0}$ is a dummy variable indicating whether agribusiness contract *i* is located in a post-conflict zone and $vuln\_pop_{i,t=0}$ is also a dummy variable that determines whether agribusiness contract *i* involves producers from vulnerable populations. In addition, $X'_{i,t=0}$ is a vector of control dummy variables for whether or not agribusiness contract *i* is still in the implementation stage and for the product types produced and sold under the agribusiness contract. All explanatory variables are determined at the time of the start of the agribusiness contract t=0.

The estimation results for Eq. 1 are presented in Table A.1. As expected, there is no statistically significant difference in duration of contracts of partnerships located in post-conflict zones, and those located in other areas. Even more notably, the hazard rate of agribusiness contract failure of PAs with vulnerable populations is 36% lower than that of the other PAs, on average and *ceteris paribus*. In addition, PAs, which have not finished the implementation stage, have a higher hazard rate of agribusiness contract failure, and thus, a shorter duration than others (183.2%)[17].

Table A. 1
Cox PH Estimates for agribusiness failure

Variables	**(1)**
Post-conflict zone (yes=1; 0=no)	-0.090
	(-0.25)
Vulnerable populations (yes=1; 0=no)	-0.447*
	(-0.24)
Still in Implementation Stage (yes=1; 0=no)	1.041***
	(-0.23)
Temporary crop (yes=1; 0=no)	0.240
	(-0.31)
Livestock (1=yes; 0=no)	1.115***
	(-0.34)
Milk (1=yes; 0=no)	-0.691*
	(0.38)
Fish (1=yes; 0=no)	0.789*
	(-0.43)
Other non-crop products (1=yes; 0=no)	-0.074
	(-0.50)
Observations	444
Model Chi²	35.24
Df	8
Pseudo-Log(L)	-613.6
N. of failures (without commercial tie)	119

For all reported outcomes, standard significance levels were used of * 10%, ** 5% and *** 1 %.
Standard errors are shown in parenthesis.

[17] In the Cox PH model the interpretation of the derivative, with respect to x, for a continuous variable is β_i; and for a discrete variable is $[\exp(\beta_i x_i) - 1]x100$.

In the scope of the PAAP, it is important to note that a shorter duration of agribusiness contracts does not necessarily have a negative connotation. Producers might simply have better opportunities, which make it worth changing or breaking the initial agribusiness contract. This analysis is limited by the fact that it is not possible to determine who terminated the contract due to lack of information.

Table A. 2
Summary statistics for milk producers in Cauca

Variables	Mean (Std Dev)		Difference in means
	Treatment	Control	p-value
Outcome variables			
Annual household income (millions of COP)	16.10 (27.40)	7.54 (2.23)	0.001***
Sales of milk (millions of COP)	4.83 (5.45)	2.60 (3.39)	0.000***
Household PPI score	34.00 (11.70)	34.70 (9.26)	0.4980
Household food security index	0.71 (0.68)	0.47 (0.59)	0.004**
Explanatory variables			
Gender of household head (1=male; 0=female)	0.84 (0.37)	0.73 (0.45)	0.003**
Age of household head	47.69 (11.78)	49.28 (14.22)	0.2143
Years of schooling of household head	4.40 (3.34)	5.32 (3.78)	0.009**
Average years of schooling in household	5.37 (2.32)	5.41 (2.71)	0.8427
Proportion of females [0-1]	0.47 (0.20)	0.45 (0.24)	0.2457
Number of household members	5.00 (2.33)	3.76 (1.91)	0.000***
Indigenous members (1=yes; 0=no)	0.70 (0.56)	0.34 (0.47)	0.000***
Cook without electricity	0.62 (0.48)	0.86 (0.35)	0.000***
Farm size (hectares)	21.44 (29.11)	9.35 (10.82)	0.000***
Access by paved road (1=yes; 0=no)	0.74 (0.44)	0.52 (0.50)	0.000***
Irrigation with running water (1=yes; 0=no)	0.25 (0.43)	0.4 (0.47)	0.048*
Number of farms	1.12 (0.35)	1.21 (0.41)	0.027*

Note: Mean and differences in means of treatment and control group are computed before the matching.

Table A. 3
Summary statistics for raw sugar cane producers in Risaralda

Variables	Mean (Std Dev)		Difference in means
	Treatment	Control	p-value
Outcome variables			
Annual household income (millions of COP)	22.71 (15.22)	13.63 (24.33)	0.006**
Sales of sugar cane (millions of COP)	18.96 (12.71)	11.32 (11.38)	0.000***
Household PPI score	35.56 (9.59)	39.84 (8.34)	0.002**
Household food security index	0.58 (0.74)	1.17 (1.04)	0.004**
Explanatory variables			
Gender of household head (1=male; 0=female)	0.97 (0.17)	0.83 (0.38)	0.003**
Age of household head	49.31 (9.77)	54.60 (11.57)	0.002**
Years of schooling of household head	4.18 (3.76)	4.36 (3.14)	0.7378
Average years of schooling in household	4.62 (3.00)	4.86 (2.79)	0.5890
Proportion of females [0-1]	0.42 (0.21)	0.43 (0.28)	0.7024
Number of household members	4.10 (1.81)	3.03 (1.60)	0.000***
Indigenous members (1=yes; 0=no)	0.00 (0.00)	0.21 (0.41)	0.000***
Cook without electricity	0.82 (0.39)	0.69 (0.47)	0.0545*
Farm size (hectares)	21.05 (31.69)	6.65 (8.29)	0.000***
Access by paved road (1=yes; 0=no)	0.84 (0.37)	0.79 (0.41)	0.3566
Irrigation with running water (1=yes; 0=no)	0.20 (0.40)	0.28 (0.45)	0.2070
Number of farms	1.06 (0.23)	1.10 (0.33)	0.3691

Note: Mean and differences in means of treatment and control group are computed before the matching.

Table A. 4
Coefficients - Predicting the probability of participation in PAAP for milk and raw sugar cane producers

Variables	Milk	Raw Sugar Cane
Years of schooling of household head	-0.238***	-0.214*
	(0.071)	(0.110)
Average years of schooling in household	-0.017	0.104
	(0.088)	(0.105)
Gender of the household head (1=male; 0=female)	0.530	2.177***
	(0.358)	(0.711)
Age of the household head	-0.038***	-0.039*
	(0.012)	(0.022)
Proportion of women [0-1]	0.732	
	(0.725)	
Household members	0.274***	0.286**
	(0.080)	(0.115)
Farm size (hectares)	0.114***	0.144**
	(0.024)	(0.059)
Road access (1=yes; 0=no)	1.020***	
	(0.337)	
Irrigation by running water (yes=1; 0=no)	-0.777**	
	(0.321)	
Indigenous members (1=yes; 0=no)	3.255***	
	(0.338)	
Cook without electricity (1=yes; 0=no)	-1.507***	
	(0.391)	
Number of farms	-0.988**	-2.024**
	(0.0424)	(0.894)
Constant	0.871	
	(0.793)	
Observations	405	173
Chi^2	101.51	18.70
Prob > Chi^2	0.000	0.009
Pseudo R^2	0.4697	0.3043

For all reported outcomes, standard significance levels were used of * 10%, ** 5% and *** 1 %.
Standard errors are shown in parenthesis.

Table A. 5
Robustness Check - ATT of PAAP on household outcomes – Milk producers in Cauca.

	Total annual income	Sales of the PAAP product (milk)	PPI	Food Security
Treatment	$ 12,492,751	$ 3,260,371	33.20	0.76
Control	$ 12,993,314	$ 2,430,913	32.88	0.59
ATT	-$500,563	$ 829,458*	0.31	0.17
Matched observations	366	366	364	220

(1) For all reported outcomes, standard significance levels were used of * 10%, ** 5% and *** 1%;
(2) Nearest-neighbour matching (nearest 5); and
(3) Income and sales in COP

Table A. 6
Robustness Check - ATT of PAAP on household outcomes – Raw sugar cane producers in Risaralda.

	Total annual income	Sales of the PAAP product (milk)	PPI	Food Security
Treatment	$ 21,482,461	$ 18,519,158	35.70	0.51
Control	$ 12,838,770	$ 13,496,504	37.75	0.77
ATT	$ 8,643,691**	$ 5,022,654*	-2.05	-0.26
Matched observations	366	366	364	220

(1) For all reported outcomes, standard significance levels were used of * 10%, ** 5% and *** 1%;
(2) Nearest-neighbour matching (nearest 5); and
(3) Income and sales in COP