IMPACT EVALUATION REPORT – PRODUCTIVE DEVELOPMENT AND CAPACITY-BUILDING PROJECT IN THE STATE OF CEARÁ –

PAULO FREIRE PROJECT

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PROJETO PAULO FREIRE
DESENVOLVIMENTO PRODUTIVO E DE CAPACIDADES

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Impact Evaluation Report – Productive Development and Capacity-Building Project in the State of Ceará – Paulo Freire Project

SUMMARY

EXECUTIVE SUMMARY

The Paulo Freire Project (PPF), implemented in the state of Ceará in June 2013, aims to promote the reduction of rural poverty in the semi-arid region of the state through productive insertion, access to markets, and the development of human and social capital. The Project focused on income generation – both agricultural and non-agricultural – with an emphasis on small-scale farmers, quilombola communities, indigenous people and artisanal fishers belonging to vulnerable groups, whose households are youth- and women-headed.

Through the strengthening of traditional practices and technical innovations, PPF benefited around 60,000 households from poor rural communities in an area of approximately 23,530 km^2, equivalent to 18.5% of the area of the Ceará state, covering 31 municipalities in 6 state planning regions (Cariri, Sertão de Sobral, Sertão do Inhamuns, Sertão de Crateus, Serra de Ibiapaba and Litoral Oeste/Vale do Curu). Investments made by the Project total USD 94.9 million, with USD 32.2 million financed by the International Fund for Agricultural Development (IFAD).

In this report, we sought to compare the performance of households benefiting from the Project with those that does not, before and after PPF implementation. Thus, it is intended to measure the impact of the Project on its main indicators. Entropy Balancing and Difference-in-Differences were the methods employed. Furthermore, this report presents an innovation by calculating the Multidimensional Poverty Index (MPI), which considers poverty as a phenomenon capable of affecting households in several ways. Measuring poverty includes different types of deprivation in addition to lack of income. In this sense, social capital, human capital, nutrition and food security, housing conditions, and sustainability dimensions were incorporated.

The data used in the impact evaluation were collected through the application of surveys at two points in time: before (base year 2015) and after (base year 2020) the PPF interventions were implemented. In both cases, benefiting (treatment group) and non-benefiting (control group) households were considered. Baseline data covered a total of 1,247 households, 694 from the treatment group and 553 from the control group. In the post-intervention period, surveys were applied in a total of 694 households, 320 from the treatment group and 374 from the control group. The decrease in the sample is due to the fact that the total number of benefiting households corresponds to less than 1/3 of the potential beneficiaries considered in the baseline survey.

The main, statistically significant impacts identified for the PPF were: the participation of women and the youth in community actions, the access to public policies and the adoption of agroecological and sustainable practices. In addition, it was verified the absence of statistically significant impacts of the Project on indicators of standard of living and social capital, such as housing, per capita income and nutrition and food security, associativism, and the access to agricultural policy.

The impacts were different with regard to the gender and the age of the household head. PPF impacts seem to have been concentrated among households headed by men over 29 years of age. Such a scenario can be justified by the fact that the actions aimed specifically at women and the youth were implemented only from 2018 onwards, so that such interventions may not have had the necessary maturation time to be translated into specific gains for these households.

In relation to agricultural activities, the study indicated that the average quantity and the average value of sales grew more among the treated, in relation to controls, for the production of poultry, sheep, goats, swine, honey, fava beans, beans, corn, fruits and vegetables. In a more disaggregated way, benefiting households showed increases in the value of the sales of eggs, honey, fruits and vegetables. Regarding the quantity produced, the Project led to the increase of the production of poultry, swine and honey among the treated.

Regarding the MPI, it is noticed that the poverty rate fell for both groups – treatment and control – from 2015 to 2020. In the treatment group, this drop was much more expressive, from 44% to 34%, i.e., a reduction of 10 percentage points in poverty incidence. This is a result that signals that the actions of the Project in the State of Ceará have been positive in reducing Multidimensional Poverty.

With regard to PPF result indicators, which were extracted from the Project's Logical Framework, a very positive balance was found. In fact, a significant evolution was identified for the four indicators considered. Despite the fact that the poverty level and the total assets of households did not reach the planned objectives, the results were very close to surpassing the threshold defined a priori. The evolution of production and the adoption of improved inputs and technologies, on the other hand, reached the target previously set, thus exceeding the expectations of the Project.

Finally, the report highlights that the lack of impacts should be analyzed with caution, as it does not indicate a lack of results or an undesirable outcome. This is just an indication that benefiting households did not show significant changes in the average values of these indicators when compared to the non-benefiting ones, although other variables, which were not captured in this study, may have been positively impacted. It is also worth noting the fact that 2020 is

the base year of the endline survey, so that the consequences of the COVID-19 pandemic on the social and economic conditions of the analyzed population may have been reflected in the results of the impact evaluation. In addition, there is another issue: in 2020, some productive investments were still not 100% completed and/or in the maturation phase.

1. INTRODUCTION

1.1. Context

Since the 1980s, the International Fund for Agricultural Development (IFAD) has been collaborating with the Federal and State Governments by investing in rural development activities in the semi-arid region of Northeastern Brazil. The operations supported by IFAD has been characterized by the provision of appropriate tools to family farmers to thrive in a challenging environment through the application of technical innovations and the best agricultural practices.

IFAD initiatives aim at increasing the production and income of family farmers, facilitating their access to essential services (e.g., training and capacity-building, rural credit, and technical assistance—especially climate-adapted technologies), strengthening farmers associations and connecting them to the market. Therefore, all IFAD-funded project in the country focus on supporting and promoting family farming, working to guarantee that the most vulnerable groups (indigenous and quilombola communities, land reform settlers, the youth and women) are benefited by these projects (IFAD, 2020).

Several projects have been financed by IFAD in Brazil, among which six worth highlighting: Rural Sustainable Development Project in the Semi-arid Region of Bahia (Pró-Semiárido); Productive Development and Capacity-Building Project in the State of Ceará (Paulo Freire); Cariri and Seridó Sustainable Development Project (PROCASE); Semi-arid Sustainable Development Project in the State of Piauí (Viva o Semiárido); Rural Business for Small Producers Project (Dom Távora); and Policy Coordination and Dialogue for Reducing Poverty and Inequalities in Semi-Arid North-east Brazil (Dom Helder Câmara). Together, these projects have benefited more than 250,000 households via investments amounting to roughly USD 450 million, being spatially concentrated in the Northeast region of Brazil.

In Brazil, rural poverty has been persistently concentrated in the Northeast region. In fact, for 2015, the percentage of people in extreme poverty—considering a (extreme) poverty line of BRL 70.00—in the state of Ceará, the Northeast region, and Brazil as a whole was 7.7%, 7.3%, and 3.4%, respectively. At the same time, this figure reached 16.7% in rural Ceará (IPECE, 2017a).

In this sense, the targeting of social protection and rural development policies conducted in this region—like the focused actions promoted by the IFAD since the 1980s—

sought to improve the access of the rural population to key services as credit, infrastructure and technical assistance.

Among the projects carried out in the semi-arid region of Northeastern Brazil, the Paulo Freire Project (PPF) has been operating in the state of Ceará since June 2013. PPF main objective is to promote the reduction of rural poverty in the semi-arid region of Ceará through the development of human and social capita as well as the productive development. The Project focuses on income generation (both agricultural and non-agricultural), targeting small-scale farmers (with emphasis on the most vulnerable groups like quilombola, indigenous and fishing communities); women (women-headed households); and the rural youth (youth-headed households). Total investment amounts to USD 94.9 million, of which USD 32.2 million financed by IFAD.

PPF population universe corresponds to 60,000 households from poor rural communities distributed in an area of roughly 23,530 km^2, equivalent to 18.5% of the area of the state of Ceará. The Project comprises 31 municipalities from the following planning regions (IFAD, 2013; 2020):

1) Cariri: Altaneira, Antonina do Norte, Araripe, Assaré, Campos Sales, Nova Olinda, Potengi, Salitre, Santana do Cariri e Tarrafas;
2) Sertão de Sobral: Coreaú, Frecheirinha, Graça, Massapê, Moraújo, Mucambo, Pacujá, Pires Ferreira, Reriutaba, Senador Sá, Sobral Rural e Varjota;
3) Sertão dos Inhamuns: Aiuaba, Arneiroz, Parambu, Quiterianópolis e Tauá;
4) Sertão dos Crateús: Hidrolândia e Ipueiras;
5) Serra da Ibiapaba: Ipu;
6) Litoral Oeste/ Vale do Curu: Irauçuba.

The criteria employed in the selection of municipalities were: (i) high incidence of rural poverty (between 30.3% to 56.4% of population in extreme poverty) with individuals in situation of nutrition and food insecurity; (ii) potential for the development of diversified, sustainable productive practices (agricultural or not), with scaling-up potential; (iii) favorable context in terms of rural public policies focusing on rural development and poverty reduction; (iv) absence of other IFAD-funded projects in the region. Furthermore, geographic contiguity was considered as well in order to strengthen territorial identity, to support experiences sharing across municipalities and to facilitate the performance of PPF operations.

Regarding the planning regions served by the Project, Table 1 presents some indicators referring to population characteristics. In 2014, slightly more than 30% of the population of Ceará lived in the regions served by PPF, which account for 42.57% of the territory. In terms

of population density, only one of the regions served by the Project had a higher value than the state average: Serra da Ibiapaba (61.46 people per km^2). Moreover, the level of urbanization in these regions is below the state average (75.06%), varying from 69.46% in Cariri to 46.28% in Sertão dos Inhamuns. As per the prevalence of extreme poverty in rural areas, it is worth highlighting that only Cariri and Serra da Ibiapaba presented a percentage of rural population in extreme poverty below the state proportion.

Table 1. Demographic indicators for the planning regions of the state of Ceará

Planning regions	Population (2014)		Area		Population density (2014)	Level of urbanization (2010)	Rural extreme poverty (2010)
	Qty.	%	km^2	%	People per km^2	%	%
Cariri	999,169	11.30	17,298.35	11.62	57.76	69.46	35.82
Centro Sul	387,141	4.38	11,581.50	7.78	33.43	58.56	36.83
Grande Fortaleza	3,949,974	44.67	7,434.91	5.00	531.27	94.43	24.43
Litoral Leste	200,126	2.26	4,631.20	3.11	43.21	54.65	27.21
Litoral Norte	390,483	4.42	9,363.50	6.29	41.70	54.18	44.67
Litoral Oeste/Vale do Curu	384,592	4.35	8,890.58	5.97	43.26	56.66	42.75
Maciço de Baturité	238,977	2.70	3,707.30	2.49	64.46	48.69	33.68
Serra da Ibiapaba	350,423	3.96	5,701.61	3.83	61.46	51.95	35.96
Sertão Central	387,164	4.38	16,014.27	10.76	24.18	56.10	41.38
Sertão de Canindé	202,808	2.29	9,202.34	6.18	22.04	55.82	45.21
Sertão de Sobral	482,399	5.46	8,533.50	5.73	56.53	70.58	40.39
Sertão dos Crateús	348,844	3.94	20,591.20	13.84	16.94	58.11	45.12
Sertão dos Inhamuns	134,115	1.52	10,863.39	7.30	12.35	46.28	41.59
Vale do Jaguaripe	386,576	4.37	15,011.98	10.09	25.75	58.61	27.37
Ceará	8,842,791	100.00	148,825.63	100.00	59.42	75.06	36.87

Source: Elaborated by the authors based on IPECE (2015a).

Table 2, in turn, shows some economic indicators related to the state of Ceará and its planning regions. Considering the regions with municipalities served by the Project, it is observed that they contributed to only 18.46% of Ceará's gross domestic product (GDP) in 2012. Such regions have the services sector as the driving force of their economies. Moreover, all of these regions have a GDP per capita below the state average, ranging from BRL 7,934.10 in Sertão de Sobral to BRL 4,833.81 in Sertão dos Inhamuns. Lastly, with regard to the proportion of households with monthly per capita income below 1/2 minimum wage, it is evidenced that all the regions served by PPF have proportions above the state's one, ranging from 59.02% in Cariri to 69.19% in Litoral Oeste/Vale do Curu (IPECE, 2015a).

In order to specifically verify the socioeconomic and socio-environmental vulnerabilities of the municipalities of Ceará, the Institute of Research and Economic Strategy of Ceará (IPECE) calculates, respectively, the Social Development Index (IDS) and the Municipal Alert Index (IMA).

Table 2. Economic indicators for the planning regions of the state of Ceará

Planning region	GDP (2012)		Sector contribution to GDP			GDP *per capita*	Households with less than 1/2 MW in 2010
	BRL 1,000	%	Agric.	Ind.	Serv.	BRL 1,000	%
Cariri	6,306,666.84	7.00	3.66	16.28	80.06	6,463.42	59.02
Centro Sul	2,144,698.53	2.38	5.96	12.70	81.34	5,646.51	60.25
Grande Fortaleza	60,578,264.48	67.21	0.68	24.82	74.50	15,824.66	42.15
Litoral Leste	1,847,169.98	2.05	14.51	35.78	49.71	9,484.92	61.26
Litoral Norte	2,187,540.27	2.43	9.40	23.78	66.82	5,757.46	71.24
Litoral Oeste/ Vale do Curu	2,357,043.46	2.62	7.28	29.26	63.46	6,324.93	69.19
Maciço de Baturité	1,111,270.03	1.23	10.09	13.14	76.77	4,757.56	66.24
Serra da Ibiapaba	1,920,066.42	2.13	19.59	11.00	69.41	5,625.50	65.89
Sertão Central	2,079,007.07	2.31	7.84	17.46	74.70	5,495.24	63.16
Sertão de Canindé	931,944.88	1.03	10.59	10.07	79.34	4,705.34	68.11
Sertão de Sobral	3,722,713.15	4.13	4.61	24.08	71.30	7,934.10	60.26
Sertão dos Crateús	1,689,837.10	1.87	9.46	12.76	77.78	4,913.92	65.24
Sertão dos Inhamuns	636,903.08	0.71	8.39	12.33	79.28	4,833.81	67.14
Vale do Jaguaripe	2,618,599.13	2.91	12.36	19.06	68.58	6,912.06	57.26
Total	90,131,724.42	100.00	3.38	22.84	73.78	10,473.12	53.67

Source: Elaborated by the authors based on IPECE (2015a).

The IDS is calculated by two approaches: the Social Development Index – Supply (IDS-O) and the Social Development Index – Results (IDS-R). The former includes indicators related mainly to the offering of public services and infrastructure. The latter, in turn, seeks to capture the results achieved due to the supply condition in each municipality, considering indicators reflecting population's well-being. The IMA, on the other hand, measures the vulnerabilities related to climate, agricultural and social aspects relevant to the meteorology, agricultural production and social assistance areas.

Therefore, by analyzing Table 3, it is observed that 3 of the 31 municipalities served by the Project are among the 10 most vulnerable according to the IDS-O in 2015: Parambu (0.672), Salitre (0.652) and Senador Sá (0.623). In addition, it is evidenced that 2 of the 31 municipalities served are among the 10 most vulnerable per the IDS-R: Aiuaba (0.494) and Ipueiras (0.487) (IPECE, 2017b).

Table 3. Top-10 most vulnerable municipalities by IDS-O and IDS-R, Ceará state, 2015

Municipality	IDS-O	Municipality	IDS-R
Parambu	0.672	Boa Viagem	0.497
Cascavel	0.672	Aiuaba	0.494
Umirim	0.669	Alto Santo	0.492
Ibaretama	0.666	Umari	0.492
Camocim	0.652	Ipueiras	0.487
Salitre	0.652	Icó	0.486
Amontada	0.652	Mulungu	0.479
Milhã	0.635	Ipaumirim	0.478
Granja	0.627	Pereiro	0.474
Senador Sá	0.623	Acarape	0.473

Source: Elaborated by the authors based on IPECE (2017b).

Table 4 shows the 20 most vulnerable municipalities in terms of IMA for the first half of 2015 and 2020. It is observed that, in 2015, the planning region that presented the largest number of municipalities in the class of high vulnerability was Centro Sul with 6, followed by Sertão Central (5), Sertão dos Inhamuns (3), Cariri (3), Sertão de Canindé (3) and Vale do Jaguaribe (2). In addition, it is evidenced that 4 of the 31 municipalities served by PPF are

among the most vulnerable in Ceará: Quiterianópolis (0.7702), Arneiroz (0.7551), Tauá (0.7410) and Irauçuba (0.7360) (IPECE, 2015b).

For 2020, the planning region whose municipalities appear most frequently in the ranking is Cariri, with 4 representatives. In sequence are the regions of Centro Sul, Sertão Central and Sertão dos Crateús, represented by 3 municipalities each. It is noteworthy that, from 2015 to 2020, there was a drop in the number of municipalities served by PPF among the 20 most vulnerable to climate change. In fact, only 3 made up the ranking in 2020: Nova Olinda (0.7359), Irauçuba (0.7210) and Salitre (0.7122) (IPECE, 2020).

Table 4. Top-20 most vulnerable municipalities by IMA, Ceará state, 2015 and 2021

2015			2020		
Municipality	Region	IMA	Municipality	Region	IMA
Milhã	Sertão Central	0.7943	Monsenhor Tabosa	Sertão dos Crateús	0.8414
Ipaumirim	Centro Sul	0.7706	Catarina	Centro Sul	0.7833
Quiterianópolis	Sertão dos Inhamuns	0.7702	Abaiara	Cariri	0.7578
Arneiroz	Sertão dos Inhamuns	0.7551	Boa Viagem	Sertão de Canindé	0.7541
Umari	Centro Sul	0.7547	Pedra Branca	Sertão Central	0.7457
Orós	Centro Sul	0.7540	Quixadá	Sertão Central	0.7394
Baixio	Centro Sul	0.7530	Nova Olinda	Cariri	0.7359
Icó	Centro Sul	0.7432	Limoeiro do Norte	Vale do Jaguaribe	0.729
Monsenhor Tabosa	Sertão dos Crateús	0.7419	Itatira	Sertão de Canindé	0.7285
Tauá	Sertão dos Inhamuns	0.7410	Quixelô	Centro Sul	0.7285
Senador Pompeu	Sertão Central	0.7410	Forquilha	Sertão de Sobral	0.7267
Boa Viagem	Sertão de Canindé	0.7395	Irauçuba	Litoral Oeste / Vale do Curu	0.721
Solonópole	Sertão Central	0.7389	Senador Pompeu	Sertão Central	0.7184
Saboeiro	Centro Sul	0.7383	Independência	Sertão dos Crateús	0.718
Mauriti	Cariri	0.7379	Iguatu	Centro Sul	0.7163
Mombaça	Sertão Central	0.7377	Morada Nova	Vale do Jaguaribe	0.7162
Barro	Cariri	0.7367	Granjeiro	Cariri	0.7162
Irauçuba	Litoral Oeste / Vale do Curu	0.7360	Tururu	Litoral Oeste / Vale do Curu	0.7146
Itatira	Sertão de Canindé	0.7355	Salitre	Cariri	0.7122
Potiretama	Vale do Jaguaribe	0.7345	Novo Oriente	Sertão dos Crateús	0.7114

Source: Elaborated by the authors based on IPECE (2015b, 2021).

1.2. Description of the Paulo Freire Project

The Paulo Freire Project aims to contribute to the reduction of rural poverty in 31 municipalities from the semi-arid region of Ceará. It is intended to increase the income and quality of life of the target population through the development of human and social capital and sustainable productive development, with emphasis on the youth and women. At Project completion, it is expected a 35% reduction in extreme poverty, a 30% increase in the assets of households benefited from technical assistance and productive investments, and a total of 60,000 family farmers and other small-scale farmers trained on the access to public policies.

The specific objectives of PPF are: 1) To strengthen the capacities of the rural population and of community and economic organizations to identify, prioritize and solve their problems, train leaders and improve their capacity to participate in local decision-making processes; 2) To support the establishment and strengthening of community and family productive initiatives, increasing their capacities and skills to develop rural businesses and access markets, including the institutional ones (e.g., PAA and PNAE); 3) To foster the sustainable productive development – agricultural and non-agricultural – to increase the productivity of communities and households, generating income and employment opportunities while adopting and promoting the use of agroecological practices and the sustainable management of natural resources[1]. In order to achieve Project's development goal, the following components were established:

a) Component 1 - Training on public policies; strengthening of local initiative and leadership development; capacity-building for the production and management of natural resources; organizational development and training for management and marketing; training the youth for economic activities and access to land; strengthening the teams of partner entities and social mobilization.
b) Component 2 - Support for activities aimed at strengthening the production, processing and marketing of agricultural and non-agricultural products; encouraging innovative initiatives and practices; promotion of activities for the protection and recovery of natural resources. Its main working tools are: diagnosis; development plan; methodology instruments; investment plan; training of continuous technical assistance; among others.

[1] Extracted from the Term of Reference of the Paulo Freire Project (Loan Agreement No. I-882-BR/E-17-BR).

The implementation of a public policy of such scope and depth requires the early establishment of a strategy and methodological instruments that allow - throughout, at the end and in subsequent years - the conduction of an accurate analytical evaluation of the results achieved, identifying their strengths and weaknesses, thus allowing for eventual adjustments and the improvement in possible later stages of development (IFAD, 2020). To this end, there is a database referring to the target population, collected through a field survey to demarcate the PPF baseline.

Considering that the main objective of the actions carried out under PPF is to raise the income and improve the standard of living of families from poor rural communities in the semi-arid of Northeastern Brazil, it is worth carefully analyzing the isolated impacts of this rural development project in order to address different levels of poverty and the constraints faced by small-scale farmers. Some important questions are: Was PPF able to improve the standard of living of farmers benefiting from it, in comparison to those who did not benefit from the Project? Also, was the Project able to generate positive impacts on the development of the benefiting rural population in comparison to non-beneficiaries?

To answer these questions, this Report aims at evaluating the impact of PPF on important outcome variables, such as poverty, agricultural production, food security, public policies, agricultural policies, as well as issues on gender, youth and the empowerment of target groups (family farmers, rural women and the youth).

1.3. Justification

The PPF Impact Evaluation will determine the extent to which its interventions have contributed to changes in the socioeconomic conditions of benefiting households, from 2015 onwards, given the different characteristics related to poverty of the Project's target population in the semi-arid of the Northeast region (family farmers, women and rural youth). These results are indispensable for the Project Completion Report.

Studies aimed to measure the impact of a particular intervention on one or several outcomes of interest have direct political relevance, since successful interventions can be related to desirable social programs or improvements in existing ones to achieve social policy goals (Cameron and Trivedi, 2005). This type of study is important to provide evidence regarding the results associated with this Project, in order to contribute to the debate about its limitations, scope, ability to generate or not the expected positive impacts for beneficiaries. In addition, it possibly facilitates the resolution of unsolved problems, addressing the issues that

the analyzed policy aimed to resolve by redirecting the focus and design of the intervention. Finally, it can also serve as a basis for the beginning of a new cycle of policies that could be implemented in the future.

2. PROJECT ASSUMPTIONS

The Paulo Freire Project aims to reduce poverty and improve the standard of living of family farmers in 31 municipalities in the State of Ceará, directly benefiting a total of 60,000 households. The development goal of PPF lies in contributing to the reduction of rural poverty in the semi-arid region of Ceará through the development of human and social capital and sustainable productive development via income generation, in agricultural and non-agricultural areas, with the main focus on the youth and women.

Specifically, as stated in the Project Design Report (IFAD, 2013), PPF aims to:

a) Strengthen the capacities of the rural population and of community and economic organizations, in order to identify, prioritize and solve their problems, train leaders and improve their capacity to participate in local decision-making processes;
b) Support the establishment and strengthening of community and family productive initiatives, increasing their capacities and skills to develop rural businesses and access markets, including the institutional ones, and other public policies for family farming;
c) Foster sustainable agricultural and non-agricultural productive development to increase the productivity of communities and families, in order to generate income and employment opportunities through the adoption and promotion of agroecological practices and the sustainable management of natural resources.

The specific objectives (a) and (b) aim at strengthening the individual and collective capacities of those benefiting from the Project in terms of managing community and economic organizations, improving production, managing their own businesses, improving conditions of access to markets and income generation. The specific objective (c) is oriented towards the realization of sustainable productive investments, in selected production chains, based on the application of agroecological principles and the sustainable management of natural resources.

In this sense, PPF is composed of four components, which focus on developing the capacities of beneficiaries and community and economic organizations (Component 1), environmentally sustainable productive development (Component 2), Project management (Component 3), and the monitoring and evaluation of the initiatives carried out (Component 4). It is through the coordinated action between these four components that the Project has sought to achieve the objectives mentioned above.

Figure 1 summarizes the causal chain of the Paulo Freire Project, which is presented according to a set of critical assumptions. Separating the four components of the Project, it can be seen that the activities and interventions carried out give rise to a set of products (outputs) and their respective results (outcomes). It is from these outcomes that PPF seeks to achieve the objectives previously highlighted and, consequently, meet the goal of reducing poverty.

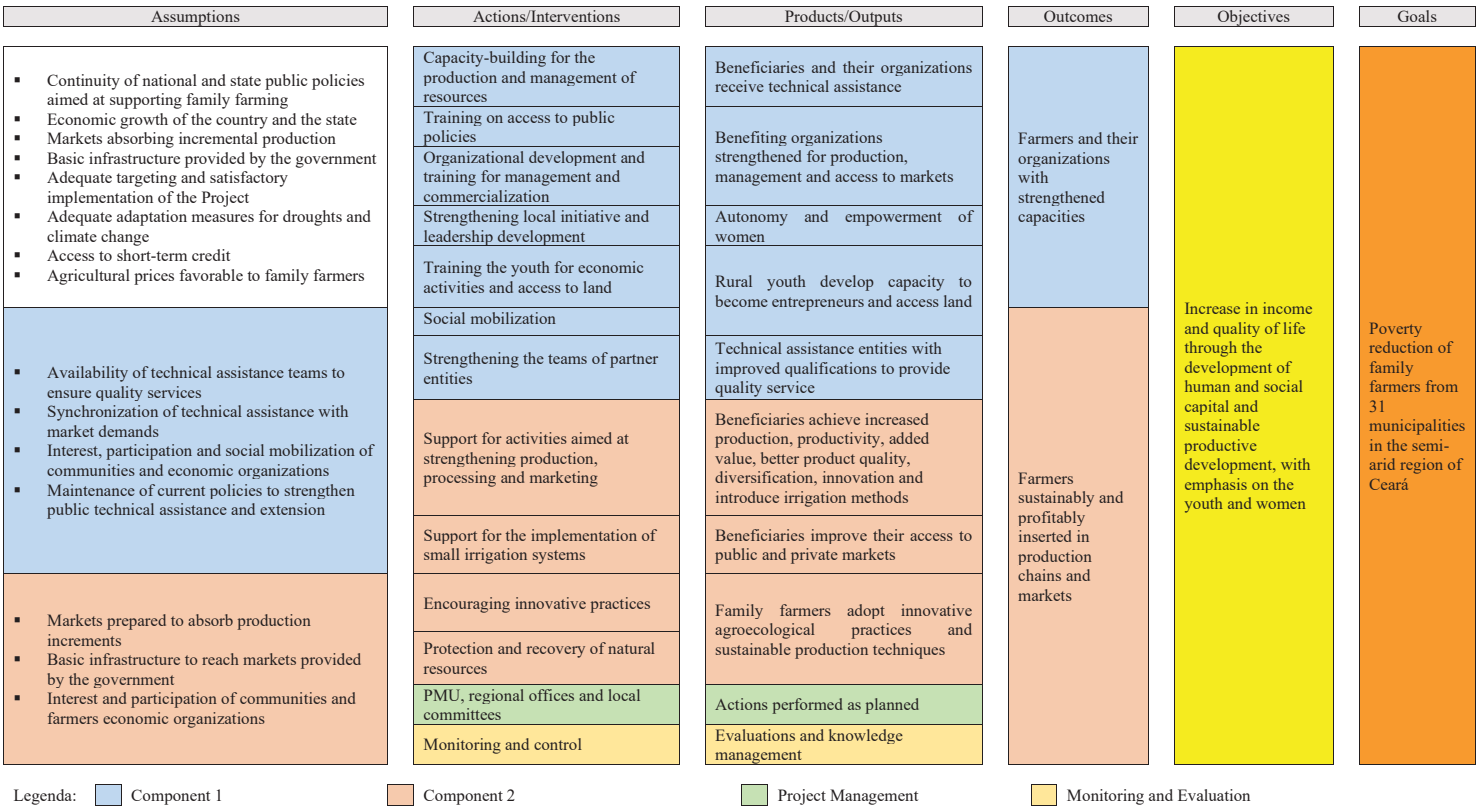


Figure 1. Causal chain of the Paulo Freire Project

Source: Elaborated by the authors.

3. METHODOLOGY

This section describes the methodology used to identify the impacts of the Paulo Freire Project (PPF). In addition to the use of traditional impact assessment techniques, this document incorporates the multidimensional poverty indicator. The one-dimensional poverty indicator, measured in terms of income alone, would hardly be able to capture the complexity of poverty. The rationale for the theoretical-methodological orientation employed in this study is based on Amartya Sen's capability approach.

This section is organized into four parts, as follows. First, we detail the calculation of the multidimensional poverty indicator. Second, we delineate the strategy used to build the so-called control group, which is used as a counterfactual to the group of individuals benefiting from the Project. Third, we present the method used to effectively estimate PPF impacts on the benefiting population. Finally, we describe the process of constructing the sample used in the evaluation.

2.1. Multidimensional poverty

Rural Multidimensional Poverty is measured by calculating the Multidimensional Poverty Index (MPI). This indicator was developed by Alkire and Foster (2011), based on Sen's (2000) capability approach, which considers poverty as a multidimensional phenomenon capable of impacting individuals in different ways. Thus, measuring poverty includes different types of deprivation.

The theoretical justification for MPI is based on the contributions of Amartya Sen. For the author, poverty cannot be explained only by the lack of income. Consideration should be given to the lack of basic capacities to achieve adequate levels of education, health, nutrition, housing, access to natural resources and equity. In this sense, in addition to income, other dimensions are considered in the measurement of families' well-being.

Firstly, as pointed out by Fahel, Teles and Caminhas (2016), the cut-off of the poverty line must be determined. In other words, it is essential to identify individuals – or households, which is the level of aggregation used in the present study – in a situation of poverty. Thus, each household is assigned a deprivation score (from 0 to 1 or 0% to 100%) based on its deprivation in the indicators that make up the index, calculated from the weighted sum of the deprivations experienced.

The household is identified as multidimensionally poor if it is deprived in X% of the indicators. The score increases as the number of deprivations grows and reaches its maximum

of 1, when the household is deprived in all indicators analyzed. The household that is not considered deprived in any of the analyzed indicators receives a score of 0.

In formal terms:

$$c_i = \sum_{j=1}^{d} w_j I_j \quad (1)$$

in which $I_j = 1$, if the household in deprived in the indicator j, e $I_j = 0$, otherwise; and w_j is the weight assigned to the indicator j with $\sum w_j = 1$ for each household i.

According to Fahel, Teles and Caminhas (2016), the second cut-off is used to identify the multidimensionally poor households, what is defined as the poverty cut-off in the Alkire-Foster approach. It corresponds to the (weighted) proportion of deprivations that households must have to be considered as poor, being denoted by k. Thus, a household is classified as poor if its deprivation score is equal to or greater than the poverty cut-off, i.e., if $c_i \geq k$. In the global MPI, households are identified as poor if they have a deprivation score equal to or greater than 1/3. Therefore, when $c_i \geq k$, then $c_i(k) = c_i$, but if $c_i < k$, then $c_i(k) = 0$. Consequently, $c_i(k)$ is the deprivation score of households classified as poor.

Next, following the adjusted headcount (M_0) measurement structure, MPI combines two key elements: the proportion or incidence of households within a given population whose weighted share of deprivations is k or more; and the intensity of that deprivation, which is the weighted average proportion of deprivations. Formally, the first element is called the incidence of multidimensional poverty (H):

$$H = q/n \quad (2)$$

in which q is the number of households multidimensionally poor and n is the total number of municipalities.

The second element is the intensity of multidimensional poverty (A). This is the average deprivation score of households that are already considered multidimensionally poor, being expressed as:

$$A = \frac{\sum c_i(k)}{q} \quad (3)$$

in which $c_i(k)$ is the censored deprivation score of the household i and q is the number of multidimensionally poor households.

Thus, MPI is the product of both:

$$M_0(MPI) = H \times A \quad (4)$$

Fahel, Teles and Caminhas (2016) draw attention to operationalization and simplification through a multifaceted analysis of poverty provided by the MPI, since a household is considered poor if its set of deprivations is equivalent to or greater than 33% of the total. In addition, the authors stress MPI flexibility and ability to adapt to different contexts, in addition to the possibility of comparative analyses, where the index can be disaggregated into different regions and broken down according to the contribution of each indicator, so that it is possible to identify the incidence and severity of poverty.

In the present study, the global MPI measures poverty from five dimensions: Income, Social Capital, Human Capital, Food Security, Housing, and Sustainability. All dimensions have the same weight and the indicators of each dimension are also equally weighted. The aforementioned dimensions, as well as the variables that compose them, are found in Table 1.

Table 1. Dimensions and variables that comprise the Multidimensional Poverty Index

Dimension	Indicator	Poverty line
Income Dimension Captures the lack of resources in households	**Income Indicator** Household per capita income	Household per capita income below 1/2 of the minimum wage (Hoffman, 2000)
Social Capital Dimension Captures the capacity of target institutions and individuals. Concerns changes both in individual capabilities and in collective actions.	**Indicator of Access to Agricultural Policies** Benefits received, given by the average of the following: (i) Production Cistern - 2nd water; (ii) Rural credit, PAA, PNAE, Crop insurance, SEAF, Agrarian reform and Land credit.	Whether the household did not have access to any of the Agricultural Policy benefits
	Indicator of Participation of the Youth and Women in Community Actions (Inclusion and Empowerment) 1. Participation of the youth in community actions; 2. Participation of women in community actions.	Whether young or female members of the household did not participate in community activities
	Associativism Indicator 1. Number of different types of associations in which the family participates, among community associations, neighborhood associations, etc.; Collective work, community work, etc.; Organized social movement; Movements linked to churches; Unions; and Others (club, sports and social associations, etc.); 2. Whether the respondent or other household member processes their production through the association; or if the commercialization of the production or part of the production is done through the association.	Whether household members did not participate in at least one type of association
	Indicator of Access to Public Policies and Services 1. Benefits received, identified by access to the following: Pension, Social Security, Unemployment Insurance, Bolsa Família, School Allowance, Food Card, Gas Voucher, Basic Food Basket, Education Scholarship, Educa Mais Brasil, English without	Whether the household did not have access to at least one type of Public Policy or Service

	Borders, Jovem Aprendiz, Pronatec, Sisutec, Sisu, Prouni, FIES Pós-Graduação, Bus Pass, Senior Citizen Card, Social Driver's License, Viver sem Limites, Saúde Não Tem Preço, Rede Cegonha, Social Electricity Tariff, Luz no Campo, Luz para Todos, Cistern for human consumption - 1st water, Technical Assistance/Rural Extension, PBSM, Program to Combat Rural Poverty, MEI, Refis or SEBRAE Program, Emergency Aid - Drought, PSF and Seguro-defeso. 2. Public services accessed: Health Agent; PSF/presence of physician in the community/district; School Bus; Public Transport and Public Security.	
	Indicator of Access to Credit Whether the respondent or other household member has ever accessed the following benefits: Minha Casa Minha Vida/Minha Casa Melhor; Rural Credit; Pronaf; Garantia-Safra	Whether the household did not have access to any type of Credit Policy
Human Capital Dimension Captures the level of education and training in rural households.	**Education Indicator** Respondent's educational level	If the respondent has reached a minimum educational level, as follows: - individuals between 20 and 59 years old, who did not complete the first cycle of secondary education; and - individuals aged 60 years and over, who did not have a complete primary education
	Indicator of Access to Training Programs Whether the respondent or other household member is part of a community business plan with training actions	Whether household members did not participate in training actions
	Indicator of Access to Technical Assistance If the respondent or other household member is part of a community business plan with advisory actions and technical assistance	Whether household members did not participate in advisory and technical assistance actions
Nutrition and Food Security Dimension Captures food security in terms of access to food, diversification of food, and origin of food.	**Indicator of Difficulty in Obtaining Food** Whether there was a time when the family had a lot of difficulty getting food, or even went through the situation of not having anything to eat;	Whether the household had a lot of difficulty getting food or could not get it at all
	Indicator of Dietary Diversity The frequency to which the family has a varied/diverse diet (vegetables, greens, fruits, meats, beans, rice, juice)	Whether it never happened
	Indicator of Food Origin Whether it came from donations from neighbors and relatives	Whether the household received a food donation
Housing Dimension Captures the housing conditions referring to the place where family members live and where they spend most of their time, and if they have access to important social facilities.	**Indicator of Housing Conditions** Type of home	If the home is a shack;
	Material used for exterior walls	Whether the main material used for exterior walls is rammed earth or other temporary material (straw, canvas, plastic)
	Material used in the roof	Whether the main roof material is: wood, straw, canvas, plastic

	Material used in the floor	If the main material used for the floor is adobe
	Existence of a bathroom/toilet in the house	Whether there is no bathroom in the house
	Existence of running water	Whether there is no running water at home
	Household overcrowding = Number of people per bedroom = amount of bedrooms / number of household members	Households with three or more people per dorm
	Electricity in the house	Whether there is no electricity at home
	Indicator of Durable Goods Whether there is: stove, refrigerator, stereo, telephone, TV	Households that do not have at least three of the following items: stove, refrigerator, washing machine, TV, cell phone
Sustainability Dimension Captures the adoption of agroecological and sustainable practices	**Indicator of Cultivation Practices** Whether the farmer uses agricultural burning; pesticides; chemical fertilizer; organic compost; manure; straw	Whether the farmer uses at least one of the following cultivation practices: agricultural burning, pesticides, chemical fertilizers, do not use organic compost, manure or straw
	Indicator of Destination of Pesticide Packaging Whether packages are returned; buried, burned or discarded; reused	Whether the farmer makes one of the following actions regarding the destination of pesticide packages: they are not returned; they are buried, burned or reused
	Indicator of Destination of Household Waste Whether household waste is collected by the municipal system; recycled; buried/burned; thrown into the environment; Whether organic waste is separated from domestic waste for composting.	Whether household members make at least one of the following actions regarding the destination of household waste: it is not collected; it is not recycled; it is buried or burned; it is thrown into the environment; or there is no separation of organic waste.
	Indicator of the Conservation Status of Water Bodies and Riparian Forest Conservation status of water bodies (water springs included) and riparian forest	Whether at least one of the following situations occurs: the water body is silted up or has no riparian vegetation; water springs are degraded or poorly preserved; riparian forest is absent or scarce.

Source: Elaborated by the authors based on the Paulo Freire Project's Survey Instrument (FIDA, 2021).

2.2. Methods for Impact Evaluation

In this subsection, we present the methodology used for the impact evaluation of the Paulo Freire Project. The main objective of this study is to compare the performance of households benefiting from PPF with those that did not, before and after the implementation of the Project, thus capturing the effect of PPF on outcome variables. In this sense, it is possible to compare the initial state of the intervention with the reality of its conclusion, according to the proposed objective. Entropy balancing and the difference-in-differences method are the techniques used to achieve this goal.

The first step to implement the methodological strategy aims to obtain an adequate comparison group based on observable characteristics prior to the Project. At this stage, entropy balancing is used as a pairing/matching technique. In a second step, the difference-in-differences method is used to compare the results of the treatment and control groups, before and after the intervention. By using this method, we are able to control for differences in unobservable characteristics, which, if not considered, can lead to biased estimates regarding the effects of the Project. The combination of entropy balancing with the differences-in-differences method allows controlling the units evaluated by their initial conditions, minimizing the existence of selection bias. Next, these two tools are formalized.

2.2.1. Entropy balancing

Proposed by Hainmuller (2012), the entropy balancing method was used to obtain, based on a vector of observable characteristics, a sample of non-benefiting households comparable to those benefiting from the Project. The entropy balancing method defines a weighting scheme that incorporates the balance of explanatory variables (covariates) in the weight function that is applied to the analyzed units. Specifically, it is a non-parametric method that allows weighting a set of observable variables so that the distributions of these variables in the weighted observations satisfy a set of special moment conditions (resulting in an equilibrium regarding the moments of these covariates).

Instead of specifying a parametric model that explains the probability of participating in the treatment (as in the propensity score), the method assigns weights to each control unit in such a way that the weighted treatment and control groups satisfy a set of equilibrium constraints while remaining as close as possible to a set of initial uniform weights. Such restrictions are imposed on the sample moments of the explanatory variables (mean, variance and skewness), guaranteeing that the weighted groups have the same specified moments. This

weighting ensures balance and similarity between the control and treatment groups (COSTA; FREITAS, 2018).

In this study, the restriction used refers to the adjustment of the first moment of covariates. Thus, for all explanatory variables (selected based on their influence on the probability of participating in PPF), the method calculates the means in the treatment group and searches for a set of entropy weights such that the weighted means of the control group are similar to those of the treatment group.

Specifically, the following observable variables were considered, referring to 2015 (base year), for the pre-processing of data via the entropy balancing method: (i) communities' sociocultural identification (land reform settlement, quilombola community, rural community); (ii) participation in the Bolsa Família Program; (iii) possession of durable consumer goods (refrigerators, stoves, motorcycles); (iv) household density; (v) gender of household head; (vi) number of children; (vii) effects of drought periods; and (viii) level of education of household head.

Table 2. Variables used in the entropy balancing method

Variable	Description
PPF	Binary variable that equals 1 for households benefiting from PPF and 0 otherwise
Land reform settlement	Binary variable that equals 1 for households from land reform settlements and 0 otherwise
Quilombola community	Binary variable that equals 1 for households from quilombola communities and 0 otherwise
Rural community	Binary variable that equals 1 for households from rural communities and 0 otherwise
Bolsa Família Program	Binary variable that equals 1 for households benefiting from PBF[2] and 0 otherwise
Refrigerator	Binary variable that equals 1 for households with a refrigerator and 0 otherwise
Stove	Binary variable that equals 1 for households with a stove and 0 otherwise
Motorcycle	Binary variable that equals 1 for households with a motorcycle and 0 otherwise
Household density	Ratio of people to bedrooms
Gender	Binary variable that equals 1 for women-headed households and 0 otherwise
Number of children	Number of children per household
Drought	Binary variable that equals 1 for households affected by droughts during the last 5 years and 0 otherwise
Level of education	Level of education of household head

Source: Elaborated by the authors based on the Paulo Freire Project's Survey Instrument (FIDA, 2021).

2.2.2. Difference-in-differences

[2] One of the five benefits most frequently received by households.

Data pre-processing and the consequent definition of the control group to be used as a counterfactual for the treatment group allows the estimation of the impact of the Paulo Freire Project on the benefiting households. To this end, the difference-in-differences method was used to compare changes in outcome variables over time between Project beneficiaries (treatment group) and non-beneficiaries (control group). The method provides a way to identify the effect related to participation alone and not to other factors (given that not every difference between the treated and control groups over time can be attributed to the Project).

Denoting the outcome variable by $Y_{g,t}$, where g indicates the group (1 = treatment, 0 = control) and t indicates the time (1 = 2020, 0 = 2015), the difference-in-differences method is illustrated in Table 3. In the first step, the intertemporal difference of the outcome variable is obtained for each group ($\Delta\bar{Y}_1$ for the treatment group and $\Delta\bar{Y}_0$ for the control group). In the second step, the impact of the Project is estimated by subtracting the intertemporal difference calculated for the control group from the intertemporal difference calculated for the treatment group.

Table 3. The difference-in-differences method

Time	Group	
	Treatment (= 1)	Control (= 0)
2015 (= 0)	$\bar{Y}_{1,0}$	$\bar{Y}_{0,0}$
2020 (= 1)	$\bar{Y}_{1,1}$	$\bar{Y}_{0,1}$
1st difference	$\Delta\bar{Y}_1 = \bar{Y}_{1,1} - \bar{Y}_{1,0}$	$\Delta\bar{Y}_0 = \bar{Y}_{0,1} - \bar{Y}_{0,0}$
2nd difference	$\Delta\bar{Y}_1 - \Delta\bar{Y}_0$	

Source: Elaborated by the authors.

In regression terms, the difference-in-differences method is specified as follows:

$$Y_{it} = \beta_0 + \beta_1 PFF_{it} + \beta_2 T_{it} + \beta_3 D_{it} + u_{it} \quad (5)$$

in which Y_{it} denotes the outcome variable for the household i, in year t; PPF is a binary variable that equals 1 for the treatment group and 0 for the control group; T is a binary variable that equals 1 for 2020 and 0 for 2015; D is a binary variable for the interaction between treatment status and time, being equal to 1 only for the treatment group in 2020.

The variables corresponding to the time period (T) and the treatment status (PPF) are included separately to capture the variation in outcome between the two periods, as well as the unobserved heterogeneity of the treated group. Thus, β_3 is the main coefficient of interest,

which represents the estimated impact of the Project on outcome variables of benefiting households (KHANDKER, KOOLWAL and SAMAD, 2010). Also, it should be noted that u_{it} refers to the random error.

An important issue refers to the possibility of heterogenous effects depending on the nature of beneficiaries. Since the youth and women correspond to two of the groups targeted by PPF actions, the model was also estimated considering: i) only women-headed households; ii) only men-headed households; iii) only youth-headed households; and iv) only non-youth-headed households. Comparing the results enables the investigation of the possibility that PPF had a different impact on households according to the gender and/or age sex of the head of household. The same outcome variables (Y_{it}) are considered both in the general analysis and in the evaluation of the effects of PPF on these specific groups.

The outcome variables considered for estimating the impact of the Paulo Freire Project comprise the indicators calculated in the Final Report of the Baseline Study (2016), namely (i) indicator of participation of women and the youth in community actions; (ii) associativism indicator; (iii) housing indicator; (iv) rate of access to public policies; (v) rate of access to agricultural policies; (vi) drought indicator; (vii) poverty indicator; (viii) indicator of agroecological and sustainable practices; and (ix) food security indicator. These variables are expected to capture different dimensions of the wellbeing of the benefiting population. The description of the calculation method of these indicators is presented in Appendix 1.

Considering the nature of the benefits granted by the Paulo Freire Project, with a special focus on the Investment Plans, we also evaluated the PPF impact on the stock (livestock herd) and the income obtained from the sale of agricultural and livestock products (products of animal and plant origin), as well as the value of household self-consumption. To evaluate revenue, the monetary values recorded for 2015 (base year) were deflated using the Broad National Consumer Price Index (IPCA), expressed in real terms as of December 2020.

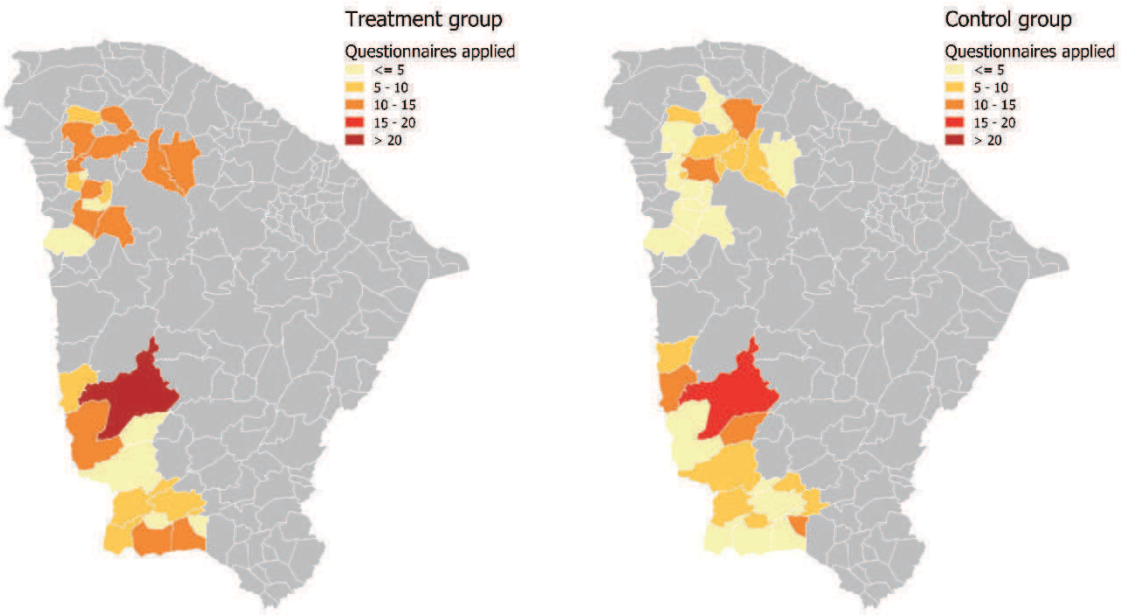
2.3. Data regarding the definition of the sample

The data used in the impact evaluation comprise two moments in time: before and after the interventions carried out under the Paulo Freire Project. Information related to the period prior to the granting of PPF benefits was collected through the baseline survey (base year 2015), while data referring to the post-intervention period were obtained through the application of the endline survey (base year 2020). In both cases, households benefiting (treatment group) or not (control group) from the Project were considered.

The baseline survey covered a total of 1,247 households, of which 694 from the treatment group and 553 from the control group. The endline survey, presented in Appendix 2, was applied to a total of 694 households, 320 from the treatment group and 374 from the control group. The decrease in the sample size is justified by the difference between the number of potential beneficiaries considered in the baseline (60,000 families) and the effective number of beneficiaries (17,763 families). Even so, the sampling error did not exceed the 5% level.

The endline survey was applied between July and August 2021. The MDA Research Institute, a company contracted to carry out the field research, allocated 7 (seven) researchers to conduct the survey in-person. The field research lasted a total of 30 (thirty) days, so that each researcher carried out, on average, more than 3 (three) interviews per day. Access to the selected communities was carried out through rented vehicles and the location of the households to be visited was based on the geographic coordinates collected in the baseline survey.

Of the 694 questionnaires planned for the endline survey, 693 were actually applied. Situations inherent to the realization of repeated surveys, however, make it virtually impossible to follow the observations that make up the sample in all periods of analysis. Examples include the death of respondents, change of residence and refusal to answer the questionnaire. Ultimately, the impact evaluation considered a sample of 490 households, 264 from the treatment group and 226 from the control group (Figure 2).



(a) (b)

Figure 2. Geographic distribution of households in the treatment group (a) and in the control group (b).

Source: Elaborated by the authors.

4. DESCRIPTIVE ANALYSIS

In this section, we conduct a descriptive analysis of the data referring to the observations that make up the sample, as well as the indicators used to evaluate the impact of the Paulo Freire Project. The goal here is to elaborate a descriptive overview of the evolution presented by the individuals of the treatment and control groups between the years 2015 and 2020.

3.1. Description of the sample

This subsection provides a brief description of the sample used in the present study. Tables 6 and 7 present the geographic distribution of the sample analyzed by municipalities from the state of Ceará in terms of the number of households visited and the total number of residents. Table 6 refers to the treatment group, while Table 7 refers to the control group.

Table 6. Sample distribution by municipality, treatment group

Municipality	Households		Household members	
	2015	2020	2015	2020
Aiuaba	1	1	4	4
Altaneira	7	7	28	34
Antonina do Norte	9	9	45	42
Araripe	11	11	59	58
Arneiroz	2	2	8	7
Assaré	8	8	28	27
Campos Sales	6	6	25	21
Coreaú	9	9	32	29
Graça	10	10	40	35
Hidrolândia	13	13	58	46
Ipu	10	10	44	37
Ipueiras	5	5	14	13
Irauçuba	13	13	43	40
Massapê	13	13	48	39

Moraújo	10	10	43	46
Mucambo	12	12	40	38
Nova Olinda	5	5	25	16
Novo Oriente*	1	0	2	0
Pacujá	4	4	15	13
Parambu	16	16	55	54
Pires Ferreira	4	4	16	9
Potengi	1	2	5	10
Quiterianópolis	9	9	33	38
Reriutaba	11	11	43	36
Salitre	9	9	39	36
Santana do Cariri	13	13	55	53
Sobral	12	12	45	38
Tauá	32	32	112	107
Varjota	8	8	31	30
Total	264	264	1,035	956

Source: Research results.

Note: Municipalities with * do not comprise the area of the Paulo Freire Project.

As previously explained, the treatment group sample comprises 264 households, geographically distributed in 29 different municipalities. Together, these households had 1,035 and 956 residents in 2015 and 2020, respectively. The control group, in turn, is composed of 226 households, which are located in 36 different municipalities. The total number of residents in this group was 825 in 2015 and 711 in 2020.

Table 7. Sample distribution by municipality, control group

Municipalities	Households		Household members	
	2015	2020	2015	2020
Aiuaba	6	7	22	19
Altaneira	5	5	14	12
Antonina do Norte	5	5	10	8
Araripe	5	5	22	22
Arneiroz	14	14	50	40

Assaré	3	2	10	5
Campos Sales	7	7	22	18
Cariré*	11	11	39	32
Coreaú	7	7	20	14
Farias Brito*	10	10	42	29
Forquilha*	7	7	20	21
Frecheirinha	3	3	9	10
Graça	3	3	17	12
Groaíras*	8	8	32	27
Hidrolândia	5	5	15	18
Ipu	5	5	19	14
Ipueiras	4	4	16	10
Irauçuba	1	1	4	2
Massapê	3	3	18	12
Moraújo	7	7	25	28
Mucambo	3	3	12	8
Nova Olinda	12	12	57	44
Novo Oriente*	6	6	26	23
Pacujá	9	9	36	29
Pires Ferreira	4	4	13	14
Potengi	6	6	20	21
Quiterianópolis	12	12	47	38
Reriutaba	3	3	9	8
Salitre	4	4	16	14
Santana do Acara*	12	12	49	48
Santana do Cariri	5	5	16	13
Senador Sá	3	3	8	10
Sobral	8	8	24	22
Tarrafas	8	8	20	22
Tauá	11	11	43	41
Varjota	1	1	3	3
Total	226	226	825	711

Source: Research results.

Note: Municipalities with * do not comprise the area of the Paulo Freire Project.

The data in Tables 6 and 7 indicate that there was a decrease in the average number of household members. This is true regardless of the group considered. Between 2015 and 2020, the average number of household members in the treatment group went from 3.9 to 3.6. In the same period, the average registered for the control group dropped from 3.7 to 3.1 household members. This downward trend is verified in Brazil, according to IBGE surveys, which point out that the fall in the fertility rate (number of children per woman) and the aging of the population explain this movement.

3.2. Sociocultural identification of communities

This subsection seeks to draw a general profile of the households included in the sample. To this end, the characteristics of housing and communities, the productive activities performed and the social benefits and public services accessed by the members of the investigated households are highlighted. Such information is presented in Tables 8, 9, 10, 11, 12, 13 and 14.

Table 8 shows the sociocultural identification of the community according to respondents. Households that make up the sample are predominantly located in rural communities. It is also necessary to highlight the percentage of households located in black or quilombola communities, especially in terms of the treatment group.

Table 8. Sociocultural identification of the community

Community characterization	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Land reform settlement	4	4	=	12	17	▲
	(1.52)	(1.52)		(5.31)	(7.52)	
Black or quilombola	48	49	▲	27	28	▲
	(18.18)	(18.56)		(11.95)	(12.39)	
Indigenous	7	6	▼	8	7	▼
	(2.65)	(2.27)		(3.54)	(3.10)	
Artisanal fishers	0	0	=	0	0	=
	(0.00)	(0.00)		(0.00)	(0.00)	

Rural	253	219	▼	218	185	▼
	(95.83)	(82.95)		(96.46)	(81.86)	
Other	0	0	=	1	3	▲
	(0.00)	(0.00)		(0.44)	(1.33)	

Note: Percentage of total households in parentheses.

Source: Research results.

Figure 3. Paulo Freire Project sign in the community of Casa Forte, Sobral.

Source: Photograph taken by the endline survey team.

In this study, the houses of respondents were classified as clustered or diffuse, as shown in Table 9. In 2015, diffuse houses predominated, while most of them were clustered in 2020. The increase in the proportion of clustered housing may be related, for example, to the construction of new housing on land previously owned by the family, as may be the case with a newly married son or daughter.

Table 9. Classification of houses

Classification of houses	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Clustered	101	182	▲	95	169	▲
	(38.26)	(68.94)		(42.04)	(74.78)	
Diffuse	163	82	▼	131	57	▼
	(61.74)	(31.06)		(57.96)	(25.22)	

Note: Percentage in parentheses.

Source: Research results.

The distribution of households in terms of the main productive activities conducted by their members can be seen in Table 10. Regardless of the group and the year considered, the most recurrent productive activities are i) Goat, sheep or poultry farming; ii) agricultural production; and iii) handicrafts and other non-agricultural activities.

Therefore, it is evident that most of the households in the sample are engaged in agricultural activities. It is worth noting, however, that the percentage of families that process products from agricultural activities is significantly small.

Table 10. Main productive activities conducted

Productive activities	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Beekeeping	5	20	▲	3	3	=
	(1.89)	(7.58)		(1.33)	(1.33)	
Processing	0	2	▲	1	1	=
	(0.00)	(0.76)		(0.44)	(0.44)	
Goat, sheep, poultry	219	227	▲	172	166	▼
farming	(82.95)	(85.98)		(76.11)	(73.45)	
Processing	16	1	▼	16	0	▼
	(6.06)	(0.38)		(7.08)	(0.00)	
Aquaculture	17	10	▼	12	2	▼
	(6.44)	(3.79)		(5.31)	(0.88)	
Processing	2	0	▼	2	0	▼
	(0.76)	(0.00)		(0.88)	(0.00)	
Agricultural	210	196	▼	168	155	▼
production	(79.55)	(74.24)		(74.34)	(68.58)	
Plant extractivism	7	0	▼	4	1	▼
	(2.65)	(0.00)		(1.77)	(0.44)	
Fruit processing	2	0	▼	1	2	▲
	(0.76)	(0.00)		(0.44)	(0.88)	
Cassava processing	13	11	▼	11	2	▼
	(4.92)	(4.17)		(4.87)	(0.88)	
	27	32	▲	22	24	▲

Handicrafts and other non-agricultural activities	(10.23)	(12.12)		(9.73)	(10.62)	
Artisanal fishing	1 (0.38)	8 (3.03)	▲	2 (0.88)	4 (1.77)	▲
Other activities (agricultural and non-agricultural)	6 (2.27)	54 (20.45)	▲	10 (4.42)	39 (17.26)	▲

Note: Percentage in parentheses.

Source: Research results.

Figure 4. Goat farming in Lagoa do Carmo, Campos Sales

Source: Photograph taken by the endline survey team.

Among the government policies aimed at family farmers, the National Program for Strengthening Family Farming (Pronaf) can be highlighted, which aims to promote rural development and food security through the granting of subsidized rural credit. To access Pronaf, family farmers must have the so-called Declaration of Aptitude to Pronaf (DAP).

The proportion of households that have DAP is shown in Table 11. For both 2015 and 2020, the share of households eligible for Pronaf is higher for the treatment group than for the control group. Furthermore, it is evident that the proportion of households with DAP in the treatment group increased between the years analyzed, contrary to what was observed for

controls. This result is possibly associated with the services provided by the Continuous Technical Assistance (CTA) teams under the PPF.

Table 11. Declaration of Aptitude to Pronaf (DAP)

Have DAP?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	180	197	▲	133	120	▼
	(68.18)	(74.62)		(58.85)	(53.10)	
No	84	67	▼	93	106	▲
	(31.82)	(25.38)		(41.15)	(46.90)	

Note: Percentage in parentheses.

Source: Research results.

The DAP, which is the gateway for family farmers to public policies aimed at encouraging production and income generation, can be divided into different categories, as shown in Table 12. Although most respondent claimed to have the Main DAP, the proportion observed for the Accessory Women DAP, at least for the year 2015, can also be highlighted.

Table 12. Type of Declaration of Aptitude to Pronaf (DAP)

Type of DAP	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Main	154	131	▼	123	80	▼
	(85.56)	(66.50)		(92.48)	(66.67)	
Accessory Women	56	3	▼	28	2	▼
	(31.11)	(1.52)		(21.05)	(1.67)	
Accessory Youth	1	1	=	2	5	▲
	(0.56)	(0.51)		(1.50)	(4.17)	
Special	1	13	▲	1	5	▲
	(0.56)	(6.60)		(0.75)	(4.17)	
Total	180	197	▲	133	120	▼
	(100.00)	(100.00)		(100.00)	(100.00)	

Note: Percentage in parentheses.

Source: Research results.

The social benefits and public policies accessed by the households investigated are shown in Table 13. In general, access to social benefits and public policies decreased between 2015 and 2020, which is valid for both groups. Two points may justify this situation. First, there was a significant change in the national political scenario during the analyzed period. Second, the COVID-19 pandemic has imposed severe economic and health limitations on the provision and use of these benefits/policies.

For 2015, the most accessed social benefits or public policies were i) Bolsa Família Program; ii) Cistern for human consumption (1st water); iii) Plano Brasil sem Miséria; iv) Water for Human Consumption in Water Trucks; and v) Garantia-Safra. As previously stated, however, access to all these benefits/policies has significantly decreased for 2020.

On the other hand, contrary to the downward trend in access to social benefits and public policies, the increase in the use of cisterns for productive use (2nd water) by the treatment group stands out[3]. This is a result that is possibly related to the operation of PPF in the region as the control group showed a decrease in the use of this social equipment.

Table 13. Access to social benefits and public policies

Social benefits and public policies	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Pension, social security	90 (34.09)	57 (21.59)	▼	118 (52.21)	42 (18.58)	▼
Unemployment insurance	41 (15.53)	3 (1.14)	▼	32 (14.16)	3 (1.33)	▼
Bolsa Família Program	214 (81.06)	94 (35.61)	▼	162 (71.68)	58 (25.66)	▼
Education scholarship	13 (4.92)	7 (2.65)	▼	10 (4.42)	5 (2.21)	▼
Bus pass, senior citizen card, social driver's license	13 (4.92)	4 (1.52)	▼	15 (6.64)	4 (1.77)	▼
	10	1	▼	0	0	=

[3] Of the 264 benefiting households that compose the treatment group, 20 were benefited with cisterns for productive use.

Viver sem limites, Saúde não tem preço, Rede cegonha	(3.79)	(0.38)		(0.00)	(0.00)	
Minha Casa Minha Vida, Minha Casa Melhor	19 (7.20)	3 (1.14)	▼	11 (4.87)	3 (1.33)	▼
Luz no Campo	20 (7.58)	1 (0.38)	▼	25 (11.06)	0 (0.00)	▼
Luz para Todos	126 (47.73)	49 (18.56)	▼	93 (41.15)	38 (16.81)	▼
Cistern for domestic use (1st water)	206 (78.03)	114 (43.18)	▼	161 (71.24)	76 (33.63)	▼
Cistern for productive use (2nd water)	43 (16.29)	52 (19.70)	▲	30 (13.27)	23 (10.18)	▼
Technical assistance and rural extension	62 (23.48)	42 (15.91)	▼	25 (11.06)	10 (4.42)	▼
Rural credit	57 (21.59)	20 (7.58)	▼	21 (9.29)	9 (3.98)	▼
Pronaf	35 (13.26)	27 (10.23)	▼	24 (10.62)	16 (7.08)	▼
PAA	9 (3.41)	10 (3.79)	▲	3 (1.33)	3 (1.33)	=
PNAE	7 (2.65)	5 (1.89)	▼	5 (2.21)	1 (0.44)	▼
Garantia-Safra	163 (61.74)	26 (9.85)	▼	124 (54.87)	18 (7.96)	▼
Insurance for family farmers (SEAF)	3 (1.14)	3 (1.14)	=	2 (0.88)	0 (0.00)	▼
Agraria reform program, land credit	2 (0.76)	3 (1.14)	▲	0 (0.00)	1 (0.44)	▲
Programa de combate à pobreza rural	2 (0.76)	3 (1.14)	▲	3 (1.33)	0 (0.00)	▼

Individual microentrepreneur (MEI)	36 (13.64)	2 (0.76)	▼	22 (9.73)	0 (0.00)	▼
Bolsa Estiagem	11 (4.17)	3 (1.14)	▼	4 (1.77)	0 (0.00)	▼
Programa Saúde da Família (PSF)	148 (56.06)	70 (26.52)	▼	122 (53.98)	62 (27.43)	▼
Seguro defeso	13 (4.92)	8 (3.03)	▼	7 (3.10)	3 (1.33)	▼
State Water Supply System	81 (30.68)	25 (9.47)	▼	82 (36.28)	35 (15.49)	▼
Water for Human Consumption in Water Trucks	168 (63.64)	70 (26.52)	▼	127 (56.19)	54 (23.89)	▼
Plano Brasil sem Miséria	179 (67.80)	6 (2.27)	▼	146 (64.60)	3 (1.33)	▼
Crop Insurance	2 (0.76)	14 (5.30)	▲	4 (1.77)	7 (3.10)	▲
Social Electricity Tariff	162 (61.36)	94 (35.61)	▼	119 (52.65)	76 (33.63)	▼

Note: Percentage in parentheses.

Source: Research results.

Unlike for social benefits or public policies, the use of public services did not show a large decrease between the years analyzed, having even presented an increase in three of the five services considered (Table 14). In terms of prevalence, it can be highlighted the fact that more than 90% of households declared that they were assisted by health agents.

The relatively low proportion of households served by public transport and public security services may be related to the fact that the analyzed sample is essentially composed of households located in rural areas, which are often characterized by low population density and sparse distribution of the properties. Furthermore, the provision of such services tends to be concentrated in urban areas.

Table 14. Access to public services

Public service	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Health agents	253	244	▲	215	211	▼
	(95.83)	(92.42)		(95.13)	(93.36)	
PSF	146	183	▲	132	170	▲
	(55.30)	(69.32)		(58.41)	(75.22)	
School bus	215	189	▼	170	147	▼
	(81.44)	(71.59)		(75.22)	(65.04)	
Public transportation	17	46	▲	25	40	▲
	(6.44)	(17.42)		(11.06)	(17.70)	
Public security	83	68	▼	84	58	▼
	(31.44)	(25.76)		(37.17)	(25.66)	

Note: Percentage in parentheses.

Source: Research results.

3.3. Characterization of household members

This subsection provides a brief description of household members. Characteristics such as kinship, gender, age, literacy and level of education, occupation and job position are included. This information is presented for all members of the analyzed households.

Table 15 shows the kinship relationship of household members with the household head. It is evident that most households have the following structure: father, mother and children/stepchildren. The presence of parents, in-laws or siblings is not very common.

Table 15. Kinship relationship with the household head

Degree of kinship	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Household head	264	264	=	226	226	=
	(25.51)	(27.62)		(27.39)	(31.79)	
Spouse	218	216	▼	163	159	▼
	(21.060	(22.59)		(19.76)	(22.36)	
Children/Stepchildren	509	416	▼	352	260	▼
	(49.18)	(43.51)		(42.67)	(36.57)	

Parents/In-laws	7	7	=	15	6	▼
	(0.68)	(0.73)		(1.82)	(0.84)	
Siblings	4	4	=	13	7	▼
	(0.39)	(0.42)		(1.58)	(0.98)	
Another relative	33	44	▲	53	50	▼
	(3.19)	(4.60)		(6.42)	(7.03)	
Nonrelative	0	5	▲	3	3	=
	(0.00)	(0.52)		(0.36)	(0.42)	
Total	1,035	956	▼	825	711	▼
	(100.00)	(100.00)		(100.00)	(100.00)	

Note: Percentage in parentheses.

Source: Research results.

Figure 5. Household members from Santa Luzia, Sobral

Source: Photograph taken by the endline survey team.

With regard to the gender of household members, there is a great balance in the sample (Table 16). This is valid both in terms of the analyzed group and in relation to the year considered. It is noteworthy, however, that, there is a higher proportion of women in the treatment group, whilst men predominate in the control group.

Table 16. Gender of household members

Gender	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Male	513	468	▼	430	366	▼

	(49.57)	(48.95)		(52.12)	(51.48)	
Female	522	488	▼	395	345	▲
	(50.43)	(51.05)		(47.88)	(48.52)	

Note: Percentage in parentheses.

Source: Research results.

The distribution of household members by age group is shown in Figure 6, where the age pyramid for 2015 is shown on the left and the age pyramid for 2020 is shown on the right. Each age range comprises a five-year span from 0-4 to 80+.

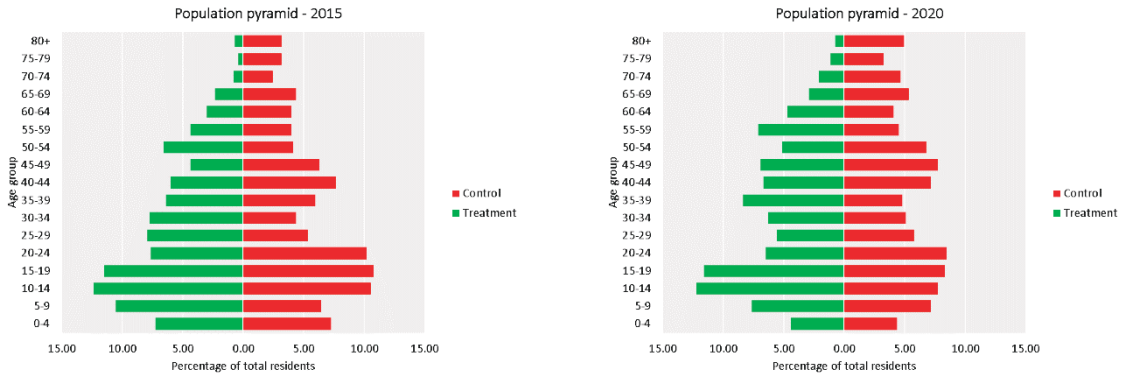


Figure 6. Age pyramid

Source: Research results.

It can be observed, for both years analyzed, that the treatment group is composed of members who are relatively younger than those in the control group. Differences in age pyramids are more pronounced at older ages, given that the proportion of individuals over 60 years of age, for example, is higher among untreated than among treated individuals.

When considering the literacy of household heads, there is a relative stability in the proportion of individuals who know how to read. In comparative terms, as shown in Table 17, the share of individuals who know how to read is higher in the treatment group than in the control group.

Table 17. Literacy

Know how to read?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	706	648	▼	494	431	▼

	(68.21)	(67.78)	(59.88)	(60.62)	

Note: Percentage in parentheses.

Source: Research results.

Table 18 shows the distribution of household members in terms of education level. The highest proportion is observed for uneducated individuals, especially in the control group. The share of individuals with 9th grade of elementary school and 3rd grade of high school is also relevant. Not coincidentally, these are completion points for the elementary and high school stages.

Comparing the treatment and control groups, an important divergence was found for higher education, whether complete or not. On the one hand, there was a decrease in the number of household members in the control group with at least incomplete higher education between 2015 and 2020. On the other hand, the treatment group showed a positive evolution in this matter, with the number of individuals with at least incomplete higher education having increased during the period.

Table 18. Level of Education

Level of Education	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Uneducated	127	144	▲	178	139	▼
	(12.27)	(15.06)		(21.58)	(19.55)	
Daycare	38	17	▼	12	15	▲
	(3.67)	(1.78)		(1.45)	(2.11)	
Kindergarten	19	14	▼	17	19	▲
	(1.84)	(1.46)		(2.06)	(2.67)	
1st grade (E.S.)	50	60	▲	30	55	▲
	(4.83)	(6.28)		(3.64)	(7.74)	
2nd grade (E.S)	53	54	▲	52	57	▲
	(5.12)	(5.65)		(6.30)	(8.02)	
3rd grade (E.S.)	68	58	▼	51	31	▼
	(6.57)	(6.07)		(6.18)	(4.36)	
4th grade (E.S.)	55	46	▼	33	38	▲
	(5.31)	(4.81)		(4.00)	(5.34)	

5th grade (E.S.)	77	88	▲	65	49	▼
	(7.44)	(9.21)		(7.88)	(6.89)	
6th grade (M.S.)	82	52	▼	40	39	▼
	(7.92)	(5.44)		(4.85)	(5.49)	
7th grade (M.S.)	54	53	▼	34	20	▼
	(5.22)	(5.54)		(4.12)	(2.81)	
8th grade (M.S.)	50	52	▲	29	18	▼
	(4.83)	(5.44)		(3.52)	(2.53)	
9th grade (M.S.)	106	91	▼	79	53	▼
	(10.24)	(9.52)		(9.58)	(7.45)	
10th grade (H.S.)	60	32	▼	37	24	▼
	(5.80)	(3.35)		(4.48)	(3.38)	
11th grade (H.S.)	31	39	▲	26	19	▼
	(3.00)	(4.08)		(3.15)	(2.67)	
12th grade (H.S.)	108	113	▲	84	109	▲
	(10.43)	(11.82)		(10.18)	(15.33)	
Incomplete Higher Ed.	9	10	▲	8	5	▼
	(0.87)	(1.05)		(0.97)	(0.70)	
Complete Higher Ed.	4	10	▲	11	4	▼
	(0.39)	(1.05)		(1.33)	(0.56)	
Not applicable	44	23	▼	39	17	▼
	(4.25)	(2.41)		(4.73)	(2.39)	

Note: Percentage in parentheses.

Source: Research results.

The list of the main occupations of household members is presented in Table 19. In line with the fact that the vast majority of households are located in rural communities, there is a predominance of workers in the agricultural sector (agriculture, livestock, plant extractivism, aquaculture). There is also a relevant portion of household members who carry out domestic activities and who are retired.

The scenario highlighted above may be directly related to PPF actions. One can consider, for example, the hypothesis that productive investment plans carried out under the Project may have encouraged the migration of members of benefiting households to the

agricultural activity, if it had become more attractive, in economic terms, thus accounting for a greater share of household income.

Table 19. Main occupation

Occupation	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Agriculture (agriculture, livestock, plant extractivism, aquaculture)	460 (44.44)	604 (63.18)	▲	323 (39.15)	448 (63.01)	▲
Management of agricultural activities	1 (0.10)	2 (0.21)	▲	1 (0.12)	1 (0.14)	=
Extensionists, agricultural technicians	0 (0.00)	1 (0.10)	▲	0 (0.00)	0 (0.00)	=
Specialized agricultural occupations (tractor driver, vaccinator, etc.)	0 (0.00)	1 (0.10)	▲	0 (0.00)	0 (0.00)	=
Other agricultural occupations	0 (0.00)	0 (0.00)	=	1 (0.12)	0 (0.00)	▼
Industry, construction	8 (0.77)	1 (0.10)	▼	9 (1.09)	4 (0.56)	▼
Trade and auxiliary activities	12 (1.16)	5 (0.52)	▼	5 (0.61)	3 (0.42)	▼
Services provision	29 (2.80)	3 (0.31)	▼	27 (3.27)	6 (0.84)	▼
Technical, scientific, artistic, teaching	5 (0.48)	1 (0.10)	▼	6 (0.73)	1 (0.14)	▼
Management	0 (0.00)	4 (0.42)	▲	0 (0.00)	1 (0.14)	▲
Social service	0 (0.00)	1 (0.10)	▲	2 (0.24)	0 (0.00)	▼
Transport	2 (0.19)	0 (0.00)	▼	1 (0.12)	0 (0.00)	▼
Handicraft	6	3	▼	0	1	▲

	(0.58)	(0.31)		(0.00)	(0.14)	
Others	2	8	▲	9	7	▼
	(0.19)	(0.84)		(1.09)	(0.98)	
Housework	70	19	▼	85	19	▼
	(6.76)	(1.99)		(10.30)	(2.67)	
Retired without occupation	26	44	▲	55	50	▼
	(2.51)	(4.60)		(6.67)	(7.03)	
No occupation due to disability	3	0	▼	4	3	▼
	(0.29)	(0.00)		(0.48)	(0.42)	
No occupation/Not applicable	411	250	▼	297	167	▼
	(39.71)	(26.15)		(36.00)	(23.49)	

Note: Percentage in parentheses.

Source: Research results.

Figure 7. Family farmer from Conceição, Antonina do Norte

Source: Photograph taken by the endline survey team.

Focusing on the households benefiting from the Project, there was a significant drop in the number of people who had no occupation (-39%). This situation is probably linked to the aging of the population, so that individuals who were not working age at the time of the baseline survey entered the labor market between 2015 and 2020.

Taking into account the household members who declared having some paid occupation, Table 20 classifies these individuals in terms of their position at work. In line with

the predominance of agricultural workers, most individuals declared being self-employed, possibly in rural areas, with this proportion more than doubling between 2015 and 2020.

Also noteworthy is the very expressive drop in household members classified as sharecroppers, that is, those who produce in partnership with the landowner. Such a scenario may be indicating that PPF investments plans are making the benefiting farmers more independent in relation to agricultural production, thus no longer needing an external partnership.

As explained above, agriculture is the occupation with the highest number of household members in the treatment group, and is also the one that presented the greatest variation between 2015 and 2020. As the position at work that most evolved in this period is self-employment, it is plausible to consider that most of these workers act as family farmers.

Table 20. Position at work

Position at work	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Self-employed (gigs, family farmer)	368 (35.56)	614 (64.23)	▲	269 (32.61)	454 (63.85)	▲
Sharecroppers	100 (9.66)	0 (0.00)	▼	66 (8.00)	0 (0.00)	▼
Temporary worker in rural areas	14 (1.35)	2 (0.21)	▼	14 (1.70)	3 (0.42)	▼
Unregistered worker (permanent position)	19 (1.84)	3 (0.31)	▼	25 (3.03)	10 (1.41)	▼
Registered worker (permanent position)	22 (2.13)	5 (0.52)	▼	17 (2.06)	3 (0.42)	▼
Unpaid worker, housework	137 (13.24)	21 (2.20)	▼	181 (21.94)	20 (2.81)	▼
Civil servant, military	3 (0.29)	12 (1.26)	▲	6 (0.73)	4 (0.56)	▼
Employer	0 (0.00)	1 (0.10)	▲	0 (0.00)	0 (0.00)	=
Intern/Apprentice	0 (0.00)	0 (0.00)	=	0 (0.00)	0 (0.00)	=

No occupation/Not applicable	372 (35.94)	298 (31.17)	▼	247 (29.94)	217 (30.52)	▼

Note: Percentage in parentheses.

Source: Research results.

The location of the main occupation of household members is shown in Table 21. In line with the fact that the communities that make up the sample are predominantly rural, the proportion of residents who work in rural areas is significantly higher than that of urban workers.

Table 21. Location of main occupation

Location	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Rural (including fishing)	976 (94.30)	645 (67.47)	▼	782 (94.79)	483 (67.93)	▼
Urban	59 (5.70)	30 (3.14)	▼	43 (5.21)	13 (1.83)	▼
Don't know / No answer / Not applicable	0 (0.00)	281 (29.39)	▲	0 (0.00)	215 (30.24)	▲

Note: Percentage in parentheses.

Source: Research results.

3.4. Household income

In this subsection, we present the average value obtained for each source of household income. In terms of agricultural production, most of the income refers to self-consumption, as shown in Table 22, indicating that the analyzed households consume a large part of their production.

With the exception of income from the sale of animal production, all other items related to agricultural production increased for the treatment group. The average income obtained from the sale of products of animal origin, the sale of plant production and the sale of products of plant origin grew, respectively, by 82%, 92% and 298% in the investigated period.

Another important item in the composition of household income is pensions. As seen earlier, the control group is comparatively older, which translates into a higher average income earned through pensions when compared to the treatment group.

A sharp drop in the average value of social benefits obtained by households is also evident. This is true for both Bolsa Família Program and the emergency aid in disasters, which include the dry spell, for example. On the one hand, this may indicate an improvement in the quality of life of households and/or an improvement in climatic conditions. On the other hand, these values may simply reflect the aforementioned decline in access to social benefits (see Table 13).

Table 22. Average annual household income by income sources

Income source	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Income from agricultural activities						
Sale of animal production	1,532.06 (5,371.32)	1,424.64 (3,973.00)	▼	878.26 (3,139.80)	1,259.97 (3,744.86)	▲
Sale of products of animal origin	390.18 (2,163.68)	710.31 (3,171.03)	▲	246.37 (1,321.12)	384.24 (1,750.17)	▲
Sale of plant production	328.10 (1,230.56)	959.27 (2,456.53)	▲	516.01 (2,697.41)	620.93 (1,853.96)	▲
Sale of products of plant origin	48.75 (337.96)	191.16 (1,982.12)	▲	113.11 (883.69)	8.32 (81.83)	▼
Self-consumption	2,942.14 (5,911.35)	3,516.84 (4,576.08)	▲	2,108.74 (2,747.41)	2,519.53 (2,982.43)	▲
Income from non-agricultural activities						
Income from non-agricultural activities	319.76 (2,164.99)	273.04 (1,205.27)	▼	205.69 (1,235.42)	104.81 (402.98)	▼
Income from off-farm occupations						
Temporary work	925.27 (3,190.72)	420.64 (1,254.81)	▼	1,109.81 (2,988.31)	417.59 (1,206.76)	▼
Permanent work	1,718.24 (5,468.73)	1,026.70 (3,985.27)	▼	1,156.29 (4,056.64)	796.55 (3,280.97)	▼

Income from social benefits						
Bolsa Família Program	2,069.69 (1,900.37)	639.43 (918.55)	▼	1,551.00 (1,907.66)	464.23 (913.39)	▼
Emergency aid in disasters	364.05 (574.99)	0.00 (0.00)	▼	273.77 (477.09)	0.00 (0.00)	▼
Seguro-defeso	44.33 (358.06)	95.74 (582.15)	▲	25.89 (274.60)	43.08 (372.31)	▲
Paid maternity leave	106.74 (621.49)	104.24 (604.85)	▼	82.28 (506.83)	82.21 (555.00)	▼
Others	495.53 (2,583.13)	652.84 (2,838.03)	▲	263.67 (1,645.41)	964.27 (3,937.07)	▲
Income from pensions						
Pension	4,044.14 (8,415.53)	6,334.38 (10,164.90)	▲	8,083.35 (11,008.42)	9,858.14 (11,773.36)	▲
Dependant's pension	654.50 (2,740.32)	493.26 (2,464.31)	▼	656.26 (2,731.36)	391.28 (2,128.92)	▼
Income from other sources						
Remittances from non-resident relatives	11.48 (182.83)	6.82 (63.72)	▼	40.52 (318.66)	12.83 (161.28)	▼
Others	60.94 (661.93)	6.82 (110.78)	▼	76.55 (526.89)	0 (0)	▼
Total income						
Total income	12,973.83 (11,813.83)	16,856.13 (15,617.63)	▲	14,049.86 (10,455.46)	17,927.98 (13,156.97)	▲

Note: Standard deviation in parentheses.

Source: Research results.

3.5. Goods and patrimony

Table 23 indicates the share of household heads that are landowners. There was, for both the treatment and control groups, a significant change in the scenario regarding land ownership between 2015 and 2020. At first, it would be plausible to relate the drop in the share

of landowners to the sale of properties in response to droughts. However, as will be shown further, the number of households affected by droughts has decreased dramatically during the period analyzed. Therefore, the results found for land ownership deserve to be investigated in more depth.

Table 23. Land ownership

Any household member is landowner?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	200	76	▼	173	66	▼
	(75.76)	(28.79)		(76.55)	(29.20)	

Note: Percentage of total households in parentheses.

Source: Research results.

Considering all households, not only the ones in which at least one of the members was a landowner, Table 24 presents the average size of rural properties. In 2015, the properties of the treatment group were almost three times bigger, on average, than those of the control group. For 2020, however, there was a significant increase in the average size of properties, with the value obtained for the control group exceeding that of the treatment group.

Table 24. Property Size

Property Size	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Hectares	11,49	18,66	▲	4,28	22,78	▲
	(49.25)	(34.12)		(13.77)	(51.49)	

Note: Standard deviation in parentheses.

Source: Research results.

The list of goods that families in the treatment and control groups owned in 2015 and 2020 is shown in Table 25. It is observed that, for most consumer durables, there was an expansion in the proportion of households with access to them. This scenario is valid for both groups.

Regarding productive assets, it is observed that the two groups showed a similar tendency for the possession of corral/stable (increase), well/cacimba/cacimbão (fall) and plow

(increase). For other productive items, on the other hand, there was an increase for the treated and a decrease for controls.

As for the so-called residential goods, a very similar trend was generally observed for the groups. There was, for example, an increase in the number of motor vehicles (cars and motorcycles), while a reduction in the number of bicycles was observed. Also noteworthy was the increase in the number of cell phones and televisions.

Table 25. Goods and assets owned

Good/Asset	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Productive assets						
Corral. stable	48	76	▲	37	42	▲
	(18.18)	(28.79)		(16.37)	(18.58)	
Well, cacimba, cacimbão	61	55	▼	52	28	▼
	(23.11)	(20.83)		(23.01)	(12.39)	
Plow, traction disk	10	22	▲	2	6	▲
harrow	(3.79)	(8.33)		(0.88)	(2.65)	
Hydraulic pump	46	61	▲	40	38	▼
	(17.42)	(23.11)		(17.70)	(16.81)	
Wain, carriage, bullock	6	8	▲	7	4	▼
cart	(2.27)	(3.03)		(3.10)	(1.77)	
Residential goods						
House	229	261	▲	203	224	▲
	(86.74)	(98.86)		(89.82)	(99.12)	
Automobile	19	39	▲	23	25	▲
	(7.20)	(14.77)		(10.18)	(11.06)	
Motorcycle	167	186	▲	127	134	▲
	(63.26)	(70.45)		(56.19)	(59.29)	
Satellite dish	255	234	▼	210	198	▼
	(96.59)	(88.64)		(92.92)	(87.61)	
Sound system, radio	227	185	▼	166	168	▲
	(85.98)	(70.08)		(73.45)	(74.34)	
Bicycle	137	89	▼	120	70	▼

	(51.89)	(33.71)		(53.10)	(30.97)	
Gas stove (2 burners or more)	245 (92.80)	260 (98.48)	▲	215 (95.13)	222 (98.23)	▲
Freezer	34 (12.88)	32 (12.12)	▼	27 (11.95)	19 (8.41)	▼
Refrigerator	247 (93.56)	260 (98.48)	▲	209 (92.48)	220 (97.35)	▲
Sewing machine	47 (17.80)	38 (14.39)	▼	36 (15.93)	16 (7.08)	▼
Telephone (mobile or landline)	195 (73.86)	228 (86.36)	▲	155 (68.58)	168 (74.34)	▲
TV	250 (94.70)	258 (97.73)	▲	209 (92.48)	218 (96.46)	▲

Note: Percentage of total households in parentheses.

Source: Research results.

Figure 8. House with a car and a satellite dish in Lagoa Dantas, Assaré

Source: Photograph taken by the endline survey team.

3.6. Effects of drought on property ownership

In this subsection, we consider the effects of droughts on the income and wealth of the households studied. Considering Table 26, it is observed that the percentage of households affected by droughts is quite similar between groups. However, it is worth mentioning the fact that there was a significant drop, between 2015 and 2020, in the proportion of households affected by droughts, which is evidenced for both groups.

Table 26. Households affected by droughts in the last 5 years

Was affected by droughts?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	248 (93.94)	157 (59.47)	▼	210 (92.92)	134 (59.29)	▼

Note: Percentage of total households in parentheses.

Source: Research results.

Taking into account the households whose respondent claimed to have been affected by drought, Table 27 presents the observed reaction to this adverse natural phenomenon. The most common reactions are the reduction of work and the loss of agricultural production. However, in view of the decrease in the proportion of households affected by drought between 2015 and 2020, the share of families with these reactions also decreased. On the other hand, at least for the treatment group, there was an increase in the number of households who admitted to having lost animals as a result of the drought.

Table 27. Households' reaction to drought

Reaction to drought	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Work reduction	208 (78.79)	137 (51.89)	▼	181 (80.09)	106 (46.90)	▼
Difficulties in domestic life	181 (68.56)	120 (45.45)	▼	148 (65.49)	90 (39.82)	▼
Loss of agricultural production	227 (85.98)	138 (52.27)	▼	186 (82.30)	115 (50.88)	▼
Loss of animals	61 (23.11)	80 (30.30)	▲	55 (24.34)	47 (20.80)	▼

Note: Percentage of total households in parentheses.

Source: Research results.

Table 28 indicates whether drought-affected households needed to sell any assets in response to adverse effects. Between 2015 and 2020, there was a drop in the proportion of households who had to give up some type of property. It is noteworthy, however, that the percentage recorded by the control group is lower than that recorded by the treatment group. The detailing of which type of property are carried out below, which helps in understanding the results presented here.

Table 28. Sale of assets to face the effects of drought

Sold property?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	50	25	▼	34	9	▼
	(20.16)	(15.92)		(16.19)	(6.72)	

Note: Percentage of total households in parentheses.

Source: Research results.

The assets that had to be sold in response to the adverse effects caused by the drought are detailed in Table 29. There was a decrease in the number of households who had to get rid of animals, one of the main sources of income for those who live in rural areas and drive agricultural activities. In addition, there were also no households who had to sell a house or land to overcome the effects of the drought in 2020. Together with the information presented in Table 23, this result deserves to be analyzed in more depth for a proper understanding of this situation.

Table 29. Consumer goods or assets sold as a result of the drought

Good/Assets	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Animals	39	22	▼	23	9	▼
	(78.00)	(88.00)		(67.65)	(100.00)	
	7	3	▼	6	0	▼

Motorcycle and other durable goods for transport or work	(14.00)	(12.00)		(17.65)	(0.00)	
Home appliances	3 (6.00)	1 (4.00)	▼	2 (5.88)	0 (0.00)	▼
Land or house	3 (6.00)	0 (0.00)	▼	3 (8.82)	0 (0.00)	▼
Total	50 (100.00)	25 (100.00)	▼	34 (100.00)	9 (100.00)	▼

Note: Percentage of total households in parentheses.

Source: Research results.

3.7. Agricultural and environmental practices

This subsection presents the agricultural and environmental practices carried out by the households analyzed. We highlight the agricultural practices adopted, the use of irrigation, the presence of water bodies, and the disposal of waste.

The agricultural practices used are shown in Table 30. Despite presenting a decrease during the period analyzed, the use of agricultural burning is the most widespread practice. This fact may be related to cultural issues, being used for centuries to clear land for agricultural cultivation or formation of pastures. Despite the environmental impact, agricultural burning is still attractive from a financial point of view, given its low cost.

The use of pesticides, on the other hand, showed a significant decrease between 2015 and 2020. The use of manure and straw grew significantly during this period. These results are connected with environmental sustainability, agroecology principles and the coexistence with the semi-arid, which are points addressed by CTA teams during interactions with benefiting farmers.

Table 30. Agricultural practices adopted

Agricultural practices	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Irrigation	9 (3.41)	17 (6.44)	▲	9 (3.98)	10 (4.42)	▲

Watering	16	51	▲	12	26	▲
	(6.06)	(19.32)		(5.31)	(11.50)	
Agricultural burning	122	122	=	83	104	▲
	(46.21)	(46.21)		(36.73)	(46.02)	
Pesticides	82	24	▼	57	35	▲
	(31.06)	(9.09)		(25.22)	(15.49)	
Chemical fertilizer	5	8	▲	3	3	=
	(1.89)	(3.03)		(1.33)	(1.33)	
Organic compost	3	30	▲	4	21	▲
	(1.14)	(11.36)		(1.77)	(9.29)	
Manure	31	68	▲	23	51	▲
	(11.74)	(25.76)		(10.18)	(22.57)	
Crop residues (straws)	11	85	▲	6	55	▲
	(4.17)	(32.20)		(2.65)	(24.34)	

Note: Percentage of total households in parentheses.

Source: Research results.

Although irrigation is not used frequently by the households analyzed, the adoption of this practice increased between 2015 and 2020. Table 31 highlights the crops for which irrigation is applied. Considering the year of 2020, this practice is mainly applied in fruit production, not being used, for example, in cassava production. The use of irrigation may have been enhanced by the dissemination of the water reuse system among PPF beneficiaries.

Table 31. Irrigated crops

Crop	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Not applicable	254	247	▼	214	216	▲
	(96.21)	(93.56)		(94.69)	(95.58)	
Fruit trees	3	8	▲	5	4	▼
	(1.14)	(3.03)		(2.21)	(1.77)	
Grass	2	1	▼	3	0	▼
	(0.76)	(0.38)		(1.33)	(0.00)	

Cassava	1	0	▼	1	0	▼
	(0.38)	(0.00)		(0.44)	(0.00)	
Maize	4	1	▼	3	1	▼
	(1.52)	(0.38)		(1.33)	(0.44)	
Beans	4	1	▼	3	1	▼
	(1.52)	(0.38)		(1.33)	(0.44)	
Other	9	0	▼	7	0	▼
	(3.41)	(0.00)		(3.10)	(0.00)	

Note: Percentage of total households in parentheses.

Source: Research results.

Figure 9. Irrigated banana tree in Araripe, Ceará

Source: Photograph taken by the endline survey team.

As shown in Table 32, the most common types of water bodies found in rural properties are weirs and dams. It should be noted, however, that the proportion of properties with this type of water body decreased between 2015 and 2020, which may be related to the effects of drought on the households studied.

Table 32. Type of existing water body on the rural property.

Type of water body	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Not applicable	196	152	▼	169	140	▼
	(74.24)	(57.58)		(74.78)	(61.95)	
Weir	31	21	▼	43	22	▼
	(11.74)	(7.95)		(19.03)	(9.73)	
Pond	9	10	▲	2	3	▲
	(3.41)	(3.79)		(0.88)	(1.33)	
Dam	28	18	▼	11	10	▼
	(10.61)	(6.82)		(4.87)	(4.42)	
Other	6	0	▼	5	1	▼
	(2.27)	(0.00)		(2.21)	(0.44)	

Note: Percentage of total households in parentheses.

Source: Research results.

Figure 10. Weir of Pedra da Cruz, Antonina

Source: Photograph taken by the endline survey team.

The conservation status of the water bodies is shown in Table 33. A drop in the number (and proportion) of water bodies with riparian forest is observed. In addition, the increase in the quantity (and proportion) of water bodies that were silted stands out.

Table 33. Conservation status of water bodies.

Status	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Silted	6	14	▲	5	10	▲
	(8.82)	(26.92)		(8.77)	(23.26)	
With riparian forest	42	27	▼	35	14	▼
	(61.76)	(51.92)		(61.40)	(32.56)	
Without riparian forest	15	11	▼	12	19	▲
	(22.06)	(21.15)		(21.05)	(44.19)	
Other	5	0	▼	5	0	▼
	(7.35)	(0.00)		(8.77)	(0.00)	
Total	68	52	▼	57	43	▼
	(100.00)	(100.00)		(100.00)	(100.00)	

Note: Percentage of total households in parentheses.

Source: Research results.

In general, more than 85% of the sample declared that their rural properties do not have streams, and this proportion increased between 2015 and 2020, as shown in Table 34. On the other hand, there was a drop in the percentage of farmers whose rural properties had at least one stream.

Table 34. Number of streams that pass through the rural property.

Number of streams	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
0	230	244	▲	194	211	▲
	(87.12)	(92.42)		(85.84)	(93.36)	
1	29	20	▼	29	14	▼
	(10.98)	(7.58)		(12.83)	(6.19)	
2	3	0	▼	2	1	▼
	(1.14)	(0.00)		(0.88)	(0.44)	
3	2	0	▼	1	0	▼
	(0.76)	(0.00)		(0.44)	(0.00)	

Note: Percentage of total households in parentheses.

Source: Research results.

A major change can be seen in terms of the presence of riparian forest in the streams that cut the properties investigated, as shown in Table 35. In 2015, riparian forest was absent in most properties with streams. In 2020, there was a predominance of riparian forest present or scarce, especially for the treatment group.

Table 35. Status of riparian forest

Status of riparian forest	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Absent	29 (85.29)	2 (10.00)	▼	29 (90.63)	3 (20.00)	▼
Scarce	3 (8.82)	8 (40.00)	▲	2 (6.25)	9 (60.00)	▲
Present	2 (5.88)	10 (50.00)	▲	1 (3.13)	3 (20.00)	▲
Total	34 (100.00)	20 (100.00)	▼	32 (100.00)	15 (100.00)	▼

Note: Percentage of total households in parentheses.

Source: Research results.

The number of water springs on rural properties was also surveyed and is shown in Table 36. Differently from what was observed for the water bodies and streams, practically no properties were recorded with the presence of water springs in the evaluated sample.

Table 36. Number of water springs on the rural property

Number of water springs	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
0	259 (98.11)	256 (96.97)	▼	219 (96.90)	226 (100.00)	▲
1	4 (1.52)	8 (3.03)	▲	6 (2.65)	0 (0.00)	▼
2	1	0	▼	1	0	▼

	(0.38)	(0.00)		(0.44)	(0.00)	

Note: Percentage of total households in parentheses.

Source: Research results.

Most of the (few) water springs were, in 2015, preserved or poorly preserved, as can be seen in Table 37. It is interesting to note the low proportion of degraded springs. This result is possibly related to the awareness of the individuals sampled via technical assistance and rural extension services, given that water sources are a fundamental tool for the coexistence with the semi-arid.

Table 37. Status of water springs on the rural property

Status of water springs	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Degraded	1 (20.00)	1 (12.50)	=	0 (0.00)	0 (0.00)	=
Poorly preserved	1 (20.00)	5 (62.50)	▲	5 (71.43)	0 (0.00)	▼
Preserved	3 (60.00)	2 (25.00)	▼	2 (28.57)	0 (0.00)	▼
Total	5 (100.00)	8 (100.00)	▲	7 (100.00)	0 (100.00)	▼

Note: Percentage of total households in parentheses.

Source: Research results.

There are several destinations given to the water obtained from water springs, as can be seen in Table 38. In 2015, the main destination was the domestic use, either for the household itself or for the community as all. In 2020, on the other hand, the productive use of this water predominates, both for animal husbandry and for crop irrigation.

Table 38. Use of water from springs

Use of water from springs	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Not applicable	261	256	▼	221	226	▲

	(98.86)	(96.97)		(97.79)	(100.00)	
Running water for	2	1	▼	4	0	▼
domestic use	(0.76)	(0.38)		(1.77)	(0.00)	
Water destined for	3	1	▼	4	0	▼
the community	(1.14)	(0.38)		(1.77)	(0.00)	
Water used for	0	3	▲	2	0	▼
animal husbandry	(0.00)	(1.14)		(0.88)	(0.00)	
Water used for	1	2	▲	0	0	=
irrigation	(0.38)	(0.76)		(0.00)	(0.00)	
Water running its	1	1	=	1	0	▼
natural course	(0.38)	(0.38)		(0.44)	(0.00)	
Other use	0	0	=	0	0	=
	(0.00)	(0.00)		(0.00)	(0.00)	

Note: Percentage of total households in parentheses.

Source: Research results.

Contrary to what is recommended, empty agrochemical containers continue to be primarily buried, burned or thrown into the environment. Even so, as can be seen in Table 39, the number of households that dispose of in this way decreased between 2015 and 2020.

Table 39. Destination of empty agrochemical containers

Destination	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Not applicable	182	224	▲	167	184	▲
	(68.94)	(84.85)		(73.89)	(81.42)	
Returned at collection	1	5	▲	3	3	=
points	(0.38)	(1.89)		(1.33)	(1.33)	
Buried / Burnt / Thrown to	78	27	▼	55	31	▼
the environment	(29.55)	(10.23)		(24.34)	(13.72)	
Reused	1	1	=	0	1	▲
	(0.38)	(0.38)		(0.00)	(0.44)	
Other destination	3	1	▼	2	2	=
	(1.14)	(0.38)		(0.88)	(0.00)	

Note: Percentage of total households in parentheses.

Source: Research results.

Similarly, domestic waste is usually buried or burned, which is also harmful to the environment (Table 40). Although the absolute number of households that dispose domestic waste in this way has decreased between 2015 and 2020, the proportion is still close to 80% of the sample, for both the treatment and the control group.

Table 40. Destination of domestic waste

Destination	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Collected by the municipal system	31 (11.74)	59 (22.35)	▲	40 (17.70)	58 (25.66)	▲
Recycled	3 (1.14)	30 (11.36)	▲	2 (0.88)	20 (8.85)	▲
Buried / Burnt	236 (89.39)	215 (81.44)	▼	181 (80.09)	176 (77.88)	▼
Thrown to the environment	19 (7.20)	15 (5.68)	▼	21 (9.29)	24 (10.62)	▲
Separation of organic waste for composting	25 (9.47)	23 (8.71)	▼	23 (10.18)	12 (0.00)	▼
Other destination	3 (1.14)	0 (0.00)	▼	2 (0.88)	0 (0.00)	▼

Note: Percentage of total households in parentheses.

Source: Research results.

3.8. Food security

This subsection deals with the food security of the households investigated. Specifically, we analyze the origin of the food consumed, the frequency with which households have a diversified diet and the occurrence of episodes in which households had difficulty obtaining food.

The origin of the food consumed is shown in Table 41. The prevalence of workers allocated to the agricultural sector is not necessarily connected with self-consumption of agricultural and livestock production, but a significant portion of households consumed food from their own properties. This percentage even increased between the years analyzed.

Given the difficulty of producing all the food necessary on the property itself, over 95% of all households purchase from neighbors or at fairs, warehouses and markets. On the other hand, a small portion, between 6 and 15% of the total, resorts to donations or exchanges.

Table 41. Origin of food consumed

Origin	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Donations from neighbors and relatives	40 (15.15)	17 (6.44)	▼	30 (13.27)	30 (13.27)	=
From own swidden	215 (81.44)	239 (90.53)	▲	173 (76.55)	198 (87.61)	▲
Exchanges with neighbors and relatives	29 (10.98)	62 (23.48)	▲	17 (7.52)	44 (19.47)	▲
Government donations	12 (4.55)	58 (21.97)	▲	12 (5.31)	43 (19.03)	▲
Purchased from neighbors or at fairs, warehouses, markets	261 (98.86)	253 (95.83)	▼	219 (96.90)	222 (98.23)	▲

Note: Percentage of total households in parentheses.

Source: Research results.

Table 42 shows the frequency with which respondents claim to have a diversified diet. It is interesting to note that a process of diet improvement seems to be taking place. In fact, between 2015 and 2020, the proportion of households that always had a diversified diet practically doubled, while a significant drop was observed in those that never had it.

Table 42. Frequency with which diet is diversified

	Treatment	Control

How often does the household have a diversified diet?	2015	2020	Var.	2015	2020	Var.
Always	56 (21.21)	103 (39.02)	▲	42 (18.58)	84 (37.17)	▲
Sometimes	170 (64.39)	139 (52.65)	▼	138 (61.06)	121 (53.54)	▼
Never happened	36 (13.64)	14 (5.30)	▼	44 (19.47)	8 (3.54)	▼
Don't know, didn't answer	2 (0.76)	8 (3.03)	▲	2 (0.88)	13 (5.75)	▲

Note: Percentage of total households in parentheses.

Source: Research results.

Despite the possible improvement in terms of dietary quality, there is still a significant portion of households that go through episodes of difficulty in obtaining food. Between 2015 and 2020, according to the data in Table 43, there was a percentage increase for the treatment group and a slight decrease for the control group.

Table 43. Existence of period with difficulty in obtaining food

Has the household ever faced difficulty of getting food?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	61 (23.11)	73 (27.65)	▲	53 (23.45)	48 (21.24)	▼

Note: Percentage of total households in parentheses.

Source: Research results.

3.9. Gender and the youth

This subsection deals with issues related to the participation of the youth and women in community actions, as well as the occupations they have already exercised. As can be seen in Table 44, the proportion of households with female members who actively participate in

community actions is higher in the treatment group than in the control group. In addition, the fact that this percentage increased between 2015 and 2020 is also noteworthy.

Table 44. Participation of women in community actions

Has women actively participated in community actions?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	171 (64.77)	213 (80.68)	▲	103 (45.58)	110 (48.67)	▲

Note: Percentage of total households in parentheses.

Source: Research results.

Among the occupations presented in Table 45, women work predominantly in agriculture. This is a result that may be related to the fact that most of the households analyzed are in rural areas, where agriculture is one of the most relevant sources of income.

During the period analyzed, there was a substantial drop in the number of women who had already worked in public services or with service provision. On the other hand, the proportion of women who had already worked in the processing or manufacturing of products grew significantly, especially in the treatment group.

Table 45. Occupations of women

Occupation already held by women in the last 5 years	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Agricultural activities	224 (84.85)	235 (89.02)	▲	171 (75.66)	147 (65.04)	▼
Products processing or manufacturing	10 (3.79)	54 (20.45)	▲	9 (3.98)	28 (12.39)	▲
Public service (school, health center, etc.)	27 (10.23)	10 (3.79)	▼	22 (9.73)	2 (0.88)	▼
Service provision (maid, manicurist, nanny, seamstress, etc.)	20 (7.58)	3 (1.14)	▼	18 (7.96)	2 (0.88)	▼
Trade	5	4	▼	10	2	▼

	(1.89)	(1.52)		(4.42)	(0.88)	
Handicraft	28	35	▲	21	20	▼
	(10.61)	(13.26)		(9.29)	(8.85)	

Note: Percentage of total households in parentheses.

Source: Research results.

Compared to women, a different scenario is observed for the youth in relation to active participation in community actions. Although the proportion was higher for the treatment group than for the control group, in both cases there was a drop in the proportion of households whose young members are engaged in community actions, as can be seen in Table 46.

It should be noted, however, that both the baseline (2015) and endline (2020) surveys were applied to exactly the same households. As individuals are classified as young according to age, the passage of time between surveys and the consequent aging of household members (see Figure 6) may explain the decrease in the proportion of households with young members who actively participate in community actions.

Table 46. Youth participation in community actions

Has the youth actively participated in community actions?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	67	56	▼	33	22	▼
	(25.38)	(21.21)		(14.60)	(9.73)	

Note: Percentage of total households in parentheses.

Source: Research results.

Table 47 presents the distribution of households in terms of occupations already held by young household members. In view of the classification used to define who are young (individuals up to 29 years of age), most young members only study / studied. Even so, a significant portion of young household members work in the agricultural sector.

Table 47. Occupation of the youth

Occupation already held by youth in the last 5 years	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.

Agricultural activities	85	91	▲	74	57	▼
	(32.20)	(34.47)		(32.74)	(25.22)	
Products processing or	1	24	▲	4	7	▲
manufacturing	(0.38)	(9.09)		(1.77)	(3.10)	
Public service (school, health	1	3	▲	2	1	▼
center, etc.)	(0.38)	(1.14)		(0.88)	(0.44)	
Service provision (manicurist,	11	3	▲	12	1	▼
maid, nanny, seamstress, etc.)	(4.17)	(1.14)		(5.31)	(0.44)	
Trade	4	6	▲	5	3	▼
	(1.52)	(2.27)		(2.21)	(1.33)	
Handicraft	2	6	▲	4	4	=
	(0.76)	(2.27)		(1.77)	(1.77)	
Only studies / studied	167	76	▼	134	44	▼
	(63.26)	(28.79)		(59.29)	(19.47)	

Note: Percentage of total households in parentheses.

Source: Research results.

3.10. Housing conditions

Housing conditions are described in this subsection. Specifically, we highlight the type of home, the materials used for exterior walls, roof and floor, the existence of bathroom, electricity and running water, among others. As pointed out in Table 48, the absolute majority of the sample is composed of houses.

Table 48. Type of home

Type of home	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
House	262	249	▼	226	212	▼
	(99.24)	(94.32)		(100.00)	(93.81)	
Shack	1	13	▲	0	12	▲
	(0.38)	(4.92)		(0.00)	(5.31)	
Other	1	2	▲	0	2	▲
	(0.38)	(0.76)		(0.00)	(0.88)	

Note: Percentage of total households in parentheses.

Source: Research results.

Table 49 presents the main material used for exterior walls. Most homes are covered with masonry, either with bricks or blocks. One cannot ignore, however, the portion of households whose external walls are covered with adobe or rammed earth. Wood flooring, on the other hand, is rarely used.

Table 49. Main material used for exterior walls

Main material used for exterior walls	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Masonry (brick, block)	229 (86.74)	216 (81.82)	▼	197 (87.17)	179 (79.20)	▼
Adobe	3 (1.14)	27 (10.23)	▲	3 (1.33)	26 (11.50)	▲
Wood	0 (0.00)	7 (2.65)	▲	0 (0.00)	5 (2.21)	▲
Rammed earth	32 (12.12)	13 (4.92)	▼	25 (11.06)	15 (6.64)	▼
Other temporary material (straw, canvas, plastic)	0 (0.00)	1 (0.38)	▲	1 (0.44)	1 (0.44)	=

Note: Percentage of total households in parentheses.

Source: Research results.

Figure 11. Rammed earth house with ceramic tile in Quixaba, Irauçuba

Source: Photograph taken by the endline survey team.

The distribution of the households according to the roof material is shown in Table 50. The use of ceramic tile is predominant, regardless of the group and year considered. It can also be highlighted, to a lesser extent, the use of concrete slab.

Table 50. Main material used in the roof

Roof material	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Ceramic tile	261	225	▼	223	190	▼
	(98.86)	(85.23)		(98.67)	(84.07)	
Concrete slab	0	24	▲	1	18	▲
	(0.00)	(9.09)		(0.44)	(7.96)	
Zinc, asbestos	0	10	▲	0	16	▲
	(0.00)	(3.79)		(0.00)	(7.08)	
Other material (wood,	3	5	▲	4	2	▼
straw, canvas, plastic)	(1.14)	(1.89)		(1.77)	(0.88)	

Note: Percentage of total households in parentheses.

Source: Research results.

As observed for exterior walls, the vast majority of homes have floors made of masonry, with materials such as cement, bricks, blocks or tiles (Table 51). Almost no households have wooden floors and a very small portion of households have earthen floors.

Table 51. Main material used in the floor

Floor material	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Masonry (cement,	253	225	▼	213	186	▼
brick, block, tiles)	(95.83)	(85.23)		(94.25)	(82.30)	
Wood	2	6	▲	0	6	▲
	(0.76)	(2.27)		(0.00)	(2.65)	
Earthen floor	9	6	▼	13	9	▼
	(3.41)	(2.27)		(5.75)	(3.98)	
Other	0	27	▲	0	25	▲

	(0.00)	(10.23)		(0.00)	(11.06)	

Note: Percentage of total households in parentheses.

Source: Research results.

Table 52 presents the distribution of households in terms of the number of bedrooms. In 2020, there was no register of households with no bedrooms. In general, most households have two bedrooms. A significant portion also have one or three bedrooms.

Table 52. Number of bedrooms

Number of bedrooms	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
0	2	0	▼	0	0	=
	(0.76)	(0.00)		(0.00)	(0.00)	
1	57	38	▼	58	28	▼
	(21.59)	(14.39)		(25.66)	(12.39)	
2	134	158	▲	110	149	▲
	(50.76)	(59.85)		(48.67)	(65.93)	
3	59	59	=	45	37	▼
	(22.35)	(22.35)		(19.91)	(16.37)	
4	11	7	▼	7	12	▲
	(4.17)	(2.65)		(3.10)	(5.31)	
5	1	2	▲	3	0	▼
	(0.38)	(0.76)		(1.33)	(0.00)	
6	0	0	=	3	0	▼
	(0.00)	(0.00)		(1.33)	(0.00)	

Note: Percentage of total households in parentheses.

Source: Research results.

As shown in Table 53, more than 3/4 of households have at least one bathroom. The proportion of households with a bathroom increased from 2015 to 2020. Even so, this percentage remained (slightly) higher for the control group than for the treatment group.

Table 53. Existence of a bathroom at home

Is there a bathroom at home?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	197 (74.62)	226 (85.61)	▲	181 (80.09)	202 (89.38)	▲

Note: Percentage of total households in parentheses.

Source: Research results.

The main destination of sewage is reported in Table 54. Considering that the rural area is usually not served by the sewage collection network, the proportion of households where this is the main destination is relatively small. However, the observance of an increase in this percentage between 2015 and 2020 stands out.

Most households dispose sewage in septic tanks, whether with or without coating. In 2015, a significant portion of households still carried out the disposal in the open or in rivers/lakes/sea, but this proportion decreased significantly in 2020.

Table 54. Main destination of household sewage

Main destination of household sewage	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Sewage collection network	8 (3.03)	40 (15.15)	▲	3 (1.33)	39 (17.26)	▲
Coated septic tank	152 (57.58)	149 (56.44)	▼	148 (65.49)	140 (61.95)	▼
Uncoated septic tank	13 (4.92)	25 (9.47)	▲	13 (5.75)	17 (7.52)	▲
Open air, ditch, river, lake or sea	81 (30.68)	43 (16.29)	▼	56 (24.78)	26 (11.50)	▼
Other	10 (3.79)	7 (2.65)	▼	6 (2.65)	4 (1.77)	▼

Note: Percentage of total households in parentheses.

Source: Research results.

Access to electricity is shown in Table 55. Considering the threshold legally defined by the Ministry of Mines and Energy, it can be said that the sample of households is virtually

electrified. This result may be directly related to access to social benefits such as the Luz no Campo and Luz para Todos programs.

Table 55. Existence of electricity at home

Is there electricity at home?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	264 (100.00)	261 (98.86)	▼	224 (99.12)	220 (97.35)	▼

Note: Percentage of total households in parentheses.

Source: Research results.

Unlike access to electricity, the existence of running water was not yet fully disseminated among the households analyzed in 2020, as can be seen in Table 56. Even so, it is noteworthy that there was a reasonable increase in the proportion of households that had at least one room with running water between 2015 and 2020.

Table 56. Existence of running water at home

Is there running water at home?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	125 (47.35)	172 (65.15)	▲	137 (60.62)	162 (71.68)	▲

Note: Percentage of total households in parentheses.

Source: Research results.

Table 57 highlights the main sources of water used. Cisterns are used by more than 2/3 of the sample to obtain water, the proportion being higher for the treatment group compared to the control group. Next, it is highlighted the obtainment of water from fountains or springs. The proportion of households that depend on water from a water truck decreased between 2015 and 2020.

The prevalence of the use of cisterns, especially for the treatment group, is possibly linked to the initiatives carried out within the scope of the Project. In fact, the PPF is notable for the availability of cisterns as one of the benefits received by some of the households that participated in the Project.

Table 57. Main sources of water

Main sources of water	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Water supply network	55	53	▼	59	60	▲
	(20.83)	(20.08)		(26.11)	(26.55)	
Well or water spring	132	152	▲	87	112	▲
	(50.00)	(57.58)		(38.50)	(49.56)	
Cistern	202	195	▼	158	148	▼
	(76.52)	(73.86)		(69.91)	(65.49)	
Creek, lagoon, weir, dam,	37	42	▲	49	47	▼
watery	(14.02)	(15.91)		(21.68)	(20.80)	
Water truck	148	71	▼	84	48	▼
	(56.06)	(26.89)		(37.17)	(21.24)	
Other	8	1	▼	13	4	▼
	(3.03)	(0.38)		(5.75)	(1.77)	

Note: Percentage of total households in parentheses.

Source: Research results.

Figure 12. First water cistern (human consumption) in Várzea da Palha, Varjota

Source: Photograph taken by the endline survey team.

3.11. Social capital

To conclude the descriptive analysis of the sample, we present the information related to social capital. In this case, the participation of respondents in associations, including those through which PPF actions are conducted, stands out.

As shown in Table 58, the proportion of respondents who have participated in associative activity or social organization is higher for the treatment group than for the control group. In terms of time, there was a slight drop in the proportion between 2015 and 2020, with the decrease having been more pronounced for the control group.

Table 58. Participation in associative activity or social organization

Have you ever participated in associative activity or social organization?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Yes	242 (91.67)	228 (86.36)	▼	166 (73.45)	140 (61.95)	▼

Note: Percentage of total households in parentheses.

Source: Research results.

Table 59 shows the classification of respondents in terms of the type of associative activity or organization they have already participated in. Approximately 80% of individuals in the treatment group participated in community, neighborhood, producer or cooperative associations, while this share does not exceed 60% in the control group.

It should be noted that participation in the association is a mandatory condition for beneficiaries to receive PPF training and investment plans. Thus, the fact that this percentage did not reach 100% for the treatment group may be related to situations in which the person who answered the survey was not the head of the household and, possibly, was not himself a member of the association linked to the Project.

Table 59. Associative activity or social organization that survey respondent participated in

Associative activity or social organization	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Community, neighborhood, farmers or cooperative associations	219 (82.95)	213 (80.68)	▼	134 (59.29)	118 (52.21)	▼

Collective work	36 (13.64)	99 (37.50)	▲	18 (7.96)	45 (19.91)	▲
Organized social movement (NGO, MST, MLT, FETAG, CONTAG etc.)	1 (0.38)	8 (3.03)	▲	1 (0.44)	8 (3.54)	▲
Movements linked to churches	48 (18.18)	44 (16.67)	▼	20 (8.85)	21 (9.29)	▲
Unions	124 (46.97)	106 (40.15)	▼	98 (43.36)	60 (26.55)	▼
Others (clubs, sports and social associations, etc.)	3 (1.14)	0 (0.00)	▼	0 (0.00)	0 (0.00)	=

Note: Percentage of total households in parentheses.

Source: Research results.

Figure 13. Association in Boa Vista community, Irauçuba

Source: Photograph taken by the endline survey team.

Respondents' knowledge in terms of meeting held by the association to which they paticipate in is described in Table 60. The share of individuals whose associations did not hold meetings throughout the year decreased between 2015 and 2020. In addition, the fact that the proportion of individuals in which the associations held meetings is greater for the treatment group than for the control group. This may indicate a higher level of activity from treatment group associations.

Table 60. Meetings held throughout the year

Has the association held meetings throughout the year?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
No	37 (14.02)	6 (2.27)	▼	37 (16.37)	12 (5.31)	▼
Yes	211 (79.92)	222 (84.09)	▲	147 (65.04)	128 (56.64)	▼
Don't know / didn't answer	16 (6.06)	36 (13.64)	▲	42 (18.58)	86 (38.05)	▲

Note: Percentage of total households in parentheses.

Source: Research results.

Table 61 shows the frequency with which respondents participate in association meetings throughout the year. The proportion of individuals who did not participate in meetings in 2020 is higher than that recorded for 2015. This may be a reflection of the social distancing imposed by the COVID-19 pandemic. Still, respondents in the treatment group seem to be more engaged than those in the control group, given the difference in the percentage of individuals who reported having attended all meetings held during the year.

Table 61. Participation in meetings throughout the year

How many meetings did you attend during the year?	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
None	18 (6.82)	34 (12.88)	▲	36 (15.93)	36 (15.93)	=
Some	77 (29.17)	71 (26.89)	▼	57 (25.22)	50 (22.12)	▼
All	116 (43.94)	117 (44.32)	▲	54 (23.89)	42 (18.58)	▼
Not applicable	53 (20.08)	42 (15.91)	▼	79 (34.96)	98 (43.36)	▲

Note: Percentage of total households in parentheses.

Source: Research results.

3.12. Socioeconomic indicators

3.12.1. Indicator of Participation of Women and the Youth in Community Actions

Table 62 presents the classification of the households analyzed in relation to the participation rate of women and the youth in community actions. For the control group, the distribution of households between the classification ranges remained practically constant, with a predominance of households with a low participation rate. For the treatment group, however, there was, at the same time, a decrease in households with a low participation rate and an increase in those with a medium rate, the predominant classification for this group.

Table 62. Distribution of the participation of women and the youth in community actions

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Low	85	48	▼	117	114	▼
	(32.20)	(18.18)		(51.77)	(50.44)	
Medium	120	163	▲	82	92	▲
	(45.45)	(61.74)		(36.28)	(40.71)	
High	59	53	▼	27	20	▼
	(22.35)	(20.08)		(11.95)	(8.85)	

Source: Research results.

3.12.2. Associativism Indicator

Table 63 presents the classification of households in relation to the associativism indicator. For the control group, there was a drop in the percentage of households with no participation and a consequent increase in the other classification ranges, with a predominance of households with a low indicator. In terms of the treatment group, a similar panorama is evidenced, although the classification of households in the medium and high groups is comparatively higher than that observed for the control group.

Table 63. Distribution of the associativism indicator

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Does not participate	12	4	▼	24	7	▼
	(5.69)	(1.80)		(16.33)	(5.47)	
Very low	108	105	▼	80	77	▼
	(51.18)	(47.30)		(54.42)	(60.16)	
Low	69	89	▲	39	35	▼
	(32.70)	(40.09)		(26.53)	(27.34)	
Medium	17	18	▲	4	9	▲
	(8.06)	(8.11)		(2.72)	(7.03)	
High	5	6	▲	0	0	=
	(2.37)	(2.70)		(0.00)	(0.00)	

Source: Research results.

3.12.3. Housing Indicator

The temporal evolution of the classification of households analyzed in terms of the housing indicator is shown in Table 64. A relatively similar scenario can be observed for the two groups. Between 2015 and 2020, there was a decrease in the share of households with medium and very high classification, although there was an expansion in the percentage of households classified in the high range. In fact, households with a high housing indicator are the ones that predominate in the sample.

Table 64. Distribution of the housing indicator

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Low	5	2	▼	1	2	▲
	(1.89)	(0.76)		(0.44)	(0.88)	
Medium	91	77	▼	61	51	▼
	(34.47)	(29.17)		(26.99)	(22.57)	
High	128	158	▲	124	143	▲
	(48.48)	(59.85)		(54.87)	(63.27)	
Very high	40	27	▼	40	30	▼

	(15.15)	(10.23)	(17.70)	(13.27)

Source: Research results.

3.12.4. Poverty Indicator

Table 65 shows the distribution of households analyzed in relation to the level of per capita income in the years 2015 and 2020. When comparing the groups, it is observed that the proportion of households that have a per capita income of up to 1/8 minimum wage is higher for the treated. In both cases, however, there was an increase in the share of households in this income classification group. It is also noteworthy that almost 50% of households in the control group had a per capita income greater than 1/2 minimum wage in 2020, while the proportion observed for the treatment group in that same year was slightly greater than 30%.

Table 65. Distribution of the Poverty Indicator

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Up to 1/8 minimum wage	58	77	▲	45	61	▲
	(21.97)	(29.17)		(19.91)	(26.99)	
From 1/8 to 1/4 of minimum wage	66	44	▼	43	28	▼
	(25.00)	(16.67)		(19.03)	(12.39)	
From 1/4 to 1/2 of minimum wage	73	57	▼	54	30	▼
	(27.65)	(21.59)		(23.89)	(13.27)	
From 1/2 to 1 minimum wage	43	58	▲	50	49	▼
	(16.29)	(21.97)		(22.12)	(21.68)	
More than 1 minimum wage	24	28	▲	34	58	▲
	(9.09)	(10.61)		(15.04)	(25.66)	

Source: Research results.

3.12.5. Food Safety Indicator

The temporal evolution of the classification of households in terms of the housing indicator is shown in Table 66. Although the two groups showed a reduction in the share of households with a very low food security indicator during the investigated period, the

proportion of households in this range in 2020 is lower among treated than among controls. In addition, an increase in the share of households with a medium or high level of food security was observed for the treatment group.

Table 66. Distribution of the food security indicator

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Very low	43	7	▼	51	15	▼
	(16.29)	(2.65)		(22.57)	(6.64)	
Low	170	190	▲	133	165	▲
	(64.39)	(71.97)		(58.85)	(73.01)	
Medium	45	64	▲	37	39	▲
	(17.05)	(24.24)		(16.37)	(17.26)	
High	6	3	▼	5	7	▲
	(2.27)	(1.14)		(2.21)	(3.10)	

Source: Research results.

3.12.6. Indicator of Access to Public Policies

Table 67 shows the distribution of analyzed households in terms of access to public policies in the years 2015 and 2020. Regarding the treatment group, there was an expansion of the medium range to the detriment of the high range, while the percentage of households with very low or low value remained practically unchanged. For the control group, on the other hand, there was an increase in the share of households with a low value concomitantly with a decrease in those with a high value. If in the treatment group more than 65% of the households had a medium or high value in 2020, for the control group this share does not reach 40%.

Table 67. Distribution of the indicator of access to public policies

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Very low	8	9	▲	35	48	▲
	(3.03)	(3.41)		(15.49)	(21.24)	
Low	80	77	▼	69	90	▲

	(30.30)	(29.17)		(30.53)	(39.82)	
Medium	134	159	▲	95	85	▼
	(50.76)	(60.23)		(42.04)	(37.61)	
High	42	19	▼	27	3	▼
	(15.91)	(7.20)		(11.95)	(1.33)	

Source: Research results.

3.12.7. Indicator of Access to Agricultural Policies

Table 68 presents the classification of households from the control and treatment groups, for the years 2015 and 2020, in relation to the indicator of access to agricultural policies. For the treatment group, there is a predominance of households with medium or high access to agricultural policies, exceeding 60% of the total. Between 2015 and 2020, however, there was an expansion of the middle range to the detriment of the high range. A different scenario is observed for the control group, where the proportion of households with medium or high access went from 50% to less than 40% of the total, with a predominance of low and very low ranges for this group in 2020.

Table 68. Distribution of the indicator of access to agricultural policies

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Very low	10	9	▼	40	50	▲
	(3.79)	(3.41)		(17.70)	(22.12)	
Low	86	85	▼	73	92	▲
	(32.58)	(32.20)		(32.30)	(40.71)	
Medium	129	156	▲	96	82	▼
	(48.86)	(59.09)		(42.48)	(36.28)	
High	39	14	▼	17	2	▼
	(14.77)	(5.30)		(7.52)	(0.88)	

Source: Research results.

3.12.8. Drought Indicator

The temporal evolution of the classification of households in terms of the drought indicator is shown in Table 69. A relatively similar scenario is observed for the two groups. The distribution of households between the classification ranges and the evolution between the years 2015 and 2020 is practically the same for the treatment and control groups. This similarity may be related to the observation of a more satisfactory volume of rainfall in 2020 than in 2015. Less than 10% of households were not affected by the drought in 2015, a proportion that reached 40% in 2020.

Table 69. Distribution of the drought indicator

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Very affected	60	62	▲	49	33	▼
	(22.73)	(23.48)		(21.68)	(14.60)	
Affected	188	95	▼	161	101	▼
	(71.21)	(35.98)		(71.24)	(44.69)	
Little affected	0	0	=	0	0	=
	(0.00)	(0.00)		(0.00)	(0.00)	
Not affected	16	107	▲	16	92	▲
	(6.06)	(40.53)		(7.08)	(40.71)	

Source: Research results.

3.12.9. Indicator of Agroecological and Sustainable Practices

Table 70 presents the classification of households, for 2015 and 2020, in relation to the indicator of agroecological and sustainable practices. For the treatment group, an increase in the proportion of households with a good indicator was identified, while the opposite was observed for the control group. This fact may be directly related to the activities of Continuous Technical Assistance (ATC) made available by the Project.

Table 70. Distribution of the indicator of agroecological and sustainable practices

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Low	86	82	▼	46	82	▲

	(32.58)	(31.06)		(20.35)	(36.28)	
Regular	163	155	▼	159	130	▼
	(61.74)	(58.71)		(70.35)	(57.52)	
Good	15	27	▲	21	14	▼
	(5.68)	(10.23)		(9.29)	(6.19)	

Source: Research results.

3.13. Socioeconomic indicators - Women and youth

Considering only women-headed households, Table 71 shows the distribution of households among the different categories of socioeconomic indicators, also highlighting the temporal variation in the composition of each of the categories considered. In general, similar behavior is observed among women-headed households, whether treated or not. Some differences, however, should be highlighted.

In both groups, there was a reduction in the number of households with high participation of women and youth in community actions and a reduction in the number of those with low participation. It is noted, however, that the households benefiting from the PPF showed a greater reduction in the percentage of the category of low participation in community actions (negative variation of 38% for treated and 22% for controls).

As for the associativism indicator, it appears that most of the women-headed households have a low or very low degree of associativism. There was a slight increase in the number of households with a very low rate of associativism in the control group, whilst there was a small reduction in the treatment group.

Women-headed households with a low level of housing conditions are rare, whether treated or not. Interestingly, there was an increase in the number of households with a very high housing conditions rate among treated women-headed households (19%), but a reduction in this number among those who did not benefit from the PPF (-10%).

There was a significant reduction in the category of low access to public policies in all women-headed households. However, this drop was about 5 times greater among those benefiting from the PPF (-25% versus -5%).

The high level of access to agricultural policies is higher among women-headed households benefiting from PPF, although there has been a reduction in the number of households in this category in the period (by 25%). On the other hand, there was a reduction

of around 26% in the number of households with low access among those treated and of 14% among women-headed households who did not participate in the Project.

In terms of the effects of droughts, large proportion of women-headed households, whether treated or not, are in the "little affected" category. There was a similar reduction in the number of households in this category in both groups over time.

In 2015, about 30% of women-headed households from the treatment group had a per capita income between 1/8 and 1/4 of the minimum wage. In the same year, the majority of households from the control group (25%) were in the per capita income stratum between 1/4 and 1/2 minimum wage. In 2020, most of treated women-headed households were in the income category between 1/4 and 1/2 minimum wage per capita (26%). On the other hand, in the control group, women-headed households became more frequent in the lowest income category (33%). In both groups, there was an increase in the percentage of households belonging to the lowest income category (up to 1/8 minimum wage) and this increase was more pronounced for the treated (56% versus 27% for controls). On the other hand, there was an increase in the number of women-headed households in the highest income stratum (greater than a minimum wage): increases of 43% and 100% for the treated and controls, respectively.

As for the indicator of agroecological and sustainable practices, it is noted that most of women-headed households had a "regular" level of adoption in both years and groups. Both in the treatment and control groups, there was a reduction in the number of women-headed households with a "good" level of adoption, although in the treatment group the reduction was lower (-50% versus -57% for the controls).

In terms of the indicator of nutrition and food security, most of the women-headed households were in the "low" category in both periods for both groups. It is observed, however, that there was a reduction in the percentage of households with "low" and "very low" levels over time. It is also noted that the reduction in the number of women-headed households with "very low" food insecurity was more pronounced in households benefiting from PPF: 55% versus 42%.

Table 71. Distribution of women-headed households for the socioeconomic indicators

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
	Participation of women and the youth in community actions					
High	18	13	▼	7	4	▼

Medium	37	48	▲	23	27	▲
Low	13	8	▼	32	25	▼
			Associativism			
High	2	1	▼	0	0	=
Medium	5	5	▲	0	2	▲
Low	22	24	▲	11	11	▲
Very low	26	25	▼	17	20	▲
Does not participate	2	3	▲	5		▼
			Housing			
Medium	25	19	▼	13	12	▼
Low	1	0	▼	0	0	=
Very low	42	50	▲	49	44	▼
			Access to public policies			
High	5	3	▼	5	0	▼
Medium	36	44	▲	21	22	▲
Low	25	18	▼	21	20	▼
Very low	2	4	▲	15	14	▼
			Access to agricultural policies			
High	8	6	▼	1	0	▼
Medium	31	39	▲	22	21	▼
Low	27	20	▼	22	19	▼
Very low	2	4	▲	17	16	▼
			Drought			
Affected	12	12	▲	12	5	▼
Little affected	55	29	▼	42	22	▼
Not affected	1	0	▼	8	4	▼
			Per capita income			
More than 1 MW	7	10	▲	7	14	▲
Between 1/2 and 1 MW	14	13	▼	12	10	▼
Between 1/4 and 1/2 MW	17	18	▲	16	7	▼
Between 1/8 and 1/4 MW	21	14	▼	12	6	▼
Less than 1/8 MW	9	14	▲	15	19	▲
			Agroecological and sustainable practices			

Good	4	2	▼	7	3	▼
Regular	47	48	▲	40	30	▼
Low	17	19	▲	15	23	▲
			Nutrition and food security			
High	1	3	▲	0	1	▲
Medium	9	17	▲	10	11	▲
Low	47	44	▼	40	37	▼
Very low	11	5	▼	12	7	▼

Note: Δ denotes the variation between 2015 and 2020; MW denotes minimum weight.

Source: Research results.

To allow comparison regarding the performance of women-headed households and the men-headed ones, Table 72 shows the same data only for households headed by men.

Similarly to women-headed households, men-headed households benefiting from PPF are also more incident in the middle class participation of women and the youth in community actions. However, while there was a reduction in the incidence of men-headed households with low social participation, there was a considerable increase in the percentage of treated households with medium participation (39%) when compared to men-headed households from the control group (10% increase).

It is also worth mentioning the rate of access to public policies. Both women- and men-headed households benefiting from the Project are more present in the "medium" category in both years. When restricted to men-headed households, it is noted that both the treated and controls showed a reduction in households with high access. However, the reduction was significantly smaller among benefiting households (-50% versus -84%). Likewise, while in treated men-headed households there was a 17% reduction in the percentage of households with "very low" access, in the control group there was a 55% increase in this number. In the treatment group, there was an increase in the percentage of households with "low" access of 5%, while the control group had an increase of 52% in this number.

Access to agricultural policies by men-headed households also seems to have been better for the treated compared to controls. This is because men-headed households benefiting from the Project are more frequent in the category of medium access. There was an increase of 19% in the number of treated households in this category, while the control group showed a reduction of households in this class of 18%. There is also a 38% reduction in the number of

households with “very low” access in the treatment group versus a 48% increase in households in the lowest category of access among controls.

As well as women-headed households, the men-headed ones are also more present in the category of “little affected” by the drought.

In terms of income categories, there is a pronounced difference between women- and men-headed households. While women-headed households benefiting from PPF are more frequent in the income stratum between 1/8 and 1/4 of the minimum wage, men-headed households from the treatment group are mostly in the income category between 1/4 and 1/2 of minimum wage.

Comparing men-headed households from treatment and control groups, it is identified a reduction in the percentage of households in income classes between 1/8 and 1/4 and from 1/4 to 1/2 minimum wage per capita in both groups. On the other hand, there was an increase in the number of households belonging to the lowest income class in both groups, although this increase was smaller in the treatment group (29% versus 40%). It is also interesting to note that the number of households in the income category between 1/2 and 1 minimum wage increased by 55% in the treated group but only 3% in the control group. There was also a sharp reduction in the number of households with the highest income class (above 1 minimum wage per capita) among controls (-63%) while the treated showed an increase in this number (6%).

In terms of the adoption of agroecological and sustainable practices, women- and men-headed households present, for the most part, a “regular” level of adoption. However, it is noted that among the men-headed households benefiting from PPF, there was a 127% increase in the number of those with a “good” adoption in the period, versus an increase of only 21% in the control group.

As for the indicator of nutrition and food security, men-headed households are also more present in the category of “low” food security. It is noteworthy that, while there was a reduction of 85% in the number of households with "very low" food security among men-headed households benefiting from the Project, the control group showed an increase of 68%.

Table 72. Distribution of men-headed households for the socioeconomic indicators

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
	Participation of women and the youth in community actions					
High	41	40	▼	20	16	▼

Low	72	40	▼	85	89	▲
Medium	83	115	▲	59	65	▲
			Associativism			
High	3	5	▲	0	0	=
Low	47	65	▲	28	24	▼
Very low	82	80	▼	63	57	▼
Medium	12	13	▲	4	7	▲
Does not participate	10	1	▼	19	7	▼
			Housing			
Low	4	2	▼	1	2	▲
Very low	126	135	▲	115	129	▲
Medium	66	58	▼	48	39	▼
			Access to public policies			
High	32	16	▼	19	3	▼
Low	56	59	▲	46	70	▲
Very low	6	5	▼	22	34	▲
Medium	102	115	▲	77	63	▼
			Access to agricultural policies			
High	31	8	▼	16	2	▼
Low	59	65	▲	51	73	▲
Very low	8	5	▼	23	34	▲
Medium	98	117	▲	74	61	▼
			Drought			
Affected	48	45	▼	41	27	▼
Not affected	12	5	▼	8	8	=
Little affectes	136	66	▼	115	68	▼
			Per capita income			
Less than 1/8 MW	49	63	▲	30	42	▲
Between 1/8 and 1/4 MW	45	30	▼	31	22	▼
Between 1/4 and 1/2 MW	56	39	▼	38	23	▼
Between 1/2 and 1 MW	29	45	▲	38	39	▲
More than 1 MW	17	18	▲	27	44	▼
			Agroecological and sustainable practices			

Low	69	63	▼	31	59	▼
Good	11	25	▲	14	11	▼
Regular	116	107	▼	119	110	▼
			Nutrition and food security			
High	7	3	▼	5	7	▲
Low	127	142	▲	98	126	▼
Very low	26	4	▼	31	10	▲
Medium	36	46	▲	30	27	▲

Note: Δ denotes the variation between 2015 and 2020; MW denotes minimum weight.

Source: Research results.

Table 73 presents data for youth-headed households (aged between 15 and 29 years old in 2015) benefiting or not from PPF, before and after the Project. In general, households showed similar trends between years, with slight distinctions.

Youth-headed households benefiting from PPF more frequently have "medium" degree of participation of women and young household members in community actions[4] both in 2015 and in 2020. Households from the control group, on the other hand, were usually had a "low" participation in 2015, although they had more of an "average" participation in 2020. There was a 30% increase in the number of households with "medium" participation among the treated, whilst controls registered an increase of only 17% over the analyzed period.

As for the associativism indicator, there was a reduction in the number of youth-headed households benefiting from PPF that were in the "very low" category (4%), while there was a 18% increase in this number among controls.

Most of the youth-headed households fall into the "very high" category of the housing indicator in both years for both groups. However, while there was an increase in the number of households from the treatment group in this category (19%), there was a reduction for the control group (10%).

Youth-headed households from the treatment group were more frequent in the category of medium access to public policies: 52% in 2015 and 63% in 2020. For the control group, these percentages were lower in both years: 33% in 2015 and 39% in 2020. It is also noted that

[4] By way of comparison, a means comparison test was carried out separately for the proportion of women and the youth who actively participate in community actions. For the treatment group, the percentage of women increased by approximately 16 pp between 2015 and 2020 and the percentage of young people increased by 4 pp. As for the control group, there was a drop of 3 pp for women and an increase of around 5 pp for the youth.

the incidence of households among the categories of access to agricultural policies follows the same pattern.

Youth-headed households, whether benefiting or not from PPF, appear to have been similarly affected by drought. Most of them were little affected by this adverse event.

In terms of the distribution of households in income classes, the incidence of youth-headed households benefiting from the Project was slightly higher in the class between 1/8 and 1/4 of the minimum wage in 2015. Controls were more present in the income class between 1/4 and 1/2 of the minimum wage in this same year. On the other hand, in 2020, most of the households from the treatment group moved to the income stratum between 1/4 and 1/2 minimum wage. Among controls, however, there was a greater concentration of youth-headed households in the lowest income stratum (less than 1/8 of the minimum wage per capita) between the years.

The distribution of youth-headed households among the categories of the indicator of adoption of agroecological and sustainable practices is similar between the groups.

Finally, in terms of the indicator of nutrition and food security, it is noted that most households, whether treated or not, had "low" food security in both years. The groups also showed similar evolution over the analyzed period.

Table 73. Distribution of youth-headed households for the socioeconomic indicators

Classification	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
	Participation of women and the youth in community actions					
High	18	13	▼	7	4	▼
Low	13	8	▼	32	25	▼
Medium	37	48	▲	23	27	▲
	Associativism					
High	2	1	▼	0	0	=
Low	22	24	▲	11	11	=
Very low	26	25	▼	17	20	▲
Medium	5	5	▲	0	2	▲
Does not participate	2	3	▲	5	0	▼
	Housing					
Low	1	0	▼	0	0	=

Very low	42	50	▲	49	44	▼
Medium	25	19	▼	13	12	▼
			Access to public policies			
High	5	3	▼	5	0	▼
Low	25	18	▼	21	20	▼
Very low	2	4	▲	15	14	▼
Medium	36	44	▲	21	22	▲
			Access to agricultural policies			
High	8	6	▼	1		▼
Low	27	20	▼	22	19	▼
Very low	2	4	▲	17	16	▼
Medium	31	39	▲	22	21	▼
			Drought			
Affected	12	12	0,00	12	5	▼
Not affected	1	0	▼	8	4	▼
Little affected	55	29	▼	42	22	▼
			Per capita income			
Less than 1/8 MW	9	14	▲	15	19	▲
Between 1/8 and 1/4 MW	21	14	▼	12	6	▼
Between 1/4 and 1/2 MW	17	18	▲	16	7	▼
Between 1/2 and 1 MW	14	13	▼	12	10	▼
More than 1 MW	7	10	▲	7	14	▲
			Agroecological and sustainable practices			
Low	17	19	▲	15	23	▲
Good	4	2	▼	7	3	▼
Regular	47	48	▲	40	30	▼
			Nutrition and food security			
High	1	3	▲	0	1	▲
Low	47	44	▼	40	37	▼
Very low	11	5	▼	12	7	▼

Medium	9	17	▲	10	11	▲

Note: Δ denotes the variation between 2015 and 2020; MW denotes minimum weight.

Source: Research results.

4. RESULTS

4.1. Multidimensional Poverty Index

In this section, we show the results of the Multidimensional Poverty Analysis. Specifically, we present the Multidimensional Poverty Index for the entire sample, which was calculated for the whole area covered by the Project and, separately, by planning region. We also verify the contribution of each dimension to the general index. Finally, we compare the MPI calculated for the treated and the controls.

Before starting the analysis, it is necessary to clarify some points. Regarding the weight structure adopted for the different dimensions, it should be noted that equal weights were assumed for all dimensions. This is due to the lack of consensus or satisfactory theoretical justification for applying a particular weight structure.

Regarding the choice of cut-off points, it is noteworthy that the first of them is carried out for each dimension separately. The following cut-offs were defined for the dimensions analyzed: Income (BRL 550.00), Social Capital (3), Human Capital (2), Nutrition and Food Security (1), Housing (2) and Sustainability (2). Such values were chosen based on the statistical analysis of indicators, as well as on the decision criterion of Alkire and Foster (2011), which defines that the cut-off point is defined as the value at which there is great discontinuity in the number of households according to the number of deprivations suffered.

In terms of the dual cutoff point—that is, the point that defines in how many dimensions the household must simultaneously be deprived to be considered as poor—Alkire and Foster (2011) claim that it is interesting to analyze MPI values obtained for different values of k. The decision is made for the point where there is a large drop in relation to the MPI. Therefore, the dual cut-off point chosen was $k = 2$, as can be seen in Table 74.

Table 74. Alkire and Foster's Adjusted Headcount Multidimensional Poverty Index for the entire sample, with k ranging from 1 to 3, 2015 and 2020

k	M_0		
	2015	2020	Var.
1	47%	41%	▼
2	45%	37%	▼

3	36%	27%	▼

Source: Research results.

It is interesting to note that, for all values of k presented in Table 74, the MPI values are lower in 2020 than in 2015. Therefore, it is evidenced a drop in poverty rates during the analyzed period, which went from 45% to 37% for $k = 2$.

MPI can contribute to the planning of policies aimed at combating poverty, as it can be broken down to reveal the incidence of poverty in different population groups. In this analysis, the decomposition was performed by planning regions, as can be seen in Table 75. It is important to note that, for all planning regions, multidimensional poverty rates are lower in 2020 than in 2015. The regions of Litoral Oeste/Vale do Curu, Serra da Ibiapaba and Cariri regions have the highest rates of multidimensional poverty, with the Litoral Oeste/Vale do Curu region standing out. The regions of Sertão de Sobral, Sertão dos Crateús and Sertão dos Inhamuns had the lowest rates, with emphasis on the latter.

Table 75. Multidimensional Poverty Index for the whole sample, by planning regions, with $k = 2$, 2015 and 2020

Region	M_0		
	2015	2020	Var.
Litoral Oeste/Vale do Curu	50%	46%	▼
Serra da Ibiapaba	61%	44%	▼
Sertão de Sobral	44%	37%	▼
Sertão dos Crateús	44%	35%	▼
Sertão dos Inhamuns	40%	27%	▼
Cariri	47%	44%	▼

Source: Research results.

Complementing the previous analyses, we present the results of MPI broken down by dimensions. Table 76 shows the contribution of each dimension in the two years surveyed. First, it can be seen that four dimensions—Income, Nutrition and Food Security, Housing, and Sustainability—showed a drop in their contribution to the MPI. This result indicates that these dimensions lost relevance in multidimensional poverty, which can be a good indication of improvements in living conditions due to PPF actions, since these dimensions contribute less

to the poverty rate. On the other hand, the dimensions of Social Capital and Human Capital showed an increase in their contribution to multidimensional poverty, which may indicate a worsening in the conditions of these dimensions.

Also according to Table 76, it is noted that deprivations in Income, Social Capital, and Human Capital are the ones that most contribute to the MPI in 2020. These results illustrate how the decomposition of the index can help to identify priorities and direct actions to reduce poverty through the identification of the most urgent needs of the population. Therefore, public policy interventions should be aimed at ensuring improvements in these dimensions, which could lead to a lower level of poverty. Greater investment in quality education, for example, may have an impact on the reduction of the incidence of poverty, bringing good future results as greater schooling leads to better opportunities for income generation.

Table 76: Relative contribution of each dimension to the Multidimensional Poverty Index for the whole sample, with $k = 2$, 2015 and 2020

Dimensions	M_0		
	2015	2020	Var.
Income	25.17%	23.65%	▼
Social Capital	9.50%	19.15%	▲
Human Capital	26.38%	28.96%	▲
Nutrition and Food Security	16.13%	13.22%	▼
Housing	13.04%	9.89%	▼
Sustainability	9.80%	5.13%	▼

Source: Research results.

In Table 77, very important results are found. It is noticed that the poverty rate dropped in both groups from 2015 to 2020. However, this drop was much more expressive in the treatment group (from 44% to 34%). This is a good result and may indicate that the actions of the Paulo Freire Project in the State of Ceará have been positive in reducing multidimensional poverty.

Table 77. Alkire and Foster's Adjusted Headcount Multidimensional Poverty Index for the treatment and control groups, with k=2, 2015 and 2020

M_0

Treatment			Control		
2015	2020	Var.	2015	2020	Var.
44%	34%	▼	45%	42%	▼

Source: Research results.

Therefore, more and more comparative studies must be carried out, in order not only to incorporate new available indicators and to extend the temporal analysis, but also in an attempt to capture the changes that occur in certain groups of the population over time.

4.2. Impact evaluation

4.2.1. A descriptive outlook based on balancing variables

Table 78 shows data referring to the average values of some of the main variables of interest—the same ones used for the entropy balancing—for the control and treatment groups, before and after the Project.

In 2015, only 1.5% of the households benefiting from the Project were located in agrarian reform settlements. For the control group, in turn, this percentage was 5.31%. In 2021, there was no significant change in the percentage of households from settlements in the treatment group, although there was a relative increase in the control group, reaching 7.5% of households.

Table 78. Average value of variables used in the entropy balancing, 2015 and 2020

Variable	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Settlements	0.0152	0.0152	=	0.0531	0.0752	▲
Quilombola community	0.1818	0.1856	▲	0.1195	0.1239	▲
Rural community	0.9583	0.8295	▼	0.9646	0.8186	▼
Bolsa Família Program	0.8106	0.3561	▼	0.7168	0.2566	▼
Refrigerator	0.9356	0.9848	▲	0.9248	0.9734	▲
Stove	0.9280	0.9848	▲	0.9513	0.9823	▲
Motorcycle	0.6326	0.7045	▲	0.5619	0.5929	▲
Household density	2.0917	1.8417	▼	2.0067	1.5844	▼

Gender of household head	0.2576	0.2614	▲	0.2743	0.2478	▼
Number of children	1.92803	1.5758	▼	1.5575	1.1504	▼
Effects of drought periods	0.0606	0.4053	▲	0.0708	0.4071	▲
Level of education	5.6250	5.2008	▼	4.6062	4.1770	▼

Source: Research results.

The variable “gender” indicates women-headed households.

For the treatment group, the relative presence of quilombola communities also remained approximately constant: both before and after PPF, quilombola households accounted for 18% of those benefiting from the Project. In the control group, quilombola communities were less present in both periods: 11% in 2015 and 12% in 2020. Therefore, PPF may have been successful in its strategy of targeting quilombola communities.

For the treatment group, 95% of households were located in rural communities in 2015, while this figure decreased to 82% in 2020. A similar reduction was identified for the control group either, as the percentage of households from rural communities decreased from 96% to 81%.

As for the participation of households in the Bolsa Família Program, there was a reduction for both groups. This participation, however, was higher among those benefitig from PPF in both periods, an initial evidence of the Project's proper targeting of poor households. In 2015, about 81% of PPF households also participated in the Bolsa Família Program. In 2020, this percentage dropped significantly, reaching 35%. In the control group, 71% of the households were beneficiaries of the Bolsa Família Program in 2015, while this share decreased in 46 percentage points in 2021.

Regarding the ownership of household assets, it is noted that the refrigerator is an item owned by practically all households surveyed. In the treatment group, there was an increase of almost 5 percentage points between 2015 and 2020 (from about 93% to 98%). Among controls, there was a similar increase in the proportion of households with at least one refrigerator: from 92% to 97%.

The stove is also present in more than 90% of households in both years, for both groups. Among those benefiting from the Project, it appears that in 2015, 92% of households had this appliance. In 2020, this percentage rose by more than 5 percentage points, to more than 98% of households. Although in 2020, the control group also showed the presence of a stove in about 98% of households, it is interesting to note that the increase in the presence of this item was lower in this group (which grew by about 3 percentage points, from 95% in 2015).

Another household asset that is important to highlight is the presence of motorcycles. It was present in about 63% of households benefiting from PPF in 2015 and in more than 70% of them in 2020. In the control group, these percentages were lower in both periods: 56% in 2015 and 59% in 2020.

An initial indication of well-being refers to household density. Thus, it appears that there were about 2 people per room in households from the treatment group in 2015. This density was slightly lower in 2020: 1.84. A similar trend is observed in the control group: from 2 people per room in 2015 to 1.5 in 2020.

Before the Project, 25% of benefiting households were headed by women ("gender" in the Table). Among controls, this percentage was 27%. After PPF, there was a slight increase in the percentage of women-headed households in the treatment group, reaching 26%. Women-headed households became less frequent among controls. This may be an indication of PPF focus on raising and guaranteeing the participation of women-headed households throughout its operation.

The households participating in PPF have, on average, a higher number of children in both years: there are almost 2 children per household in 2015 and 1.5 in 2020. In the control group, there are 1.5 children per household in 2015 and 1.1 in 2020.

In 2015, only about 6% of households benefiting from PPF declared that they had not been affected by drought in the last 5 years. This percentage rose dramatically in 2020, reaching 40.5%. In the control group, a similar increase occurred, going from 7% to 40%. In 2020, there seems to be no significant difference in the perception of the effect of drought between the treated and controls.

As for the average level of education, it seems that those benefiting from PPF have more school years, both before and after the Project: 5.6 years in 2015 and 5.2 in 2020. In the control group, the mean was 4.6 years in 2015 and 4.1 in 2020. An intriguing aspect refers to the reduction in average level of education in both groups over the analyzed period.

In addition to the variables mentioned above, it is also important to check the ones related to the agricultural sector, which is so important for households benefiting from PPF. Table 79 shows the average value of the sales of agricultural products, taking into account farmers in the treatment and control groups before (2015) and after the implementation of the PPF (2020). In addition, we also show the variation between the periods in order to verify possible percentage changes in average prices between the years and groups considered.

Table 79. Average value of the sales of agricultural products

Item	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Plant production (A)	428.73	821.09	▲	657.70	794.92	▲
Products of plant origin (B)	75.31	573.66	▲	131.96	15.01	▼
Agriculture (C = A + B)	540.27	1,487.68	▲	789.66	809.94	▲
Animal production (D)	1,910.68	1,728.34	▼	758.30	1,201.73	▲
Products of animal origin (E)	414.82	825.29	▲	233.37	390.64	▲
Livestock (F = D + E)	2,276.40	2,486.14	▲	991.67	1,592.37	▲
Agriculture and Livestock (G = C + F)	2,427.38	3,553.40	▲	1,781.33	2,402.30	▲

Note: Δ denotes the variation between 2015 and 2020.

Source: Research results.

Considering the agricultural sector in general, which brings together livestock and agriculture, it appears that the average sale values grew both for the control and treatment groups, with the most striking increase for the treated (46%).

Disaggregating the agricultural sector into livestock and agriculture activities, it is possible to conclude that for both groups the average value of sales rose between 2015 and 2020. In this case, it should be noted that the magnitude of this increase was differentiated between activities as well as between the treatment and control groups.

In the case of agriculture, the difference was extremely high. The value of sales grew by 175% for the treatment group and only 3% for the control group after PPF implementation. Disaggregating agriculture in plant production and products of plant origin, the differences are significant. In the case of plant production, the average value of sales grew by 92% for the treatment group and 21% for the control group. Considering the products of plant origin, in addition to the high discrepancy in terms of magnitude, the sign of the variation in average value of sales between the groups was also different. In fact, the treatment group showed a growth of 662%, while the control group saw a decline of 89%.

Considering the variation in the average value of the sales of livestock products between the years analyzed, a very different magnitude can also be observed between the treatment and control groups, but this time with the advantage of the latter. Thus, for the treated and controls, the average value of the sales of livestock products grew by 9% and 61% between 2015 and 2020, respectively.

Disaggregating the livestock sector between animal production and products of animal origin, important differences are also observed. In the case of animal production, the average value of sales for the treated decreased by 10%, while increasing by 58% for controls. On the other hand, considering the products of animal origin, the average value of sales rose 99% for the treatment group and 67% for the control group. Such a result may indicate that households benefiting from the Project are focusing more on the sale of products of animal origin than on the direct sale of animals. Thus, animals would be taken more as productive inputs than as production itself.

To better specify the behavior of livestock products, Table 80 specifies the average value of sales and the quantity produced. The results are complementary to those presented in the previous table. It is worth noting, however, that if Table 79 considers average values for all households surveyed, Table 80 shows the average value per product considering only the households that actually produced each of these products. For this reason, the average aggregate sale of animals has decreased, although the average sale of each of the products considered individually has increased.

For poultry, both the quantity and the average value of the sales increased after the implementation of PPF for both the treated and controls, with the former group presenting the highest variation. The average amount of birds increased by 117% for the treatment group and only 1% for the control group. As for the average value of sales, the difference in terms of variation was smaller between the groups. The mean value increased by 41% for the treated and 36% for controls.

Table 80. Average quantity and value of sales of livestock products, 2015 and 2020

Item	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
			Poultry			
Quantity	20.41	44.35	▲	29.55	29.85	▲
Value of sales	236.48	332.49	▲	211.65	288.18	▲
			Eggs			
Quantity	364.53	97.22	▼	826.10	82.00	▼
Value of sales	92.69	201.58	▲	182.77	119.34	▼
			Sheep			
Quantity	6.96	13.08	▲	13.15	21.38	▲

Value of sales	248.41	418.17	▲	672.11	908.67	▲
			Goats			
Quantity	8.34	10.34	▲	18.47	18.69	▲
Value of sales	442.59	578.95	▲	1,096.35	642.45	▼
			Pigs			
Quantity	3.69	8.85	▲	6.37	5.78	▼
Value of sales	875.81	1,845.39	▲	279.48	465.83	▲
			Honey			
Quantity	13.67	123.80	▲	30.00	193.93	▲
Value of sales	183.57	1,203.73	▲	0.00	1,763.39	▲

Note: Δ denotes the variation between 2015 and 2020.

Source: Research results.

For egg production, positive variation was identified only for the average value of sales of the treatment group, which grew by 117% between 2015 and 2020. On the other hand, a decrease of 35% was observed for the control group. In the case of average quantity, a decrease was recorded for both groups, with the drop being more prominent for controls (-90%) than for treated (-73%).

For sheep, both the average quantity and the average value of sales grew after the implementation of PPF, with a higher magnitude for the treatment group. Comparing the two groups, the difference was more significant for the average value of sales, where the increase for the treated was of 68% compared to 35% for the controls. Regarding the average quantity, the increase was of 88% for the treatment group and of 63% for the control group.

With regard to goats, the discrepancies were again important between the groups in the analyzed period. For the average quantity, the variation was positive in 24% for the treated and in 1% for the untreated. In the case of average value of sales, differences were also observed in the direction of variation. In the case of the treated, the average value of sales grew by 31%, while a decrease of 41% was registered for controls.

With regard to swine, the average quantity increased by 140% for the treated after the implementation of the Project, decreasing by 9% for controls. As for the value of sales, the increase was more substantial for the treatment group (111%) than for the control group (67%).

Finally, with regard to honey production, the average quantity of honey increased considerably for both groups, with an advantage for the treated, which showed an increase of around 806% against the 546% growth recorded for controls.

4.2.2. Entropy balancing

In order to validate the use of the entropy balancing method, Table 81 shows the test of means before and after balancing the control group (with data prior to the PPF, in 2015).

In the two columns referring to the control group, in addition to variables means, we also present the results of the mean comparison test between treated and controls, before and after the balancing. It is noted that before balancing, the groups are statistically different in terms of the following variables: percentage of households in settlements and in quilombola communities, percentage of households benefiting from the Bolsa Família Program, number of children per household and average education level of the head of the household.

All these differences disappear in the balanced sample. The second columns of each group show the means after balancing for each variable. It is verified that the groups become statistically equal in terms of the means of the variables of interest, an indication of the quality of the balancing performed.

Table 81. Means comparison test for the treatment and control groups, before and after balancing, 2015

Variable	Treatment		Control	
	Before	After	Before	After
Settlements	0.015	0.015	0.053**	0.016^{NS}
Quilombola community	0.182	0.175	0.119*	0.175^{NS}
Rural community	0.958	0.958	0.965^{NS}	0.958^{NS}
Bolsa Família Program	0.811	0.809	0.717**	0.808^{NS}
Refrigerator	0.936	0.938	0.925^{NS}	0.938^{NS}
Stove	0.928	0.927	0.951^{NS}	0.927^{NS}
Motorcycle	0.633	0.637	0.562^{NS}	0.637^{NS}
Household density	2.092	2.09	2.007^{NS}	2.09^{NS}
Gender of household head	0.258	0.251	0.274^{NS}	0.251^{NS}
Number of children	1.928	1.935	1.557***	1.935^{NS}
Effects of drought periods	0.061	0.061	0.071^{NS}	0.061^{NS}
Level of education	5.625	5.610	4.606**	5.614^{NS}

Note: Asterisks indicate the statistical significance of the means comparison test between the treatment and control groups. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. ^{NS} not statistically significant. Variable “gender” indicates women-headed households.

Source: Research results.

4.2.3. Impacts of the Paulo Freire Project

In this section, we present the results found by the impact evaluation methods used. In addition to depicting the general results of the sample, we also highlight disaggregated results. Specifically, possible heterogeneities related to the region where the sampled households are located, as well as the gender and the age of the household head (whether young or not) are considered.

In addition to the socioeconomic indicators described earlier, PPF impact was also evaluated in terms of agricultural production, considering that one of the main lines of action of the Project refers to productive investment plans. Specifically, we evaluated the impacts of PPF on the quantity and value of livestock sales, such as poultry, sheep and goats, among others.

As will be shown further, no significant positive impact was identified for some variables, especially those associated with living conditions. However, the Project generated important results on the group of beneficiaries, as can be seen in the descriptive analysis of the indicators.

In addition, it is important to highlight that the adverse shocks triggered by the COVID 19 pandemic, which greatly affected the social and economic conditions of the entire population, may have contributed to the estimation of modest or even non-existent results related to PPF, even though some other important positive effects not captured by the variables used may have existed.

4.2.3.1. Socioeconomic indicators

4.2.3.1.1. Indicator of participation of women and the youth in community actions

Figure 14 depicts the average value of the indicator obtained for the treatment and control groups in 2015 and 2020, in addition to presenting the coefficient estimated by the differences-in-differences model. The intertemporal variation of the treatment group was positive and statistically significant at the 5% level, while the control group showed a negative difference, which is statistically equal to zero. Ultimately, it can be seen that the Project had, in fact, a positive and statistically significant impact on the participation of female and young household members in community actions.

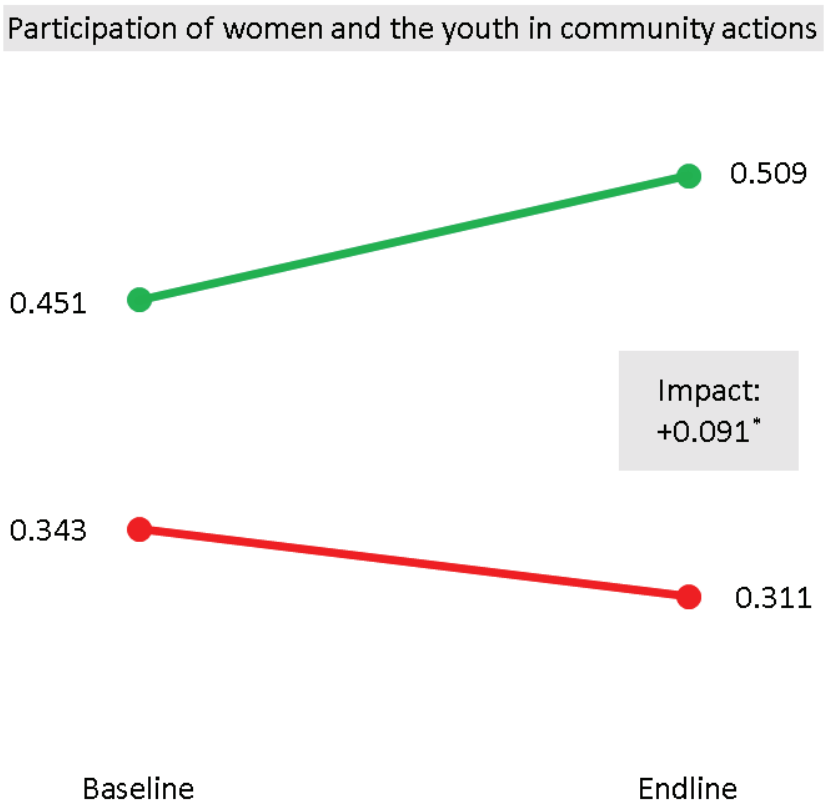


Figure 14. Impact of the Paulo Freire Project on the participation of women and the youth in community actions.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.1.2. Associativism indicator

Figure 15 presents the average value of the index obtained for the treatment and control groups in 2015 and 2020, as well as the estimate of the treatment effect. Although a positive variation was observed for the treatment group, the intertemporal difference was not statistically significant. For the control group, however, the positive variation observed between the years 2015 and 2000 was statistically significant at the 5% level. Although the evolution presented by the indicator was relatively greater for the control group, thus giving rise to a negative difference, the estimate was not statistically significant, demonstrating that the treatment had no effect on this indicator.

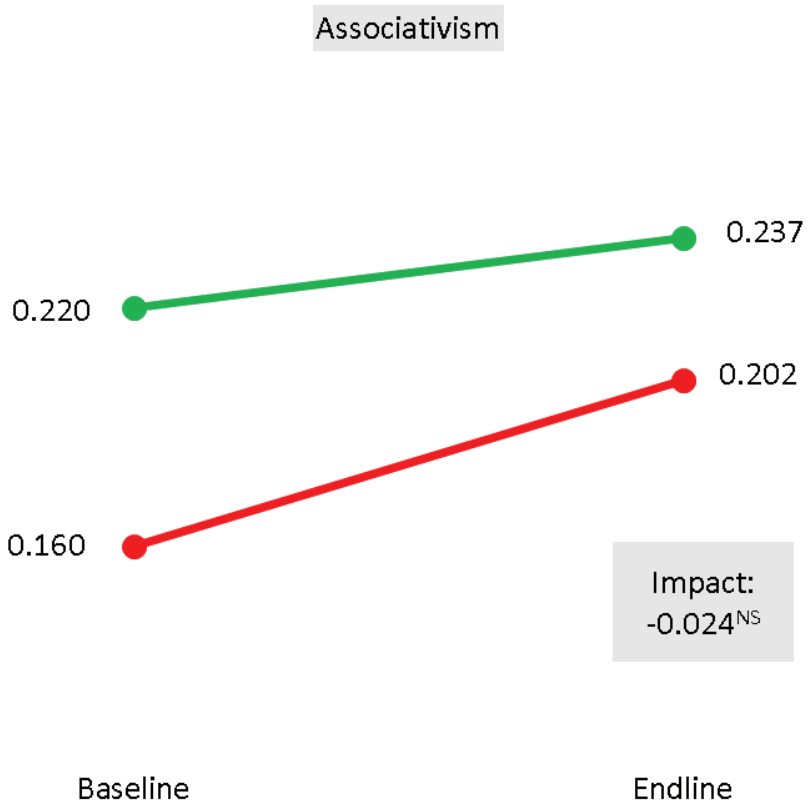


Figure 15. Impact of the Paulo Freire Project on the associativism indicator.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.1.3. Housing indicator

The average value of the indicator calculated for the treatment and control groups in 2015 and 2020 and the estimated impact of the Paulo Freire Project are shown in Figure 16. The average value of the two groups showed a positive variation between the years of analysis, although these differences have been statistically equal to zero. Ultimately, the difference between these differences, which is nothing more than the result of the model of difference-in-differences, was also statistically equal to zero, indicating that there was no effect of the Project on this indicator.

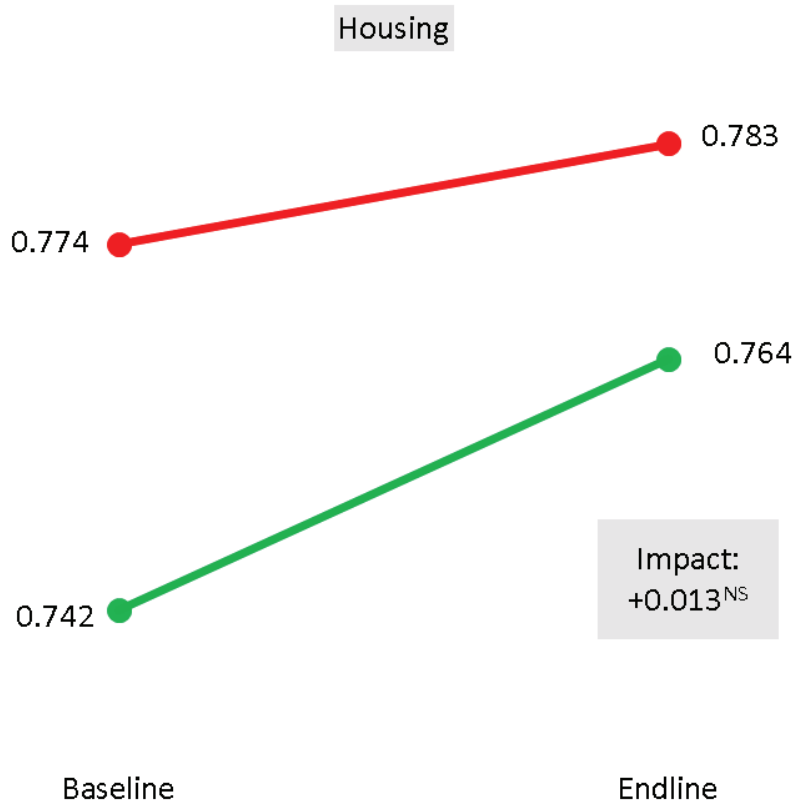


Figure 16. Impact of the Paulo Freire Project on the housing indicator.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.1.4. Indicator of access to public policies

Figure 17 depicts the average value of the indicator obtained for the treatment and control groups in 2015 and 2020, in addition to presenting the coefficient estimated by the difference-in-differences model. There was, for both groups, a decrease in the mean value between the years investigated, although the intertemporal variation was comparatively smaller for the treatment group than for the control group. In both cases, the difference between the years was statistically significant. In addition, a positive and statistically significant effect (at the 10% level) was estimated for the treatment, indicating that the Paulo Freire Project had a satisfactory influence on access to public policies.

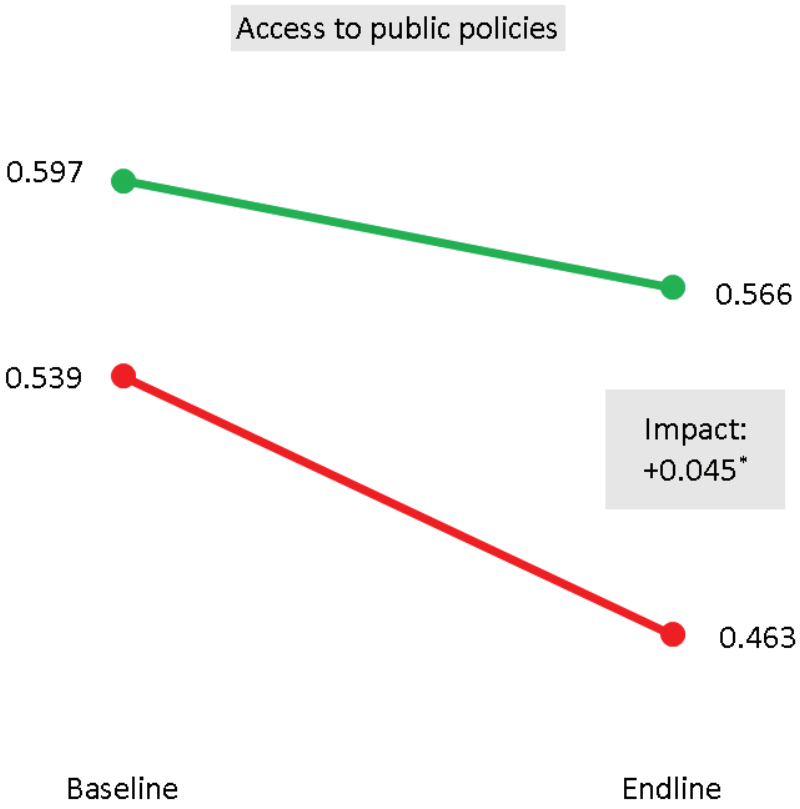


Figure 17. Impact of the Paulo Freire Project on the indicator of access to public policies.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.1.5. Indicator of access to agricultural policies

Figure 18 presents the average value of the indicator for the treatment and control groups in 2015 and 2020, as well as the estimate of the treatment effect. Negative intertemporal variation was observed for both the treatment and control group. For the latter, however, the (negative) difference observed between the years analyzed was comparatively greater and statistically significant at the 1% level. Although the coefficient estimated by the difference-in-differences model was positive, it was not statistically different from zero, associating a null impact of the Paulo Freire Project on the access to agricultural policies.

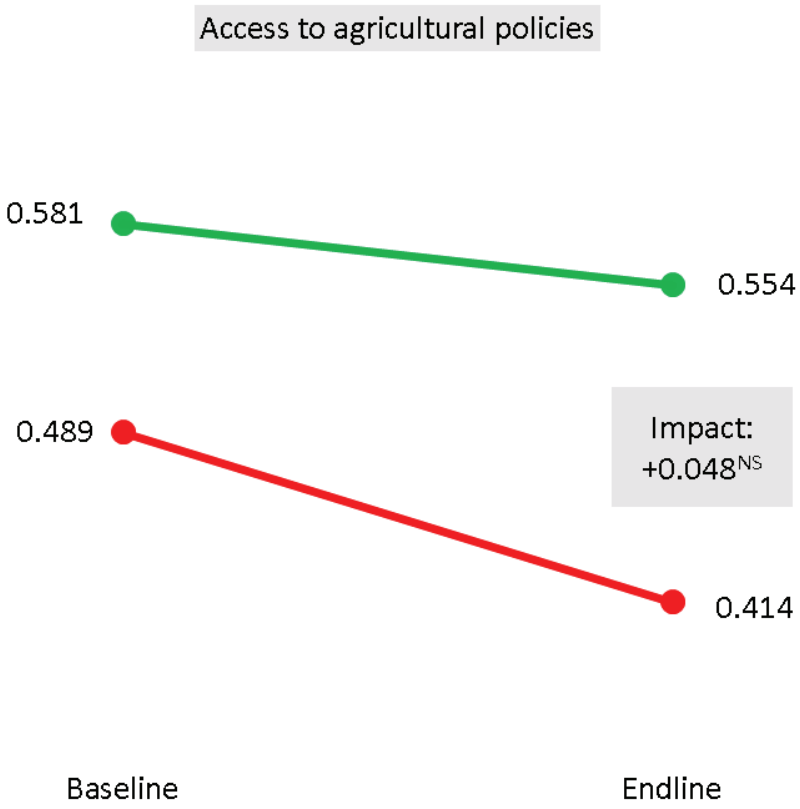


Figure 18. Impact of the Paulo Freire Project on the indicator of access to agricultural policies.
Notes: * Statistically different from zero. NS Statistically equal to zero.
Source: Research results.

4.2.3.1.6. Drought indicator

The average value of the indicator calculated for the treatment and control groups in 2015 and 2020 and the estimated impact of the Paulo Freire Project are shown in Figure 19. As observed for the change in the classification of households, both groups showed a decrease in the value of the indicator of almost identical magnitudes. In both cases, the (negative) variation between the years 2015 and 2020 was statistically significant at the 1% level. As a result, the coefficient estimated by the difference-in-differences model was significantly small and statistically equal to zero, with no direct effect of the Project being identified.

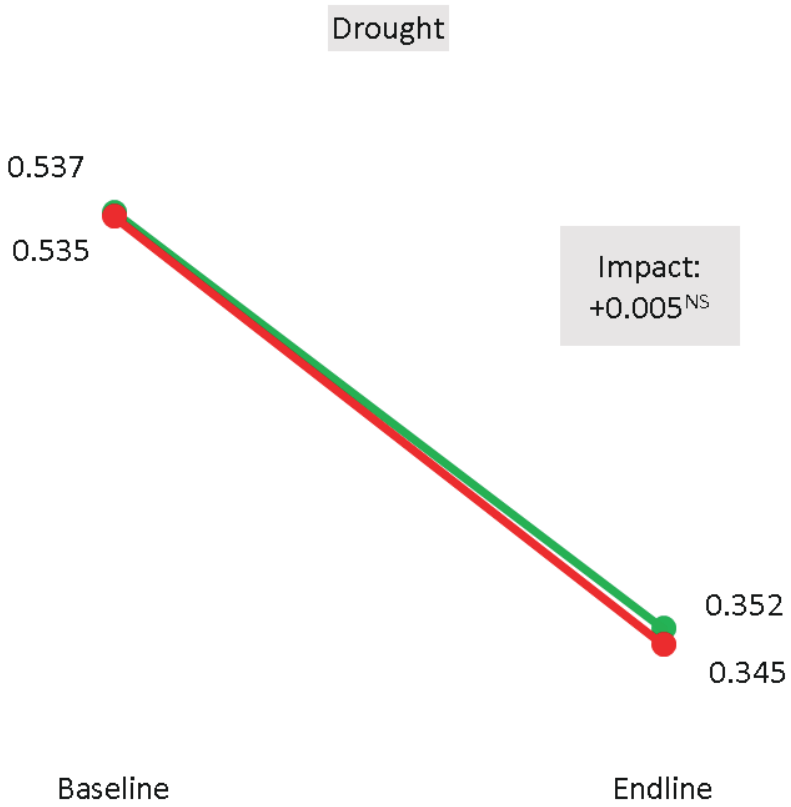


Figure 19. Impact of the Paulo Freire Project on the drought indicator.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.1.7. Poverty indicator

Figure 20 presents the average value of the indicator obtained for the treatment and control groups in 2015 and 2020, as well as the estimate of the treatment effect. Positive intertemporal variation was observed for both groups, although that observed for the control group was comparatively greater than that of the treatment group and also statistically significant at the 1% level. As a result, the coefficient obtained through the difference-in-differences model was negative. This estimate, however, was not statistically different from zero, indicating that there was no direct impact of the Project on monthly per capita income.

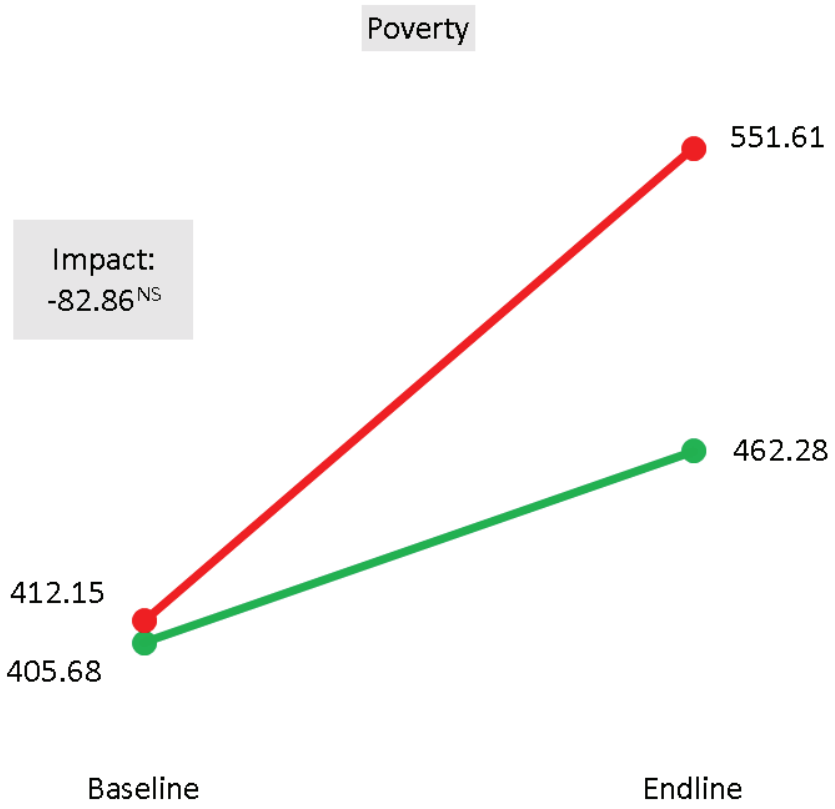


Figure 20. Impact of the Paulo Freire Project on the poverty indicator.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.1.8. Indicator of agroecological and sustainable practices

Figure 21 presents the average value of the indicator obtained for the treatment and control groups in 2015 and 2020, as well as the estimate of the treatment effect. A slight increase was observed for the mean of the treatment group during the analysis period, while a statistically significant decrease was identified for the control group. Ultimately, a positive and statistically significant impact was estimated using the difference-in-differences model. In other words, it is evident that the Paulo Freire Project had a positive influence on the adoption of agroecological and sustainable practices.

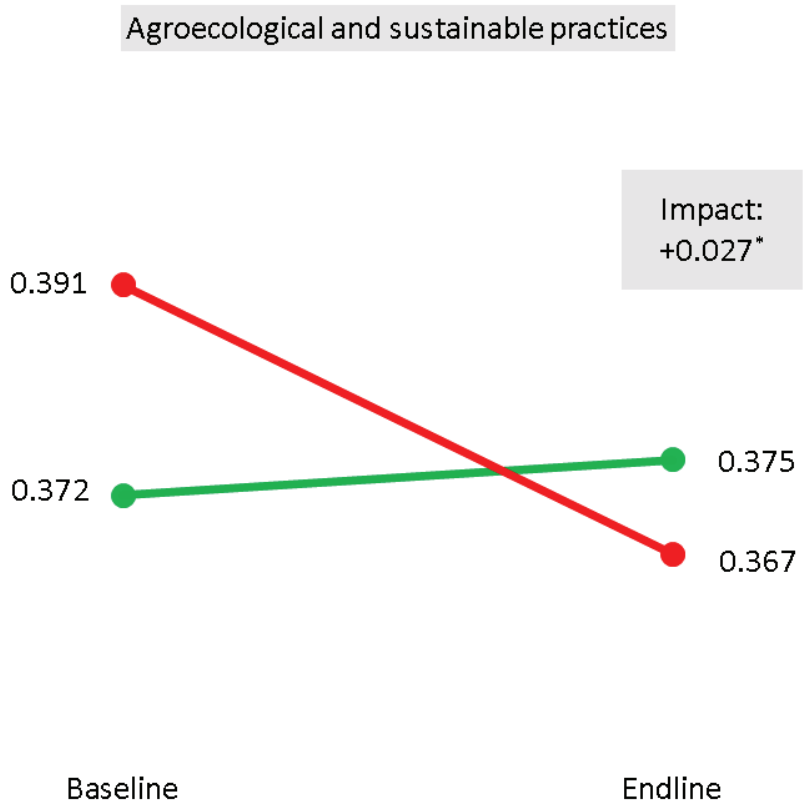


Figure 21. Impact of the Paulo Freire Project on the indicator of agroecological and sustainable practices.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.1.9. Indicator of nutrition and food security

The average value of the indicator calculated for the treatment and control groups in 2015 and 2020 and the estimated impact of the Project are shown in Figure 22. For both groups, there was a positive and statistically significant intertemporal variation in the average of the food security indicator. The variation was slightly greater for the treatment group compared to the control group, which led to the estimation of a positive coefficient by the difference-in-differences model. This estimate, however, was not statistically different from zero, indicating that the Project had no effect on the food security of benefiting households.

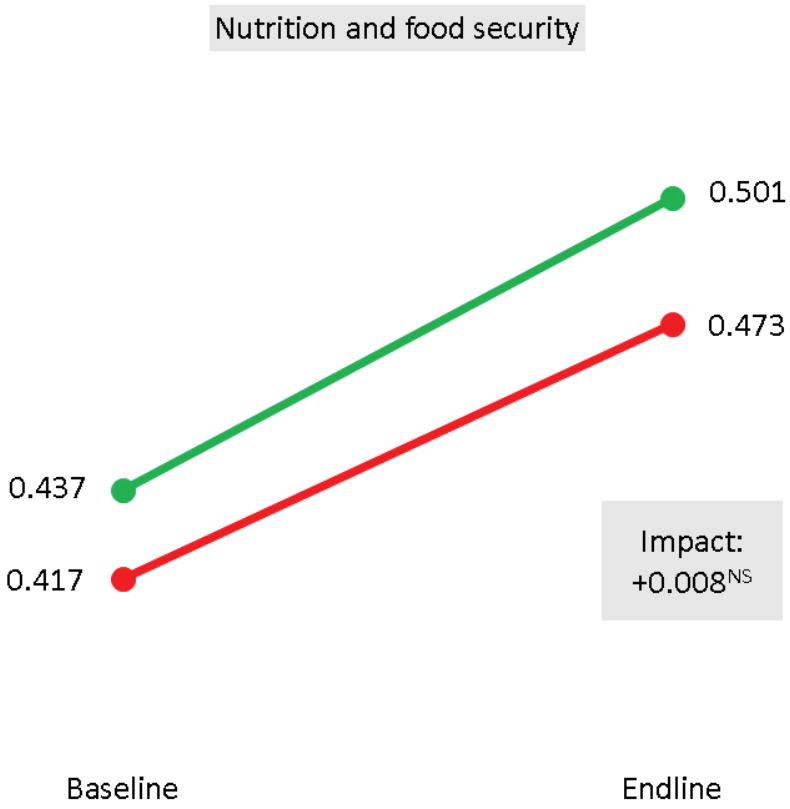


Figure 22. Impact of the Paulo Freire Project on the indicator of nutrition and food security.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.1.10. Regional analysis

Table 82 presents the results of the impact evaluation at the regional level. The six planning regions that have at least a municipality in the studied sample were aggregated in geographic terms in order to facilitate the analysis. Specifically, the region of Sobral is composed of the municipalities of Sertão de Sobral, Serra da Ibiapaba and Litoral Leste/Vale do Curu, while the region of Inhamuns-Crateús is given by the junction of the municipalities of Sertão de Inhamuns and Sertão de Crateus.

Table 82. Impacts of the Paulo Freire Project on selected socioeconomic indicators for the regions of Sobral, Inhamuns-Crateús, and Cariri

Socioeconomic indicator	Region		
	Sobral	Inhamuns-Crateús	Cariri
Participation of women and the youth in community actions	+0.075NS	+0.072NS	+0.102NS

Associativism	-0.040^{NS}	-0.005^{NS}	-0.014^{NS}
Housing	+0.009^{NS}	-0.018^{NS}	+0.045^{NS}
Access to public policies	+0.102*	+0.012^{NS}	+0.026^{NS}
Access to agricultural policies	+0.130*	+0.006^{NS}	+0.027^{NS}
Drought	-0.003^{NS}	-0.020^{NS}	+0.114*
Poverty	-76.51^{NS}	-84.93^{NS}	-53.36^{NS}
Agroecological and sustainable practices	+0.025^{NS}	+0.039^{NS}	+0.014^{NS}
Nutrition and food security	+0.004^{NS}	+0.047^{NS}	+0.001^{NS}

Notes: * Statistically different from zero. ^{NS} Statistically equal to zero.

Source: Research results.

For the region of Sobral, there were positive and significant impacts on the indicators of access to public policies and access to agricultural policies, which possibly indicate that the Project was effective in improving the access of beneficiaries to policies of this nature, through various types of benefits identified, such as pension, social security, Bolsa Família Program, Minha Casa Minha Vida Program, agricultural credit, Pronaf, PAA, PNAE, Guarantia-Safra, crop insurance, SEAF, agrarian reform and land credit, among others, as well as public services, such as the Family Health Program, school and public transport, etc.

With the exception of the two indicators mentioned, there is no positive and statistically significant impacts of the Project on the other indicators analyzed. Although it seems that benefiting households may be positively affected for some indicators, the number of households in each region may not be large enough for the effects to appear in the average values of all indicators.

4.2.3.1.11. Analysis by gender of the head of household

Table 83 presents the results of the impact evaluation of PPF on the socioeconomic indicators of interest according to the gender of the household head. These results indicate the possibility of heterogeneous impacts of the Project between women- and men-headed households.

Table 83. Impacts of the Paulo Freire Project on selected socioeconomic indicators, by gender of household head

Socioeconomic indicator	Household head	
	Woman	Man
Participation of women and the youth in community actions	-0.008^{NS}	+0.123*
Associativism	-0.064^{NS}	-0.010^{NS}

Housing	+0.066^{NS}	-0.005^{NS}
Access to public policies	+0.004^{NS}	+0.059*
Access to agricultural policies	+0.004^{NS}	+0.063*
Drought	-0.022^{NS}	+0.015^{NS}
Poverty	-74.99^{NS}	-84.59^{NS}
Agroecological and sustainable practices	+0.017^{NS}	+0.031*
Nutrition and food security	+0.049^{NS}	-0.005^{NS}

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

Firstly, we highlight the absence of statistically significant impacts on any indicators for households headed by women. Thus, there are indications that, when considering only the women-headed households, there was no statistically different performance between the treatment and control groups.

It should be noted, however, that this result does not necessarily imply the Project's inability to impact women-headed households, but suggests that households benefiting from the Project that are women-headed did not show significant mean changes in terms of the dimensions evaluated in relation to the control group (other dimensions may have changed and some households may indeed have been positively affected, but the amount may not be large enough to influence the mean values)[5].

It should also be noted that women-headed households are, in Brazil, those most vulnerable to poverty. Data from the Population Census show that, in 2010, 37.3% of households were women-headed. The vast majority of these households, 87.4%, were made up of single parent families, that is, with the presence of children and without a spouse (IBGE, 2010).

In terms of income, 32% of women-headed households had a per capita income of up to 1/2 minimum wage in 2010. In the same year, among men-headed households, this percentage was around 28% (IBGE, 2010). More recent data indicate that 18.5% of female household heads received up to 1/4 of the minimum wage in 2015, against 7.1% of male household heads. On the other hand, 6.4% of female household heads had an income above 5 minimum wages, against 12% of male household heads (CAVENAGHI; ALVES, 2018).

[5] The data presented in Table 71 indicate only the average change in the values of the variables for the treatment and control groups, before and after the Project. In this section, however, we present the results of the effective impact evaluation, indicating how much of this change over time in the variables of interest is actually due to participation in the Project and not to other factors.

According to Batista and Costa (2019), the fact that a household is headed by a woman increases its chances of belonging to the poorest 5% of Brazil. For the period between 2011 and 2015, the main factors that increase the vulnerability of these households are the race of the woman (non-whites are more likely to be poor), the fact that they work double shifts, the level of education (less educated are more likely to be poor), age (the younger the household head, more vulnerable it tends to be) and location of the household (those in rural areas tend to be more vulnerable).

Such a scenario of multiple relative disadvantages in several dimensions highlights the complexity and challenge of development projects to effectively impact women-headed households. In addition, PPF actions effectively aimed at women only started in 2018. Considering that the endline survey has 2020 as the base year, it is possible this short time interval did not enable impacts to arise.

As for the results achieved by men-headed households, it is noted that the Project significantly increased the average participation of female and young household members in community actions. Although the active participation of these household members was not affected in women-headed households (perhaps because these households already had a high participation), there was a significant improvement in men-headed households. This may be an indication of a positive effect of the Project on the empowerment of women and the youth in households where this was most needed.

The Project appears to have significantly increased access to public and agricultural policies in men-headed households. Thus, there is an indication that PPF was effective in facilitating the benefiting households to organize and take advantage of important public and agricultural policies (such as pensions, social security, Bolsa Família Program, Minha Casa Minha Vida Program, Luz no Campo Program, Luz para Todos Program, Pronaf, crop insurance, agrarian reform, and access to public services such as public transport, family health program and others).

It is also noted an increase in the perception of the negative effects of drought among men-headed households benefiting from the Project. This result may corroborate the PPF objective of focusing on more vulnerable households and those susceptible to the adverse effects of catatrophic climatic events such as drought. It may also be an indication that the Project has increased the sensitivity of the treated to the adverse effects of drought (making them the ones who most reported having suffered from it). This is plausible, since one of PPF actions consisted of raising awareness and knowledge about coexisting with the semi-arid region.

Finally, the results also indicate that PPF has significantly increased the adoption of agroecological and sustainable practices in men-headed households, an important result that may also reflect the knowledge, extension and encouragement of coexisting with the semi-arid provided by the Project. In fact, as previously highlighted in this report, the Continuous Technical Assistance (CTA) stands out as one of the main lines of action of PPF with the benefiting households.

It should be noted that the fact that men-headed households have been impacted differently from the women-headed ones may also be a result of the greater relative participation of the former among the treatment group, since they make up about 75% of the sample. If women-headed households are a minority, then the identification of average impacts can face methodological challenges related to the representativeness and the sample size itself.

On the other hand, it should be noted that these results may provide important evidence about the reality of the Project. Such information, backed by the scientific rigor used in the PPF impact evaluation, can be used to reaffirm (and reinforce) one of the Project's focal points, thus considering the participation and particularities of women-headed households.

4.2.3.1.12. Analysis by age of the household head

Similar to what is presented in Table 83, Table 84 also carries out an investigation exercise regarding the possibility of heterogeneous impacts of PPF. Now, however, the interest lies in providing evidence that supports (or not) the hypothesis that the impact of the Project on the socioeconomic indicators of interest may vary as a result of the age of the household head, i.e., whether the household is youth-headed (up to 29 years of age) or not.

Table 84. Impacts of the Paulo Freire Project on selected socioeconomic indicators, by age of the household head

Socioeconomic indicator	Household head	
	Youth	Non-youth
Participation of women and the youth in community actions	$+0.184^{NS}$	$+0.075^{NS}$
Associativism	-0.060^{NS}	-0.019^{NS}
Housing	-0.006^{NS}	$+0.018^{NS}$
Access to public policies	$+0.050^{NS}$	+0.046*
Access to agricultural policies	$+0.059^{NS}$	$+0.049^{NS}$
Drought	$+0.079^{NS}$	-0.005^{NS}
Poverty	-199.15^{NS}	-74.55^{NS}
Agroecological and sustainable practices	$+0.026^{NS}$	+0.026*
Nutrition and food security	$+0.040^{NS}$	$+0.005^{NS}$

Notes: * Statistically different from zero. NS Statistically equal to zero.
Source: Research results.

It is noted, at first, that the Project did not affect—in a statistically significant way—any of the indicators evaluated in the youth-headed households (up to 29 years of age in 2015). Thus, it is identified that youth-headed households, regardless of the group to which they belong, seem to have presented a similar evolution between the two periods in terms of the analyzed socioeconomic dimensions.

It is noteworthy, once again, that although this is initial evidence, it is not necessarily the final answer regarding the impacts on these households. Youth-headed households are even less frequent in the sample: around 11% of total households. Thus, even if some of them were indeed impacted by the Project, they may be too few for the average effects to be statistically significant in the estimated models. It is also worth noting that PPF actions specifically aimed at this audience only started in 2018, which may also explain the lack of significant impacts.

On the other hand, it is observed that most of the significant effects of the Project, as already evidenced in this report, occurred among non-youth-headed households, i.e., people over 29 years of age in 2015. These are the households where PPF significantly increased access to public policies, the average perception on the negative effect of drought and the average adoption of agroecological and sustainable practices.

4.2.3.1.13. Analysis by sociocultural identification

Following the example of Tables 83 and 84, Table 85 presents evidence regarding a possible heterogeneity of PPF impacts in relation to the sociocultural identification of the communities in which the sampled families reside. Specifically, the focus of the analysis falls on the quilombola households, because, among the traditional peoples and communities considered, they are the most representative in the studied sample.

Table 85. Impacts of the Paulo Freire Project on selected socioeconomic indicators, quilombola and non-quilombola families

Socioeconomic indicators	Sociocultural identification	
	Quilombola	Non-quilombola
Participation of women and the youth in community actions	+0.149^{NS}	+0.077^{NS}

Associativism	+0.030^{NS}	-0.038^{NS}
Housing	-0.008^{NS}	+0.018^{NS}
Access to public policies	+0.005^{NS}	+0.053*
Access to agricultural policies	+0.037^{NS}	+0.050^{NS}
Drought	+0.199*	-0.037^{NS}
Poverty	+22.33^{NS}	-105.87*
Agroecological and sustainable practices	-0.008^{NS}	+0.035*
Nutrition and food security	-0.020^{NS}	+0.014^{NS}

Notes: * Statistically different from zero. ^{NS} Statistically equal to zero.

Source: Research results.

An analysis of Table 85 shows the existence of a marked difference between the quilombola and non-quilombola subsamples in terms of the results of the difference-in-differences model. For quilombola households in particular, the Project does not seem to have a satisfactory impact on any of the considered indicators. Statistically significant coefficient was estimated only for the drought index. As a higher value of this indicator indicates a greater (adverse) effect of drought, quilombola households benefiting from the Project became more vulnerable to this climatic phenomenon between 2015 and 2020.

For the non-quilombola subsample, on the other hand, three statistically significant estimates were obtained. Both access to public policies and the use of agroecological and sustainable practices had a positive impact on non-quilombolas benefiting from PPF. Regarding the poverty indicator, it is possible to identify the existence of a negative impact among beneficiaries, which exceeded the per capita value of BRL 100.00.

4.2.3.2. Livestock indicators[6]

To estimate the impact of the Project on agricultural activities, only those individuals who benefited from investment projects aimed at each activity evaluated were considered. The results obtained by benefiting farmers were then compared with the results presented by the farmers who carry out the same activities. Specifically, the treatment effect was calculated in terms of the quantity produced (number of heads of poultry, sheep, goats and swine; dozens of eggs; and kilograms of honey) and the annual value of sales (expressed in Brazilian reais in values of December 2020) of the analyzed products.

[6]The variables for which the impacts presented in this section were evaluated were also considered to investigate the possibility of differential effects in women-headed households. In view of the absence of significant impacts of the Project in all specifications for women-headed households, the results were not presented in this report.

4.2.3.2.1. Poultry

Figure 23 shows the intertemporal variation in poultry quantity, also presenting the treatment effect. The difference in the average number of birds in the control group was practically null, having remained close to the level of 30 heads per rural property. On the other hand, a significant increase was identified for the treatment group, with the average poultry quantity going from 20 in 2015 to more than 44 in 2020. Based on this increase, the difference-in-differences model estimated a positive and statistically significant impact. The Project led to an average increase of more than 20 birds per benefiting farmer.

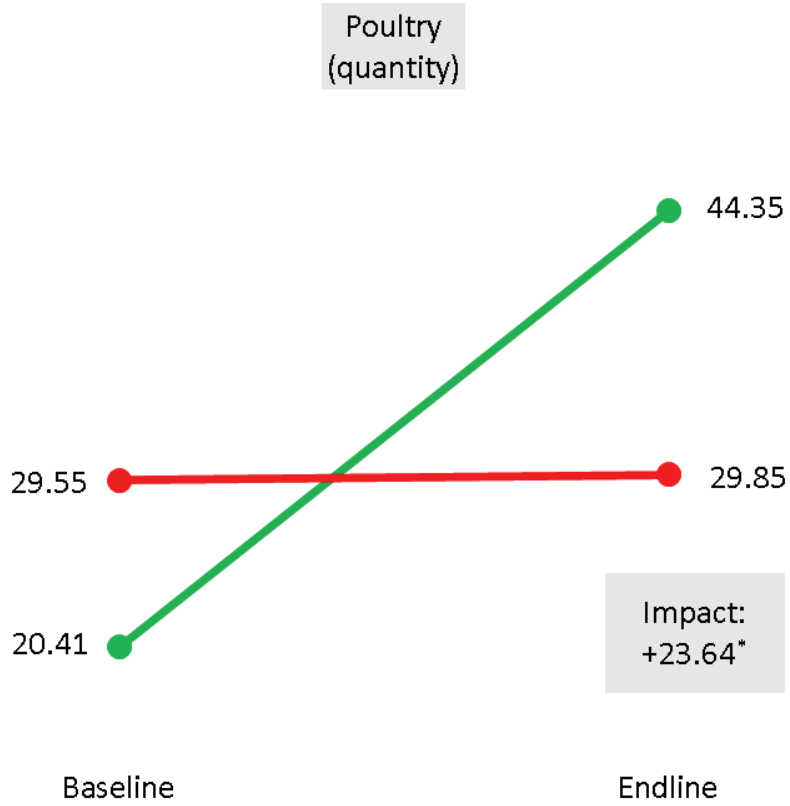


Figure 23. Impact of the Paulo Freire Project on poultry quantity.
Notes: * Statistically different from zero. NS Statistically equal to zero.
Source: Research results.

In the wake of the increase in the poultry quantity, the value of sales also showed a positive temporal evolution for the treatment group, with an average increase of more than BRL 95.00 (Figure 24). Despite the insignificant increase in quantity, the average value of poultry sales for the control group also showed a positive variation between 2015 and 2020,

with an increase of more than BRL 75.00. PPF impact on the value of poultry sales, although positive, cannot be differentiated from zero in statistical terms.

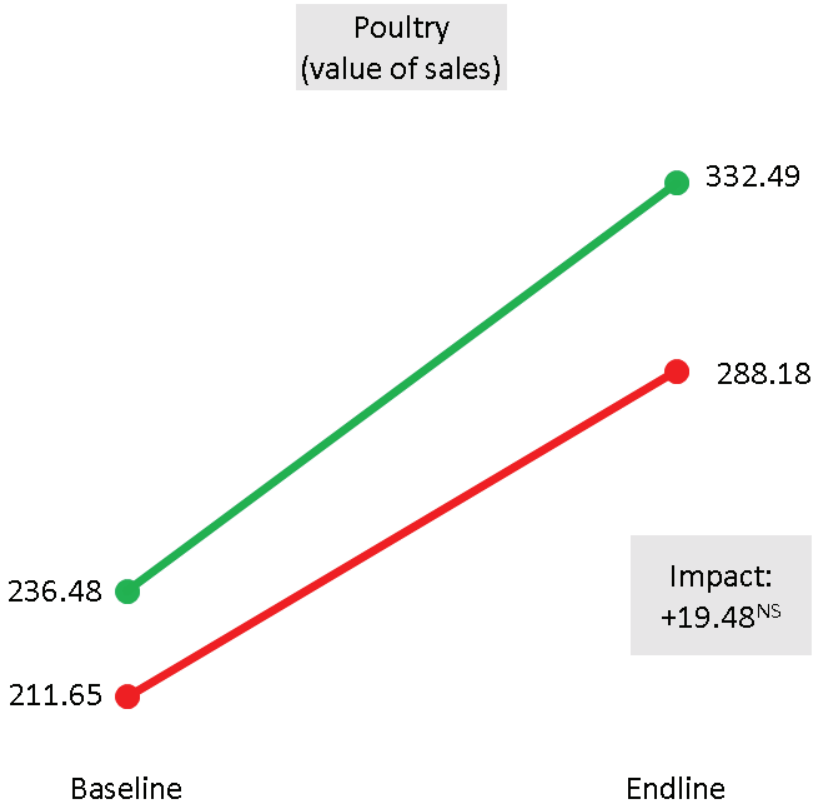


Figure 24. Impact of the Paulo Freire Project on the value of poultry sales.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.2.2. Eggs

As shown in Figure 25, the average amount of eggs produced by poultry farmers significantly decreased for the control group, while an expressive increase was registered for the treatment group. Such results may be an indication that PPF positively impacted the production of eggs of benefiting poultry farmers. In fact, a positive and statistically significant impact of the Project on the quantity of eggs was evidenced. In 2015, the average quantity produced by the control group was nearly double that produced by the treatment group. With the Project, benefiting farmers were able to circumvent the downward trend in egg production observed for the controls.

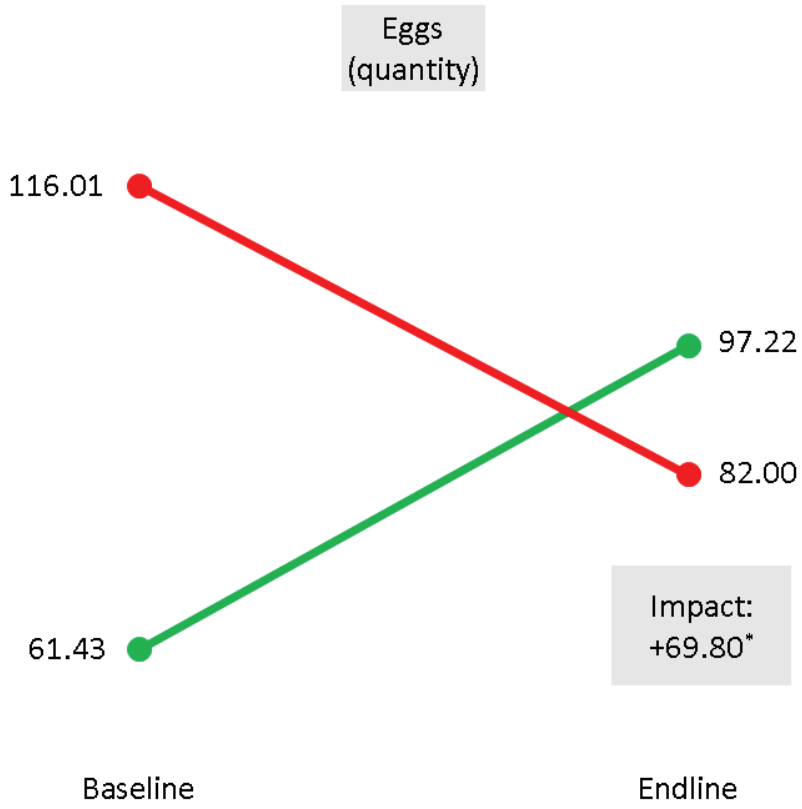


Figure 25. Impact of the Paulo Freire Project on the number of eggs.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

A similar scenario was identified for both groups in terms of the value of egg sales as a decrease (increase) was registered for the control (treatment) group. The average of controls decreased by approximately 35%, whilst the treated showed an increase of 117% in the value of sales. Therefore, the coefficient estimated by the difference-in-differences model indicates that PPF had an impact of more than BRL 170.00 on value of egg sales for the benefiting farmers.

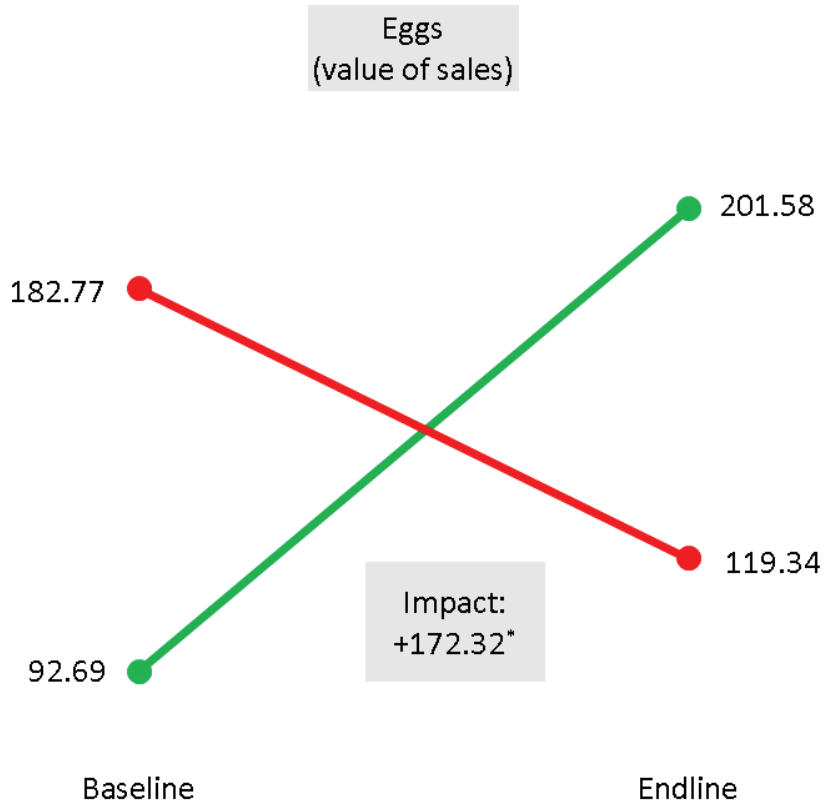


Figure 26. Impact of the Paulo Freire Project on the value of egg sales.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.2.3. Sheep

Whichever year is considered, the average size of the sheep herd is larger for the control group than for the treatment group. In any case, a similar variation was experienced by both groups, with the intertemporal difference in the number of sheep being positive for the treatment and control groups. Ultimately, the difference between these differences, that is, the coefficient estimated by the econometric model, was quite small, not being statistically different from zero. This is an indication that the Project had no impact on the average size of the sheep herd.

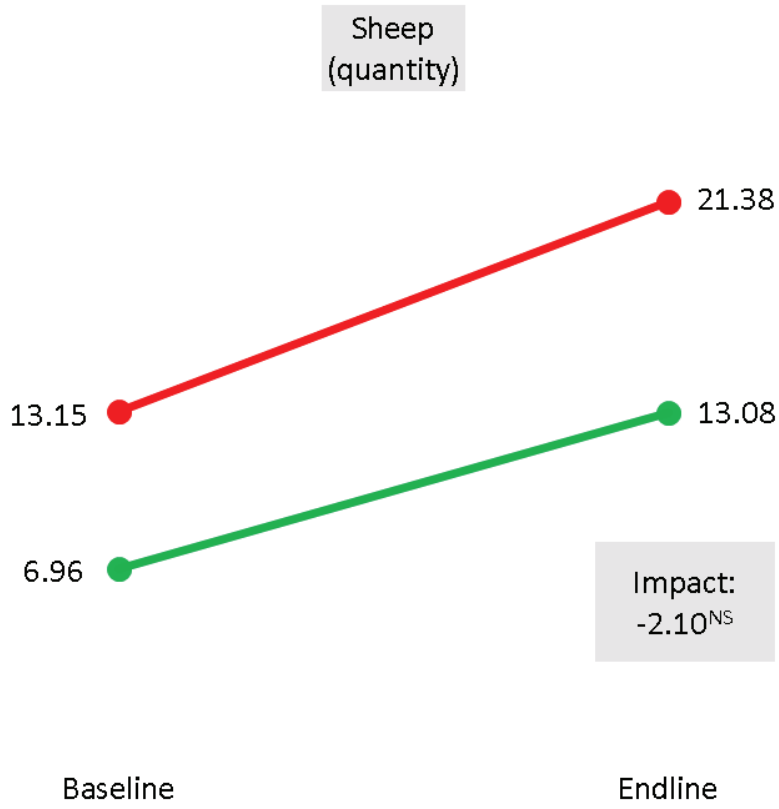


Figure 27. Impact of the Paulo Freire Project on the number of sheep.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

Similarly, the average value of sheep sales also evolved positively for both groups. The evolution between 2015 and 2020 was 68% for the treatment group and 35% for the control group. The coefficient estimated by the difference-in-differences model was negative, considering that the magnitude of the expansion of the mean value of the control group – in absolute terms – was greater than that observed for the treatment group. However, the estimate of the double difference was not statistically significant, indicating that the Project had no impact on the value of sheep sales.

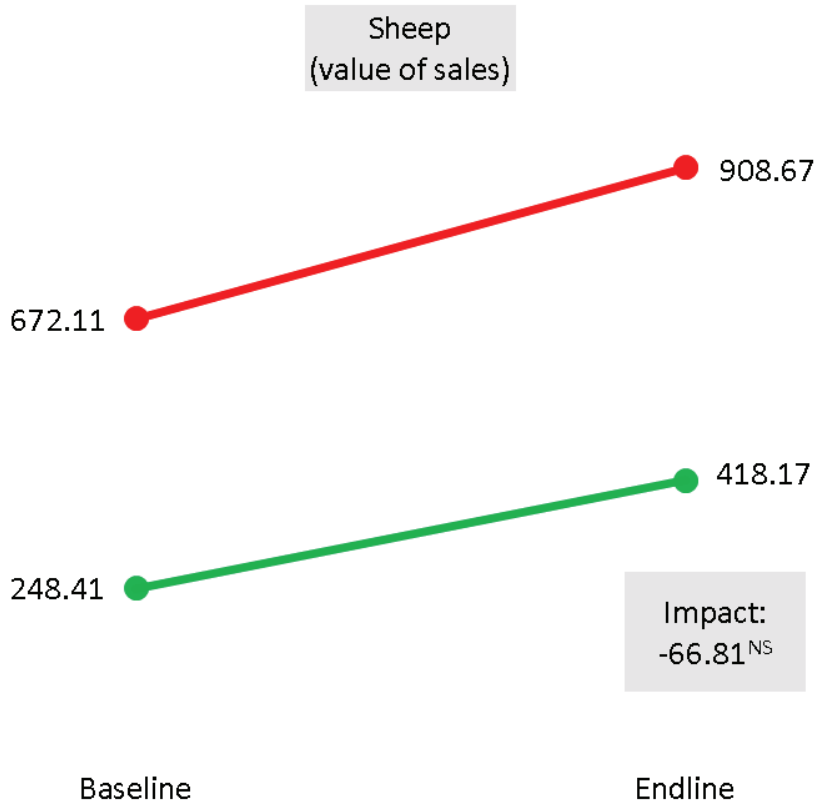


Figure 28. Impact of the Paulo Freire Project on the value of sheep sales.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.2.4. Goats

Although the average size of the goat herd is larger for the control group than for the treatment group, a greater expansion observed for the farmers benefiting from the Project. There was an increase of two heads in the average amount of the treated, which translates into a 24% increase in the herd size. On the other hand, an increase of just over 1% was identified for the control group. In the case of the number of goats, the coefficient estimated by the econometric model was statistically equal to zero, with no impact of the Project being identified.

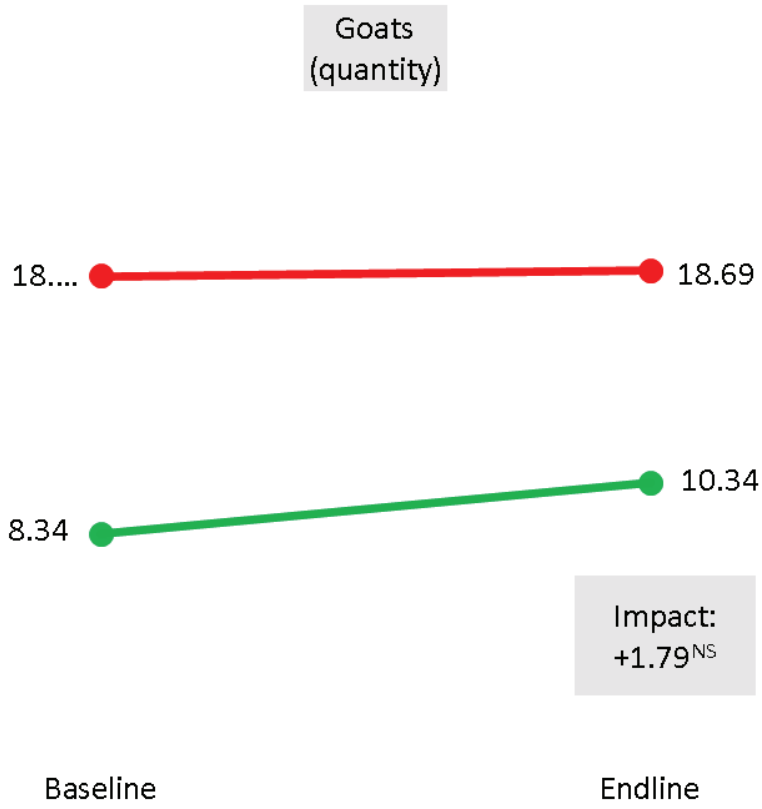


Figure 29. Impact of the Paulo Freire Project on the number of goats.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

Regarding the value of goat sales, the estimate calculated by the difference-in-differences model was not statistically different from zero. In other words, there was also no impact of the Project on the value of goat sales. Still, there was an average increase of approximately 31% for the treatment group, whereas the control group experienced a decrease of more than 40% in the average value of goat sales between 2015 and 2020.

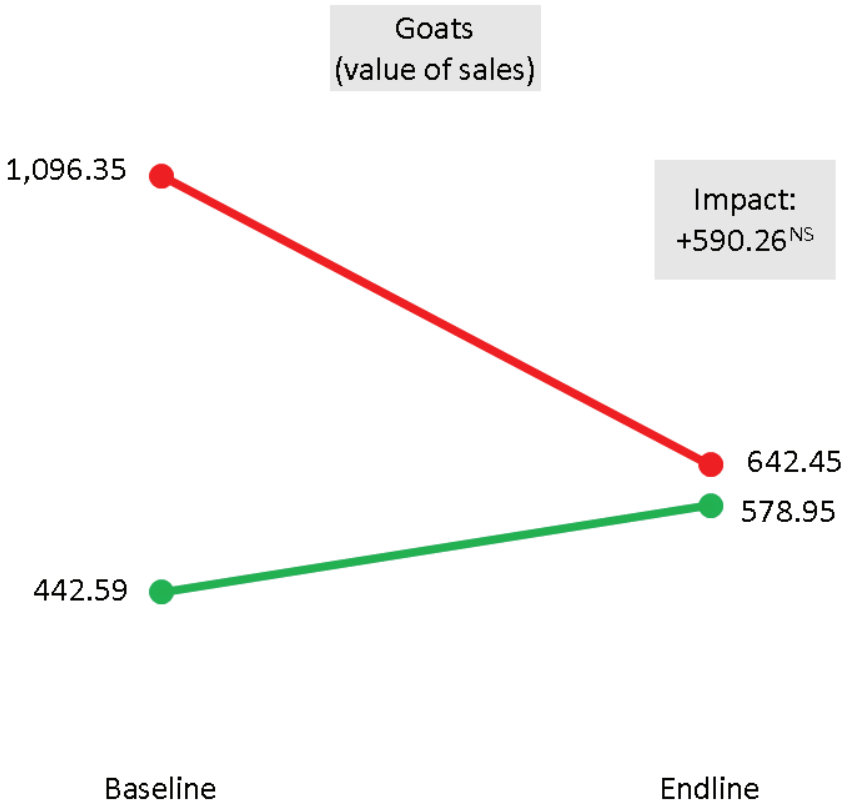


Figure 30. Impact of the Paulo Freire Project on the value of goat sales.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.2.5. Swine

The average size of the swine herd evolved significantly for the treatment group between 2015 and 2020, while a decrease was observed for the control group. In fact, the increase recorded for the treatment group was of approximately 140%, while the decrease identified for the control group was of around 9%. Therefore, the estimated coefficient for the double difference was positive and statistically significant at the 10% probability level. It is evident, therefore, that the Project had, on average, a positive impact of approximately five heads of swine for its beneficiaries.

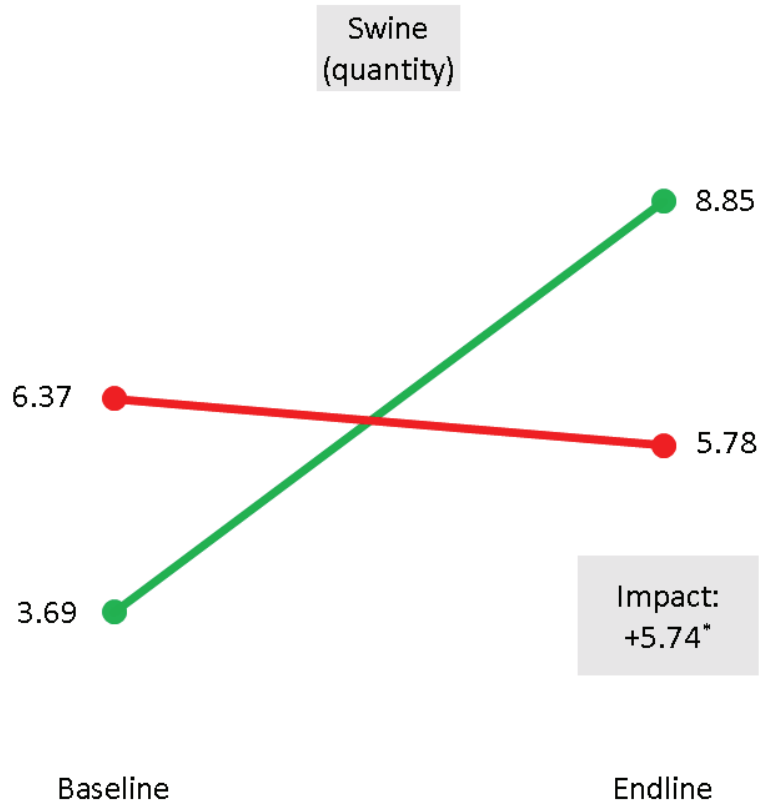


Figure 31. Impact of the Paulo Freire Project on the number of pigs.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

The magnitude of the expansion in the average value of swine sales stands out, both for the control group and, mainly, for the treatment group. Similarly, although the estimated coefficient for the double difference is relatively large, a positive impact was not observed on the investigated variable. Still, it is observed that the average value of sales for the treatment group more than doubled, while the control group experienced a growth of approximately 67% from 2015 to 2020.

Figure 32. Impact of the Paulo Freire Project on the value of swine sales.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.2.6. Honey

Honey production increased significantly for both the treatment and control groups, although the intertemporal variation was not statistically significant in any of the cases. This situation may be related to the sample size of beekeepers, which reduces the accuracy of estimates. Although the evolution observed for the control group was comparatively greater than that identified for the treatment group, the estimated coefficient, despite being negative, was statistically equal to zero. In other words, the Paulo Freire Project cannot be related to any changes observed in the honey production of benefiting households.

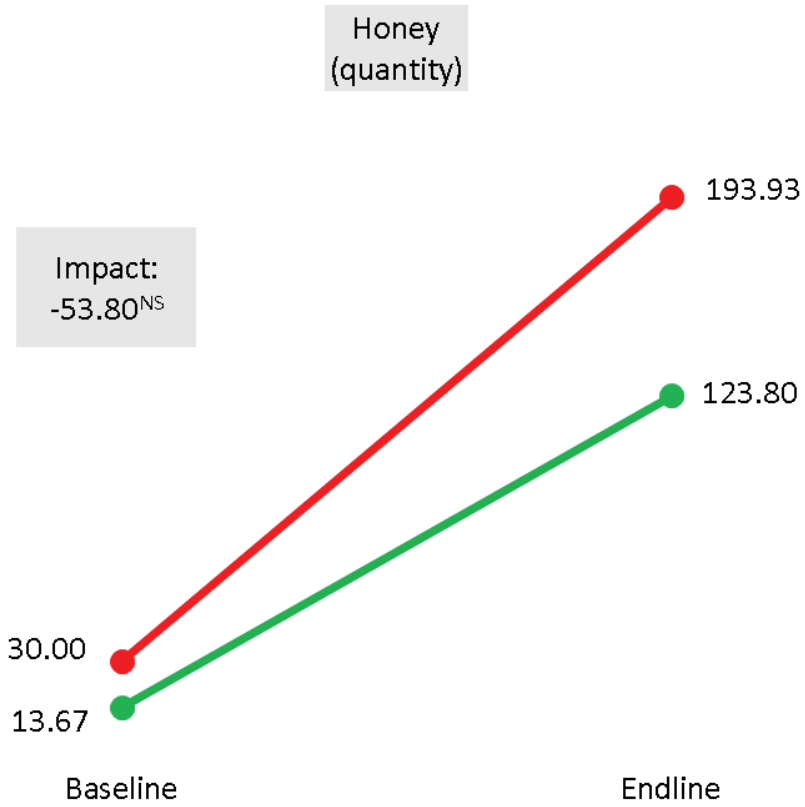


Figure 33. Impact of the Paulo Freire Project on the quantity of honey.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.3. Agriculture indicators

In order to assess the impact of the Project on agriculture, the following productions were considered: fava beans, beans, corn, fruits and vegetables. Fava beans, beans and corn are three of the most widespread crops in the region. Although such crops are not included in the Productive Investment Projects (PIPs), their productivity may have been increased as a result of CTA actions. In the case of fruit trees and vegetables, it is expected that the influence of the Project has occurred via CTA and PIPs (in the form of productive backyards).

PPF impact on agriculture was measured in terms of the quantity harvested (kgs) and the value of production (BRL). Fava beans, beans and corn were investigated in relation to the quantity harvested. Fruits and vegetables, however, were evaluated based on their production value (value of sales plus the value of self-consumption), as standardizing the measurement units proved impossible due to incompatibilities in the responses recorded in the baseline and endline surveys. In any case, the value of production is believed to be a good approximation of the quantity produced.

4.2.3.3.1. Fava beans

Baseline data indicate that, on average, the amount of fava beans harvested by the treated was practically double that obtained by controls. Between 2015 and 2020, there was an increase in the average quantity observed for both groups. A more expressive increase was identified for the control group, so that the endline data point to a higher average for this group in relation to the treated. The estimate of the econometric model, although negative, was not statistically significant, i.e., the Project did not impact the amount of fava beans produced.

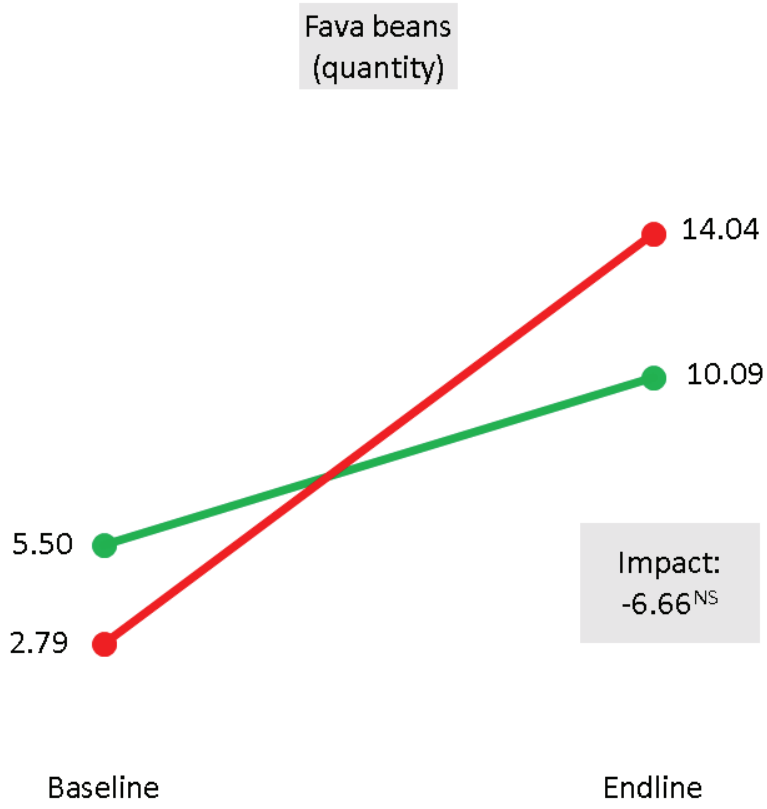


Figure 34. Impact of the Paulo Freire Project on the harvested quantity of fava beans.
Notes: * Statistically different from zero. NS Statistically equal to zero.
Source: Research results.

4.2.3.3.2. Beans

Between 2015 and 2020, the average harvested quantity of beans remained higher for the control group than for the treatment group. It should be noted, however, that, in both cases, there was a decrease during the analyzed period. In relative terms, this involution was

practically identical for both groups, in view of the similarity of the slope of the evolution lines. Such similarity is translated into the coefficient estimated by the difference-in-differences model, as it is very close to zero. Thus, it is evident that PPF also did not have an impact on bean production.

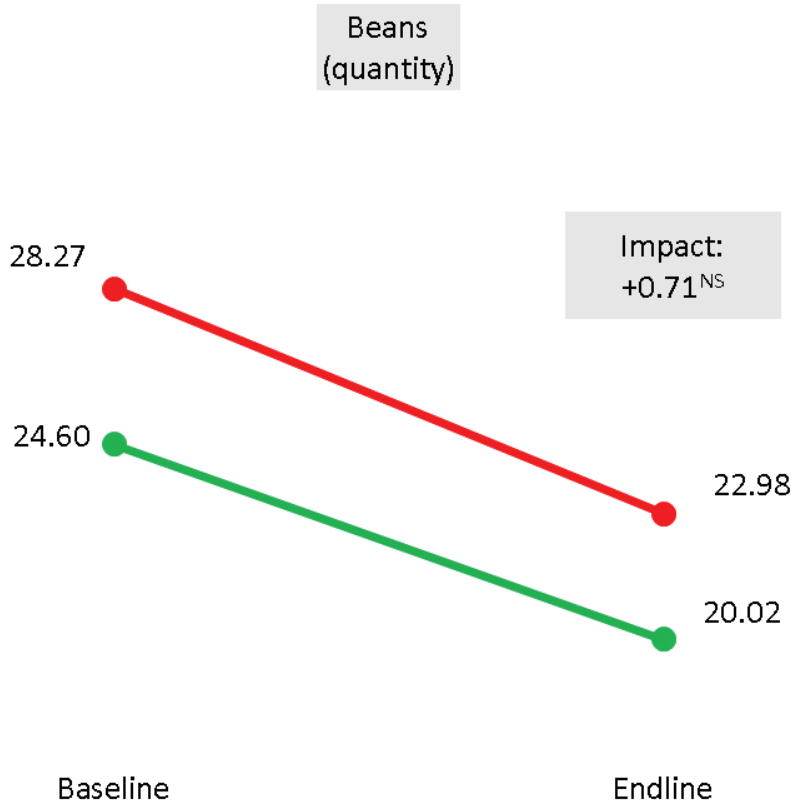


Figure 35. Impact of the Paulo Freire Project on the harvested quantity of beans.
Notes: * Statistically different from zero. NS Statistically equal to zero.
Source: Research results.

4.2.3.3.3. Corn

A trend of expressive evolution of the average quantity harvested of corn was observed for both the treatment and the control groups. The expansion identified for the control group, however, was comparatively greater. In fact, while the average difference between the groups was 13 kilograms in 2015, this value dropped to less than 2 kilograms in 2020. As a result, the estimate obtained through the application of the difference-in-differences model was negative. It should be noted, however, that the estimated coefficient was not statistically significant, indicating that there was no impact (either positive or negative) of the Project on the quantity harvested of corn.

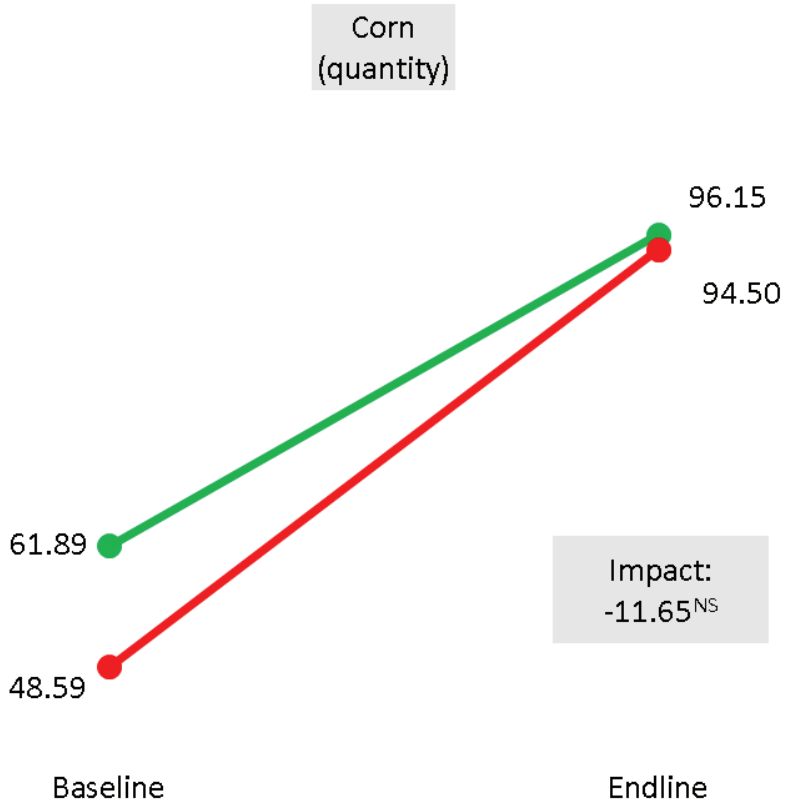


Figure 36. Impact of the Paulo Freire Project on the quantity harvested of corn.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.3.4. Fruits

An expressive evolution of the average value of fruit production was observed for both groups. It should be noted, however, that the mean expansion of the treatment group was comparatively greater. In fact, when considering the year of 2020, the average production value of the treatment group was 85% higher than that calculated for the control group. This difference translates into a positive and statistically significant estimate obtained through the application of the differences-in-differences model. In other words, it is evident that the Project had a positive impact on benefiting farmers in terms of the value of fruit production.

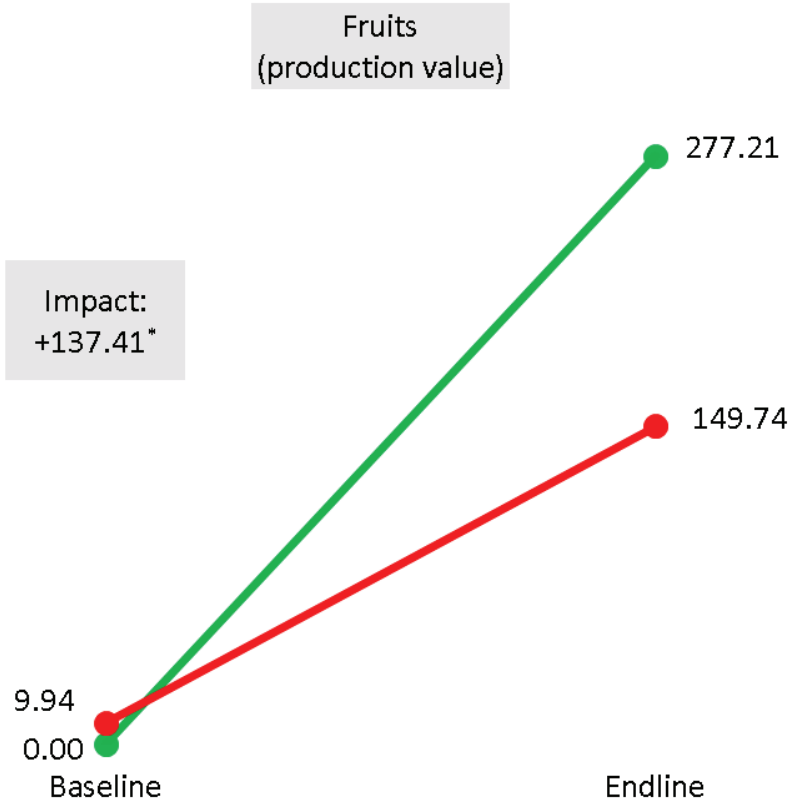


Figure 37. Impact of the Paulo Freire Project on the production value of fruits.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.2.3.3.5. Vegetables

Similar to what was observed for fruits, a positive impact was also identified and statistically different from zero for vegetables, meaning that PPF had a positive effect on the production value of vegetables cultivated by benefiting farmers. Even though the average value of the control group more than tripled between 2015 and 2020, the treatment group showed an expansion of almost four times what was observed at baseline. In numbers, there was an average impact of more than BRL 500.00 on the production value of vegetables.

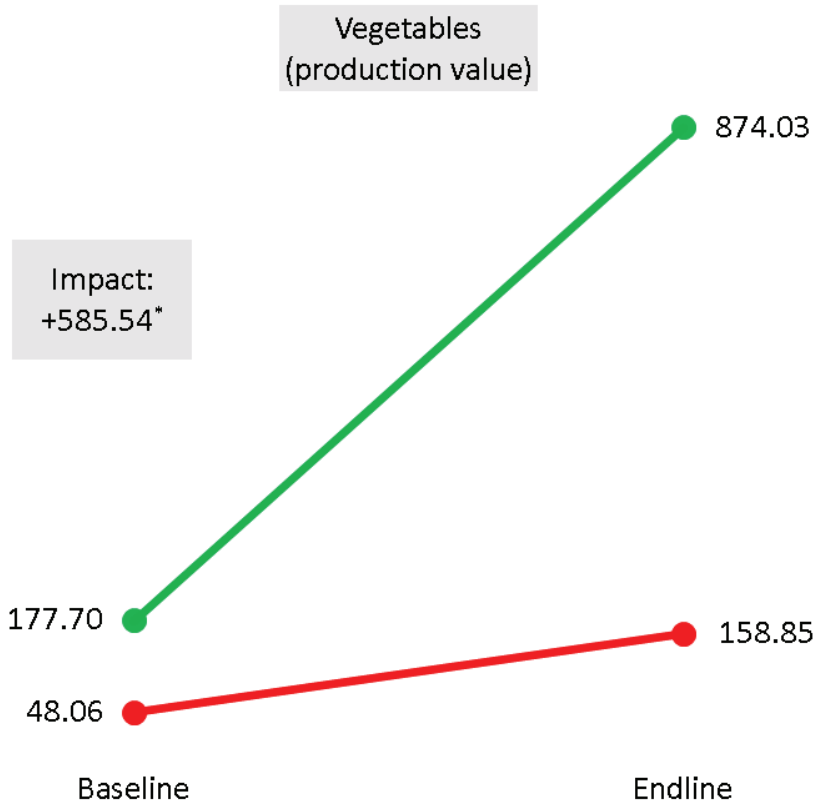


Figure 38. Impact of the Paulo Freire Project on the production value of vegetables.

Notes: * Statistically different from zero. NS Statistically equal to zero.

Source: Research results.

4.3. Outcome indicators: Logical Framework

Based on PPF's Logical Framework, and in line with the Theory of Change, the present subsection highlights the evolution of a set of outcome indicators for the Project[7]. Specifically, the reduction of extreme poverty, the increase in household assets, the increase in agricultural and livestock production, and the number of households reporting the adoption of new or improved inputs, technologies or practices are considered.

4.3.1. Reduction of extreme poverty by 35% at Project completion

In order to measure the evolution of extreme poverty from the data collected through the impact evaluation survey, we calculated the multidimensional poverty index. In this case, we considered poverty as a phenomenon of multiple dimensions, being thus capable of

[7] Additional results for the agricultural activity are presented in Appendix 3.

impacting surveyed households in the most diverse ways and not only from a financial perspective.

Table 86. Proportion of poor households according to the multidimensional poverty index.

Indicator	Treatment		Control	
	2015	2020	2015	2020
Poor households	44%	34%	45%	42%

Source: Research results.

It is observed that, between 2015 and 2020, the drop in the poverty level was much more pronounced in the treatment group than in the control group. In fact, multidimensional poverty was reduced by less than 7% for the control group, while the drop recorded for the treatment group was approximately 23%. This percentage, however, was below the goal established in the Logical Framework.

The fact that the data from the impact evaluation survey do not show that the threshold established in the Logical Framework was not reached does not diminish the Project's impact in terms of poverty reduction in the region served. On the contrary, it is necessary to consider that the results for 2020 may have been affected by the COVID-19 pandemic, influencing the effects of PPF on poverty level.

4.3.2. Increase in household assets by 30%

In order to analyze the evolution of the assets of benefiting households, we focused on the section H of the impact evaluation survey, which deals with the assets of surveyed households. The items considered include both household and production assets. For each item, the total number of households that own it and the total number of items owned were considered.

Table 87. Assets of households benefiting from the Paulo Freire Project

Item	Households			Total items		
	2015	2020	Δ%	2015	2020	Δ%
House	227	261	14.98	229	267	16.59
Corral, stable	44	70	59.09	48	73	52.08
Well, cacimba, cacimbão	61	49	-19.67	66	50	-24.24
Plow, traction disk harrow	8	16	100.00	8	16	100.00
Automobile	17	38	123.53	17	38	123.53
Hydraulic pump	46	60	30.43	46	60	30.43

Wain, carriage, bullock cart	6	7	16.67	6	7	16.67
Motorcycle	162	181	11.73	172	190	10.47
Satellite dish	252	231	-8.33	258	231	-10.47
Sound system, radio	220	184	-16.36	230	184	-20.00
Bicycle	142	86	-39.44	172	95	-44.77
Gas stove (2 burners or more)	245	259	5.71	247	259	4.86
Freezer	34	32	-5.88	35	33	-5.71
Refrigerator	244	258	5.74	249	259	4.02
Sewing machine	47	34	-27.66	48	34	-29.17
Telephone (mobile or landline)	192	220	14.58	253	320	26.48
TV	246	255	3.66	264	260	-1.52
Cattle	43	49	13.95	337	297	-11.87
Swine	107	131	22.43	658	905	37.54
Goats	39	39	0.00	686	674	-1.75
Sheep	42	73	73.81	820	1436	75.12
Poultry	198	220	11.11	6818	7677	12.60
Horses, donkeys, mules	11	39	254.55	14	55	292.86
Average	114.48	121.39	28.03	507.87	583.48	28.42

Source: Research results.

For 16 of the 23 items considered, there was an increase in the number of households owning them, considering the interval between 2015 and 2020. Production assets can be highlighted, such as corral/stable and plow/harrow. It is also interesting to note the increase in the number of households with livestock, especially sheep and pigs.

In terms of the total number of assets, a positive evolution was observed in 61% of cases (14 of 23 items). In general, the relative increase in the total quantity of assets was similar to that observed for the number of households owning such items. A more than proportional increase was identified for the number of cell phones (26% vs. 14%) and the swine herd (37% vs. 22%).

On average, the total amount of surveyed items owned by households, an amount used as an approximation for asset ownership, grew by more than 28% between 2015 and 2020. This is a percentage that significantly approaches the goal defined in the Logical Framework of the Project. As the assets considered have a different nature, we decided to consider the average individual growth of each item.

4.3.3. 60% of households reporting increased production

The impact evaluation survey does not have a specific question on the perception of beneficiary families regarding the increase in agricultural production. To investigate the Project

reached the goal set for this indicator, the value of agricultural production was considered, in view of the different units of measurement in which the quantity produced is presented. When using real values, the effect of price changes is excluded.

Table 88. Value of agricultural production

Indicator	Treatment	Control
Average variation in production value (BRL)	1,288.65	1,248.64
Households with increase in production value (%)	64.02	60.18

Source: Research results.

When considering the treatment group as a whole, an average increase of approximately BRL 1,290.00 in production value was observed. This value is 3% higher than that observed for the control group. It is also worth noting that 64% of the households benefiting from PPF showed an increase in production value, a percentage that exceeds the threshold defined in the Project's Logical Framework.

4.3.4. Number of households reporting the adoption of new or improved inputs, technologies or practices

The calculation of this indicator considered a set of questions that were not present in the baseline survey, but were added to the endline survey. Specifically, these questions refer to the practices implemented by the respondents based on the guidelines of the Project's continuous technical assistance (or the technical assistance and rural extensions services, in the case of farmers from the control group). In total, 28 practices were considered.

More than 90% of farmers in the treatment group adopted at least one of the aforementioned practices and, on average, these individuals adopted approximately 8 of such practices. For the control group, on the other hand, just under 80% of farmers reported having adopted at least one of the listed practices and, taking the group average, just over 5 practices were adopted per individual.

Considering that the universe of PPF beneficiaries corresponds to 17,763 families and that the endline survey considered a representative sample of this population, the results found using data from this survey can be extrapolated. Therefore, it is assumed that 16,215 households benefiting from the Project have adopted new or improved inputs, technologies or practices, corresponding to a significantly higher value than the target initially set.

4.3.5. 80% of households assisted by technical assistance and productive investments increase their average income by at least 30%

Total household income was calculated from the sum of income obtained from different sources, such as agricultural and livestock production, non-agricultural external work, and government benefits and aid. In order to compare the information obtained in the baseline and endline surveys, the 2015 monetary values were adjusted for inflation using the IPCA, being thus expressed in 2020 values.

In terms of monthly per capita income, data extracted from the database used in the impact evaluation survey indicate that 40% of families benefiting from the Project obtained, between 2015 and 2020, a variation of more than 30%. This result, below the initial expectation, may be mainly related to the effects of the COVID pandemic on family income.

On average, the income obtained through agricultural production—the main focus of the Project—grew significantly. On the other hand, income from non-agricultural external work (temporary or permanent) and from government aid (federal) showed, on average, a considerable decrease. As an example, there is the income from the Bolsa Família Program, which decreased, on average, 70% in the period.

4.3.6. 70% of those benefiting from technical assistance and investment plans access public policies

The baseline and endline surveys collected information about access to social benefits and public policies by the investigated households. Specifically, the surveys considered 29 social benefits and public policies granted by the government. The list of such benefits/policies can be seen in Table 13.

Considering the data obtained through the endline survey, it is observed that only 11% of the households benefiting from PPF did not obtain, in 2020, access to any of the social benefits and public policies listed. For that specific year, beneficiaries had access, on average, to approximately 10% of the benefits/policies mentioned in the survey.

Still considering the base year of 2020, the social benefits and public policies most accessed by the households benefiting from the Project were Cistern for Human Consumption (43% of households), Social Electricity Tariff (36%) and the Bolsa Família Program (36%).

This result highlights the prevalence of government initiatives aimed at combating poverty and the effects of drought in the region.

4.3.7. At least 30% increase in production volume of households benefiting from productive investment

The volume of agricultural production refers to the physical quantity produced by households benefiting from productive investments. However, obtaining a single value for each family is practically impossible, due to productive diversification and the incompatibility of unit measures. In fact, vegetables are measured in portions, fruits are measured in kilograms, animals are measured in units, and so on.

To make the different agricultural products compatible, the present analysis considered the production value, in order to express all products in the same measure: Brazilian reais. Production value was obtained by adding the value of sales and the value of self-consumption. In order to allow for an intertemporal comparison, the 2015 values were corrected by the IPCA, being expressed in terms of 2020 values.

Considering only the households benefiting from productive investments, the total production value showed a positive evolution between 2015 and 2020, going from approximately BRL 1.25 million to more than BRL 1.5 million in this interval. In relative terms, there was an expansion of about 23% in the total value of agricultural production of benefiting households.

Analyzing the households benefiting from productive investment individually, an average real increase in the value of agricultural production of around 250% was observed. The divergence between the aggregate evolution and the average evolution is justified by the distribution of individual results, as shown in Figure 39. Although the average increase is expressive, slightly less than 40% of the households showed a negative variation.

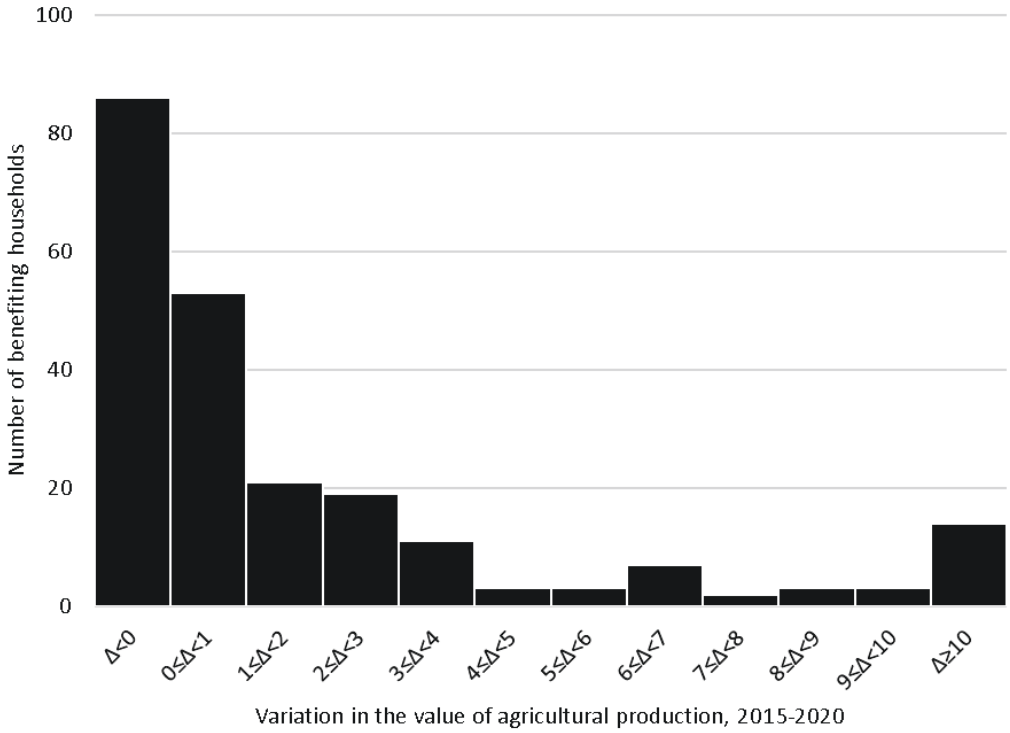


Figure 39. Histogram of the number of benefiting households (productive investment) by category of variation in the value of agricultural production.

Notes: Δ denotes variation. Thus, Δ=1 indicates a positive variation of 100%.

Source: Research results.

4.3.8. At least a 30% increase in the sale of beneficiaries' products, results of productive investments

The variation in the sale of products by beneficiaries of productive investments was analyzed based on the value of agricultural sales. In order to exclude the effect of inflation observed from 2015 to 2020, the values were corrected using the IPCA. In this way, the monetary values collected through the baseline survey are now expressed in BRL from of December 2020.

Adding to all households benefiting from productive investments, the total value of agricultural sales exceeded the mark of BRL 725,000.00 in 2020. As the total value of agricultural sales in 2015 had reached just over BRL 540,000.00, it is observed an increase of approximately 34% in the aggregate result during the time interval considered in the present study.

In individual terms, there was an average real increase in the value of agricultural sales of more than 275% among households benefiting from PPF productive investments. Once

again, the divergence between the aggregate result and the average result is explained by the distribution of benefiting households between the variation intervals, as shown in Figure 40.

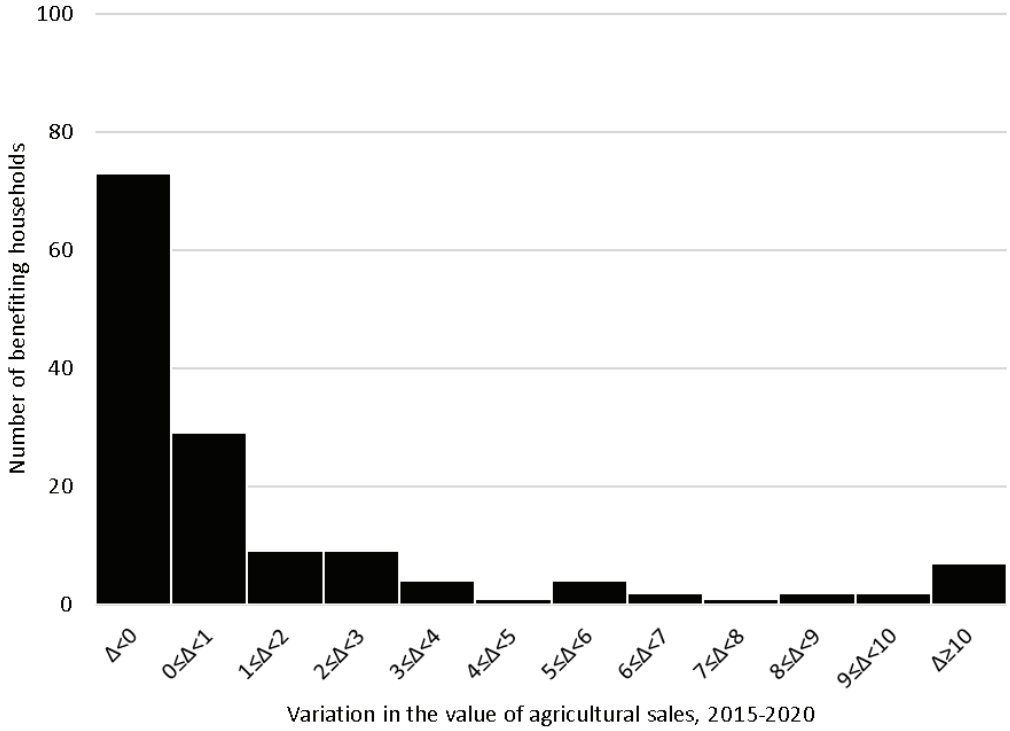


Figure 40. Histogram of the number of benefiting households (productive investments) by category of variation in the value of agricultural sales.
Notes: Δ denotes variation. Thus, Δ=1 indicates a positive variation of 100%.
Source: Research results.

4.3.9. At least 70% of households benefiting from productive investments access public policies such as PRONAF

When considering the access to PRONAF as the effective taking of a subsidized loan, less than 5% of families benefiting from productive investments have accessed this public policy. This statement is valid for both the baseline (base year 2015) and endline surveys (base year 2020). However, the information collected does not allow identifying the reason for this scenario.

If, on the other hand, possession of a Declaration of Aptitude for PRONAF (DAP) is analyzed as an indicator of access to this public policy, the scenario changes completely. In fact, taking the base year of 2020, it is observed that slightly less than 75% of benefiting

households had a DAP. This result represents an evolution in relation to that observed for 2015, when 67% of households benefiting from investment projects had a DAP.

5. CONCLUSION

The main objective of the Paulo Freire Project (PPF) is to reduce the incidence of poverty among benefiting family farmers. In light of this, the present report evaluated the impact of PPF[8] on selected socioeconomic and agricultural indicators, comparing farmers benefiting from the Project (treatment group) with farmers not benefiting from it (control group). Information on these groups of farmers are compared for 2015 (base year) and 2020 (after PPF implementation).

Based on the observation that poverty is a phenomenon capable of impacting households in several ways, this report innovates in calculating the Multidimensional Poverty Index (MPI) for the sample of households analyzed. Therefore, poverty measurement includes different types of deprivation in addition to lack of income. In this sense, social capital, human capital, nutrition and food security, housing conditions, and sustainability dimensions were incorporated in poverty analysis.

With regard to the MPI, it is noticed that the poverty rate dropped for both groups – treatment and control – from 2015 to 2020. For the treated, this drop was much more expressive, from 44% to 34%, i.e., a reduction of 10 percentage points in poverty incidence. For the control group, in turn, the MPI went from 45% to 42%. Although this is not a cause-and-effect analysis like the impact evaluation, this result suggests that PPF actions may have a positive influence on the reduction of multidimensional poverty.

The analysis of the impact of the Project on socioeconomic indicators showed that PPF significantly increased the active participation of women and the youth in community actions, the access to public policies and the adoption of agroecological and sustainable practices. These results indicate that the Project was effective in increasing the empowerment of women and youth. At the same time, access to relevant public and agricultural policies and the adoption of important sustainable agricultural and environmental practices corroborate the importance of the Continuous Technical Assistance (CTA) provided under PPF.

There was a considerable drop in the number of households benefiting from PPF that had a very low level of food security (from 16% to 3% of the treatment group). As for the effects of drought, a significant increase in the number of benefiting households that were not affected by this adverse event (from 6% to 41%). Additionally, it worth stressing that the

[8] A summary table of PPF impacts on selected socioeconomic and agricultural indicators is presented in Appendix 4.

volume of treated households with a good level of adoption of agroecological and sustainable practices practically doubled during the time period considered, going from 5.7% in 2015 to 10.2% in 2020.

Research results identified the absence of statistically significant impacts of the Project on the indicators of standard of living—such as housing, per capita income and food security—in addition to some indicators related to social capital—the level of associativity and access agricultural policy. Regarding the way in which PPF affects households' relationship with drought effects, it was observed an increase in the awareness of the adverse effects of drought on households' assets.

When comparing sampled households in terms of both the gender and the age of the head of the household, the impact evaluation showed that PPF has a heterogeneous effect on benefiting households. The impacts of the Project seem to have been concentrated in households headed by men over 29 years of age. Despite these results, it cannot be concluded that the Project has not been effective in granting benefits to individuals from focus groups.

As noted in the description of the data used in the impact evaluation, the socioeconomic status of individuals in the focus groups improved in several dimensions. Therefore, the fact that no significant estimates of PPF impacts on youth- and women-headed households were found tends to be related more to the sample size than to the effectiveness of the Project. On the one hand, 25% of the households were headed by women. On the other hand, just over 10% of households were youth-headed.

Finally, the agricultural sector was considered in detail with the evaluation of PPF impacts on the value of sales and the quantity harvested of farmers benefiting from the Project. It is important to highlight that, in general, both the average quantity and average value of sales grew more for the treatment group than the control group between 2015 and 2020. As an exception, there are the cultivation of fava beans, beans and corn. Nevertheless, such cultures were not part of any investment project, so that the positive results, if they had been found, would have been related only to the provision of CTA services.

Regarding the impacts of PPF on the value of sales for the agricultural sector in general and its subdivisions, agriculture (plant production and products of plant origin) and livestock (animal production and products of animal origin), no significant impacts were found. At a more disaggregated level, it was identified that PPF significantly increased the value of the sales of eggs, honey, fruits and vegetables produced by benefiting farmers. In terms of quantity, the Project led to the increase of poultry, swine and honey production for the treatment group.

It is also important to highlight the results found in terms of reaching the Project's objectives defined in the Logical Framework. Both poverty reduction and the increase in household assets were indicators that failed to reach the established target value, although the results identified were very close to the thresholds defined a priori. The evolution of production and the adoption of inputs, technologies or innovative practices, on the other hand, achieved the goal stipulated at the beginning of the Project. It is also worth noting that there was a significant evolution in all outcome indicators between the baseline (2015) and endline (2020) surveys.

Considering all the results reported, the fact that the Project has increased the level of participation of women and the youth in community actions, the access to public policies and the adoption of agroecological and sustainable practices are extremely favorable results. Several positive effects stem from the increase in women and youth empowerment, the greater access to public policies and the adoption of agroecological and sustainable practices: changes in household bargaining power between spouses, increased investment in agricultural activity and diversification of production, among others.

It is also important to highlight that the lack of impacts on the other dimensions analyzed and specifically on women- and youth-headed households does not indicate a lack of result or an undesirable result. This finding only suggests that benefiting households did not show significant changes in the average values of the analyzed indicators, although other variables, which were not captured in the analysis, may have been positively impacted.

In addition, it is worth noting that 2020 was an atypical year due to the COVID-19 pandemic, which also has effects on the change in households' assets. Based on the methodology employed, it was not possible to completely isolate the adverse effects on assets arising from climatic events, such as drought, from those arising from public health events, such as the COVID-19 pandemic. It is also worth emphasizing that adverse shocks triggered by the COVID-19 pandemic may have contributed to the modest or non-existent impacts on some indicators, although there may have been other important positive effects not captured by the variables used here.

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APPENDIX 1

Table 1A. Description of the calculation of indicators

Indicator	Description
Participation of women and the youth in community actions	$I_{J\&M} = \frac{C_1 + C_2}{2}$ In which: C_1 indicates the participation of young household members in community actions; and C_2 indicates the participation of female household members in community actions. Classification: a) $I_{J\&M} = 0$ (low) b) $I_{J\&M} = 0.5$ (medium) c) $I_{J\&M} = 1$ (high)
Associativism	$I_{assoc} = \frac{(Q_{assoc} \times F_1 \times F_2) + C_1 + C_2}{8}$ In which: Q_{assoc} indicates the number of different types of associations household members participate in among the options below: a) Community associations b) Collective work c) Organized social movement d) Movements linked to churches e) Unions f) Others (clubs, sports associations, social associations) F_1 indicates if the respondent is aware of meetings held in the last year: a) Don't know = 0.5 b) Did not have = 0.75 c) Did have = 1 F_2 indicates the frequency of attendance at meetings in the last year:

a) None = 0.5
b) Some = 0.75
c) All = 1

$C_1 = 1$ indicates whether production is processed via association and 0 otherwise

$C_2 = 1$ indicates whether production is commercialized via association and 0 otherwise

Classification:

a) $I_{assoc} = 0$ (does not participate)
b) $0 < I_{assoc} \leq 0.2$ (very low)
c) $0.2 < I_{assoc} \leq 0.4$ (low)
d) $0.4 < I_{assoc} \leq 0.6$ (medium)
e) $0.6 < I_{assoc} \leq 1$ (high)

Housing

$$I_M = \frac{I_{ID} + I_S}{2}$$

In which:

I_{ID} indicates household infrastructure, being given by the average of the following indicators:

a) Type of home (1 if house, 0 otherwise)
b) Material used for exterior walls (1 if masonry, 0 otherwise)
c) Material used in the roof (1 if ceramic tile, 0 otherwise)
d) Material used in the floor (0 if earthen floor, 1 otherwise)
e) Bathroom at home (1 if yeas, 0 if no)

I_S indicates the sanitation condition, being given by the average of the following indicators:

a) Destination of household sewage (1 if sewage collection network or septic tank, 0 otherwise)
b) Electricity (1 if yes, 0 if no)
c) Running water (1 if yes, 0 if no)
d) Water from the State Supply System (1 if yes, 0 if no)

Classification:

a) $I_M < 0.333$ (low)
b) $0.333 < I_M \leq 0.666$ (medium)

c) $0.666 < I_M \leq 0.900$ (high)

d) $0.900 < I_M \leq 1.000$ (very high)

Access to public policies

$$I_{APP} = \frac{I_b + I_a + I_{DAP} + I_S}{4}$$

In which:

I_b indicates the benefits received, being given by the average of the 29 benefits identified in the survey

$I_a = 1$ indicates whether some household member participates in any association and 0 otherwise

$I_{DAP} = 1$ indicates whether some household member has DAP and 0 otherwise

I_S indicates the services accessed, being given by the average of the 5 services identified in the survey

Classification:

a) $I_{APP} \leq 0.25$ (very low)

b) $0.25 < I_{APP} \leq 0.50$ (low)

c) $0.50 < I_{APP} \leq 0.75$ (medium)

d) $0.75 < I_{APP} \leq 1.00$ (high)

Access to agricultural policies

$$I_{APA} = \frac{I_b + I_a + I_{DAP}}{3}$$

In which:

I_b indicates the benefits received, being given by the average of the benefits below:

a) Cistern for productive used – 2nd water

b) Technical assistance and rural extension

c) Agricultural credit

d) Pronaf

e) PAA

f) PNAE

g) Garantia-safra

h) Crop insurance

i) SEAF

j) Land reform

k) Land credit

$I_a = 1$ if some household member participates in any association and 0 otherwise

$I_{DAP} = 1$ if some household member has DAP and 0 otherwise

Classification:

a) $I_{APP} \leq 0.25$ (very low)
b) $0.25 < I_{APP} \leq 0.50$ (low)
c) $0.50 < I_{APP} \leq 0.75$ (medium)
d) $0.75 < I_{APP} \leq 1.00$ (high)

Drought

$$I_{seca} = \frac{C_1 + C_2 + C_3}{3}$$

In which:

$C_1 = 1$ if the household faced a period of drought and 0 otherwise

C_2 indicates the effects of drought (animal losses, crop losses...)

C_3 indicates the sale of assets/goods due to drought, with weight 1 for the sale of animals or appliances, weight 3 for the sale of durable goods, and weight 5 for the sale of a house or land

Classification:

a) $I_{seca} \leq 0.10$ (not affected)
b) $0.10 < I_{seca} \leq 0.30$ (little affected)
c) $0.30 < I_{seca} \leq 0.60$ (affected)
d) $0.60 < I_{seca} \leq 1.00$ (very affected)

Poverty

Households are classified into per capita income (R) brackets according to the minimum wage (SM) in force, as follows:

a) $R \leq \frac{1}{8}SM$
b) $\frac{1}{8}SM < R \leq \frac{1}{4}SM$
c) $\frac{1}{4}SM < R \leq \frac{1}{2}SM$
d) $\frac{1}{2}SM < R \leq SM$
e) $SM < R$

Adoption of agroecological and sustainable practices

$$I_{ECO} = \frac{I_p + I_{espelho} + I_{riacho} + I_{nascente}}{14 + n}$$

In which:

I_p indicates the adoption of agroecological practices, given by the sum of the following indicators

a) Use of agricultural burning (Yes = 0)
b) Use of pesticides (Yes = 0)
c) Use of chemical fertilizer (Yes = 0)
d) Use of organic compost (Yes = 1)
e) Use of manure (Yes = 0)
f) Use of straw (Yes = 1)
g) Empty packaging is returned (Yes = 1)
h) Empty packaging is buried, burned or discarded (Yes = 0)
i) Empty packaging is reused (Yes = 1)
j) Household waste is collected by the municipal system (Yes = 1)
k) Household waste is recycled (Yes = 1)
l) Household waste is buried or burned (Yes = 0)
m) Household waste is thrown into the environment (Yes = 0)
n) Organic waste is separated from domestic waste for composting (Yes = 1)

$I_{espelho} = 1$ if there is riparian forest in the water layer and 0 otherwise

$I_{riacho} = 1$ if there is riparian forest in the stream and 0 otherwise

$I_{nascente} = 1$ if the water spring is preserved and 0 otherwise

n indicates the number of types of water source registered on the property, among water layers, streams and springs (ranging from 0 to 3)

Classification:

a) $I_{ECO} \leq 0.35$
b) $0.35 < I_{ECO} \leq 0.50$
c) $0.50 < I_{ECO} \leq 1.00$

Nutrition and food security

$$I_{segalim} = \frac{\left(3 \times I_{fome}\right) + 2 \times \left[I_{var} + \left({}^{1}/_{3} \times I_{fonte}\right) + (0{,}1 \times I_{outros})\right]}{9}$$

In which:

$I_{fome} = 0$ if the household experienced hunger and 1 otherwise

I_{var} indicates whether the household had a varied diet (1 if always, 0.5 if sometimes and 0 if it never happened or if the respondent was unable to answer)

I_{fonte} indicates the number of household food sources among the 3 mentioned below:

a) Swidden or own farming;
b) Exchange with neighbors and relatives
c) Purchased from neighbors or at fairs, warehouses or markets

I_{outros} is an indicator composed of the following factors:

a) Brackets of the poverty indicator, with weights ranging from 0 and 4 (0 corresponds to income between 0 and 1/8 MW, and 4 to income greater than 1 MW)
b) Permanent job (1 if any household member has it, 0 otherwise)
c) Pension (1 if any household member receives it, 0 otherwise)
d) If the household engage in animal production (1 = Yes)
e) If the household engage in plant production (1 = Yes)
f) If any household member participates in an association (1 = Yes)
g) If the household was affected by drought (1 = No)

Classification:

a) $0 < I_{segalim} \leq 0.3$ (very low)
b) $0.3 < I_{segalim} \leq 0.6$ (low)
c) $0.6 < I_{segalim} \leq 0.8$ (medium)
d) $0.8 < I_{segalim} \leq 1$ (high)

Source: Elaborated by the authors based on the Paulo Freire Project's Survey Instrument (FIDA, 2021).

APPENDIX 2

SURVEY – INSTRUMENT FOR INFORMATION COLLECTION

IDENTIFICATION

1. Interviewer number, name or identifier code: [.....]
2. Date: [...../...../.....]
3. Start time: [.....]
4. Group: 1-Treatment, 2-Control [.....]
5. Municipality: [.....]
6. Community: [.....]
7. GPS coordinates: [.....]
8. What is the sociocultural identification of the community? (multiple answer)

1 – Yes 2 – No

[.....] A – Settlement

[.....] B – Black or quilombola community

[.....] C – Indigenous community

[.....] D – Pasture bottom community

[.....] E – Rural community

[.....] F – Fishing community

[.....] G – Other identity

9. Characterization of the houses in the community [.....]

1 – Agglomerated buildings 2 – Diffuse buildings

10. Main Productive Activities (multiple answer):

[.....] A – Beekeeping (extraction of honey, propolis, pollen, wax, etc.)

[.....] B – Goat farming

[.....] C – Sheep farming

[.....] D – Poultry farming

[.....] E – Pig farming

[.....] F – Aquaculture (fish oyster, shrimp, etc.)

[.....] G – Agriculture, irrigated horticulture, irrigation

[.....] H – Productive backyard

[.....] I – Plant extractivism

[.....] J – Processing of bee products

[.....] K – Processing of goat, sheep, poultry and swine products

[.....] L – Processing of aquaculture products

[.....] M – Processing of fruits (e.g., cashew, cajá, mango, acerola, seriguela, banana, coconut, watermelon, melon, passion fruit, guava)

[.....] N – Cassava processing and production of derivatives

[.....] O – Crafts and other non-agricultural activities (e.g., sewing, embroidery, wood, clay, leather, straw)

[.....] P – Artisanal fishing

[.....] Q – Other activities (agricultural and non-agricultural)

11. Respondent name: [.....]

12. Household head name: [.....]

13. Household head CPF: [.....]

14. Household head NIS/CadUnico: [.....]

15. Household head phone number: [.....]

16. Spouse name: [.....]

17. Spouse CPF: [.....]

18. Spouse NIS/CadUnico: [.....]

19. Spouse phone number: [.....]

20. Has DAP? [.....]

1 – Yes 2 – No (go to 22)

21. DAP type (multiple answer):

1 – Yes 2 – No

[.....] A – Main

[.....] B – Accessory Women

[.....] C – Accessory Youth

[.....] D – Special

22. Have you or a member of your family ever accessed the following benefits? (multiple answer)

1 – Yes 2 – No

[.....] A – Pension, Social Security

[.....] B – Unemployment insurance

[.....] C – Bolsa Família Program, School Allowance, Food Card, Gas Voucher, Basic Food Basket

[.....] D – Education scholarship, Educa Mais Brasil, English Without Borders, Jovem Aprendiz, Pronatec, Sisutec, Sisu, Prouni, FIES Pós-graduação

[.....] E– Paid maternity leave

[.....] F – Emergency aid

[.....] G –Mais Infância Ceará Program (“mais infância” card)

[.....] H – Minha Casa Minha Vida, Minha Casa Melhor

[.....] I – Hora de Plantar Program

[.....] J – Luz para Todos

[.....] K – Cistern for human consumption – 1st water

[.....] L – Cistern for productive use – 2nd water

[.....] M – Technical assistance and rural extension (ATER)

[.....] N – Agricultural credit

[.....] O – Pronaf

[.....] P – PAA

[.....] Q – PNAE

[.....] R – PAA (Purchase with Simultaneous Donation)

[.....] S – Garantia-Safra

[.....] T – PAA milk

[.....] U – Seguro Safra

[.....] V – Family Farming Crop Insurance – SEAF (antigo Proagro)

[.....] W – Land Reform Program, Land Credit

[.....] X – Program to Combat Rural Poverty

[.....] Y – Individual microentrepreneur (MEI), Refis or SEBRAE

[.....] Z – Emergency Aid - Drought

[.....] AA – Family Health Program (PSF)

[.....] AB – Seguro Defeso

[.....] AC – State Water Supply System

[.....] AD – Water for Human Consumption in Water Trucks

[.....] AE – Viver sem limites, Saúde não tem preço, Rede cegonha

[.....] AF – Bus Pass, Senior Citizen Card, Social Driver's License

[.....] AG – Luz no campo

[.....] AH – Social Electricity Tariff

[.....] AI - Programa Criança Feliz

[.....] AJ – Land Credit

[.....] AK – Land Regularization (IDACE - CE)

[.....] AL – Plano Brasil sem Miséria (PBSM)

[.....] AE – Other program/benefit [.....]

23. Does your family benefit from the following public services? (multiple answer)

1 – Yes 2 – No

[.....] A – Health agent

[.....] B - PSF/presence of a doctor in the community

[.....] C – School transport

[.....] D – Public transport

[.....] E – Public security

A – CHARACTERIZATION OF HOUSEHOLD MEMBERS

24. No.	25. Name	26. NIS	27. Kinship with the household head	28. Age	29. Gender	30. Can you read/write?	31. Level of education	32. Main occupation	33. Position at work	34. Location of the main occupation
1										
2										
⋮										
n										

B – ANIMAL PRODUCTION

35. No.	36. Code	37. Activity	38. No. of animals	39. Total value of animals	40. Production sold	Share of production destined for:				44. Total value of sales	46. Value of family self-consumption
						41. PAA or PNAE	42. Local markets in the same state	43. Other states	45. Family self-consumption		
1	101	Cattle farming									
2	102	Pig farming									
3	103	Goat farming									
4	104	Sheep farming									
5	105	Poultry farming									
6	107	Fishing (ext.)									
7	108	Oysters									
8	109	Fishing (cult.)									
9											
10											

C – PRODUCTS FROM ANIMAL ORIGIN

47. No.	48. Code	49. Product	50. Qty.	51. Un.	52. Unit price	53. Qty. sold	Share of production destined for:				57. Total value of sales	59. Value of family self-consumption
							54. PAA or PNAE	55. Local markets in the same state	56. Other states	58. Family self-consumption		
1	111	Bovine milk										
2	113	Goat milk										
3	205	Cheese or cream cheese										
4	212	Jerked beef/sun-dried meat										
5	216	Eggs										
6	217	Honey										
7	218	Dairy beverage										
8	219	Fish fillet										
9												
10												

D – PLANT PRODUCTION AND EXTRACTIVISM

60. No.	61. Code	62. Crop	Harvested area		65. Qty.	66. Un.	67. Unit price	68. Qtd. sold	Share of production destined for:				72. Total value of sales	74. Value of family self-consumption
			63. Pure	64. Intercropping					69. PAA or PNAE	70. Local markets in the same state	71. Other states	73. Family self-consumption		
1	300	Greens												
2	345	Watermelon												
3	600	Fruits												
4	605	Cotton (cottonseed)												
5	610	Banana												
6	618	Cashew (nut)												
7	651	Passion fruit												
8	708	Rice (husk)												
9	722	Fava beans												
10	723	Beans (grain)												
11	744	Cassava												
12	743	Manioc												
13	748	Corn (grain)												
14	749	Corn (cob)												
15	750	Pumpkin												
16	619	Cashew (apple)												
17														
18														

E – PRODUCTS OF PLANT ORIGIN

75. No.	76. Code	77. Product	78. Qty.	79. Un.	80. Qty. consumed	81. Unit price	82. Qty. sold	Share of production destined for:			86. Total value of sales
								83. PAA or PNAE	84. Local markets in the same state	85. Other states	
1	802	Processed rice									
2	826	Cassava flour									
3	827	Tapioca									
4	439	Wooden planks									
5	446	Firewood									
6	502	Charcoal									
7											
8											

F – NON-AGRICULTURAL PRODUCTION

87. No.	88. Code	89. Description	90. Product	91. Main material used	92. Qty.	93. Un.	94. Unit price	95. Qty. sold	Share of production destined for:		98. Total value of sales
									96. Local markets in the same state	97. Other state	
1	999	Handicraft									
2	999	Rural tourism									
3											
4											

G – HOUSEHOLD INCOME

Sources of Income		99. Annual value (BRL)
A. Agriculture and Livestock	A1. Sale of animal production	
	A2. Sale of products of animal origin	
	A3. Sale of plant production	
	A4. Sale of products of plant origin	
	A5. Family self-consumption (non-monetary income)	
B. Non-agricultural production	B1. Income from non-agricultural activities (crafts, commerce, services, etc.)	
	B2. Family self-consumption (non-monetary income)	
C. Paid work	C1. External temporary work	
	C2. External permanent work	
D. Benefits	D1. Bolsa Família Program	
	D2. Emergency aid for catastrophic events	
	D3. Seguro Defeso	
	D4. Paid maternity leave	
	D5. Emergency aid (COVID-19)	
	D6. Others	
E. Other income	E1. Pension	
	E2. Social Security, alimony	
	E3. Remittances from non-resident family members and others (donation)	
	E4. Others (rents, leases)	
F. TOTAL (fill in after the interview)		

H – ASSETS

100. Any household member is landowner? [.....]

1 – Yes 2 – No

101. How many hectares of land did the household members own or possess? [.....]

102. In recent years, have you identified the acquisition of Collective Use Goods acquired by the association and/or community in which you participate? [.....]

1 – Yes 2 – No

102. Line	103. Code	104. Item	105. Quantity
1		House	
2		Corral, stable	
3		Well, cacimba, cacimbão	
4		Plow, traction disk harrow	
5		Automobile	
6		Hydraulic pump	
7		Wain, carriage, bullock cart	
8		Motorcycle	
9		Satellite dish	
10		Sound system, radio	
11		Bicycle	
12		Gas stove (2 burners or more)	
13		Freezer	
14		Refrigerator	
15		Sewing machine	
16		Telephone (mobile or landline)	
17		TV	
18		Cattle (heads)	
19		Swine (heads)	
20		Goats (heads)	
21		Sheep (heads)	
22		Poultry (heads)	
23		Horses, donkeys, mules (head)	

I – DROUGHT AND COVID EFFECTS ON INCOME AND ASSETS

106. Have you been affected by drought in the last 5 years? [.....]

1 – Not affected (go to 111) 2 – Affected

107. How did the drought affect family life? Indicate the effects of drought (multiple answer)

1 – Yes 2 – No

[.....] A – Work reduction

[.....] B – Difficulties in domestic life due to lack of water for drinking and cooking

[.....] C – Crop losses

[.....] D – Animal losses

[.....] E – Nutrition and food insecurity

108. Have you sold assets in response to drought?

1 – Yes 2 – No (go to 111)

109. Consumer goods or assets sold in response to drought:

1 – Sim 2 – Não

[.....] A – Animals

[.....] B – Motorcycle and other durable goods for transport or work

[.....] C – Home appliances

[.....] D – Land or house

110. Amount obtained from the sale of assets in response to drought: [BRL.....]

110B. What practices (and/or policies) of coexistence with the semiarid implemented based on the guidelines of the technical assitance that mitigate the effects of the drought?

1 – Yes 2 – No

[.....] A – Agroforestry System

[.....] B – Mulch

[.....] C – Organic fertilization

[.....] D – Intercropping

[.....] E – Conservation of native forest

[.....] F – Crop diversification (plantation diversity)

[.....] G – Crop rotation

[.....] H – Terrace farming

[.....] I – Use of mulch on the ground

[.....] J – Agroecological Productive Backyard

[.....] K – Soil recovery (degraded area)

[.....] L – Composting

[.....] M – Contour barriers

[.....] N – Rainwater retention ditches

[.....] O – Use animal manure in plantation areas

[.....] P – Reuse of greywater to irrigate medium and large plants (e.g., banana, acerola and guava trees).

[.....] Q – Small irrigations with reusable materials.

[.....] R – Small localized irrigation with drip (plastic swab stick) to serve as a micro sprinkler.

[.....] S – Planting fruit trees, especially bananas near septic tanks and damp places (water outlets from the bath and kitchen sink).

[.....] T – Implementation of the Banana Circle.

[.....] U – Enrichment of areas with the planting of native species.

[.....] V – Thinning and Lowering of the Caatinga.

[.....] W – Forage support for the dry season.

[.....] X – Haying and silage practices with resources from the caatinga.

[.....] Y – Use of agroecological natural pesticides to combat plant pests and diseases.

[.....] Z – Ecological pasture for the animals with rotation of paddocks.

[.....] AA – Cleaning and hygiene of the chicken coop, corral, sheepfold and/or other facilities for animal husbandry.

[.....] AB – Vaccination of animals.

[.....] AC – Use of vermifuge to combat animal diseases.

[.....] AD – Quarantine on newly arrived animals.

[.....] AE – Isolation of sick animals.

[.....] AF – Navel disinfection in newborn sheep and goats.

[.....] AG – Use of native forage plants, such as matapasto, xanana and others to make hay to be used as animal feed in the dry season.

[.....] AH – Implementation of forage support adapted to the climatic conditions of the semiarid region.

[.....] AI – Implantation of bee pasture with native species of caatinga.

[.....] AJ – Rational water management (cisterns for human consumption and agricultural production).

[.....] AK – Protein bank in its diversity of forage species, sorghum and palm, guaranteeing the feeding of sheep and goats.

[.....] AL – Biodigesters integrated into pig farming, which in addition to protecting against soil and water pollution, produce biogas (avoiding the use of firewood for the oven) and organic fertilizer.

[.....] AM – None of the options.

110C. Has there been an improvement in the coexistence with the semiarid?

1 – Yes 2 – No

110D. How has the COVID-19 pandemic affected family life? Indicate the effects of the pandemic (multiple answer)

1 – Yes 2 – No

[.....] A – There were changes in the volume of production sales

[.....] B – There were changes in the way of accessing the market

[.....] C – There was a change in sales prices

[.....] D – There was a change in the prices of inputs

[.....] E – There was a reduction in household income

[.....] F – There was at least one household member infected with COVID-19

[.....] G – There was at least one household member who has passed away due to COVID-19

[.....] H – There were solidarity emergency actions in the community

[.....] I – There were preventive campaigns in the community

[.....] J – There was a reduction in the amount and diversity of food

J – AGRICULTURAL AND ENVIRONMENTAL PRACTICES

111. Between January and December 2020, did you adopt the following practices?

1 – Yes 2 – No

[.....] A – Use of irrigation

[.....] B – Use of watering

[.....] C – Use of agricultural burning

[.....] D – Use of pesticides

[.....] E – Use of chemical fertilizer

[.....] F – Use of organic compost

[.....] G – Use of manure

[.....] H – Use of crop residues (straws)

[.....] I – Intercropping

[.....] J – Crop rotation

[.....] K – Reforestation

[.....] L – Agroforestry System

112. Which crops are irrigated:

1 – Yes 2 – No/Not applicable

[.....] A – Fruit trees

[.....] B – Grass

[.....] C – Manioc/cassava

[.....] D – Corn

[.....] E – Beans

[.....] F – Vegetables (greens, roots, bulbs, tubers from productive backyards)

113. What type of water body (reservoir, if any) is there on the property:

1 – Yes 2 – No/Not applicable (go to 115)

[.....] A – Weir

[.....] B – Lagoon

[.....] C – Pond

[.....] D – Precast cistern

[.....] E – Polyethylene cistern

[.....] F – Other

114. What is the condition of the item above:

[.....] A – Silted up

[.....] B – With riparian forest

[.....] C – Without riparian forest

[.....] D – Other

115. How many streams run through the property? [.....] (if zero, go to 117)

116. What is the condition of the riparian forest? [.....]

1 – Absent 2 – Scarce 3 – Present

117. How many water springs on the property? [.....] (if zero, go to 120)

118. Wha tis the condition of springs? [.....]

1 – Degraded 2 – Poorly preserved 3 – Preserved

119. What is the use of spring water? (multiple answer)

1 – Yes 2 – No 3 – Does not use/Not applicable

[.....] A – Piped for domestic use

[.....] B – Destined for the community

[.....] C – Used for animal production

[.....] D – Used for irrigation

[.....] E – Flowing its natural course

[.....] F – Other use: [.....]

120. What is the destination of empty agrochemical containers? (multiple answer)

1 – Yes 2 – No 3 – Does not use/Not applicable

[.....] A – Returned at collection points

[.....] B – Buried/Burned/Thrown into the environment

[.....] C – Reused

[.....] D – Other destination: [.....]

121. What is the destination of household waste? (multiple answer)

1 – Yes 2 – No

[.....] A – Collected by the municipal system

[.....] B – Recycled

[.....] C – Buried/burned

[.....] D – Thrown into the environment

[.....] E – Separation of organic waste for composting

[.....] F – Other destination: [.....]

K – NUTRITION AND FOOD SECURITY

122. What is the origin of the food consumed by household members in the last 12 months? (multiple answer)

1 – Yes 2 – No

[.....] A – Donations from neighbors and relatives

[.....] B – From own farming production

[.....] C – Exchanges with neighbors and relatives

[.....] D – Donated by the government or other institutions

[.....] E – Purchased from neighbors or at fairs, warehouses, markets

[.....] F – Productive backyards

123. During the last 12 months, was there a time when household members had a hard time getting food, or even had nothing to eat? [.....]

1 – Yes 2 – No

124. How often does household members have a varied/diverse diet (vegetables, greens, fruits, meats, beans, rice, juice)? [.....]

1 – Always 2 – Sometimes 3 – Never happened 4 – Does not know, did not respond

125. In the last 7 days, have you eaten/consumed the items below?

1 – Yes 2 – No

[.....] Cereals

[.....] White tubers and roots

[.....] Vegetables

[.....] Fruits

[.....] Meat

[.....] Eggs

[.....] Fish and other seafood

[.....] Legumes, nuts and seeds

[.....] Milk and dairy products

[.....] Oil and fat

[.....] Candies

[.....] Spices, condiments and beverages

126. In general, how do you evaluate the household diet – in abundance and quality – in relation to 2020? [.....]

1 – Much better 2 – Better 3 – Equal 4 – Worst 5 – Much worst

L – GENDER AND YOUTH

127. In your household, do women actively participate in community activities or in the Association? [.....]

1 – Yes 2 – No

128. Which occupations have female household members held in the last 5 years? (multiple answer) [.....]

1 – Yes 2 – No

[.....] A – Agriculture and livestock

[.....] B – Processing and manufacturing of products

[.....] C – Public services (school, health center, etc.)

[.....] D – Services provision (maid, manicurist, nanny, seamstress, etc.)

[.....] E – Trade

[.....] F – Handicraft

[.....] G – Member of Association/Cooperative

[.....] H – Board member of Association/Cooperative

129. In your household, do young members actively participate in community activities or in the Association? [.....]

1 – Yes 2 – No

130. After the beginning of PPF, did any woman in your household begin to perform an activity that generates income (money)? [.....]

1 – Yes 2 – No

131. Did PPF activities have adequate and flexible schedules, which ensured the participation of women? [.....]

1 – Yes 2 – No

132. After PPF, was there any improvement in the redistribution/socialization of housework and care? [.....]

1 – Yes 2 – No

133. What are the occupations already carried out by young household members in the last 5 years? (multiple answer)

1 – Yes 2 – No

[.....] A – Agriculture and livestock

[.....] B – Processing and manufacturing of products

[.....] C – Public services (school, health center, etc.)

[.....] D – Services provision (maid, manicurist, nanny, seamstress, etc.)

[.....] E – Trade

[.....] F – Handicraft

[.....] G – Just study (studied)

[.....] H – Member of Association/Cooperative

[.....] I – Board member of Association/Cooperative

134. After the beginning of PPF, did any young household member begin to perform an activity that generates income (money)? [.....]

1 – Yes 2 – No

M – HOUSING

135. Type of home: [.....]

1 – House 2 – Shack 3 – Outros

136. Main material used for exterior walls: [.....]

1 – Masonry (brick, block) 2 – Adobe 3 – Wood 4 – Rammed earth 5 – Other temporary material (straw, canvas, plastic)

137. Main material used in the roof: [.....]

1 – Ceramic tile 2 – Concrete slab 3 – Zinc, asbestos, ethernit 4 – Other material (wood, straw, canvas, plastic)

138. Main material used in the floor: [.....]

1 – Masonry (cement, brick, block, tile, etc.) 2 – Wood 3 – Earthen floor

139. Number of bedrooms: [.....]

140. Is there a bathroom at home? [.....]

1 – Yes 2 – No

141. What was the main destination of household sewage? [.....]

1 – Sewage collection network 2 – Coated septic tank 3 – Uncoated septic tank 4 – Open air, ditch, river, lake or sea

5 – Other

142. Is there electricity at home? [.....]

1 – Yes 2 – No (if not, go to 138)

143. Type of electricity [.....]

1 – Single-phase 2 – Three-phase

144. Does the house have running water in at least one room? [.....]

1 – Yes 2 – No

145. What are the main sources of water used in the house? (multiple answer) [.....]

1 – Yes 2 – No

[.....] A – General distribution network (public network)

[.....] B – Well or spring (cacimba, cacimbão, fountain)

[.....] C – Cistern

[.....] D – Stream, lagoon, weir, dam, watery

[.....] E – Water truck

[.....] F – Desalinator

[.....] G – Other forms

146. In which year did you start having internet at home?

[.....] A – Before 2015

[.....] B – 2016

[.....] C – 2017

[.....] D – 2018

[.....] E – 2019

[.....] F – 2020

[.....] G – Does not have

N –SOCIAL CAPITAL

Associative experience

147. Have you ever participated in an association, union, community work, social movement, NGO, political party or community organizing work? [.....]

1 – Yes 2 – No (go to 149)

148. What kind of community associative activity/social organization have you participated in? (multiple answer)

1 – Yes 2 – No

[.....] A – Community, neighborhood, producer, cooperative associations

[.....] B – Collective work

[.....] C – Organized social movement (NGO, MST, MLT, FETAG, CONTAG, etc.)

[.....] D – Movements linked to churches

[.....] E – Unions

[.....] F – Youth group

[.....] G – Women group

[.....] H – Indigenous, Quilombolas and Fishers

[.....] I – Others (club, sports and social associations, etc.)

149. Do you know in which year the association was created? [.....]

1 – Yes 2 – No (go to 151)

150. In what year was the association created? [.....]

151. Did the association hold meetings in 2020? [.....]

1 – Yes 2 – No (go to 153) 3 – Does not know (go to 153)

152. How many association meetings did you attend in 2020? [.....]

1 – None 2 – Some 3 – All

153. Do you (or other household member) process the production through the association? [.....]

1 – Yes 2 – No

154. Is the commercialization of your production (or part of it) done through the association? [.....]

1 – Yes 2 – No

155. What benefits has the association brought to its members? [.....]

Experience in the IFAD project

156. When did you join the association? [.....]

1 – Before Project implementation 2 – During Project implementation 3 – After Project implementation 4 – Not applicable

157. Did you attend a meeting to choose the project? [.....]

1 – Yes 2 – No

158. In what year was the project implemented/started operating? [.....]

159. Main Productive Activities of the Project (multiple answer):

1 – Yes 2 – No

[.....] A – Beekeeping (extraction of honey, propolis, pollen, wax, etc.)

[.....] B – Goat farming

[.....] C – Sheep farming

[.....] D – Poultry farming

[.....] E – Pig farming

[.....] F – Aquaculture (fish, oyster, shrimp, etc.)

[.....] G – Agriculture, irrigated horticulture, irrigation

[.....] H – Productive Backyard

[.....] I – Plant extractivism

[.....] J – Processing of bee products

[.....] K – Processing of goat, sheep, poultry and swine products

[.....] L – Processing of aquaculture products

[.....] M – Processing of fruits (e.g., cashew, cajá, mango, acerola, seriguela, banana, coconut, watermelon, melon, passion fruit, guava)

[.....] N – Cassava processing and production of derivatives

[.....] O – Crafts and other non-agricultural activities (e.g., sewing, embroidery, wood, clay, leather, straw)

[.....] P – Artisanal fishing

[.....] Q – Other activities (agricultural and non-agricultural)

160. Do you consider yourself well informed about what the association does in project execution (project decisions, accountability, project execution, other initiatives)? [.....]

1 – Yes 2 – No

161. Are you (or other household member) included in any community investment plan? [.....]

1 – Yes 2 – No

162. Did you (or other household member) participate in actions of... (multiple answer):

1 – Yes 2 – No

[.....] A – Productive Investments

[.....] B – Technical advisory and assistance

[.....] C – Capacity-building

[.....] D – Access to public policies

[.....] E – Access to markets (private and/or institutional)

163. How many new job occupations were generated in the household as a result of PPF actions? [.....]

164. The training/capacity-building actions carried out by the Paulo Freire Project and Continuous Technical Assistance contributed to … (multiple answer)

1 – Yes 2 – No

[.....] A – learn about animal handling

[.....] B – learn to forage

[.....] C – increase production in the productive yard

[.....] D – learn to use natural pesticides

[.....] E – learn new water use and reuse techniques

[.....] F –better coexistence with the semiarid

[.....] G – learn about how to preserve/improve the environment

[.....] H – understand more about gender

[.....] I – know and use social technologies

APPENDIX 3

Based on the information identified in the PPF impact evaluation, this subsection presents the results obtained by the benefiting households in terms of agricultural activities. Considering the total number of households benefiting from agricultural and livestock investment projects, Table 1A shows the extrapolated results for the quantity produced and the value of sales, also showing the variation obtained between 2015 and 2020.

Table 1A. Evolution of the quantity and the value of sales of agricultural production of households benefiting from the Paulo Freire Project, extrapolation to the benefiting population

Activity	Households	Quantity (1,000)			Value of sales (BRL 1,000)		
		2015	2020	Δ%	2015	2020	Δ%
Poultry	7,599	155	337	117***	1,797.01	2,526.59	41***
Eggs	7,599	467	739	58**	704.35	1,531.81	117**
Sheep	5,788	40	76	88**	1,437.80	2,420.37	68***
Goats	5,788	48	60	24NS	2,561.71	3,350.96	31NS
Swine	2,740	10	24	140*	2,399.72	5,056.37	111NS
Honey	672	9	83	806NS	123.36	866.69	603*
Cassava	28	11	21	88NS	47,57	28.51	-67NS
Fruits	73	-	-	-	0,00	20.24	-
Vegetables	7,712	-	-	-	1,370.42	6,740.52	392***

Note: Quantity expressed in: (i) number of heads for poultry, sheep, goats and swine; (ii) dozens for eggs; and (iii) kilograms for honey. Value of sales expressed in values of December 2020. Superscripts indicate the statistical significance of the estimates. *** $p<0.01$; ** $p<0.05$; * $p<0.1$; NS $p>0.1$.

Source: Research results.

In terms of quantity, all items analyzed showed positive variation during the period investigated. Statistically significant intertemporal differences were obtained for poultry (both birds and egg production), sheep and swine. On the other hand, the quantities produced in 2015 and 2020 were not statistically different for goats, honey and cassava.

Regarding poultry, both the quantity and the value of sales of birds showed a positive variation in the time interval considered. The increase in quantity was comparatively greater than the growth in the value of sales. This scenario, together with the one identified for eggs, may indicate that the Project had a great impact on poultry farming of benefiting communities.

Although the baseline and endline surveys collected data for sheep and goats separately, the Project, within the scope of the PIPs, considers sheep and goat farming together, so that the

number of families considered for extrapolation is the same for the two activities. Both in terms of quantity and value of sales, the evolution among sheep was higher than among goats.

Still with regard to livestock, pig farming stands out as the activity that presented the highest relative growth in terms of quantity. In fact, the swine herd of those benefiting from the Project grew by approximately 140% between 2015 and 2020. As for the value of sales, the evolution was also expressive, more than doubling during the period considered.

In general, beekeeping was the activity that showed the most significant progress between the years analyzed. This is valid both for the quantity produced and for the value of honey sales. On the one hand, the amount of honey produced by benefiting farmers grew by more than 800%, surpassing 80 tons in 2020. On the other hand, the value of sales is approaching the BRL 1,000,000.00 mark.

Cassava showed a distinct evolution between quantity and value of sales, with an increase in the former and a decrease in the latter. The quantity produced grew by more than 80%, whilst the value of sales decreased by more than 60%. This is an indication of a possible increase in the self-consumption of this product.

Due to the difficulty in standardizing the data referring to the production of fruits and vegetables, these analyses are done only in terms of the value of sales. The data collected in the baseline questionnaire indicate that the sale of fruits was virtually non-existent among PPF beneficiaries in 2015. Vegetables, in turn, showed significant growth in the value of sales during the years investigated.

Still based on the information collected in the baseline and endline surveys, but now without extrapolating the data to the total number of benefiting households, the evolution of agricultural productivity is analyzed (Table 2A). Given the importance for regional agriculture, the crops investigated were fava beans, beans and corn. Even though they were not included in PIPs, such cultures could be influenced by ACT actions.

Table 2A. Evolution of crop yield for selected crops, Paulo Freire Project

Crop	Crop yield		
	2015	2020	Δ%
Fava beans	33.05	72.84	120^{NS}
Beans	59.14	38.11	-36*
Corn	178.84	155.00	-13^{NS}

Note: Crop yield expressed in kilograms per hectare. Superscripts indicate the statistical significance of the estimates. *** p<0.01; ** p<0.05; * p<0.1; ^{NS} p>0.1.

Source: Research results.

Of the three crops investigated, only fava beans showed a positive evolution in terms of crop yield in the interval between 2015 and 2020. Even if expressive, the difference in the average yield of this crop was not statistically significant. Both beans and corn, on the other hand, showed a decrease in average crop yield, with the difference calculated for the former being statistically different from zero.

In the evaluated region, fava beans, beans and corn are mainly rainfed. Water availability depends, most of the time, on the random realizations of the climate. Thus, the periodic occurrence of drought events may explain the average drop in crop yields. In the long term, given the benefits granted by PPF, producers can migrate from grain production to the Project's focus activities.

Differently from agricultural production, measuring the productivity of livestock production based on the data collected in the baseline and endline surveys is comparatively more complex. This is true as herd (or stock) size is measured in numbers of animals, while production sold is usually measured in terms of weight (kilograms).

To circumvent the limitations highlighted above, two yield measures of livestock production were used. First, the ratio between the total value of sales and the total value of animals was considered, which provides an approximation of the percentage of production that was effectively sold. Second, the ratio between the quantity sold (kilograms) and the size of the herd (number of animals) was analyzed.

Table 3A presents the aforementioned indicators, calculated for the treatment group, for the years 2015 and 2020. The ratio between the value of sales and the total value of animals increased for all activities, more than doubling for poultry, sheep and goat farming. Regarding the ratio between the production sold and the number of animals, the evolution was comparatively lower, with a decrease for pig farming.

Table 3A. Evolution of the indicators of livestock yield for the farmers benefiting from the Paulo Freire Project

Activity	Value of sales / Total value of animals			Production sold / Number of animals		
	2015	2020	Δ%	2015	2020	Δ%
Poultry	0.29	0.61	110*	0.67	0.99	48NS
Sheep	0.19	0.40	111**	5.81	6.03	4NS
Goats	0.17	0.51	200**	3.49	7.39	112*
Swine	0.80	1.14	43NS	62.27	14.99	-76NS

Note: Superscripts indicate the statistical significance of the estimates. *** p<0.01; ** p<0.05; * p<0.1; NS p>0.1.

Source: Research results.

APPENDIX 4

Table 2A. Summary of the results obtained by the impact assessment

Indicator	Result
Socioeconomic factors	
Participation of women and the youth in community actions	▲
Associativism	▼
Housing	△
Access to public policies	▲
Access to agricultural policies	△
Drought	△
Poverty (monthly per capita income)	▼
Agroecological and sustainable practices	▲
Nutrition and food safety	△
Agriculture and livestock	
Poultry (quantity)	▲
Poultry (value of sales)	△
Eggs (quantity)	▲
Eggs (value of sales)	▲
Sheep (quantity)	▼
Sheep (value of sales)	▼
Goats (quantity)	△
Goats (value of sales)	△
Swine (quantity)	▲
Swine (value of sales)	△
Honey (quantity)	▼
Fava beans (quantity)	▼
Beans (quantity)	△
Corn (quantity)	▼
Fruits (production value)	▲
Vegetables (production value)	▲

Note: Triangle facing up indicates positive estimate. Triangle facing down indicates negative estimate. Gray triangle indicates null impact (estimate statistically equal to zero). Green triangle (facing up) indicates positive impact. Red triangle (facing down) indicates negative impact.

Source: Research results.