



Impact Evaluation Report

RURAL SUSTAINABLE DEVELOPMENT PROJECT IN THE SEMIARID REGION OF BAHIA – PRÓ-SEMIÁRIDO





Impact Evaluation Report – Rural Sustainable
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Pró-Semiárido

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LIST OF ACRONYMS AND ABBREVIATIONS

ATER – Technical Assistance and Rural Extension
CAR – Regional Development and Action Company
CONTAG – National Confederation of Agricultural Workers
DAP – Declaration of Eligibility to Pronaf
FETAG – Federation of Agricultural Workers
IFAD – International Fund for Agricultural Development
MPI – Multidimensional Poverty Index
MEI – Individual Microentrepreneur
MLT – Land Fight Movement
MST – Landless Workers’ Movement
NGO – Non-Governmental Organization
PAA – Food Acquisition Program
PBSM – Brazil Without Extreme Poverty Plan
PNAE – National School Feeding Program
Pró-Semiárido – Rural Sustainable Development Project in the Semiarid Region of Bahia
Pronaf – National Program for Strengthening Family Farming
PSF – Family Health Program
SEAF – Family Farming Insurance

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The Rural Sustainable Development Project in the Semi-arid Region of Bahia (Pró-Semiárido), which started operating in 2014, aims to contribute to the reduction of rural poverty in the semi-arid region of northern Bahia via income generation, increases in production, creation of agricultural and non-agricultural work opportunities, and development of human and social capital, with special attention to women and the youth. It is a partnership between the Government of Bahia and the International Fund for Agricultural Development (IFAD), which involves a total amount of approximately US\$ 105 million.

Since its inception, Pró-Semiárido has already benefited more than 75,000 families by offering continuous and specialized technical assistance and rural extension (ATER) services, by promoting activities of water security and sustainable production, agro-industrialization and commercialization of production, and access to public policies for rural areas and family farming. The area covered by Pró-Semiárido involves 32 municipalities, which are distributed among five identity territories: Bacia do Jacuípe, Piemonte da Diamantina, Piemonte Norte do Itapicuru, Sisal and Sertão do São Francisco.

In this report, the performance of families benefiting from Pró-Semiárido was compared with non-benefiting ones, before and after the implementation of the Project. With that, the impact of the initiatives conducted under Pró-Semiárido was measured on a set of indicators. To this end, the methods of Entropy Balancing and Difference-in-Differences were used. In an innovative manner, the Multidimensional Poverty Index was also calculated, thus considering poverty as a multifaceted phenomenon.

The data used in the investigation were collected through the application of two surveys at different points in time. The baseline survey was applied in 2018 (base-year 2017) and the endline survey was applied in 2023 (base-year 2022). Ultimately, the analyzed sample comprised 1,162 households, of which 751 were benefited by Pró-Semiárido initiatives, forming the treatment group. The remaining 411 households were not exposed to Project interventions, thus corresponding to the control group.

The document presents a descriptive analysis of benefiting and non-benefiting families based on the information collected in the baseline and endline surveys. This information enabled the characterization of households and their residents, household income, family goods and assets; the effects of drought on family assets; the agricultural and environmental practices adopted; aspects of food security, gender and youth; housing conditions; and, finally, social capital.

The impact of Pró-Semiárido was estimated for a set of socioeconomic indicators, as well as for variables related to agricultural activity (quantity produced and value of sales). In order to investigate the possibility that the Project had a different impact on beneficiaries according to their characteristics, separate models were estimated according to the sex and age of the heads of household.

Regarding the investigation of multidimensional poverty, it was noticed that the prevalence of poor families decreased between 2017 and 2022, both for the treatment and control groups, although the former showed a decrease considerably greater than the latter. The index showed a decrease of more than 20 percentage points for benefiting families, signaling that the interventions actions carried out under the Project have exerted a positive influence in reducing the level of multidimensional poverty.

The analysis of the impact on socioeconomic indicators showed that Pró-Semiárido had a positive effect on most of the variables analyzed, with the exception of the participation of women and young people in community actions and the level of food security. These results indicate that the Project was effective in increasing the level of associativity, the access to public policies in general and agricultural policies in specific, drought tolerance, and the adoption of agroecological and sustainable practices.

By stratifying the sample in terms of the gender and age group of the head of household, the impact evaluation proved that the Project has a heterogeneous effect on its beneficiaries. The impacts of Pró-Semiárido on socioeconomic indicators seem to have been especially concentrated in households other than the youth-headed ones. For agricultural indicators, on the other hand, impacts seem to have been concentrated in male-headed households.

Despite these results, one cannot conclude that the Project has not been effective in benefiting individuals from the focus groups. As observed

in the description of the data, the socioeconomic situation of the individuals in the focus groups showed improvements in several aspects. Therefore, the fact that few significant estimates of the impact of the Pró-Semiárido on women- and youth-headed households were found is possibly related to the sample size than to the effectiveness of the Project.

With regard to the impacts of Pró-Semiárido on agricultural and livestock activities, the value of sales for the agricultural sector in general was analyzed, in addition to its subdivisions: agriculture (plant production and plant-based products) and livestock (animal production and animal-based products). Regardless of the level of aggregation, no impact of the Project was identified, given that all coefficients estimated by the Difference-in-Differences model were statistically equal to zero.

As explained in the methodological section, the present study focused solely on the results achieved by individual farmers, thus focusing on community agreements. As a consequence, the results induced by Pró-Semiárido on economic organizations (cooperatives and farmers associations) benefited by the Project were disregarded. The lack of impact on the agricultural indicators of farmers benefiting from Pró-Semiárido may be an indication that, when considering the productive dimension, Project benefits may have reached farmers indirectly, based on their participation in economic organizations.

With regard to the Project's outcome variables, which were extracted from the Logical Framework, a very positive balance was obtained. This is especially true for the ownership of domestic assets, the adoption of innovative practices and the evolution of agricultural production. Despite the fact that the growth rates of the quantities produced and sold and of the proportion of families with increased income did not reach the established goals, the results achieved were very close to surpassing the thresholds initially defined.

Finally, it should be noted that the period between 2017 and 2022 was considerably atypical due to the COVID-19 pandemic. The economic and social consequences of the pandemic possibly affected the families analyzed in a number of dimensions. That is, adverse shocks triggered by the COVID-19 pandemic may have contributed to the estimation of modest or non-existent impacts on some indicators, even though there may have been other important positive effects not captured by the model employed and the variables used.

1. INTRODUCTION

1.1 Context

Brazil is one of the countries with the largest number of rural development projects carried out in partnership with the International Fund for Agricultural Development (IFAD), all of which are focused on the Northeast region. Since 1980, the country hosted 13 projects (closed or ongoing), which, together, add up to investments of around USD 1,180,000,000. Of the total invested, approximately 24% was financed by the IFAD. It is estimated that more than 615,000 families have benefited or are still benefiting from the actions of these rural development projects.

Among ongoing IFAD-financed projects, the Rural Sustainable Development Project in the Semiarid Region of Bahia worth stressing. Also known as Pró-Semiárido, it was established in 2014, when the Government of the State of Bahia, through the Regional Development and Action Company (CAR), signed a financing agreement of USD 45,000,000 with IFAD for the execution of the project, whose total budget is USD 105,000,000.

The Pró-Semiárido operates in the rural areas of 32 municipalities from the semiarid region of Bahia, which are located in the central-north part of the state. These municipalities belong to five identity territories (Bacia do Jacuípe, Piemonte de Diamantina, Piemonte Norte do Itapicuru, Sisal and Sertão do São Francisco), having been chosen based on their high levels of poverty, social exclusion and aridity. In these locations, the Project works with rural communities and economic organizations (e.g., farmers associations and cooperatives).

1.2 Description of the Pró-Semiárido Project

The main objective of Pró-Semiárido is to contribute to the reduction of rural poverty. To this end, the Project focuses on generating

income, increasing production, creating opportunities for agricultural and non-agricultural work, and developing human and social capital, with emphasis on women and young people. The communities served by Pró-Semiárido interventions were chosen according to the prevalence of poverty, while economic organizations were selected according to their representativeness, their capacity and their potential for productive development.

The Project is operationalized through 3 (three) main components, namely: (1) Development of Human and Social Capital, (2) Productive Development and Markets and (3) Management. The first component aims at the associative and individual empowerment necessary to promote the sustainable development of benefiting families, both in their communities and in the economic organizations in which they participate.

The second component aims to support initiatives that help boost and intensify agricultural production, in addition to promoting the sustainable use of natural resources based on the principles of coexistence with the semiarid region. It also aims to finance productive investments focusing on improving agricultural production; develop non-agricultural processing and business activities, marketing, adoption of innovative production practices and sustainable management of natural resources.

The third and final component is responsible for the management, monitoring and evaluation of Project's execution, as well as knowledge management.

1.3 Justification

Pró-Semiárido's Impact Evaluation will determine to what extent the interventions carried out under the Project have contributed to changes in the economic and living conditions of participating families, observed in the beneficiary units of the analyzed project, from 2017 onwards, given the different characteristics related to the poverty of the target population in the semiarid region of Northeastern Brazil (family farmers, women and rural youth). These results are indispensable for the Project Completion Report.

Studies that aim to measure the impact of some type of intervention on one or several types of outcomes of interest have direct political relevance,

since successful treatments can be related to desirable social programs or improvements in existing ones to achieve the objectives of social policy (CAMERON; TRIVEDI, 2005). This type of study is important to add evidence regarding the results associated with analyzed projects, with the aim of contributing to the debate about its limitations, scope, ability to generate expected positive impacts or not for its beneficiaries.

The preparation of impact evaluation studies allows the provision of subsidies for solving open problems, which may indicate the complete resolution of the issues that the policy aimed to resolve, by redirecting the intervention, as well as the focus and design of the policy, when it can still be changed. Finally, it can also serve as a basis for the beginning of a new cycle of policies, which may be implemented in the future.

2. METHODOLOGY

This section describes the methods used to identify the impacts of Pró-Semiárido. In addition to the use of traditional impact evaluation techniques, the investigation also relied on the calculation of a multidimensional poverty indicator (MPI), in order to improve the measurement of Project's effects. The complexity of poverty was considered in terms of a economic and social phenomenon, thus going beyond the simple use of income as a unidimensional indicator of poverty.

This section is organized into four parts, as follows. First, the calculation of the multidimensional poverty indicator is detailed. Second, the strategy used to build the control group is highlighted, which is used as a counterfactual to the group of individuals benefited by Pró-Semiárido. Third, the method used to effectively estimate Project's impacts on beneficiaries is presented. Finally, the process of defining the sample used in the evaluation is presented.

2.1 Multidimensional Poverty Indicator

The measurement of multidimensional poverty was performed by calculating the Multidimensional Poverty Index (MPI) proposed by Alkire and Foster (2011). The IPM is based on the ideas of Amartya Sen, who considers poverty as a multidimensional phenomenon that impacts individuals in different ways. As such, the measurement of poverty must include different types of deprivation. Therefore, in addition to income, other dimensions were defined to measure the well-being of families.

According to Fabel, Teles and Caminhas (2016), the calculation of MPI initially requires the establishment of a cutoff for the poverty line. In other words, it is fundamental to identify the households – the level of aggregation used in this study – in a situation of poverty. Thus, each unit of analysis receives a deprivation score (from 0 to 1 or 0% to 100%) based on its deprivation in

selected the indicators that make up the index, which is calculated from the weighted sum of the deprivations experienced.

The household is identified as poor, in multidimensional terms, if it suffers deprivation in X% of the indicators. The deprivation score assigned to each household increases as the number of deprivations grows, reaching its maximum (1 or 100%) when it is identified that the household is deprived of all the indicators considered in the analysis. On the other hand, the household that is not deprived of any of the analyzed indicators receives a score equal to 0 or 0%.

Formally, the deprivation score, c_i , is given by::

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

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

The poverty cutoff, denoted by k , corresponds to the (weighted) proportion of deprivations that the household must have to be considered poor. Thus, the household is considered poor, in multidimensional terms, if the deprivation score is equal to or greater than the poverty cutoff ($c_i \geq k$). For non-poor households, the deprivation score is censored at 0, i.e., if $c_i \geq k$, then $c_i(k) = c_i$, but if $c_i < k$, then $c_i(k) = 0$. Therefore, $c_i(k)$ is the deprivation score of the households considered poor.

The MPI is effectively obtained by multiplying two factors: the incidence of poverty (H) and the intensity of poverty (A). The incidence of poverty corresponds to the proportion of analyzed households that are classified as multidimensional poor. The intensity of poverty, in turn, is given by the average deprivation score of poor households. In mathematical terms, the MPI is obtained as follows:

$$IPM = H \times A = \frac{q}{n} \times \frac{\sum c_i(k)}{q} = \frac{\sum c_i(k)}{n}$$

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

Following Fahel, Teles and Caminhas (2016), the analyzed households are classified as poor when the deprivation score is equal to or greater

than 33.3%. The IPM considers six dimensions: Income, Social Capital, Human Capital, Food Security, Housing Conditions, and Sustainability. These dimensions are equally weighted and so are the indicators for each dimension. Table A1, in the Appendix, describes the dimensions and their respective indicators.

2.2 Constructing the counterfactual: Entropy Balancing

Entropy Balancing was used in order to obtain a sample of households that are comparable to beneficiaries according to a set of observable characteristics. Proposed by Hainmuller (2012), this non-parametric data pre-processing method allows the weighting a set of observable variables, such that the distributions of these variables in the weighted observations satisfy a set of special conditions of the moments of the distributions.

Instead of specifying a parametric model that explains the probability of treatment participation (e.g., Propensity Score Matching), the method assigns weights to each control unit so that, after weighting, a set of equilibrium constraints are satisfied, which are imposed on the moments of the distributions of the explanatory variables (e.g., mean, variance, and symmetry). This ensures balance and similarity between the control and treatment groups (COSTA; FREITAS, 2018).

In the present study, the equilibrium constraint concerns the adjustment of the first moment (mean) of the explanatory variables. For all explanatory variables, which were selected based on their influence on the probability of the individual being a beneficiary of Pró-Semiárido, the method calculates the sample mean of the treatment group and, with that, searches for a set of entropy weights such that the weighted means of the control group are similar to the mean of the treatment group.

Taking 2017 as the base-year, Entropy Balancing considered the following observable variables: (i) sociocultural identification of the community (settlement, quilombola community, rural community); (ii) participation in the Bolsa Família Program; (iii) possession of durable goods (e.g., refrigerator, stove, motorcycle); (iv) household density; (v) gender of the head of household; (vi) number of children; (vii) effects of drought episodes; and (viii) level of education of the head of household.

As explained by Haimueller (2012), the limitations of the Entropy Balancing method are associated with the imposition, by the researcher, of balancing restrictions that are unrealistic or even inconsistent. The main obstacle can arise when, even with the specification of consistent balancing constraints, there is no positive set of weights that actually satisfies the constraints.

Such a situation can occur when, with a limited database, extreme balancing constraints are specified, i.e., constraints that are far from the data available for the control group. If there is not a satisfactory number of controls that are relatively similar to the treated ones, then the available data does not contain enough information for the construction of the counterfactual of interest.

Due to the way in which the sampling plan for the evaluation of Pró-Semiárido's impact was built, it is expected that problems of this nature do not influence research results. In fact, when testing the difference between the treatment and control groups in the means of the variables observed before balancing, statistical significance is observed for only four of them.

2.3 Estimating the impact: Difference-in-Differences

Data preprocessing and the consequent construction of the control group to be used as a counterfactual for the treatment group allow estimating the impact of the Project on benefiting families. For this purpose, the Difference-in-Differences method was used, in order to compare changes in outcome variables over time between beneficiaries and non-beneficiaries. The application of the method enables the identification of the impact associated solely and exclusively with the participation in Pró-Semiárido.

Denoting the outcome variable by $Y_{g,t}$, in which g indicates the group (1 = treatment, 0 = control) and t indicates the time (1 = 2022, 0 = 2017), the method is illustrated according to Table 1. In the first step, the intertemporal difference of the outcome variable is obtained for each group analyzed ($\Delta\bar{Y}_1$ for the treatment group and $\Delta\bar{Y}_0$ for the control group). In the second, the impact of the Project is estimated by subtracting the intertemporal difference calculated for the treatment group from the intertemporal difference calculated for the control group.

Table 1. Method of Difference-in-Differences

Time	Group	
	Treatment (g = 1)	Control (g = 0)
2017 (t = 0)	$\bar{Y}_{1,0}$	$\bar{Y}_{0,0}$
2022 (t = 1)	$\bar{Y}_{1,1}$	$\bar{Y}_{0,1}$
1 st difference	$\Delta\bar{Y}_1 = \bar{Y}_{1,1} - \bar{Y}_{1,0}$	$\Delta\bar{Y}_0 = \bar{Y}_{0,1} - \bar{Y}_{0,0}$
2 st difference	$\Delta\bar{Y}_1 - \Delta\bar{Y}_0$	

Source: Elaborated by the authors.

In econometric terms, the Difference-in-Differences method can be specified as follows:

$$Y_{it} = \beta_0 + \beta_1 PSA_{it} + \beta_2 T_{it} + \beta_3 D_{it} + u_{it}$$

where Y_{it} denotes the outcome variable for the household i , in year t ; PSA is a dummy that takes a value equal to 1 for the treatment group and 0 for the control group; T is a dummy that takes a value equal to 1 for 2022 and 0 for 2017; D is an interaction dummy between treatment status and the time period, taking a value equal to 1 only for the treatment group in 2022.

The variable of time period (T) and treatment status (PSA) are included separately to capture the variation in outcome between the two periods, as well as the unobserved heterogeneity of the beneficiary group. In this regard, β_3 is the main coefficient of interest, representing the estimate of Pró-Semiárido's impact on the outcomes of benefiting families (KHANDKER; KOOLWAL; SAMAD, 2010). Furthermore, it is worth stressing *destaca-se* que u_{it} se refere ao erro aleatório.

An important issue concerns the possibility of heterogeneous effects depending on beneficiaries' characteristics. Since women and young people correspond to two of the groups targeted by the interventions conducted under the Project, the model was also estimated considering: i) only women-headed households; ii) only male-headed households; iii) only youth-headed households and iv) only non-youth-headed households.

To capture the different dimensions of well-being, nine indicators were used as outcome variables: (i) the participation rate of women and young

people in community actions; (ii) indicator of associativity; (iii) indicator of housing conditions; (iv) indicator of access to public policies; (v) indicator of access to agricultural policies; (vi) indicator of drought effects; (vii) indicator of poverty; (viii) indicator of adoption of agroecological and sustainable practices; and (ix) indicator of nutrition and food security. Such indicators are described in Table A2 (Appendix).

Taking the nature of the benefits granted by the Pró-Semiárido Project into consideration, with a special focus on Investment Projects, the impact on agricultural and livestock activity was also evaluated. To this end, the quantity and value of sales were evaluated, as well as the value of family self-consumption. For the evaluation of household revenue, monetary values recorded for the base-year 2017 were deflated using the Extended National Consumer Price Index (IPCA), thus being expressed in real terms of December 2022.

2.4 Defining the sample

The data used in the impact evaluation comprise two moments in time: before and after the materialization of benefits related to participating in Pró-Semiárido. Information related to the period before the maturation of Project benefits were collected through the baseline survey (base-year 2017), while post-intervention data were obtained through the endline survey (base-year 2022). Households benefited (treatment group) and non-benefited (control group) by the Project were considered.

The research universe exclusively covers family farmers in the semiarid region of northern Bahia. In other words, the focus of the research falls on the effects of community work plans prepared under Pró-Semiárido. Therefore, any other investments that are not within the community agreements are disregarded, and economic organizations for which business plans have been prepared are not included in the analysis.

The baseline survey applied by PLAN covered a total of 2,512 households, while the endline survey applied by Praxis covered a total of 2,521 households. After matching the data from the two surveys, the final sample to be used in the impact evaluation study was defined. Specifically, the analysis of Pró-Semiárido impacts considered a total of 1,162 households,

of which 751 from the treatment group (beneficiaries) and 411 from the control group (non-beneficiaries). Even with the non-use of the complete database, the sampling error did not exceed the 5% level¹.

The geographic distribution of the households analyzed in the impact evaluation is depicted in Figure 1. Families that make up the treatment group are shown in green and those that belong to the control group are marked in red. Sampled households are distributed throughout the area assisted by Pró-Semiárido in the state of Bahia, which comprises five identity territories: Bacia do Jacuípe, Piemonte da Diamantina, Piemonte Norte do Itapicuru, Sisal and Sertão do São Francisco.

¹ Considering a population of 75,000 households benefiting from Pró-Semiárido and a confidence level of 95%, the sampling error associated with the sample of 751 households is 3.56%.

3. DESCRIPTIVE ANALYSIS

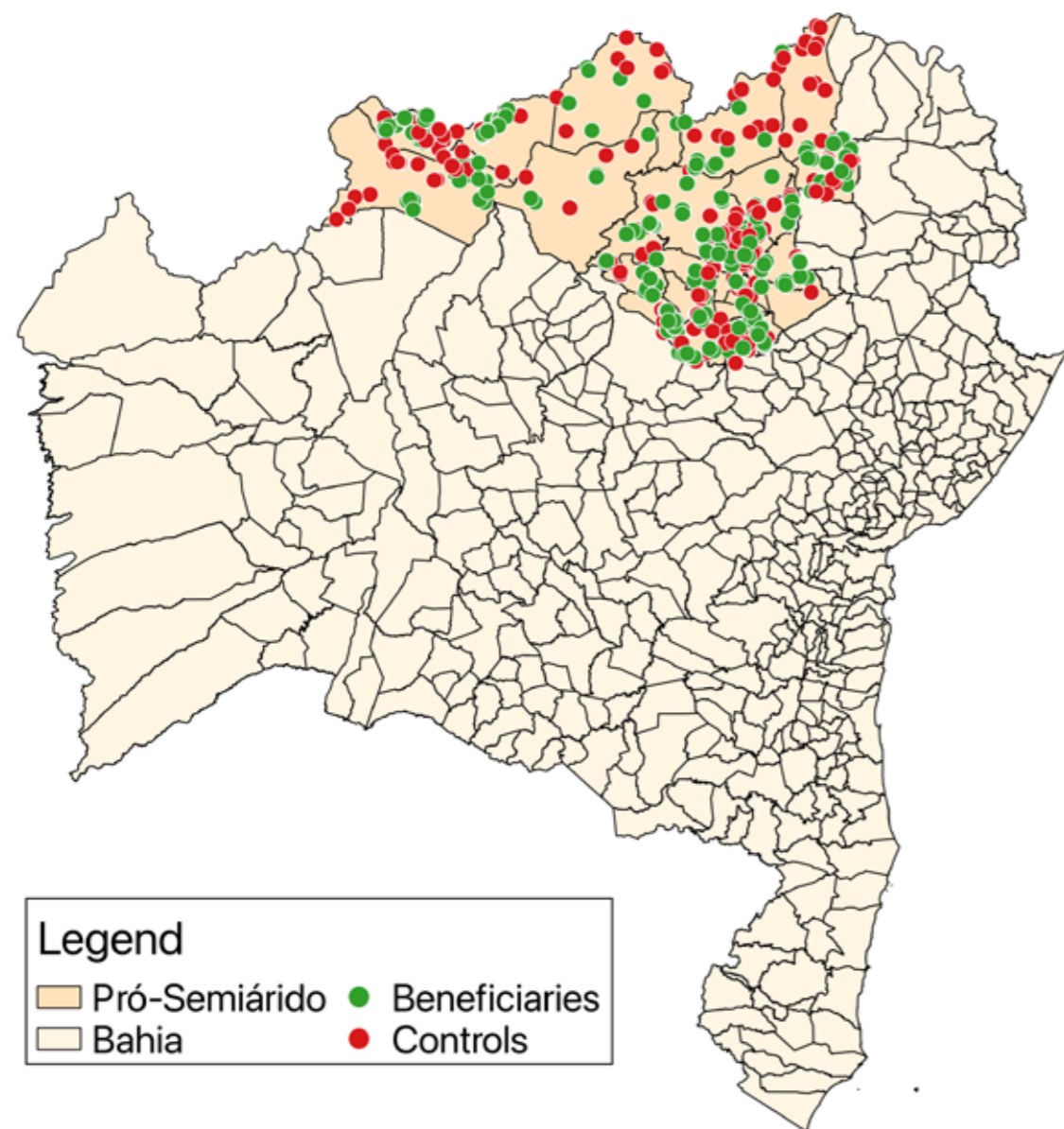
3.1 Describing the sample

This subsection provides a brief description of the sample used in the present study. Tables 2 and 3 present the geographic distribution of the sample within the municipalities from the state of Bahia in terms of the number of households visited and the total number of residents. Table 2 contemplates the treatment group, while Table 3 concerns the control group.

Table 2. Sample distribution by municipality, treatment group

Municipality	Households		Residents	
	2017	2022	2017	2022
Andorinha	12	12	37	13
Antônio Gonçalves	24	24	82	40
Caldeirão Grande	12	12	50	42
Campo Alegre de Lourdes	47	47	177	141
Campo Formoso	80	80	277	218
Capim Grosso	13	13	51	25
Casa Nova	33	33	154	42
Caém	13	13	56	22
Curaçá	14	14	49	44
Filadélfia	30	30	118	91
Itiúba	29	29	103	126
Jacobina	17	17	61	49
Jaguarari	22	22	82	74
Juazeiro	19	19	70	62
Miguel Calmon	29	29	109	91
Mirangaba	9	9	30	21
Ourolândia	28	28	91	37
Pilão Arcado	60	60	264	155
Pindobaçu	15	15	48	19

Figure 1. Distribution of households sampled for the impact evaluation.



Source: Elaborated by the authors.

Ponto Novo	5	5	16	27
Queimadas	20	20	85	72
Quixabeira	20	20	71	35
Remanso	32	32	112	60
Saúde	10	10	34	19
Senhor do Bonfim	22	22	85	65
Sento Sé	18	18	69	31
Serrolândia	18	18	53	21
Sobradinho	2	2	8	5
Uauá	65	65	211	170
Umburanas	18	18	62	38
Várzea do Poço	1	1	2	1
Várzea Nova	14	14	47	38
Total	751	751	2764	1894

Source: Research results.

As previously explained, the treated sample comprises 751 households, which are geographically distributed in 32 different municipalities. Together, these households had 2,764 and 1,894 residents in 2017 and 2022, respectively. The control group, in turn, is composed of 411 households, which are located in 28 different municipalities. The total number of residents in this group was 1427 in 2017 and 1019 in 2022.

Table 3. Sample distribution by municipality, control group

Municipality	Households		Residents	
	2017	2022	2017	2022
Andorinha	8	8	23	8
Caldeirão Grande	5	5	22	16
Campo Alegre de Lourdes	36	36	128	111
Campo Formoso	41	41	143	96
Capim Grosso	3	3	11	5
Casa Nova	17	17	67	24
Curaçá	38	38	142	115

Filadélfia	14	14	42	24
Itiúba	3	3	12	12
Jacobina	20	20	59	46
Jaguarari	13	13	43	41
Juazeiro	15	15	48	37
Miguel Calmon	22	22	78	55
Mirangaba	5	5	15	12
Ouroândia	6	6	17	18
Pilão Arcado	35	35	119	82
Pindobaçu	3	3	10	4
Queimadas	4	4	16	10
Quixabeira	6	6	18	6
Remanso	16	16	58	28
Saúde	7	7	22	11
Senhor do Bonfim	27	27	110	86
Sento Sé	8	8	30	13
Serrolândia	15	15	44	45
Uauá	31	31	97	82
Umburanas	4	4	23	15
Várzea do Poço	3	3	12	3
Várzea Nova	6	6	18	14
Total	411	411	1427	1019

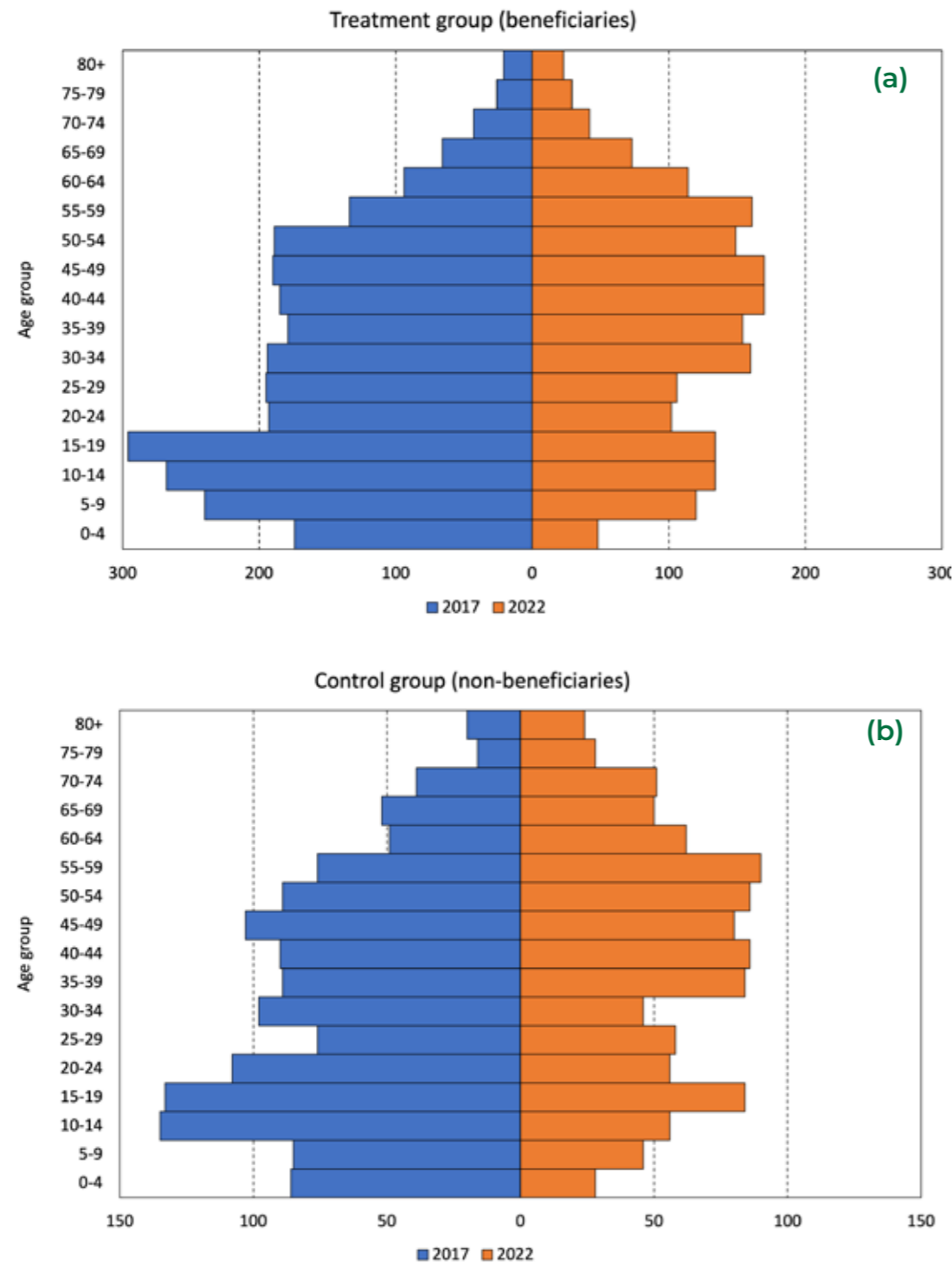
Source: Research results.

Data presented in Tables 2 and 3 indicate that there was a decrease in the average number of residents in the investigated households. This is true regardless of the group considered. Between 2017 and 2022, the average number of residents in the treatment group decreased from 3.68 to 2.52. In that same period, the average calculated for the control group dropped from 3.47 to 2.48 residents.

By presenting the age pyramid for the treatment and control groups (2017 and 2022), Figure 2 helps to understand the dynamics of the decrease in the average size of the investigated households. For both the treatment and control groups, the greatest drop was seen among young people, which, however, was not offset by an increase in the number of individuals over 30

years of age. Thus, this is evidence that most individuals who were young in 2017 were already living in another household in 2022.

Figure 2. Population pyramid for (a) treatment group and (b) control group, 2017 and 2022.



Source: Research results.

3.2 Identification of respWherents

This subsection seeks to outline a general profile of the families included in the sample analyzed. To this end, the characteristics of the households and communities, the productive activities carried out and the social benefits and public services accessed by the members of the investigated families are highlighted. Such information is presented in Tables 4, 5, 6, 7, 8, 9 and 10.

Table 4. Sociocultural identification of the community

Community characterization	Treatment		Control	
	2017	2022	2017	2022
Settlement	151 (20.11)	151 (20.11)	28 (6.81)	28 (6.81)
Black or quilombola	143 (19.04)	143 (19.04)	41 (9.98)	41 (9.98)
Common grassland	200 (26.63)	200 (26.63)	83 (20.19)	83 (20.19)
Rural community	279 (37.15)	279 (37.15)	235 (57.18)	235 (57.18)
Not specified	181 (24.10)	181 (24.10)	82 (19.95)	82 (19.95)

Note: The sum exceeds the total of households because each family could have more than one sociocultural identification.

Source: Research results.

Table 4 shows the sociocultural identification of the community as respWhered by interviewees. The households that make up the studied sample are predominantly located in rural communities. It is also worth stressing the percentage of households located in common grassland communities, especially for the treatment group.

In this study, the homes of interviewees were classified as clustered and diffused, as shown in Table 5. For both groups, there was an increase in the prevalence of diffused buildings. In this case, the control group stands out, considering that, during the period studied, the proportion of diffused buildings grew by approximately 20 percentage points.

Table 5. Housing characterization

Housing characterization	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Clustered	373	319	▼	211	134	▼
	(49.67)	(42.48)	-17%	(51.34)	(32.60)	-57%
Diffuse	378	432	▲	200	277	▲
	(50.33)	(57.52)	+14%	(48.66)	(67.40)	+39%

Note: Percentage in parenthesis.

Source: Research results.

The distribution of families in terms of the main productive activities practiced by their members can be seen in Table 6. Regardless of the group and year considered, the most recurrent productive activities are: i) production of goats, sheep or free-range chicken; ii) agricultural production and iii) beekeeping.

Thus, it is evident that most of the families that make up the analyzed sample are engaged in agricultural activities. It is worth mentioning, however, that the percentage of families that process agricultural products is relatively small. Even so, it is necessary to point out that the present investigation focuses on community agreements, instead of the agreements signed by economic organizations, which concentrate the processing of agricultural products.

Table 6. Main productive activities

Main productive activities	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Beekeeping	120	132	▲	48	47	▼
	(15.98)	(17.58)	+10%	(11.68)	(11.44)	-2%
Processing	20	19	▼	4	1	▼
	(2.66)	(2.53)	-5%	(0.97)	(0.24)	-75%
Goat, sheep, free-range chicken	701	599	▼	374	284	▼
	(93.34)	(79.76)	-15%	(91.00)	(69.10)	-24%
Processing	76	32	▼	29	11	▼
	(10.12)	(4.26)	-58%	(7.06)	(2.68)	-62%
Aquiculture	11	17	▲	14	6	▼
	(1.46)	(2.26)	-55%	(3.41)	(1.46)	-57%
Processing	3	4	▲	2	0	▼
	(0.40)	(0.53)	-33%	(0.49)	(0.00)	-100%
Agricultural production	591	281	▼	308	126	▼
	(78.70)	(37.42)	-52%	(74.94)	(30.66)	-59%
Extractivism	121	60	▼	61	20	▼
	(16.11)	(7.99)	-50%	(14.84)	(4.87)	-67%
Processing of fruits	102	36	▼	34	2	▼
	(13.58)	(4.79)	-65%	(8.27)	(0.49)	-94%
Processing of cassava	132	65	▼	48	6	▼
	(17.58)	(8.66)	-51%	(11.68)	(1.46)	-88%
Handicraft and other non-agricultural activities	105	20	▼	34	9	▼
	(13.98)	(2.66)	-81%	(8.27)	(2.19)	-74%
Artisanal fishing	23	6	▼	10	5	▼
	(3.06)	(0.80)	-74%	(2.43)	(1.22)	-50%
Other activities (agricultural and non-agricultural)	2	30	▲	2	78	▲
	(0.27)	(3.99)	+1400%	(0.49)	(18.98)	+3800%
Total	751	751		411	411	
	(100.00)	(100.00)		(100.00)	(100.00)	

Note: Percentage in parenthesis.

Source: Research results.

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 Eligibility for Pronaf (DAP).

The proportion of sampled families that have DAP is depicted in Table 7. Both for 2017 and for 2022, the share of families eligible for Pronaf is greater for the treatment group than for the control group. Furthermore, it is evident that the proportion of families with DAP in the control group showed a slight drop during the analyzed period.

Table 7. Declaration of Eligibility to Pronaf (DAP)

Has DAP?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	605	641	▲	297	293	▼
	(80.56)	(85.35)	6%	(72.26)	(71.29)	-1%
No	146	110	▼	114	118	▲
	(19.44)	(14.65)	-25%	(27.74)	(28.71)	+4%
Total	751	751		411	411	
	(100.00)	(100.00)		(100.00)	(100.00)	

Note: Percentage in parenthesis.
Source: Research results.

The DAP, which constitutes 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 8. Although most of the interviewees claimed to have the Main DAP, the proportion observed for the Women Accessory DAP can also be highlighted. In general, there was an increase in the proportion of households with DAP, regardless of type.

Table 8. Type of Declaration of Eligibility to Pronaf (DAP)

Type of DAP	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	605	641	▲	297	293	▼
	(80.56)	(85.35)	6%	(72.26)	(71.29)	-1%
No	146	110	▼	114	118	▲
	(19.44)	(14.65)	-25%	(27.74)	(28.71)	+4%
Total	751	751		411	411	
	(100.00)	(100.00)		(100.00)	(100.00)	
Especial	16	10	▼	2	5	▲
	(2,71)	(1,55)	-38%	(0,69)	(1,68)	+150%
Total	591	644	+9%	289	297	+3%
	(100,00)	(100,00)		(100,00)	(100,00)	

Note: Percentage in parenthesis.
Source: Research results.

The social benefits received by sampled families are shown in Table 9. The evolution of access to social benefits between 2017 and 2022 was relatively heterogeneous between the treatment and control groups. Of the 29 benefits analyzed, 11 showed a decrease in access by treated individuals and 19 by those in the control group during the period investigated. In any case, among the most accessed benefits, the following stand out: (i) Bolsa Família Program; (ii) Cistern for human consumption (1st water); (iii) Luz para Todos Program; (iv) Garantia-Safra Program and (v) Public Pension.

Table 9. Access to social benefits

Social benefits	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Public pension	227 (30.23)	250 (33.29)	▲ +10%	163 (39.66)	184 (44.77)	▲ +13%
Unemployment insurance	15 (2.00)	51 (6.79)	▲ +240%	4 (0.97)	26 (6.33)	▲ +550%
Bolsa Família Program	560 (74.57)	494 (65.78)	▼ -12%	244 (59.37)	212 (51.58)	▼ -13%
Education scholarship	5 (0.67)	17 (2.26)	▲ +750%	2 (0.49)	5 (1.22)	▲ +150%
Free bus pass, senior card, social driver's license	26 (3.46)	3 (0.40)	▼ -88%	19 (4.62)	3 (0.73)	▼ -84%
Viver sem limites, Saúde não tem preço, Rede cegonha	0 (0.00)	1 (0.13)	▲	0 (0.00)	1 (0.24)	▲
Social tariff on energy	274 (36.48)	138 (18.38)	▼ -50%	117 (28.47)	96 (23.36)	▼ -18%
Minha Casa Minha Vida, Minha Casa Melhor	14 (1.86)	6 (0.80)	▼ -57%	8 (1.95)	4 (0.97)	▼ -50%
Luz no Campo	0 (0.00)	55 (7.32)	▲	0 (0.00)	35 (8.52)	▲
Luz para Todos	312 (41.54)	447 (59.52)	▲ +43%	175 (42.58)	249 (60.58)	▲ +42%
Cistern for human consumption (1 st water)	481 (64.05)	524 (69.77)	▲ +9%	255 (62.04)	255 (62.04)	= 0%
Cistern for agricultural production (2 nd water)	87 (11.58)	217 (28.89)	▲ +149%	41 (9.98)	44 (10.71)	▲ +7%
Technical Assistance and Rural Extension	25 (3.33)	255 (33.95)	▲ +920%	7 (1.70)	14 (3.41)	▲ +100%
Agricultural financing	21 (2.80)	39 (5.19)	▲ +86%	7 (1.70)	18 (4.38)	▲ +157%

Pronaf	74 (9.85)	132 (17.58)	▲ +78%	35 (8.52)	81 (19.71)	▲ +131%
PAA	3 (0.40)	16 (2.13)	▲ +433%	0 (0.00)	3 (0.73)	▲
PNAE	4 (0.53)	14 (1.86)	▲ +250%	0 (0.00)	0 (0.00)	=
Harvest Guarantee Program	326 (43.41)	394 (52.46)	▲ +21%	161 (39.17)	147 (35.77)	▼ -9%
Programa Fomento (former Plano Brasil sem Miséria -PBSM)	0 (0.00)	2 (0.27)	▲	0 (0.00)	2 (0.49)	▲
Rural insurance	6 (0.80)	2 (0.27)	▼ -67%	3 (0.73)	1 (0.24)	▼ -67%
Family farming insurance (SEAF)	0 (0.00)	0 (0.00)	=	0 (0.00)	1 (0.24)	▲
Agrarian reform program, land credit	9 (1.20)	1 (0.13)	▼ -89%	3 (0.73)	0 (0.00)	▼ -100%
Program to combat rural poverty	0 (0.00)	0 (0.00)	=	0 (0.00)	0 (0.00)	=
Individual micro-entrepreneur (MEI)	0 (0.00)	3 (0.40)	▲	0 (0.00)	0 (0.00)	=
Drought Grant	93 (12.38)	53 (7.06)	▼ -43%	52 (12.65)	21 (5.11)	▼ -60%
Family Health Plan (PSF)	338 (45.01)	90 (11.98)	▼ -73%	187 (45.50)	66 (16.06)	▼ -65%
Artisanal fishers' insurance for the closed season	25 (3.33)	10 (1.33)	▼ -60%	10 (2.43)	2 (0.49)	▼ -80%
State Water Supply System	0 (0.00)	108 (14.38)	▲	0 (0.00)	43 (10.46)	▲
Water Truck	350 (46.60)	154 (20.51)	▼ -56%	200 (48.66)	76 (18.49)	▼ -62%

Note: Percentage in parenthesis.
Source: Research results.

In line with what was observed for most social benefits, especially with regard to the treatment group, access to public services showed, in general, an expansion between the years analyzed (Table 10). It is worth highlighting the fact that more than 3/4 of the families declared that they were assisted by health agents.

As it is an essentially rural population, one can understand the relatively low proportion of families served by public transport and also by public security. In fact, these services tend to be concentrated in the most urbanized areas of municipalities. Still, access to public security increased between 2017 and 2022, with emphasis on the control group.

Table 10. Access to public services

Public services	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Health agent	611	574	▼	357	354	▼
	(81.36)	(76.43)	-38%	(86.86)	(86.13)	-1%
Family Health Program	247	305	▲	130	160	▲
	(32.89)	(40.61)	+23%	(31.63)	(38.93)	+23%
Public school bus	538	521	▼	275	281	▲
	(71.64)	(69.37)	-3%	(66.91)	(68.37)	+2%
Public transportation	82	70	▼	50	41	▼
	(10.92)	(9.32)	-15%	(12.17)	(9.98)	-18%
Public security	52	89	▲	39	70	▲
	(6.92)	(11.85)	+71%	(9.49)	(17.03)	+79%

Note: Percentage in parenthesis.
Source: Research results.

3.3 Characterizing household members

In this subsection, a brief description of the family nucleus is carried out. Characteristics such as kin relationship with the head of household, sex,

age, literacy and education level, occupation and job position are included. These infos are presented to all residents of the analyzed households.

In Table 11, it is possible to observe the kin relationships of household members with the head of household. 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 11. Kin relationships with the head of household

Kin relationship	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Head of household	751	751	=	411	411	=
	(27,17)	(41,04)		(28,82)	(40,33)	
Spouse	644	488	▼	337	252	▼
	(23,30)	(26,67)	-24%	(23,63)	(24,73)	-25%
Children, stepchildren	1157	536	▼	561	305	▼
	(41,86)	(29,29)	-54%	(39,34)	(29,93)	-46%
Father, mother, father-in-law, mother-in-law	18	12	▼	9	6	▼
	(0,65)	(0,66)	-33%	(0,63)	(0,59)	-33%
Siblings	16	5	▼	9	6	▼
	(0,58)	(0,27)	-69%	(0,63)	(0,59)	-33%
Another relative	172	35	▼	96	31	▼
	(6,22)	(1,91)	-80%	(6,73)	(3,04)	-68%
Aggregate members	6	3	▼	3	8	▲
	(0,22)	(0,16)	-50%	(0,21)	(0,79)	+167%
Total	2764	1830	▼	1426	1019	▼
	(100,00)	(100,00)	-34%	(100,00)	(100,00)	-29%

Note: Percentage in parenthesis.
Source: Research results.

When it comes to the sex of residents, there is a great balance in the sample (Table 12). This is valid both in terms of the group analyzed and with regard to the year considered. Although there are more women than men in the treatment group in both years analyzed, there was a predominance of men in the control group in the initial period of analysis.

Table 12. Sex of household members

Sex	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Male	1373 (49.67)	925 (48.81)	▼ -33%	731 (51.23)	494 (48.53)	▼ -32%
Female	1391 (50.33)	970 (51.19)	▼ -30%	696 (48.77)	524 (51.47)	▼ -25%

Note: Percentage in parenthesis.
Source: Research results.

When considering the literacy of sampled individuals, there was an increase in the proportion of literate individuals between the analyzed years is observed. In comparative terms, as shown in Table 13, the share of literate individuals is greater in the treatment group than in the control group.

Table 13. Literacy

Literate?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	487 (64,85)	561 (74,70)	▲ +15%	251 (61,07)	277 (67,40)	▲ +10%

Note: Percentage in parenthesis.
Source: Research results.

Table 14 shows the distribution of household members in terms of education levels. The highest proportion is observed for individuals with no education, especially in the control group. Also relevant is the share of individuals with 9th grade (formerly 8th grade of Elementary School) and

3rd grade of High School. Not coincidentally, these are completion points of Elementary and High School stages.

Table 14. Education level

Nível de instrução	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
No education	253 (9.57)	257 (13.56)	▲ +2%	152 (11.15)	153 (15.01)	▲ +1%
Nursery	23 (0.87)	10 (0.53)	▼ -57%	8 (0.59)	8 (0.79)	=
Pre-school	62 (2.34)	33 (1.74)	▼ -47%	26 (1.91)	13 (1.28)	▼ -50%
Kindergarten	149 (5.64)	120 (6.33)	▼ -19%	96 (7.04)	76 (7.46)	▼ -21%
1 st grade – elementary	170 (6.43)	69 (3.64)	▼ -59%	85 (6.24)	41 (4.02)	▼ -52%
2 nd grade – elementary	168 (6.35)	104 (5.49)	▼ -38%	82 (6.02)	65 (6.38)	▼ -21%
3 rd grade – elementary	200 (7.56)	121 (6.39)	▼ -40%	113 (8.29)	74 (7.26)	▼ -35%
4 th grade – elementary	357 (13.50)	238 (12.56)	▼ -33%	173 (12.69)	136 (13.35)	▼ -21%
5 th grade – elementary	205 (7.75)	124 (6.54)	▼ -40%	125 (9.17)	73 (7.16)	▼ -42%
6 th grade – elementary	142 (5.37)	83 (4.38)	▼ -42%	65 (4.77)	44 (4.32)	▼ -32%
7 th grade – elementary	107 (4.05)	64 (3.38)	▼ -40%	70 (5.14)	32 (3.14)	▼ -54%

8 th grade – elementary	202	140	▼	103	65	▼
	(7.64)	(7.39)	-31%	(7.56)	(6.38)	-37%
1 st grade – high school	92	92	=	52	43	▼
	(3.48)	(4.85)		(3.82)	(4.22)	-17%
2 nd grade – high school	90	54	▼	24	31	▲
	(3.40)	(2.85)	-40%	(1.76)	(3.04)	+29%
3 rd grade – high school	363	320	▼	163	139	▼
	(13.73)	(16.89)	-12%	(11.96)	(13.64)	-15%
Incomplete higher education	22	13	▼	8	11	▲
	(0.83)	(0.69)	-41%	(0.59)	(1.08)	+38%
Complete higher education	39	53	▲	18	14	▼
	(1.48)	(2.80)	+36%	(1.32)	(1.37)	-22%
Not applicable	0	0	=	0	1	▲
	(0.00)	(0.00)		(0.00)	(0.10)	

Note: Percentage in parenthesis.
Source: Research results.

The list of main occupations of household members is presented in Table 15. 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, extraction, aquaculture). There is also a relevant portion of household members who perform domestic activities and who are retired.

Table 15. Main occupation

Occupation	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Agriculture, livestock, extractivism, aquaculture	1267 (45,84)	1021 (53,94)	▼ -19%	622 (43,59)	491 (48,23)	▼ -21%
Management of agricultural activities	0 (0,00)	59 (3,12)	▲	0 (0,00)	25 (2,46)	▲
Extension workers, agricultural technicians	0 (0,00)	0 (0,00)	=	0 (0,00)	1 (0,10)	▲
Specialized agricultural occupations (tractor driver, vaccinator, etc.)	2 (0,07)	0 (0,00)	▼ -100%	1 (0,07)	0 (0,00)	▼ -100%
Other agricultural occupations	7 (0,25)	91 (4,81)	▲ +1200%	5 (0,35)	11 (1,08)	▲ +120%
Industry, construction	21 (0,76)	1 (0,05)	▼ -95%	14 (0,98)	2 (0,20)	▼ -86%
Commerce and auxiliary activities	22 (0,80)	22 (1,16)	=	17 (1,19)	19 (1,87)	▲ +12%
Services provision	47 (1,70)	31 (1,64)	▼ -34%	33 (2,31)	33 (3,24)	=
Technical, scientific, artistic, teaching	11 (0,40)	5 (0,26)	▼ -55%	9 (0,63)	2 (0,20)	▼ -78%
Management	15 (0,54)	4 (0,21)	▼ -73%	16 (1,12)	4 (0,39)	▼ -75%
Social service	18 (0,65)	6 (0,32)	▼ -67%	16 (1,12)	6 (0,59)	▼ -63%
Transportation	7 (0,25)	3 (0,16)	▼ -57%	6 (0,42)	2 (0,20)	▼ -67%
Handicraft	7 (0,25)	6 (0,32)	▼ -14%	0 (0,00)	2 (0,20)	▲

Other	92	47	▼	26	38	▲
	(3,33)	(2,48)	-49%	(1,82)	(3,73)	+46%
Housework	202	213	▲	123	133	▲
	(7,31)	(11,25)	+5%	(8,62)	(13,06)	+8%
Retired without occupation	107	78	▼	66	67	▲
	(3,87)	(4,12)	-27%	(4,63)	(6,58)	+2%
No occupation – Disabled	10	11	▲	12	9	▼
	(0,36)	(0,58)	+10%	(0,84)	(0,88)	-25%
No occupation/ Not applicable	929	295	▼	461	173	▼
	(33,61)	(15,58)	-68%	(32,31)	(16,99)	-62%

Note: Percentage in parenthesis.
Source: Research results.

Considering those individuals who declared having some paid occupation, Table 16 groups them in terms of their job position. In line with the predominance of agricultural workers, most individuals declared to be self-employed, possibly in rural areas, although this proportion has decreased between 2017 and 2022.

Table 16. Job position

Job position	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Self-employed (part-time worker, family farmer)	1239	1146	▼	609	567	▼
	(76.48)	(60.41)	-8%	(71.14)	(55.64)	-7%
Sharecropper	8	23	▲	5	9	▲
	(0.49)	(1.21)	+188%	(0.58)	(0.88)	+80%
Temporary worker in rural area	40	86	▲	22	38	▲
	(2.47)	(4.53)	+115%	(2.57)	(3.73)	+73%
Informal employee (permanent)	53	22	▼	31	26	▼
	(3.27)	(1.16)	-58%	(3.62)	(2.55)	-16%
Formal employee (permanent)	28	25	▼	23	13	▼
	(1.73)	(1.32)	-11%	(2.69)	(1.28)	-43%
Unpaid worker, homemaker	208	138	▼	132	70	▼
	(12.84)	(7.27)	-34%	(15.42)	(6.87)	-47%

Civil servant, military	42	21	▼	33	18	▼
	(2.59)	(1.11)	-50%	(3.86)	(1.77)	-45%
Employer	1	2	▲	0	12	▲
	(0.06)	(0.11)	+100%	(0.00)	(1.18)	
Intern/Apprentice	1	2	▲	0	0	=
	(0.06)	(0.11)	+100%	(0.00)	(0.00)	
Student	0	296	▲	1	146	▲
	(0.00)	(15.60)		(0.12)	(14.33)	
Not applicable	0	136	▲	0	120	▲
	(0.00)	(7.17)		(0.00)	(11.78)	

Note: Percentage in parenthesis.
Source: Research results.

The place of main occupation of household members is presented in Table 17. In line with the fact that the communities that make up the sample are predominantly rural, the proportion of household members who work in rural areas is significantly higher than that of urban workers.

Table 17. Place of main occupation

Place	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Rural (including fishing)	1691	1871	▲	861	991	▲
	(98.60)	(98.84)	+11%	(97.40)	(97.44)	+15%
Urban	24	22	▼	23	26	▲
	(1.40)	(1.16)	-8%	(2.60)	(2.56)	+13%
Total	1715	1893	▲	884	1017	▲
	(100.00)	(100.00)	+10%	(100.00)	(100.00)	+15%

Note: Percentage in parenthesis.
Source: Research results.

3.4 Household income

This subsection presents the average value obtained for each source of income in the investigated households. When it comes to agricultural

production, most of the income is destined both to the sale of animal production and to family consumption, as shown in Table 18, indicating that analyzed families allocate a significant part of their agricultural production not only to the market, but also to self-consumption.

Two other points that worth highlighting regarding the composition of total family income are income from non-agricultural activities and pensions, which is valid for the treated and controls. For both sources of income, there was considerable growth between 2017 and 2022.

A sharp increase in the average value obtained annually by each household is also evidenced for disaster aid, which include Drought Payments, for example. This is probably a reflection of the emergency aid paid by the Federal Government as a result of the COVID-19 pandemic.

Finally, when it comes to total income, it is observed that, albeit timidly, it increased for both groups. As a result, mean household income remained higher for the control group than for the treatment group.

Table 18. Average value of annual household income, by income source

Income source	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Agricultural income						
Sales of animal production	1,307.82 (3,333.95)	1,142.42 (4,104.53)	▼ -13%	1,148.54 (2,656.89)	1,344.14 (4,828.27)	▲ +17%
Sales of animal-based products	234.76 (1,103.38)	174.17 (963.11)	▼ -26%	185.15 (1,119.71)	101.44 (796.64)	▼ -45%
Sales of plant production	347.33 (2,219.67)	143.85 (724.88)	▼ -59%	145.59 (1,126.37)	70.66 (571.19)	▼ -51%
Sales of plant-based products	116.03 (1,395.47)	17.83 (146.54)	▼ -85%	15.62 (216.16)	13.77 (198.79)	▼ -12%
Family self-consumption	1,226.80 (1,848.21)	690.05 (1,688.79)	▼ -44%	1,251.44 (2,023.18)	674.08 (2,421.82)	▼ -46%
Non-agricultural income						
Income from non-agricultural activities	62.02 (873.66)	685.99 (3,541.84)	▲ +1006%	28.57 (398.68)	418.55 (2,040.34)	▲ +1365%

Off-farm job						
Temporary job	1,501.35 (3,887.75)	827.94 (3,081.29)	▼ -45%	1,597.44 (3,893.51)	1,194.90 (3,450.25)	▼ -25%
	2,556.03 (7,784.08)	328.98 (2,447.69)	▼ -87%	3,677.00 (9,520.48)	397.05 (2,347.04)	▼ -89%
Social benefits						
Bolsa Família	1,531.42 (1,375.44)	1,625.02 (2,083.93)	▲ +6%	1,168.12 (1,348.46)	1,314.47 (2,010.37)	▲ +13%
	91.23 (269.28)	1,715.31 (3,588.86)	▲ +1780%	100.75 (300.86)	1,449.14 (3,214.68)	▲ +1338%
Artisanal fishers' insurance for the closed season	85.87 (631.84)	230.12 (1,353.24)	▲ +168%	37.35 (331.52)	67.49 (668.25)	▲ +81%
	42.93 (371.92)	36.76 (381.33)	▼ -14%	57.71 (434.42)	32.12 (336.83)	▼ -44%
Other benefits	266.17 (1,572.43)	235.23 (2,087.46)	▼ -12%	444.35 (2,054.86)	703.34 (3,664.20)	▲ +58%
	Pensions					
Retired pay	4,097.09 (7,882.73)	5,386.35 (9,651.83)	▲ +90%	5,602.50 (9,134.44)	6,817.22 (10,419.56)	▲ +22%
	301.79 (1,883.56)	358.03 (2,997.60)	▲ +19%	459.29 (2,209.70)	509.88 (4,088.77)	▲ +11%
Other sources						
Remittances from non-resident family members	6.68 (73.04)	25.57 (510.36)	▲ +283%	20.92 (304.28)	89.05 (1,663.60)	▲ +326%
	112.78 (737.95)	67.91 (1,057.86)	▼ -40%	152.33 (1,451.34)	72.99 (1,142.24)	▼ -52%
Total						
Total income	13,162.51 (13,368.27)	13,691.56 (14,078.52)	▲ +4%	15,124.13 (13,656.04)	15,270.31 (15,155.67)	▲ +1%

Note: Standard-deviation in parenthesis.
Source: Research results.

3.5 Goods and assets

Table 19 indicates the percentage of families that reported owning land. There was, both for the treatment group and for the control group, a significant change in the scenario in terms of land ownership between 2017 and 2022. The drop in the share of landowner families may be related to drought-related effects, which punished the study region during the time period considered in this research.

Table 19. Land ownership

Do any member of the household own land?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	658	524	▼	335	261	▼
	(87.62)	(69.77)	-20%	(81.51)	(63.50)	-22%

Note: Percentage of total households in parenthesis.
Source: Research results.

Considering all families in the sample, not only those in which at least one of the members owned land, Table 20 presents the average size of rural properties. In 2017, the properties of the treatment group were slightly larger, on average, than those of the control group. For 2022, however, there was a substantial increase for the treatment group, while a slight decrease was recorded for the control group.

Table 20. Size of the rural property

Size of the rural property	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Hectares	18.91	28.04	▲	18.68	18.22	▼
	(74.04)	(141.72)	+48%	(45.25)	(48.79)	-2%

Note: Percentage of total households in parenthesis.
Source: Research results.

The list of goods owned by families in the treatment and control groups in 2017 and 2022 is shown in Table 21. A relative balance is observed between the amount of durable consumer goods that experienced expansion in ownership and those for which it was identified a retraction.

Table 21. Goods and assets owned by analyzed families

Good	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
House	689	514	▼	376	251	▼
	(91,74)	(68,44)	-25%	(91,48)	(61,07)	-33%
Corral, stable	140	182	▲	75	72	▼
	(18,64)	(24,23)	+30%	(18,25)	(17,52)	-4%
Well	0	107	▲	0	55	▲
	(0,00)	(14,25)		(0,00)	(13,38)	
Plow (animal or mechanical traction)	126	70	▼	54	29	▼
	(16,78)	(9,32)	-44%	(13,14)	(7,06)	-46%
Automobile	134	206	▲	70	91	▲
	(17,84)	(27,43)	+54%	(17,03)	(22,14)	+30%
Hydraulic pump	139	118	▼	59	42	▼
	(18,51)	(15,71)	-15%	(14,36)	(10,22)	-29%
Wagon, bull-ock cart	129	91	▼	56	41	▼
	(17,18)	(12,12)	-29%	(13,63)	(9,98)	-27%
Motorcycle	435	336	▼	204	128	▼
	(57,92)	(44,74)	-23%	(49,64)	(31,14)	-37%
Satellite dish	630	435	▼	331	218	▼
	(83,89)	(57,92)	-31%	(80,54)	(53,04)	-34%
Bicycle	274	210	▼	138	82	▼
	(36,48)	(27,96)	-23%	(33,58)	(19,95)	-41%
Gas stove (2+ burners)	717	485	▼	392	236	▼
	(95,47)	(64,58)	-32%	(95,38)	(57,42)	-40%
Freezer	50	54	▲	29	24	▼
	(6,66)	(7,19)	8%	(7,06)	(5,84)	-17%
Refrigerator	618	474	▼	348	229	▼
	(82,29)	(63,12)	-23%	(84,67)	(55,72)	-34%

Sewing machine	0	83	▲	0	33	▲
	(0,00)	(11,05)		(0,00)	(8,03)	
Phone (mobile or landline)	598	361	▼	317	190	▼
	(79,63)	(48,07)	-40%	(77,13)	(46,23)	-40%
TV	669	449	▼	372	232	▼
	(89,08)	(59,79)	-33%	(90,51)	(56,45)	-38%

Note: Proportion of total households in parenthesis.
Source: Research results.

3.6 Effects of drought on family assets

This subsection considers the effects of drought episodes on the income and wealth of investigated families. Considering Table 22, it is observed that the percentage of families affected by drought is quite similar between groups. However, it is worth highlighting the fact that, between 2017 and 2022, there was a significant drop in the proportion of families affected by drought, which is evidenced for both groups.

Table 22. Households affected by drought in the last 5 years

Affected by drought?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	723	513	▼	395	243	▼
	(96.27)	(68.31)	-29%	(96.11)	(59.12)	-38%

Note: Proportion of total households in parenthesis.
Source: Research results.

Taking into account the households whose respondent claimed to have been affected by the drought, Table 23 shows how families were affected with this adverse natural phenomenon. The most common effects are the reduction of workload and the loss of agricultural production. However, in view of the decrease in the proportion of households affected by drought between 2017 and 2022, the share of families suffering from these effects also decreased.

Table 23. Families' reactions to the drought

Reaction to the drought	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Reduction of workload	539	339	▼	292	141	▼
	(71.77)	(45.14)	-37%	(71.05)	(34.31)	-52%
Difficulties in housework	539	272	▼	307	154	▼
	(71.77)	(36.22)	-50%	(74.70)	(37.47)	-50%
Loss of agricultural production	656	356	▼	343	165	▼
	(87.35)	(47.40)	-46%	(83.45)	(40.15)	-52%
Loss of animals	481	301	▼	263	166	▼
	(64.05)	(40.08)	-37%	(63.99)	(40.39)	-37%

Note: Proportion of total households in parenthesis.
Source: Research results.

Table 24 indicates whether drought-affected households needed to sell any assets in response to adverse effects. Between 2017 and 2022, there was a decrease in the proportion of families that 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.

Table 24. Sale of assets to face the effects of the drought

Did the family sell assets?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	234	108	▼	123	51	▼
	(31.16)	(14.38)	-54%	(29.93)	(12.41)	-59%

Note: Proportion of total households in parenthesis.
Source: Research results.

The assets that needed to be sold to face the adverse effects caused by the drought are detailed in Table 25. There was a significant decrease in the number of families that needed to sell animals, one of the main sources of livelihood for those who live in rural areas and conduct agricultural activities. Moreover, few families needed to sell durable goods, household appliances or properties to overcome the effects of the drought.

Table 25. Consumer goods or assets sold as a result of the drought

Good/asset sold	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Animals	214 (91.45)	102 (94.44)	▼ -52%	116 (94.31)	50 (98.04)	▼ -57%
Motorcycle and other durable goods for transport or work	16 (6.84)	9 (8.33)	▼ -44%	11 (8.94)	4 (7.84)	▼ -64%
Home appliances	2 (0.85)	3 (2.78)	▲ +50%	1 (0.81)	0 (0.00)	▼
Land or house	10 (4.27)	3 (2.78)	▼ -10%	6 (4.88)	1 (1.96)	▼ -83%
Total	234 (100.00)	108 (100.00)	▼ -54%	123 (100.00)	51 (100.00)	▼ -59%

Note: Proportion of total households in parenthesis.
Source: Research results.

Table 26 presents the average value obtained from the sale of assets due to the drought. A clear distinction can be observed in the evolution shown between the two groups from 2017 to 2022. On the one hand, even if to a lesser extent, the average value obtained by the control group was higher in 2022 than in 2017. On the other hand, the treatment group showed a very expressive growth in this period, probably due to the sale of assets.

Table 26. Average value obtained from the sale of assets due to the drought

Item	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Sales value	2,727.52 (11,083.83)	30,416.84 (226,344.28)	▲ +1015%	2,707.50 (4,642.79)	4,491.47 (5,371.48)	▲ +66%

Note: Proportion of total households in parenthesis.
Source: Research results.

3.7 Agricultural and environmental practices

This subsection presents the agricultural and environmental practices carried out by analyzed families, highlighting the agricultural practices adopted, the use of irrigation for productive crops, the presence of water mirrors, streams and springs and the disposal of garbage.

The agricultural practices used by the households investigated are shown in Table 27. The most widespread practices are the use of manure, straws and watering. In addition, it is noteworthy that, especially for the treatment group, the use of pesticides and chemical fertilizers decreased between 2017 and 2022. The use of watering, manure, straws and organic compost increased significantly during the period under analysis.

Table 27. Agricultural practices adopted

Agricultural practices	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Irrigation	34 (4.53)	65 (8.66)	▲ +91%	11 (2.68)	25 (6.08)	▲ +127%
Watering	64 (8.52)	210 (27.96)	▲ +228%	31 (7.54)	112 (27.25)	▲ +261%
Agricultural burning	20 (2.66)	22 (2.93)	▲ +10%	12 (2.92)	21 (5.11)	▲ +75%
Pesticides	16 (2.13)	6 (0.80)	▼ -63%	6 (1.46)	6 (1.46)	=
Chemical fertilizer	17 (2.26)	8 (1.07)	▼ -53%	6 (1.46)	5 (1.22)	▼ -17%
Organic compost	38 (5.06)	148 (19.71)	▲ +289%	9 (2.19)	29 (7.06)	▲ +222%
Manure	170 (22.64)	512 (68.18)	▲ +201%	69 (16.79)	195 (47.45)	▲ +183%
Straws	45 (5.99)	231 (30.76)	▲ +413%	16 (3.89)	123 (29.93)	▲ +669%

Note: Proportion of total households in parenthesis.
Source: Research results.

In the initial period of analysis, irrigation was not widespread among sampled households. However, it is worth stressing the occurrence of a great growth in the use of this practice. This is true for both groups, although the spread of irrigation seems to have been more significant among Project beneficiaries. Among irrigated crops, emphasis should be given to beans.

Table 28. Irrigated crops

Crop	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Not applicable	8	186	▲	6	88	▲
	(1.07)	(24.77)	+2225%	(1.46)	(21.41)	+1366%
Fruit trees	2	50	▲	1	35	▲
	(0.27)	(6.66)	+2400%	(0.24)	(8.52)	+3400%
Forage	2	20	▲	7	5	▼
	(0.27)	(2.66)	+900%	(1.70)	(1.22)	-29%
Cassava	33	64	▲	9	19	▲
	(4.39)	(8.52)	+94%	(2.19)	(4.62)	+111%
Maize	26	60	▲	12	24	▲
	(3.46)	(7.99)	+131%	(2.92)	(5.84)	+100%
Beans	49	375	▲	17	85	▲
	(6.52)	(49.93)	+665%	(4.14)	(20.68)	+400%
Other	8	186	▲	6	88	▲
	(1.07)	(24.77)	+2225%	(1.46)	(21.41)	+1367%

Note: Proportion of total households in parenthesis.

Source: Research results.

As shown in Table 29, the most common types of water mirror in the properties analyzed are ponds and reservoirs. It should be noted, however, that the proportion of properties with ponds decreased between 2017 and 2022, both among treated and among controls. On the other hand, there was an increase in the proportion of properties with muddy ponds.

Table 29. Type of water mirror existing on the property

Type of water mirror	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Not applicable	29	15	▼	18	8	▼
	(3.86)	(2.00)	-48%	(94.38)	(1.95)	-56%
Reservoir	30	31	▲	19	14	▼
	(3.99)	(4.13)	+3%	(4.62)	(3.41)	-26%
Pond	205	168	▼	120	93	▼
	(27.30)	(22.37)	-18%	(29.20)	(22.63)	-23%
Muddy pond	81	121	▲	52	63	▲
	(10.79)	(16.11)	+49%	(12.65)	(15.33)	+21%
Other	29	15	▼	18	8	▼
	(3.86)	(2.00)	-48%	(4.38)	(1.95)	-56%

Note: Proportion of total households in parenthesis.

Source: Research results.

The conservation status of water mirrors is presented in Table 30. It is observed, for both the treatment group and, mainly, the control group, an increase in the quantity (and proportion) of water mirrors with the presence of riparian forest. On the other hand, there is a sharp drop in the number of silted water mirrors.

Table 30. Conservation status of water mirrors

Status	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Silted	140	101	▼	88	56	▼
	(40.58)	(30.15)	-28%	(42.11)	(31.46)	-36%
Presence of riparian forest	89	104	▲	46	47	▲
	(25.80)	(31.04)	+17%	(22.01)	(26.40)	+2%
Absence of riparian forest	70	76	▲	44	45	▲
	(20.29)	(22.69)	+9%	(21.05)	(25.28)	+2%
Other	0	12	▲	3	6	▲
	(0.00)	(3.58)		(1.44)	(3.37)	+100%

Total	345	335	▼	209	178	▼
	(100.00)	(100.00)	-3%	(100.00)	(100.00)	-15%

Note: Proportion of households in parenthesis.

Source: Research results.

The vast majority of the properties analyzed do not have water streams, with this proportion exceeding 3/4 of the sample in 2022, as shown in Table 31. Consequently, there was a drop in the percentage of families whose properties had at least one water stream.

Table 31. Number of water streams running through the rural property.

Number of water streams	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
0	498	615	▲	264	314	▲
	(66.31)	(81.89)	+23%	(64.23)	(76.40)	+19%
1	216	117	▼	127	83	▼
	(28.76)	(15.58)	-46%	(30.90)	(20.19)	-35%
2	25	12	▼	16	12	▼
	(3.33)	(1.60)	-52%	(3.89)	(2.92)	-25%
3	5	7	▲	3	1	▼
	(0.67)	(0.93)	-40%	(0.73)	(0.24)	-67%
4	3	0	▼	1	0	▼
	(0.40)	(0.00)	-100%	(0.24)	(0.00)	-100%
5+	4	0	▼	0	1	▲
	(0.53)	(0.00)	-100%	(0.00)	(0.24)	

Note: Proportion of total households in parenthesis.

Source: Research results.

A major change can be seen in terms of the presence of riparian forest in the streams that cross the investigated properties, as shown in Table 32. A drop in the number of properties with absent riparian forest was observed. Most of the properties that have water streams have little riparian forest.

Table 32. Status of riparian forest

Status of riparian forest	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Absent	90	15	▼	75	9	▼
	(11.98)	(2.00)	-83%	(18.25)	(2.19)	-88%
Little present	78	67	▼	40	54	▲
	(10.39)	(8.92)	-14%	(9.73)	(13.14)	+35%
Present	83	55	▼	31	34	▲
	(11.05)	(7.32)	-34%	(7.54)	(8.27)	+10%
Total	751	751	=	411	411	=
	(100.00)	(100.00)		(100.00)	(100.00)	

Note: Proportion of households in parenthesis..

Source: Research results.

The number of water springs existing in the analyzed properties is shown in Table 33. Differently from what was observed for water mirrors and streams, practically no properties with the presence of springs were registered in the evaluated sample.

Table 33. Number of water springs in the properties

Number of water springs	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
0	694	730	▲	372	402	▲
	(92.41)	(97.20)	+5%	(90.51)	(97.81)	+8%
1	46	18	▼	35	9	▼
	(6.13)	(2.40)	-61%	(8.52)	(2.19)	-74%
2+	9	3	▼	2	0	▼
	(1.20)	(0.40)	-67%	(0.49)	(0.00)	-100%

Note: Proportion of total households in parenthesis.

Source: Research results.

The status of water springs in the properties of the families analyzed is shown in Table 34. Between 2017 and 2022, there was a drop in the proportion of preserved springs (treatment and control) and an increase in the

share of poorly preserved springs (treatment). This is a worrying result, considering the scarcity of water in the region.

Table 34. Status of water springs from analyzed properties

Status of water springs	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Degraded	22	0	▼	16	1	▼
	(41.51)	(0.00)	-100%	(43.24)	(10.00)	-94%
Poorly preserved	10	13	▲	8	7	▼
	(18.87)	(61.90)	+30%	(21.62)	(70.00)	-13%
Preserved	21	8	▼	13	2	▼
	(39.62)	(38.10)	-62%	(35.14)	(20.00)	-85%
Total	53	21	▼	37	10	▼
	(100.00)	(100.00)	-60%	(100.00)	(100.00)	-73%

Note: Proportion of total households in parenthesis.
Source: Research results.

There are several destinations given to the water obtained from the existing springs, as can be seen in Table 35. The main destination is animal husbandry, especially in the case of the treatment group. Next, one can highlight the domestic use for community consumption.

Table 35. Use of water from properties' springs

Use of spring water	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Piped water for domestic use	18	1	▼	11	2	▼
	(33.96)	(4.76)	-94%	(29.73)	(20.00)	-82%
Community use	12	7	▼	8	3	▼
	(22.64)	(33.33)	-42%	(21.62)	(30.00)	-63%
Animal husbandry	42	15	▼	22	6	▼
	(79.25)	(71.43)	-64%	(59.46)	(60.00)	-73%

Irrigation	13	4	▼	5	1	▼
	(24.53)	(19.05)	-69%	(13.51)	(10.00)	-80%
Running its natural course	6	4	▼	9	0	▼
	(11.32)	(19.05)	-33%	(24.32)	(0.00)	-100%
Other use	1	0	▼	3	0	▼
	(1.89)	(0.00)	-100%	(8.11)	(0.00)	-100%

Note: Proportion of total households in parenthesis.
Source: Research results.

Contrary to what is recommended, empty agrochemical containers continue to be buried, burned or thrown into the environment. The proportion of all destination types increased during the period evaluated, probably due to the lack of data on this question in the baseline survey.

Table 36. Destination of empty agrochemical containers

Destination	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Returned at collection points	6	57	▲	2	15	▲
	(0.80)	(7.59)	+850%	(0.49)	(3.65)	+650%
Buried/Burned/Thrown into the environment	16	91	▲	5	91	▲
	(2.13)	(12.12)	+469%	(1.22)	(22.14)	+1720%
Reused	1	3	▲	0	1	▲
	(0.13)	(0.40)	+200%	(0.00)	(0.24)	
Other destination	3	604	▲	0	305	▲
	(0.40)	(80.43)	+20033%	(0.00)	(74.21)	

Note: Proportion of total households in parenthesis.
Source: Research results.

Similarly, domestic waste is usually buried or burned, which is also harmful to the environment (Table 37). Despite the fact that the absolute number of households that dispose of household waste in this way decreased between 2017 and 2022, the proportion is still extremely high. The share of households with garbage collection, on the other hand, increased in the studied period.

Table 37. Destination of household waste

Destination	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Wastewater collection system	117 (15.58)	199 (26.50)	▲ +70%	71 (17.27)	102 (24.82)	▲ +44%
Recycled	4 (0.53)	1 (0.13)	▼ -75%	2 (0.49)	0 (0.00)	▼ -100%
Buried/Burned	616 (82.02)	570 (75.90)	▼ -7%	329 (80.05)	313 (76.16)	▼ -5%
Thrown into the environment	40 (5.33)	27 (3.60)	▼ -33%	38 (9.25)	13 (3.16)	▼ -66%
Separation of organic waste for composting	3 (0.40)	9 (1.20)	▲ +200%	3 (0.73)	3 (0.73)	=
Other destination	0 (0.00)	4 (0.53)	▲	0 (0.00)	2 (0.49)	▲

Note: Proportion of total households in parenthesis.
Source: Research results.

3.8 Nutrition and food safety

This subsection deals with the nutrition and food security of investigated families. Specifically, the analysis focus on the origin of the food consumed, the frequency with which families have a diversified diet and the occurrence of episodes in which the family had difficulty obtaining food.

The origin of the food consumed by analyzed families is presented in Table 38. Considering that most households are located in rural areas and their residents work primarily in agricultural activities, a large portion of families consume products from their production.

Given the difficulty of growing all the necessary food on their own property, the overwhelming majority of families purchase foodstuff from neighbors or at street fairs, warehouses and markets. On the other hand, a lower proportion of families rely on donations or exchanges.

Table 38. Origin of food consumed

Origin	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Donations from neighbors and relatives	73 (9.72)	58 (7.72)	▼ -21%	41 (9.98)	32 (7.79)	▼ -22%
From own agricultural production	329 (43.81)	493 (65.65)	▲ +50%	162 (39.42)	239 (58.15)	▲ +48%
Exchanges with neighbors and relatives	61 (8.12)	71 (9.45)	▲ +16%	26 (6.33)	17 (4.14)	▼ -35%
Donation from government or other institutions	11 (1.46)	62 (8.26)	▲ +464%	3 (0.73)	10 (2.43)	▲ +233%
Bought from neighbors or at street fairs, warehouses, markets	749 (99.73)	691 (92.01)	▼ -8%	409 (99.51)	387 (94.16)	▼ -5%

Note: Proportion of total households in parenthesis.
Source: Research results.

Table 39 presents the frequency with which respondents claim to have a diversified diet. It is interesting to emphasize, in this case, that a process of improvement in the diet of analyzed families seems to be taking place. In fact, between 2017 and 2022, the proportion of families that always have a diversified diet increased significantly.

Table 39. Frequency with which food is diversified

How often does the family have a diversified diet?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Always	191 (25.43)	278 (37.02)	▲ +46%	118 (28.71)	99 (24.09)	▼ -16%
Sometimes	530 (70.57)	432 (57.52)	▼ -18%	277 (67.40)	303 (73.72)	▲ +9%

Never happened	30 (3.99)	36 (4.79)	▲ +20%	16 (3.89)	7 (1.70)	▼ -56%
Do not know, did not answer	0 (0.00)	5 (0.67)	▲	0 (0.00)	2 (0.49)	▲

Note: Proportion of total households in parenthesis.
Source: Research results.

Despite the possible improvement in terms of the quality of the food consumed by analyzed families, there is still a significant number of families that go through episodes of difficulty in obtaining food. It should be noted, however, that between 2017 and 2022, according to the data in Table 40, there was a sharp drop in the percentage of families with difficulty obtaining food. This holds true for both the treated and controls.

Table 40. Existence of a period with difficulty in obtaining food

Were there times when the family had difficulty getting food?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	217 (28.89)	134 (17.84)	▼	123 (29.93)	101 (24.57)	▼

Note: Proportion of total households in parenthesis.
Source: Research results.

3.9 Sex and youth

This subsection analyzes issues related to the participation of women and young people in community actions, as well as the occupations already exercised by them. As can be seen in Table 41, the proportion of women who actively participate in community actions is higher in the control group than in the treatment group. This points to a reversal of the scenario observed at the beginning of the period of analysis.

Table 41. Participation of women in community actions

Do women actively participate in community actions?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	540 (71.90)	232 (30.89)	▼ -57%	184 (44.77)	319 (77.62)	▲ +73%

Note: Proportion of total households in parenthesis.
Source: Research results.

Among the occupations shown in Table 42, women predominantly work in agriculture. This is a result that was to be expected, given that most of the sample is composed of households from rural areas where agriculture and livestock is an important source of income for families. However, the percentage of women working in the agricultural sector decreased for the control group.

The proportion of women who had already worked in the processing or manufacture of products decreased for both groups, especially among controls. It should be noted, in turn, that the number of households with women who have worked in commerce or handicrafts is substantially low.

With the exception of work in service provision, there was a drop in the number of women in the families of the control group engaged in all activities, not just in agriculture and/or livestock. This may indicate that, between 2017 and 2022, a considerable number of women in the control group retired or, even, that they started to dedicate themselves to housework.

Table 42. Occupations of the women in the family

Occupation already carried out by the women of the family in the last 5 years	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Agriculture and/or livestock	566 (75.37)	593 (78.96)	▲ +5%	252 (61.31)	237 (57.66)	▼ -6%
Processing and/or manufacturing of products	66 (8.79)	51 (6.79)	▼ -23%	19 (4.62)	4 (0.97)	▼ -79%

Public service (school, health center, etc.)	60 (7.99)	43 (5.73)	▼ -28%	40 (9.73)	19 (4.62)	▼ -53%
Service provision (maid, manicurist, nanny, seamstress, etc.)	26 (3.46)	127 (16.91)	▲ +388%	18 (4.38)	29 (7.06)	▲ +61%
Commerce	12 (1.60)	11 (1.46)	▼ -8%	13 (3.16)	3 (0.73)	▼ -77%
Handicraft	37 (4.93)	11 (1.46)	▼ -70%	11 (2.68)	2 (0.49)	▼ -82%

Note: Proportion of total households in parenthesis.

Source: Research results.

Compared to women, a different scenario is observed for young people regarding active participation in community actions. Despite the proportion being higher for the treatment group than for controls, in both cases the level of participation can be considered low, as can be seen in Table 43.

Table 43. Participation of young people in community actions

Do young people actively participate in community actions?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	150 (19.97)	168 (22.37)	▲ +12%	43 (10.46)	43 (10.46)	=

Note: Proportion of total households in parenthesis.

Source: Research results.

Table 44 presents the distribution of households in terms of occupations already exercised by the young members of the family. Considering the classification used to define who are young (individuals up to 29 years old), the largest portion of young people only study or studied. Even so, a significant number of young people work in the agricultural sector. The change of scenery between 2017 and 2022 indicates that many of those who were initially young and were only studying started working in agriculture.

Table 44. Occupation of young people in the family

Occupation already carried out by the young people of the family in the last 5 years	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Agriculture and/or livestock	197 (29.27)	142 (69.61)	▼ -28%	98 (29.34)	37 (74.00)	▼ -62%
Processing and/or manufacturing of products	13 (1.93)	9 (4.41)	▼ -31%	6 (1.80)	2 (4.00)	▼ -67%
Public service (school, health center, etc.)	13 (1.93)	13 (6.37)	=	11 (3.29)	4 (8.00)	▼ -64%
Service provision (maid, manicurist, nanny, seamstress, etc.)	9 (1.34)	12 (5.88)	▲ +33%	8 (2.40)	2 (4.00)	▼ -75%
Commerce	5 (0.74)	8 (3.92)	▲ +60%	7 (2.10)	0 (0.00)	▼ -100%
Handicraft	2 (0.30)	2 (0.98)	=	2 (0.60)	0 (0.00)	▼ -100%
Only studies/studied	434 (64.49)	18 (8.82)	▼ -96%	202 (60.48)	5 (10.00)	▼ -98%

Note: Proportion of total households in parenthesis.

Source: Research results.

3.10 Housing conditions

Housing conditions are described in this subsection. Specifically, the text highlights the type of household, the main materials used on the external walls, roof and floor, the existence of bathroom, electricity and running water, among others. As pointed out in Table 45, the absolute majority of the sample is composed of houses.

Table 45. Type of household

Type of household	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
House	751	747	▼	409	408	▼
	(100.00)	(99.47)	-1%	(99.51)	(99.27)	-0%
Shed	0	4	▲	2	2	=
	(0.00)	(0.53)		(0.49)	(0.49)	

Note: Proportion of total households in parenthesis.

Source: Research results.

Table 46 shows the main material used in the external walls. Most homes are clad with masonry, either with bricks or blocks. One cannot ignore, however, the number of homes whose external walls are covered with adobe. Wood cladding or rammed earth, in turn, is rarely used.

Table 46. Main material used in the external walls

Main material used in the external walls	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Masonry (bricks, blocks)	388	473	▲	211	253	▲
	(51.66)	(62.98)	+22%	(51.34)	(61.56)	+20%
Adobe	350	275	▼	189	154	▼
	(46.60)	(36.62)	-21%	(45.99)	(37.47)	-19%
Wood cladding	0	0	=	1	0	▼
	(0.00)	(0.00)		(0.24)	(0.00)	-100%
Rammed earth	12	1	▼	10	4	▼
	(1.60)	(0.13)	-92%	(2.43)	(0.97)	-60%
Other temporary material (straw, canvas, plastic)	1	2	▲	0	0	=
	(0.13)	(0.27)	+100%	(0.00)	(0.00)	

Note: Proportion of total households in parenthesis.

Source: Research results.

The distribution of households according to the main material used in the roof is shown in Table 47. The use of ceramic tiles predominates, re-

gardless of the group and year considered. It can also be highlighted, to a lesser extent, the use of other materials (wood, straw, canvas, plastic).

Table 47. Main material used in the roof

Main material used in the roof	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Ceramic tile	742	733	▼	403	398	▼
	(98.80)	(97.60)	-1%	(98.05)	(96.84)	-1%
Concrete slab	0	0	=	0	0	=
	(0.00)	(0.00)		(0.00)	(0.00)	
Zinc, asbestos, eternity	0	2	▲	2	0	▼
	(0.00)	(0.27)		(0.49)	(0.00)	-100%
Other material (wood, straw, canvas, plastic)	9	16	▲	6	13	▲
	(1.20)	(2.13)	+78%	(1.46)	(3.16)	+117%

Note: Proportion of total households in parenthesis.

Source: Research results.

As observed for the cladding of external walls, the vast majority of households have floors made of masonry, with materials such as cement, bricks, blocks or slabs (Table 48). None of the households have wooden floors and almost none have earthen floors.

Table 48. Main material used in the floor

Main material used in the floor	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Masonry (cement, brick, block, slab, etc.)	724	723	▼	402	397	▼
	(96.40)	(96.27)	-0%	(97.81)	(96.59)	-1%
Wood	0	0	=	0	0	=
	(0.00)	(0.00)		(0.00)	(0.00)	
Earthen floor	27	28	▲	9	14	▲
	(3.60)	(3.73)	+4%	(2.19)	(3.41)	+56%

Other	0	0	=	0	0	=
	(0.00)	(0.00)		(0.00)	(0.00)	

Note: Proportion of total households in parenthesis.
Source: Research results.

Table 49 presents the distribution of households in terms of the number of bedrooms. Among analyzed households, none of them had no bedrooms. In general, most families live in places with three or four bedrooms. A significant portion of households also have five or more bedrooms.

Table 49. Number of bedrooms

Bedrooms	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
1	3	3	=	0	0	=
	(0.40)	(0.40)		(0.00)	(0.00)	
2	21	12	▼	21	9	▼
	(2.80)	(1.60)	-43%	(5.11)	(2.19)	-57%
3	311	257	▼	166	148	▼
	(41.41)	(34.22)	-17%	(40.39)	(36.01)	-11%
4	319	349	▲	171	188	▲
	(42.48)	(46.47)	+9%	(41.61)	(45.74)	+10%
5+	75	93	▲	43	48	▲
	(9.99)	(12.38)	+24%	(10.46)	(11.68)	+12%

Note: Proportion of total households in parenthesis.
Source: Research results.

As depicted in Table 50, more than 3/4 of the households occupied by the families considered in this study have a bathroom. The proportion of households with a bathroom increased from 2017 to 2022. Still, this percentage remained (slightly) higher for the control group than for the treatment group.

Table 50. Existence of bathroom at home

Is there a bathroom in the house?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	552	631	▲	307	352	▲
	(73.50)	(84.02)	+14%	(74.70)	(85.64)	+15%

Note: Proportion of total households in parenthesis.
Source: Research results.

The main sewage destination is informed in Table 51. Considering that rural areas are usually not served by the wastewater collection system, the proportion of households in which this is the main destination is relatively small. However, there is a residual increase in this percentage between 2017 and 2022.

Most households dispose of the sewage generated in cesspools, whether they are lined or not. In 2017, a significant portion of households still carried out waste disposal in the open or in bodies of water, but this proportion decreased for 2022.

Table 51. Main destination of household sewage

Main destination of sewage	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Wastewater collection system	8	14	▲	5	9	▲
	(1.07)	(1.86)	+75%	(1.22)	(2.19)	+80%
Masonry-lined cesspit	460	521	▲	264	263	▼
	(61.25)	(69.37)	+13%	(64.23)	(63.99)	-0%
Non-lined cesspit	33	79	▲	15	70	▲
	(4.39)	(10.52)	+139%	(3.65)	(17.03)	+367%
Open air or in a body of water	207	135	▼	104	67	▼
	(27.56)	(17.98)	-35%	(25.30)	(16.30)	-36%
Other form	43	2	▼	23	2	▼
	(5.73)	(0.27)	-95%	(5.60)	(0.49)	-91%

Note: Proportion of total households in parenthesis.
Source: Research results.

Access to electricity by the households investigated in this study is presented in Table 52. Considering the threshold legally defined by the Ministry of Mines and Energy, it can be said that the analyzed households are virtually electrified. This result may be directly related to the access to social benefits, such as the rural electrification programs Luz no Campo and Luz para Todos.

Table 52. Existence of electricity at home

Is there electricity at home?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	662	689	▲	380	386	▲
	(88.15)	(91.74)	+4%	(92.46)	(93.92)	+2%

Note: Proportion of total households in parenthesis.

Source: Research results.

In general, the predominant type of electricity in the investigated sample is the single-phase system, although its relative participation has declined for both groups between 2017 and 2022 (Table 53). An opposite trend was observed for the three-phase system, mainly for the treatment group, where this type of circuit now account for more than 50% of the total.

Table 53. Type of power circuit in the home

Tipo de energia elétrica	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Monofásica	595	209	▼	342	142	▼
	(79,23)	(27,83)	-65%	(83,21)	(34,55)	-58%
Bifásica	0	0	=	0	0	=
	(0,00)	(0,00)		(0,00)	(0,00)	
Trifásica	22	480	▲	12	244	▲
	(2,93)	(63,91)	+2082%	(2,92)	(59,37)	+1933%
Outra	0	0	=	0	0	=
	(0,00)	(0,00)		(0,00)	(0,00)	
Sem energia elétrica			=			=
	0	0		0	0	
	(0,00)	(0,00)		(0,00)	(0,00)	

Note: Proportion of total households in parenthesis.

Source: Research results.

Unlike access to electricity, the existence of piped water was not yet fully widespread among the households analyzed in 2022, as can be seen in Table 54. Even so, it should be noted that there was a reasonable increase in the proportion of households that had at least one room with running water between 2017 and 2022.

Table 54. Existence of piped water in the home

Is there piped water in the house?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	378	442	▲	211	229	▲
	(50.33)	(58.85)	+17%	(51.34)	(55.72)	+9%

Note: Proportion of total households in parenthesis.

Source: Research results.

Table 55 highlights the main sources of water used by families in their homes. Wells/springs and cisterns were used by more than half of the sample to obtain water in 2017. However, the relative participation of these water sources decreased to 2022. An opposite trend was observed for the obtainment of water through the water supply network, which increased for both groups.

Table 55. Main sources of water used by the family

Main sources of water	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Water supply network	194	289	▲	100	125	▲
	(25.83)	(38.48)	+49%	(24.33)	(30.41)	+25%
Well or water spring	221	95	▼	135	65	▼
	(29.43)	(12.65)	-57%	(32.85)	(15.82)	-52%
Cistern	463	127	▼	257	70	▼
	(61.65)	(16.91)	-73%	(62.53)	(17.03)	-73%
Body of water	95	25	▼	45	15	▼
	(12.65)	(3.33)	-74%	(10.95)	(3.65)	-67%
Water truck	245	41	▼	123	26	▼
	(32.62)	(5.46)	-83%	(29.93)	(6.33)	-79%

Other forms	78	6	▼	48	3	▼
	(10.39)	(0.80)	-92%	(11.68)	(0.73)	-94%

Note: Proportion of total households in parenthesis.
Source: Research results.

3.11 Social capital

To complete the descriptive analysis of the sample used to evaluate the impact of the Pró-Semiárido Project, there is the presentation of information on social capital. In this case, the interviewee's participation in associations stands out, including those through which the actions of the Project are carried out.

As shown in Table 56, the proportion of interviewees who have participated in associative activities or social organizations is higher for the treatment group than for the control group. In temporal terms, the occurrence of a decrease in the proportion for both groups stands out.

Table 56. Participation in associative activities or social organizations

Participation in associative activities or social organizations?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Yes	634	436	▼	268	69	▼
	(84.42)	(58.06)	-31%	(65.21)	(16.79)	-74%

Note: Proportion of total households in parenthesis.
Source: Research results.

Table 57 brings the classification of interviewees in terms of the type of associative activities or organizations that they have already participated in. Around 75% of individuals in the treatment group participated in community, neighborhood, farmers or cooperative associations in 2017, while this proportion was close to 50% in the control group for 2022. It is noteworthy, however, that a substantial drop was identified between years.

Table 57. Associative activities or social organizations that participated

Associative activities or social organizations that participated	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
Community, neighborhood, farmers or cooperative associations	574	374	▼	215	58	▼
	(76.43)	(49.80)	-35%	(52.31)	(14.11)	-73%
Collective or community work	176	185	▲	70	19	▼
	(23.44)	(24.63)	+5%	(17.03)	(4.62)	-73%
Organized social movement (NGO, MST, MLT, FETAG, CONTAG etc.)	40	24	▼	11	6	▼
	(5.33)	(3.20)	-40%	(2.68)	(1.46)	-45%
Religious movements	143	146	▲	59	16	▼
	(19.04)	(19.44)	+2%	(14.36)	(3.89)	-73%
Unions	308	112	▼	162	19	▼
	(41.01)	(14.91)	-64%	(39.42)	(4.62)	-88%
Others (club, sports and social associations, etc.)	15	0	▼	3	1	▼
	(2.00)	(0.00)	-100%	(0.73)	(0.24)	-67%

Note: Proportion of total households in parenthesis.
Source: Research results.

The respondent's knowledge in terms of the holding meetings of the association to which she belongs is described in Table 58. The share of individuals whose associations did not hold meetings during the year grew between 2017 and 2022 for both groups.

Table 58. Holding meetings throughout the year

A associação realizou reuniões durante o ano?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
No	63	98	▲	51	145	▲
	(8.39)	(13.05)	+55%	(12.41)	(35.28)	+184%
Yes	558	483	▼	205	122	▼
	(74.30)	(64.31)	-13%	(49.88)	(29.68)	-40%

4. RESULTADOS

Do not know/did not answer	13	170	▲	12	144	▲
	(1.73)	(22.64)	+1208%	(2.92)	(35.04)	+1100%

Note: Proportion of total households in parenthesis.

Source: Research results.

Table 59 shows the frequency with which respondents participate in their associations' meetings during the year. The proportion of individuals who participated in all meetings decreased significantly between the analyzed years. This is intriguing data, which may be reflecting the social distancing imposed by the COVID-19 pandemic.

Table 59. Participation in meetings during the year

How many meetings did you attend during the year?	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
None	22	23	▲	15	12	▼
	(2.93)	(3.06)	+5%	(3.65)	(2.92)	-20%
Some	215	262	▲	95	73	▼
	(28.63)	(34.89)	+22%	(23.11)	(17.76)	-23%
All	321	199	▼	95	37	▼
	(42.74)	(26.50)	-38%	(23.11)	(9.00)	-61%
Not applicable	0	0	▲	0	0	▲
	(0.00)	(0.00)		(0.00)	(0.00)	

Note: Proportion of total households in parenthesis.

Source: Research results.

This section presents the results of the impact evaluation of the Pró-Semiárido Project, which are arranged in three subsections. The first shows the results originating from the analysis of multidimensional poverty. The second comprises the descriptive analysis of the outcome variables (socioeconomic and agricultural indicators). Lastly, the third displays the results of the impact evaluation itself.

4.1 Multidimensional poverty

This subsection presents the results of the multidimensional poverty analysis, considering the years of 2017 and 2022. First, the multidimensional poverty index is presented for the sample as a whole. Subsequently, the index is portrayed for each of Bahia's identity territories covered by the Project, in addition to being disaggregated for each dimension. Finally, and most importantly, the results for the treatment and control groups are exposed and contrasted.

When it comes to the definition of the poverty line, the first cut-off point is set within each of the considered dimensions. For the dimensions of income, social capital, human capital, food security, housing conditions, and sustainability, respectively, the following cut-off points were considered: 550, 3, 2, 1, 2, and 2. These values were defined based on the statistical analysis of indicators and on the criterion suggested by Alkire and Foster (2011).

The analysis of MPI estimations for the sample of Bahia municipalities lead to the conclusion that the multidimensional poverty rate (Π0) showed a reduction from 2017 to 2022, as can be seen in Table 60. It can be seen that, for all values for k, the incidence of poverty is lower in 2022. The overall MPI for municipalities covered by Pró-Semiárido, considering the cutoff point chosen for this analysis (k=3) dropped from 64.9% to 49.4% during the analyzed period.

Table 60. Multidimensional Poverty Index, per poverty cut-off

k	Prevalence of multidimensional poverty		
	2017	2022	Var.
1	67.6%	56.7%	▼
2	67.4%	55.5%	▼
3	64.9%	49.4%	▼
4	53.5%	37.0%	▼

Source: Research results.

The results of the MPI broken down by dimensions provides the contribution of each one of them to the index, in the two years surveyed (Table 61). First, it is clear that only two dimensions – Social Capital and Housing Conditions – gained relevance in multidimensional poverty from 2017 to 2022. The other four dimensions – Income, Human Capital, Food Security and Sustainability – had their importance decreased, which is a favorable result as it evidences improvements in living conditions.

Nevertheless, the result presented above should be taken with caution. An important dimension for the quality of life of population – Housing Conditions – showed an increase in its relevance to the IPM, and other equally important dimensions showed a reduction in participation, but not very considerable – e.g., Food Security and Sustainability. These observations are relevant for directing policy actions towards those areas that are most committed to generating well-being for rural families.

In 2022, deprivations in Sustainability, Social Capital and Human Capital are the ones that most contribute to MPI. These results are important in order to identify priorities actions, as public policy interventions directed at these dimensions could lead to a lower degree of poverty among the analyzed population.

Table 61. Relative contribution of dimensions to the Multidimensional Poverty Index

Dimension	Contribution to the MPI		
	2017	2022	Var.
Income	18,59%	14,04%	▼

Social Capital	16,24%	19,50%	▲
Human Capital	21,11%	19,72%	▼
Food Security	9,29%	8,81%	▼
Housing Condition	11,80%	16,26%	▲
Sustainability	22,97%	21,68%	▼

Source: Research results.

Finally, Table 62 shows the behavior of MPI for the treated and control groups from 2017 to 2022. It is noted that, from one period to another, the multidimensional poverty rate fell for the treatment group and increased for the control group. In the last year, the poverty rate remained much lower for the treated (41.9%) in comparison to controls (62.7%). These results are very relevant as they indicate that interventions carried out under Pró-Semiárido have been positive in reducing multidimensional poverty in the areas of the State of Bahia served by the project.

Table 62. Multidimensional Poverty Index, per treatment status

Prevalence of multidimensional poverty	Treatment			Control		
	2017	2022	Var.	2017	2022	Var.
	63,1%	41,9%	▼	68,2%	62,7%	▼

Source: Research results.

4.2 Descriptive analysis

4.2.1 Socioeconomic indicators

Figure 3 presents the distribution of selected socioeconomic indicators in terms of previously stipulated categories for the treatment and control groups in 2017 and 2022. It is observed, for the participation of women and young people in community actions, that the distribution of households between categories changed slightly between 2017 and 2022. A decrease in households with high participation was observed for both groups.

Regarding the associativity indicator, a similar trend is identified for the treatment and control groups when comparing their evolution between 2017 and 2022. In both cases there was an increase in the proportion of the head of households who do not participate in associative activities.

Regarding the housing indicator, one can see that, both for the treatment and control groups, the proportion of households at the high-level category evolved positively during the analyzed period. The distribution of households between the categories is quite similar between the treatment and control groups.

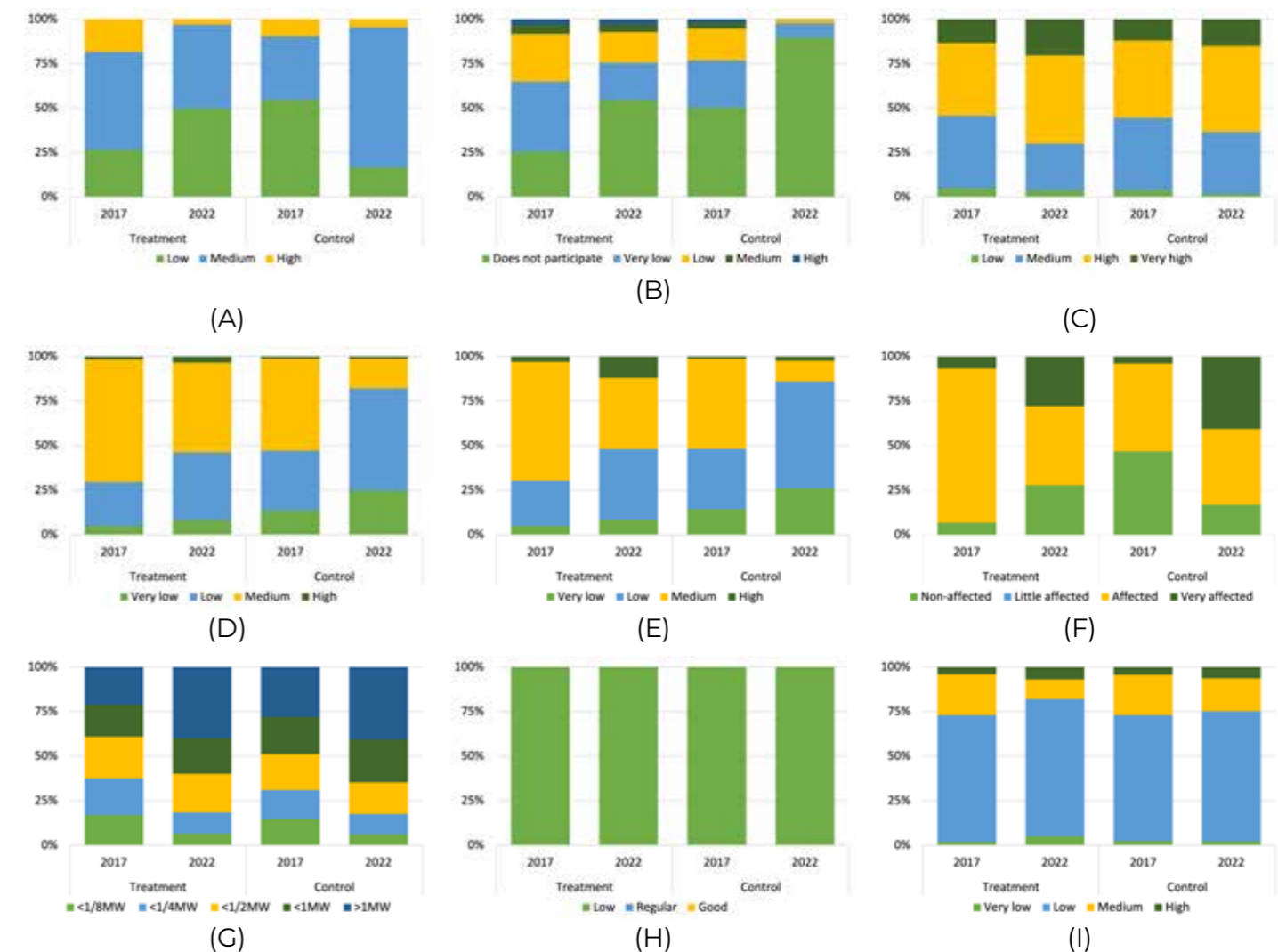
The access to public policies in general and to agricultural policies in specific evolved similarly between 2017 and 2022. For both indicators, the evolution was negative, considering the expansion of the categories of low and very low access. In comparative terms, the evolution of the control group was worse than that of the treatment group.

A similar scenario regarding the effects of drought episodes was identified for both the treatment and control groups. The indicator points out to a considerable expansion in the proportion of highly affected households. There was a decrease in affected households, which is true the treatment and control groups.

For the poverty indicator, groups presented a very similar evolution. In both cases, the participation of households with monthly per capita earning of more than the minimum wage increased between 2017 and 2022, while there was a considerable decrease in those with monthly per capita earnings of less than 1/8 of the minimum wage.

The classification regarding the adoption of agroecological and sustainable practices remained constant as all households investigate, regardless of the treatment status, showed a low level of adoption. As for the indicator of food security, a relatively negative evolution was identified for both groups. Nevertheless, the increase in the proportion of households with the lowest levels of food security was greater among beneficiaries. Source: Research results.

Figure 3. Distribution of socioeconomic indicators, treatment and control groups, 2017 and 2022. Note: (A) participation of women and young people in community actions; (B) associativity; (C) housing conditions; (D) access to public policies; (E) access to agricultural policies; (F) drought effects; (G) poverty; (H) agricultural and sustainable practices; (I) food security.



Source: Research results.

4.2.2 Agricultural indicators

Table 63 shows the average values obtained from the sales of agricultural and livestock production (raw and processed) for the treatment and control groups in 2017 and 2022. Farm production is disaggregated into livestock and agriculture, which, in turn, are disaggregated, respectively, in animals and animal-based products, and plants and plant-based products. The

value of the production consumed by the family is also presented, considering that in certain situations a significant portion of agricultural and livestock production can be used for this purpose.

Table 63. Average value of agricultural and livestock sales, treatment and control groups, 2017 and 2022

Item	Treatment			Control		
	2015	2020	Var.	2015	2020	Var.
Agriculture and livestock	1,733.79	4,051.77	▲	1,905.14	5,071.21	▲
Livestock	2,383.69	4,171.98	▲	2,255.75	5,401.18	▲
Animals	2,252.68	4,027.97	▲	2,165.37	5,416.08	▼
Animal-based products	851.71	2,043.79	▲	760.97	1,437.58	▲
Agriculture	1,999.88	1,445.52	▼	1,380.38	1,239.29	▼
Plants	1,650.92	1,459.88	▼	1,329.71	1,210.00	▼
Plant-based products	2,355.00	837.06	▼	1,605.25	1,415.00	▼
Self-consumption	1,348.94	1,857.45	▲	1,482.25	2,052.21	▲

Source: Research results.

In general, the value of agriculture and livestock sales evolved positively during the period of analysis. As prices were controlled for inflation, this result may be an indication of the strengthening of the agricultural sector as a source of income for the households investigated in this study, whether in the treatment group or in the control group.

Among the components of agriculture and livestock sales, however, the difference identified between livestock and agricultural products stands out. The first component showed a positive evolution, while the second one declined between 2017 and 2022. This is true for both the treatment group and the control group.

In addition to the value of sales, it is necessary to highlight the value of the share of production consumed by household members, given its importance in guaranteeing the nutrition and food security of analyzed families. The average value of self-consumption increased for both groups between 2017 and 2022.

4.3 Impact evaluation

4.3.1 Sample balancing

The evaluation of Project's impacts on socioeconomic and agricultural indicators requires the construction of a control group that is as similar as possible to the treatment group, in the period prior to the implementation of Pró-Semiárido, with regard to a set of observable variables that possibly influence participation in the Project. In this study, the construction of the counterfactual was performed through Entropy Balancing, whose results are described in Table 64.

Table 64. Means comparison test before and after entropy balancing, 2017

Variable	Before balancing		After balancing	
	Treatment	Control	Treatment	Control
Settlement	0.294	0.127	0.294	0.294
Quilombola community	0.163	0.100	0.163	0.163
Rural community	0.412	0.625	0.412	0.412
Bolsa Família	0.746	0.594	0.746	0.746
Refrigerator	0.825	0.847	0.825	0.825
Stove	0.957	0.954	0.957	0.957
Motorcycle	0.579	0.496	0.579	0.579
Person per bedroom	1.462	1.429	1.462	1.462
Sex	0.171	0.166	0.171	0.171
Drought	0.963	0.961	0.963	0.963
Education	6.509	5.985	6.509	6.509

Note: The variable "sex" indicates women-headed households.

Source: Research results.

Before applying entropy balancing, the control group had a mean different from that calculated for the treatment group in all variables considered. As previously expected, the balancing process turned the mean values obtained for controls as similar as possible to those calculated for treated households.

4.3.2 Impacts of Pró-Semiárido on socioeconomic indicators

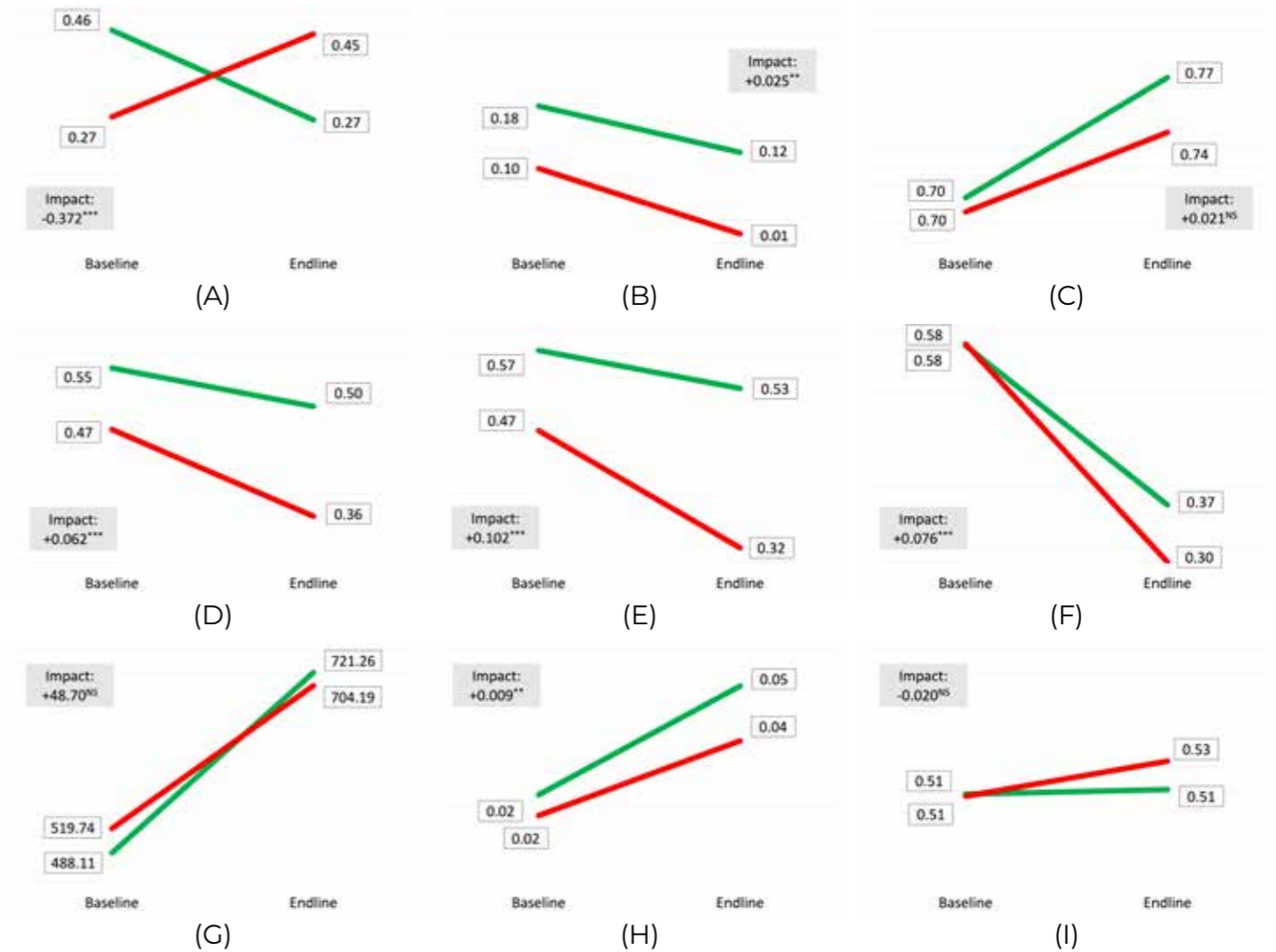
The impact of the Project on the set of socioeconomic indicators considered in this study is depicted in Figure 4. The Difference-in-Differences model estimated a positive coefficient for seven of the nine investigated indicators. For these indicators in specific, the mean intertemporal evolution (2017-2022) was more favorable for the treatment group than for the control group, i.e., either the increase was greater or the decrease was smaller for the former than for the latter.

Of the seven indicators with positive estimates, five had statistically significant coefficients. This indicates that, in statistical terms, the impact of Pró-Semiárido was, in fact, different from zero. Therefore, the participation in the Project increased the degree of associativity, the access to public policies in general and agricultural policies in specific, and the adoption of agroecological and sustainable practices, among others.

As mentioned, two other indicators also presented positive estimates, although they were not statistically significant at the 10% probability. This indicates that, at least from the perspective of the Difference-in-Differences model, there was no statistical impact of the Project. Even so, it should be noted that the fact that the estimates are positive means that, comparatively, the evolution of the treatment group in these socioeconomic dimensions was better than that of the control group.

Negative estimates were obtained for the rates of participation of women and young people in community and for the food security indicator. For the latter, however, it should be noted that the coefficient estimated was not statistically significant, which indicates that the impact of Pró-Semiárido on this socioeconomic dimension was not statistically different from zero, i.e., there was no impact at all.

Figure 4. Impacts of Pró-Semiárido on socioeconomic indicators.



Note: (A) participation of women and young people in community actions; (B) associativity; (C) housing conditions; (D) access to public policies; (E) access to agricultural policies; (F) drought effects; (G) poverty; (H) agricultural and sustainable practices; (I) food security. Source: Research results.

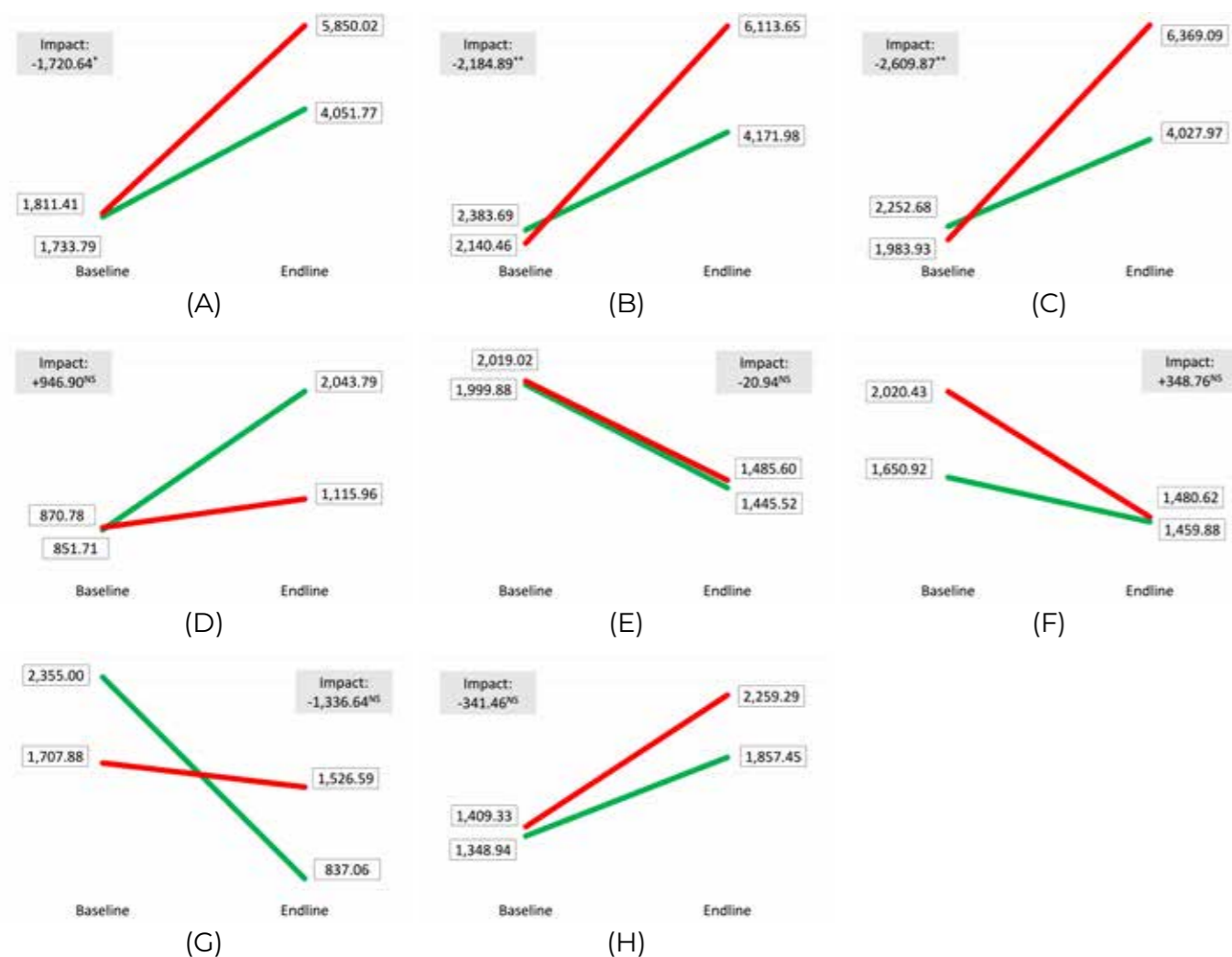
4.3.3 Impacts of Pró-Semiárido on agricultural indicators

Figure 5 shows the results obtained by the Difference-in-Differences model in terms of Project's impact on the value of agriculture and livestock sales, in addition to the value of self-consumption of agriculture and livestock products. The graphs illustrate, in a more didactic way, the values presented in the descriptive analysis, i.e., the averages of the two groups for each analyzed year. The model estimate is nothing more than the difference between groups of each group's intertemporal difference.

4.3.4 Impacts of Pró-Semiárido per sex of the head of household

The model estimated negative coefficients for all indicators, with the exception of the sales of animal- and plant-based products. In both cases, however, estimates were not statistically different from zero. For the other indicators, statistically significant coefficients were estimated for the sales of agriculture, livestock and animals, indicating that the average evolution presented by the control group was comparatively greater than that observed for the treatment group.

Figure 5. Impacts of Pró-Semiárido on the sales of agriculture and livestock.



Note: (A) agriculture and livestock; (B) livestock; (C) animals; (D) animal-based products; (E) agriculture; (F) plants; (G) plant-based products; (H) self-consumption.

Source: Research results.

In the sample analyzed in this study, only 17% of households were women-headed in 2017, which were the focus of part of interventions carried out under the Project. In this regard, the following hypothesis was raised: Did Pró-Semiárido impact benefiting households differently according to the sex of head of the household? Table 65 presents the estimates of Project's impacts on selected socioeconomic indicators according to the sex of the head of the household.

Considering the subsample composed solely of women-headed households, an impact of the Project was identified on all indicators, with the exception of associativity, poverty and food security. For male-headed households, on the other hand, statistically insignificant coefficients were estimated for housing conditions, poverty, the adoption of agroecological practices, and food security.

In addition, other points can be highlighted, such as the sign of the coefficients estimated. In all cases, without exception, the signs of the estimates were identical, regardless of the sex of the head of the household. For the indicators whose impact was statistically significant in both subsamples, it is observed that the magnitude of the impact tends to be slightly greater among women-headed households.

Table 65. Impacts of Pró-Semiárido on socioeconomic indicators, per sex of the head of household

Indicator	Head of household	
	Woman	Man
Participation of women and young people in community actions	-0.3981***	-0,3658***
Associativity	+0.0057 ^{NS}	+0.0261*
Housing conditions	+0.0808**	-0.0009 ^{NS}
Access to public policies	+0.0929**	+0.0567**
Access to agricultural policies	+0.1278**	+0.0991***
Drought effects	+0.1079***	+0.0650**
Poverty	+39.20 ^{NS}	+82.29 ^{NS}
Agricultural and sustainable practices	+0.0232***	+0.0010 ^{NS}
Food security	-0.0092 ^{NS}	-0.0244 ^{NS}

Notes: Superscripts indicate the statistical significance of estimates. *** p < 0.01; ** p < 0.05; * p < 0.1; NS p > 0.1.

Source: Research results.

Unlike what was observed for the socioeconomic indicators, there is a great divergence between women-headed and male-headed households in terms of the estimates obtained for the value of agriculture and livestock sales, as shown in Table 66. This is especially true for the magnitude of the estimated coefficients. Furthermore, it is noteworthy that none of the estimates obtained for the subsample of women-headed households was statistically significant.

For male-headed households, it is worth stressing that the coefficients estimated for the value of agriculture, livestock and animal sales were negative and statistically significant. In addition, such coefficients showed a significantly higher magnitude (in absolute terms) among male-headed households than for women-headed ones.

The representativeness of each sex in the main sample helps to explain the (dis)similarity of the results presented in this subsection with those obtained when the econometric analysis considered all observations together. In fact, as women-headed households accounted for only 17% of the main sample in the initial period, the lack of impact may be related to the relatively small size of this subsample and the consequent loss of statistical power.

Table 66. Impacts of Pró-Semiárido on the value of agriculture and livestock sales, per sex of the head of household

Indicator	Head of household	
	Woman	Man
Agriculture and livestock	-826,78 ^{NS}	-2.536,11*
Livestock	-725,54 ^{NS}	-3.151,42**
Animals	-1.165,80 ^{NS}	-3.485,30**
Animal-based products	+532,49 ^{NS}	+965,82 ^{NS}
Agriculture	-797,73 ^{NS}	-443,90 ^{NS}
Plants	-574,38 ^{NS}	+5,28 ^{NS}
Plant-based products		-2.416,21 ^{NS}
Self-consumption	+229,23 ^{NS}	-596,97 ^{NS}

Notes: Superscripts indicate the statistical significance of estimates. *** p < 0.01; ** p < 0.05; * p < 0.1; NS p > 0.1.

Source: Research results.

4.3.5 Impacts of Pró-Semiárido per age group of the head of household

As observed for women, young people are also one of the focus groups for interventions carried out under Pró-Semiárido. For this group in specific, however, the representativeness among the heads of household in the main sample is even smaller. Considering as young the person aged between 16 and 29 years old in 2017, this age group accounts for only 8.7% of the households analyzed, with the share within the treatment and control groups being of 9.5% and 7.8%, respectively.

Considering the socioeconomic indicators investigated in this study, Table 67 presents the results of the Difference-in-Differences model applied to two subsamples: households headed by young people (from 16 to 29 years of age in 2017) and households headed by non-youths (more than 29 years old in 2017). For most indicators, the signs of the estimated coefficients coincide, with the exception of associativity and the access to public and agricultural policies.

In terms of statistical significance, the results obtained for each of the subsamples were relatively different. For youth-headed households, only the rates of participation of young people and women in community actions and the poverty indicator were statistically different from zero. For households headed by non-youths, on the other hand, most estimates were statistically significant, with the exception of housing conditions, poverty and food security.

Table 67. Impacts of Pró-Semiárido on socioeconomic indicators, per age group of the head of household

Indicador	Head of household	
	Young	Non-young
Participation of women and young people in community actions	-0.3495***	-0.3736***
Associativity	-0.0094 ^{NS}	+0.0286**
Housing conditions	+0.0115 ^{NS}	+0.0222 ^{NS}
Access to public policies	-0.0819 ^{NS}	+0.0782***
Access to agricultural policies	-0.0748 ^{NS}	+0.1221***

Drought effects	+0.1243 ^{NS}	+0.0712 ^{***}
Poverty	+410.08 ^{***}	+7.85 ^{NS}
Agricultural and sustainable practices	+0.0043 ^{NS}	+0.0093 ^{**}
Food security	-0.0520 ^{NS}	-0.0160 ^{NS}

Notes: Superscripts indicate the statistical significance of estimates. *** p < 0.01; ** p < 0.05; * p < 0.1; NS p > 0.1.

Source: Research results.

Table 68 presents the results of the econometric model for the value of agriculture and livestock sales of households headed by young and non-young people. In this case, there is a reasonable divergence between subsamples for both the magnitude and the sign of the coefficients estimated.

For the subsample composed of households headed by young people, the Project had a positive and statistically significant impact on both the value of agriculture and livestock sales as a whole and the value of livestock sales in specific. As for households headed by non-youths, which correspond to the majority of the sample, negative and significant impacts of Pró-Semiárido were identified for the value of agriculture and livestock sales as a whole, and the value of livestock sales in particular as well as animal sales.

Table 68. Impacts of Pró-Semiárido on the value of agriculture and livestock sales, per age group of the head of household

Indicator	Head of household	
	Young	Non-young
Agriculture and livestock	1680,51*	-1823,62*
Livestock	2615,81*	-2419,61**
Animals	1359,03 ^{NS}	-2613,72**
Animal-based products	-46,73 ^{NS}	961,23 ^{NS}
Agriculture	-134,64 ^{NS}	128,62 ^{NS}
Plants	-146,28 ^{NS}	558,97 ^{NS}
Plant-based products		-1403,65 ^{NS}
Self-consumption	1136,04 ^{NS}	-392,79 ^{NS}

Notes: Superscripts indicate the statistical significance of estimates. *** p < 0.01; ** p < 0.05; * p < 0.1; NS p > 0.1.

Source: Research results.

4.4 Impact indicators: Logical Framework

This subsection presents the evaluation of ten outcome indicators extracted from the Project's Logical Framework. The analysis is based on the same data used in the Impact Evaluation, which covers information collected in the baseline survey (base-year 2017) and the endline survey (base-year 2022). Financial data were deflated using the Extended National Consumer Price Index (IPCA), being expressed in terms of values from December 2022.

4.4.1 Rural population living in poverty condition in the project area

The Multidimensional Poverty Index was calculated in order to measure the evolution of extreme poverty from the data collected for the Impact Evaluation Analysis. In this case, it is considered that poverty is a phenomenon of multiple dimensions, thus being able to impact interviewed individuals in the most diverse ways and not only from a financial perspective.

For this specific indicator, the whole sample used in the Impact Evaluation Analysis is considered, i.e., both the treatment and the control groups were taken into consideration. In that regard, the prevalence of multidimensional poverty in the area covered by Pró-Semiárido ranged from 64.9% in 2017 to 49.4% in 2022. In other words, there was a drop of more than 15 percentage points (approximately 24%) in the prevalence of poverty during the Project operation.

4.4.2 Prevalence of poverty among beneficiaries of productive investments

For this indicator, only the treatment group was considered. As with the indicator presented above, multidimensional poverty was also considered. In this case, the result indicates that the percentage of (multidimensionally) poor households increased from 63.1% in 2017 to 41.9% in 2022. This corresponds to a decrease of approximately 34% in the prevalence of poverty among Pró-Semiárido's beneficiaries.

Table 69. Proportion of poor households according to the multidimensional poverty index

Indicator	Treatment		Control	
	2017	2022	2017	2022
Households in situation of poverty	63.1%	41.9%	68.2%	62.7%

Source: Research results.

4.4.3 Assets of families benefited with technical assistance and productive investments

In the context of this indicator, two types of assets were considered: domestic and productive. Domestic assets include all goods and machinery owned by household members, while productive assets concern the stock of animals. Results indicate that 44.61% of beneficiaries showed an increase in the amount of domestic assets, while 36.22% of benefiting families registered an increase in the amount of productive assets.

4.4.4 Production of farming families benefited from productive investments

In view of the complexity of grouping different volume units into the same indicator, the value of agricultural production was considered. For instance, while milk production is measured in liters, crop production is measured in kilograms. To calculate the value of agricultural production for each benefiting family, the following values were added: (i) sales of animal production; (ii) sales of animal-based products; (iii) sales of plant production; (iv) sales of plant-based products; and (v) family self-consumption. The results indicate that, on average, production value increased by approximately 214% between 2017 and 2022. It can also be noted that 38.50% of benefiting household showed an increase of more than 50% in the production value.

4.4.5 Families receiving technical assistance and productive investments increase their average income by at least 30%

For this indicator, average income was taken as the per capita income, i.e., the total value of household income divided by the number of household members. The result obtained indicates that 57.72% of benefiting households achieved an increase in per capita income of over 30%.

4.4.6 Families increase their average income

For this indicator, average income was taken as the per capita income, i.e., the total value of household income divided by the number of household members. The result obtained indicates that 68.60% of benefiting households had some increase in their average income.

4.4.7 Families reporting an increase in production

In view of the complexity of grouping different volume units into the same indicator, the value of agricultural production was considered. To calculate the value of agricultural production for each benefiting family, the following values were added: (i) sales of animal production; (ii) sales of animal-based products; (iii) sales of plant production; (iv) sales of plant-based products; and (v) family self-consumption. The result obtained indicates that 48.75% of benefiting households showed an increase in the value of agricultural production between 2017 and 2022.

4.4.8 Families benefiting from productive investments gain access to public programs

For this indicator, the public programs listed in the baseline and end-line surveys (Question 22) were taken into consideration. In total, 29 programs were considered. In this scenario, it is noteworthy that all benefiting families had access to at least one of the programs listed. For 2022, beneficia-

ries accessed, on average, between 4 and 5 public programs. The evolution of access to these programs, on the other hand, was measured from the difference in the number of programs accessed by families in 2022 and 2017. It was observed, therefore, that 43.41% of households benefited by the Project increased access to public programs during the time period considered.

4.4.9 Families reporting the adoption of new/improved inputs, technologies or practices

For this indicator, the practices listed in the baseline and endline surveys (Question 111) were taken into consideration. Specifically, the following practices were considered: (i) use of irrigation; (ii) use of watering; (iii) disuse of agricultural burning; (iv) disuse of pesticides; (v) use of chemical fertilizer; (vi) use of organic compost; (vii) use of manure; and (viii) use of crop residues (straw). The results obtained indicate that all beneficiaries adopted at least one of the listed practices. In addition, it was observed that, on average, between 3 and 4 practices are adopted by each benefiting family. Finally, it is worth stressing that the number of practices adopted increased for over 78.30% of beneficiaries.

4.4.10 The products generated by productive investments go through a value-adding stage

Of all the indicators considered, this was perhaps the most complex to analyze. With the information present in the database, there is no direct way of identifying the level of processing of each family production. To get around this problem, the analysis considered the information provided by interviewees regarding the main productive activities carried out by them (Question 10). All items that consider product processing (10.6 to 10.10) were considered as value-adding processes by the beneficiary. In this case, the result obtained indicates that, in 2022, 18.91% of benefiting families carried out some process of value addition to agricultural production.

5. CONCLUSIONS

The Rural Sustainable Development Project in the Semiarid Region of Bahia, known as the Pró-Semiárido Project, is a rural development project designed in partnership with the International Fund for Agricultural Development (IFAD), that ran from 2013 (effective start in 2014) to 2023. With a total investment of US\$ 105 million, the project benefited around 75,000 families from the semiarid region of the northern part of the state of Bahia.

Faced with a scenario of high prevalence of poverty and extreme poverty in the region, Pró-Semiárido acts through interventions that focus on raising the level of income, productivity and job opportunities, as well as strengthening rural institutions. Project's interventions serve family farmers who perform both agricultural and non-agricultural activities, with a special emphasis on women and young people.

With the objective of shedding light on Project results on benefiting families, thus contributing to the design and review of its interventions, the present report evaluated the impacts of Pró-Semiárido on socioeconomic and agricultural indicators. Specifically, the study sought to verify whether, as a result of participating in Project interventions, benefiting families showed a significantly different evolution in the indicators analyzed in comparison to non-benefiting families.

The empirical strategy adopted to identify the impacts of the Project was based on the establishment of a control group, which was constructed via Entropy Balancing, and on the application of the Difference-in-Differences model. In short, the methodology compares the evolution of results obtained by beneficiaries (treatment group) and non-beneficiaries (control group). For this purpose, the analysis relied on data collected via surveys referring to the base-years of 2017 and 2022.

As a subsidy to the Impact Evaluation Analysis, a Multidimensional Poverty Index (MPI) was calculated by using the same set of data. Based on the observation that poverty is a phenomenon that impacts families in

several ways, this report introduces an innovation by calculating the MPI for the investigated sample, thus incorporating other dimensions in addition to income.

Regarding multidimensional poverty, it was possible to notice that the prevalence of poor families decreased between 2017 and 2022 for both groups, although the decrease in the level of poverty was significantly greater for the treatment group. The index showed a decrease of more than 20 percentage points for benefiting families, signaling that the interventions carried out under the Project have exerted a positive influence to the reduction of the level of multidimensional poverty.

The impact analysis on selected socioeconomic indicators showed that the Pró-Semiárido was effective in promoting the degree of associativity, the access of Project participants to public policies in general and to agricultural policies in specific, and the adoption of agroecological and sustainable practices. In addition, initiatives promoted under Pró-Semiárido also proved to be effective in combating the adverse effects of the drought on benefiting families.

Such results should be seen as extremely favorable. Together, they point to the dissemination, at least among benefiting families, of production (agroecological and sustainable practices) and management (policies for access to markets and financing) techniques capable of transforming local agriculture into a sustainable activity, both in environmental and economic terms. Ultimately, the financial strengthening of benefiting farmers and their greater awareness facilitate adaptation to and mitigation of adverse climate effects that periodically punish the region.

When stratifying the sample in terms of sex and the age group of the head of household, the impact analysis showed that the Project had a heterogeneous effect on its beneficiaries. Although similar results were obtained for male- or women-headed households, the impacts of Pró-Semiárido on socioeconomic indicators seem to have been concentrated especially in households headed by non-youths (over 29 years of age). For agricultural indicators, in turn, impacts seem to be concentrated in male-headed households.

Despite these results, one cannot conclude that the Project has not been effective in benefiting individuals from the focus groups. As detailed in the description of the data, the socioeconomic situation of individuals from the focus groups showed improvements in several aspects. Therefore, the

fact that no significant estimates of Project's impacts were found on households headed by women (agricultural indicators) and young people (socioeconomic and agricultural indicators) tends to be related more to sample variability than to the effectiveness of Pró-Semiárido.

It is important to highlight that the lack of impacts on some of the other dimensions analyzed – especially when comparing the sex and the age of the head of household – does not indicate a lack of result or an undesirable result. These findings only suggests that the beneficiaries did not present comparatively significant changes in the average values of the evaluated indicators, even though other variables, which were not explicitly considered, may have been positively impacted.

With regard to the impacts of Pró-Semiárido on farmers' production, the value of agriculture and livestock sales was analyzed, in addition to its subdivisions: agriculture (plants and plant-based products) and livestock (animals and animal-based products). Regardless of the level of aggregation, no impact was identified as all coefficients estimated by the Difference-in-Differences model were statistically equal to zero.

As explained in the methodological section, the analysis focused only on the results achieved by individual farmers, thus focusing on community agreements. Consequently, the results induced by Pró-Semiárido on economic organizations (cooperatives and farmers associations) benefited by the Project were not considered. The absence of impact on the agricultural indicators of benefiting farmers may be an indication that, when considering the productive sphere, the benefits of the Project may have reached benefiting farmers indirectly, based on their participation in economic organizations.

With regard to the result indicators of Pró-Semiárido, which were extracted from the Logical Framework, a very positive balance was obtained. This is especially true for the ownership of household goods, the adoption of innovative practices, and the evolution of agricultural production. Despite the fact that the growth rate of both production and sales and the proportion of families with increased income did not reach the planned objectives, results were very close to surpassing the initially defined threshold.

Finally, it should be noted that 2022 was an atypical year due to the COVID-19 pandemic. The economic and social consequences of the pandemic possibly affected the families analyzed in a number of dimensions.

Adverse shocks triggered by COVID-19 may have contributed to the estimation of modest or non-existent impacts on some indicators, even though there may have been other important positive effects not captured by the model employed and the variables used.

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APPENDIX

Table A1. Dimensions and variables that compose the Multidimensional Poverty Index

Dimension	Indicator	Poverty Line
Income Dimension Captures the households' insufficiency of resources	Indicator of Income Household per capita income	Per capita income below 1/2 MW – Poverty line defined by Hoffman (2000)
Social Capital Dimension Captures the training level of target institutions and individuals, concerning changes in both individual capacities and collective actions	Indicator of Access to Agricultural Policies Calculated as the average of the following agricultural policies: (i) Cistern for agricultural production - 2nd water; (ii) Agricultural financing, PAA, PNAE, rural insurance, SEAF, agrarian reform and land credit.	Family members have no access to agricultural policies
	Indicator of Participation of Women and Young People in Community Actions (Inclusion and Empowerment) 1. Participation of Young people in Community actions; and 2. Participation of women in Community actions	There is no participation of young people or women from the family in community activities
	Indicator of associativity: Number of different types of associations in which the family participates, including (i) community and neighborhood associations; (ii) collective and community work; (iii) organized social movement, religious movements and unions; and (iv) other associations (clubs, sports and social associations); 2. If some family member process the production through the association; or if the production is commercialized through the association	Family members do not participate in any type of association

	Indicator of Access to Public Policies and Public Services 1. Access to the following benefits: Public pension; Unemployment insurance; Bolsa Família Program; Education Scholarship; Free bus pass, Senior card, Social driver's license; Viver sem limites, Saúde não tem preço, Rede cegonha; Social tariff on energy; Minha Casa Minha Vida, Minha Vida Melhor; Luz no Campo; Luz para Todos; Cistern for human consumption (1 st water); Cistern for agricultural production (2 nd water); Technical Assistance and Rural Extension; Agricultural financing; Pronaf; PAA; PNAE; Harvest Guarantee Program; Programa Fomento; Rural Insurance; Family Farming Insurance; Agrarian Reform Program, Land Credit; Program to Combat Rural Poverty; Individual Micro-Entrepreneur; Drought Grant; Family Health Program; Artisanal Fishers' Insurance for the Closed Season; State Water Supply System; Water Truck 2. Public Services Accessed: Health agent; Family Health Program; Public school bus; Public transportation; Public Security	Family members have no access to Public Policies and Public Services
	Indicator of Access to Credit If some family member has ever accessed one of the following benefits: Minha Casa Minha Vida, Minha Casa Melhor; Agricultural financing; Pronaf; Harvest Guarantee Program	Family members have no access to Financing Policies

Human Capital Dimension Captures the level of education and training in rural households	Indicator of Education – Educational level of respWhereents	The respWhereent has reached a minimum educational level, understood by the following: - people between 20 and 59 years old, who have not completed the first cycle of secondary education; and - people aged 60 or over, who have not completed primary education
	Indicator of access to training programs - If any family member is included in any community business plan with Training Actions	The family did not participate in training actions
	Indicator of access to technical advisory - If any family member is included in any community business plan with Advisory Actions and technical assistance	The family did not participate in advisory and technical assistance actions
Food Security Dimension Captures food security, through the results of research on: i) access to food; ii) food diversification; iii) origin of food	Indicator of difficulty getting food - If 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;	The family had a lot of difficulty getting food or was unable to get food
	Indicator of food variability - How often does the family have a varied or diverse diet (vegetables, leaves, fruits, meat, beans, rice, juice)	It never happened
	Indicator of food origin - If it came from donations from neighbors and relatives	The family received food donations

Housing Conditions Dimension Captures housing conditions regarding where most of the family lives and where they spend most of their time and whether they have access to important social facilities	Indicator of Housing Conditions: Type of household Material used in the external walls Material used in the roof Material used in the floor Existence of bathroom in the house Existence of piped water in the house Overcrowded household = Number of people per room = number of household members / number of rooms Electricity in the house	The household is a shack; The main material used for the external walls is rammed earth or other temporary material (straw, canvas, plastic) The main material of the roof is another material such as: wood, straw, canvas, plastic The main material used in the floor is earthen floor There is no bathroom There is no piped water in the house Households with three or more people per room There is no electricity at home
	Indicator of durable goods: If the household has: stove, refrigerator, washing machine, TV, telephone	Households that do not have at least three of the following goods: stove, refrigerator, washing machine, TV, telephone
Sustainability Dimension Captures the adoption of agroecological and sustainable practices	Indicator of cultivation practices: If there is use of agricultural burning; If there is use of pesticides; If there is use of chemical fertilizer; If there is use of organic compost; If there is use of manure; If there is use of straw	At least one of the following actions occurs: use of agricultural burning, pesticides or chemical fertilizers; disuse of organic compost, manure or straw
	Indicator of destination of empty agrochemical containers: If containers are returned; If agrochemical containers are buried, burned or discarded; If agrochemical containers are reused	If at least one of the following actions occurs: containers are not returned; containers are buried or burned; containers are reused

	Indicator of destination of household waste: Wastewater collection system; Recycled; Buried or burned; Discarded; Separation of organic waste for composting	If at least one of the following actions occurs: waste is not collected; waste is not recycled; waste is buried or burned; waste is discarded; or there is no separation of organic waste for composting
	Indicator of the conservation status of water springs, water mirrors and riparian forests Conservation status of water mirrors; Conservation status of water springs; Conservation status of riparian forests	If at least one of the following situations occurs: The water mirror is silted up or has no riparian vegetation; Water springs are degraded or poorly preserved; Riparian forests are absent or not very present

Source: Elaborated by the authors.

Table 2A. Description of the calculation of socioeconomic indicators

Indicator	Description
Index of participation of women and young people in community actions	$I_{J\&M} = \frac{C_1 + C_2}{2}$ <p>Where:</p> <p>C_1 indicates the participation of young people in community activities; e</p> <p>C_2 indicates the participation of women in community activities.</p> <p>Classification:</p> <p>a) $I_{J\&M} = 0$ (low)</p> <p>b) $I_{J\&M} = 0,5$ (medium)</p> <p>c) $I_{J\&M} = 1$ (high)</p>
Índice de associatividade	$I_{assoc} = \frac{(Q_{assoc} \times F_1 \times F_2) + C_1 + C_2}{8}$ <p>Where:</p> <p>Q_{assoc} indicates the number of different types of associations in which family members participate, considering the following options:</p>

	<p>a) Community associations</p> <p>b) Collective work, volunteering</p> <p>c) Organized social movement</p> <p>d) Religious movements</p> <p>e) Unions</p> <p>f) Others (clubs, sports and social associations)</p> <p>F_1 indicates whether the interviewee knows about the realization of association's meetings in the previous year:</p> <p>a) Does not know = 0,5</p> <p>b) There were no meetings = 0,75</p> <p>c) There were meetings = 1</p> <p>F_2 indicates the frequency of participation in meetings in the previous year:</p> <p>a) None = 0,5</p> <p>b) Some = 0,75</p> <p>c) All = 1</p> <p>$C_1 = 0$ indicates whether the production is processed through the association and 0 otherwise</p> <p>$C_2 = 1$ indicates whether the production is commercialized through the association and 0 otherwise</p> <p>Classification:</p> <p>a) $I_{assoc} = 0$ (does not participate)</p> <p>b) $0 < I_{assoc} \leq 0,2$ (very low)</p> <p>c) $0,2 < I_{assoc} \leq 0,4$ (low)</p> <p>d) $0,4 < I_{assoc} \leq 0,6$ (medium)</p> <p>e) $0,6 < I_{assoc} \leq 1$ (high)</p>
Index of housing conditions	$I_M = \frac{I_{ID} + I_S}{2}$ <p>Where:</p> <p>I_{ID} indicates housing conditions, which is given by the average of the following indicators:</p> <p>a) Type of home (1 if house, 0 otherwise)</p> <p>b) Material used on external walls (1 if masonry, 0 otherwise)</p> <p>c) Material used on the roof (1 if ceramic tile, 0 otherwise)</p>

- d) Material used on the floor (0 if earthen floor, 1 otherwise)
 - e) Toilet in the house (1 if yes, 0 otherwise)
- I_S indicates the sanitation condition, which is given by the average of the following indicators:
- a) Destination of wastewater (1 if wastewater collection system or septic tank, 0 otherwise)
 - b) Electricity (1 if yes, 0 if no)
 - c) Piped water (1 if yes, 0 if no)
 - d) Water from the general distribution network (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)

Index of access to public policies

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

Where:

I_b indicates the benefits received, which is given by the average of the 29 benefits listed in the survey

I_a indicates whether someone in the household participates in any association and 0 otherwise

I_{DAP} indicates if someone in the household is registered in DAP and 0 otherwise

I_S indicates the services accessed, which is given by the average of the 5 services listed 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)

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

Where:

I_b indicates the benefits received, which is given by the average of the following benefits:

- a) Cistern for production - 2nd water
- b) Technical assistance and rural extension

- c) Agricultural financing
- d) Pronaf
- e) PAA
- f) PNAE
- g) Garantia-safrá
- h) Rural insurance
- i) SEAF
- j) Agrarian reform
- k) Land credit

$I_a = 1$ if someone from the household participates in any association and 0 otherwise

$I_{DAP} = 1$ if someone in the household is registered in 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)

Index of drought

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

Where:

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

C_2 indicates the effects of drought (e.g., loss of animals or crops)

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

Classification:

- a) $I_{seca} \leq 0,10$ (unaffected)
- b) $0,10 < I_{seca} \leq 0,30$ (little unaffected)
- c) $0,30 < I_{seca} \leq 0,60$ (affected)
- d) $0,60 < I_{seca} \leq 1,00$ (very affected)

Index of poverty	Households are classified into per capita income ranges (R) according to the minimum wage (SM), 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) $SM < R$
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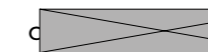
Index of agroecological	$I_{ECO} = \frac{I_p + I_{espelho} + I_{riacho} + I_{nascente}}{14 + n}$ <p>Where:</p> <p>I_p indicates the adoption of agroecological practices, which is given by the sum of the following indicators</p> <ul style="list-style-type: none"> a) Use of agricultural burning (Yes = 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) Return of empty packaging (Yes = 1) h) Buried, burned or discarded agrochemical packaging (Yes = 0) i) Reused agrochemical packaging (Yes = 1) j) Domestic waste collected by the municipal system (Yes = 1) k) Domestic waste recycled (Yes = 1) l) Domestic waste buried/burned (Yes = 0) m) Domestic waste thrown into the environment (Yes = 0) n) Separation of organic waste for composting household waste (Yes = 1) <p>$I_{espelho}$ =1 if there is riparian forest in the water mirror and 0 otherwise</p> <p>I_{riacho} =1 if there is riparian forest in the water stream and 0 otherwise</p>
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$I_{nascente}$ =1 if the water source is a spring
 n indicates the number of properties, among the property, among from 0 to 3)

Classification:

a) $I_{ECO} \leq 0,35$

b) $0,35 < I_{ECO} \leq$



Source: Elaborated by the authors.

the ones mentioned	a) Own production b) Exchange between c) Purchased from markets I_{outros} is an indicator a) Poverty indicator $4 (R \leq \frac{1}{8}SM)$ b) Permanent permanent c) Pension (pension pay) d) If the family e) If the family f) If the household (1 = Yes) g) If the family Classification: a) $0 < I_{segalim}$ b) $0,3 < I_{segalim}$ c) $0,6 < I_{segalim}$ d) $0,8 < I_{segalim}$
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