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Role of Microfinance Institutions in Farm System Resilience: A Case Study of Agroamigo in the Northeast Region of Brazil

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Abstract

The underdevelopment of the Northeast Region of Brazil has resulted in one of the highest concentrations of poverty in the nation, with more than seventeen of its roughly forty-two million people living below the poverty line. The lack of economic diversification and the reliance of the working class on agriculture has limited economic growth. Through the credit access program: Agroamigo of the development bank, the Northeast Bank of Brazil, credit is being provided to the local population to increase their economic development opportunities. Due to the accumulating economic, ecological, and societal challenges that agricultural systems in Northeast Brazil face, resilience is paramount to the long-term viability of farming operations. The sector that supports millions in the region and the credit program's success. Using the resilience assessment framework, the purpose of this paper is to provide an assessment of the impact of PRONAF and Agroamigo's credit program concerning farm systems' specific challenges as well as the farming system's desired economic functions. Data from the 1995 and 2006 agricultural censuses provided by the Brazillian Institute of Geography and Statistics was posited in an OLS regression model to examine changes in the farming system before and after the introduction of the credit access program. The study concludes that even though access to credit through Agroamigo increases the chances of insertion in the agricultural markets and stimulates production itself, it has done so at a cost to ecological resilience. Furthermore, the program's portfolio stands to weaken resilience in the long-term and for the poorest of family farms: contributing to industrialization and consolidation. Further supporting microfinance credit programs must include resilience thinking into their operations to sustainably develop farming systems over time and directly reach the most impoverished people.

1. Introduction

The Northeast region of Brazil consists of nine of Brazil's twenty-five states with around one-quarter of its population. In the Northeast, poverty and extreme poverty have declined in recent years[1]. Poverty and extreme poverty were defined in June 2011, by the institution of the Brasil sem Miséria program, that extreme poverty and poverty lines were officially set at BRL50 and BRL100 (or BRL70 and BRL140 when adjusted for inflation) in Presidential Decree 7492 of 2 June 2011[2]. Therefore, the figures from the International Policy Center for Inclusive Growth follow this definition. Poverty among agricultural households fell from 65 percent to 36 percent, but millions of rural households remain in poverty. Extreme poverty of agricultural households fell from 30 percent to 8 percent[2]. Though, extreme poverty among agricultural households is still higher in the Northeast than in any other region, including the North[2]. Poverty is thus still pervasive in the Northeast, despite considerable economic change over the last few decades and a "narrowing of the Northeast and south gap since 1970"[3]. While urban deprivation is a severe problem, poverty in the region is still primarily rural and agricultural[3]. Since 2011, the decline in poverty has slowed or even stagnated[2]. Research has shown that capitalization ranks highly among the attributes that are most important for the upward economic mobility of agricultural families[4]. Therefore, to remedy this issue, there is a continued need to expand access to credit and institutional operations to holistically address issues affecting the rural agricultural working class.

Until 1994, there were no resources directed to financing family agriculture in Brazil[5]. Therefore, the Strengthening of Family Farming (PRONAF) Program was created in 1995 with the aim to increase income and improve the quality of life of family farmers. In 2005, after the Northeast Bank made a diagnosis of the PRONAF segment, the existence of unique characteristics and needs for family farmers was observed[5]. Against this background, this case study research analyzes the most extensive rural microcredit program in Brazil, namely Agroamigo and PRONAF, on farm system resilience. The Agroamigo program was founded in 2005 as a rural microfinance project to improve the social and economic portfolio of the region[6]. Since then, the program has grown considerably with an average default rate of 3.26% and has provided about "US$2 billion in 2.3 million microloans through its 170 branches covering over 1,954 municipalities throughout Northeastern states as well as Minas Gerais"[6]. Making it the largest and most extensive microcredit program in the Northeast[6].

The dataset used in the study garnered from the 1995 and 2006 Agricultural Census, comes from family farms voluntary participation[5]. This large sample of the region can best be described as a "farm system."; farm system can be described as "a population of individual farms that have broadly similar resources bases, enterprise patterns, household livelihoods, and constraints and for which similar development strategies and interventions would be appropriate"[7]. Family farms are challenged by a number of factors: environmental, economic, social, and institutional challenges. Economic and social difficulties include more volatile prices in liberalized markets, sudden changes in access to markets, e.g., due to trade wars, political boycotts, the shift towards less stable and less protective agricultural policy environments, and increasing controversy about agricultural practices and use of limited common good resources [8][9][10]. These uncertainties exacerbate demographic issues such as a lack of successors to enable generational renewal at the farm level [10][11][12].

Response to the challenges varies depending on the contexts where these challenges emerge. Some of these challenges occur in the local context, where options to address issues depend on local circumstances. For instance, droughts' economic impact has been substantial in Brazil's semi-arid region, especially in the cattle industry[6]. Regional factors such as soil quality, cropping patterns, irrigation infrastructure, credit providers' flexibility, uptake of crop insurance, and supply chain partners' flexibility to retrieve produce from elsewhere all impede the desired functions of family farms in the region and thus the MFI institution itself [10][13][14].

The ability of farming systems to cope with these relevant challenges can be conceptualized as "resilience" [10][15][16][17]. Taking a broad view of resilience allows reflecting on the relationship between farm systems resilience and microcredit. Our emphasis is on social-ecological resilience because of its focus on interactions relevant to managing human–environment systems in the context of change [10][18]. Holling's definition of ecological resilience refers to the magnitude of disturbance that a system can absorb before shifting to an alternate regime or system state[19]. Thus, ecological resilience assumes that a system has multiple alternate equilibria and focuses on a system's capacity to maintain, including through reorganization, its essential structure and function when confronted with shocks. This capacity for self-organization has not always been clearly defined, but it is a crucial aspect of complex adaptive systems that enables them to regenerate and transform. Social-ecological resilience extends the definition of resilience from ecology to include: (i) transformability: the amount of disturbance that a system can absorb and remain within a domain of attraction; (ii) adaptability: the capacity of a system to learn and adapt; and (iii) self-organization: the degree to which the system is capable of self-organizing [10][20].

Issues such as climate change, access to credit, land governance politics, and sustainable development are critical for Northeast Brazil. The agricultural sector is a significant industry that supports a large portion of low-income family farms. Therefore, livelihoods depend on the resilience of the agricultural sector and address poverty issues as well. Recent figures show that this sector's associated growth proves to be more effective at reducing poverty than growth originating from other economic sectors [3][21]. However, without a significant improvement in farmers' access to sustainable development and credit access, the agricultural sector will not be able to adapt production systems and cope with its challenges [22][23].

These challenges will affect microfinance institutions (MFIs) and their clients in myriad ways. For example, there are already dire constraints to the growth of the agriculture sector in the semi-arid region of the Northeast with an increased incidence of droughts, flooding, storms, extreme weather events, as well as rising sea levels due to climate change, and thus, undermine their ability to repay loans[6][8][9][24]. Also, existing poverty may affect clients' health and indirectly affect an MFI's portfolio.

The fusion of microfinance with a resilience framework is particularly relevant to Brazil. Favored by governmental actions, microfinance in Brazil has experienced a significant boom over the last decade[25]. However, with 44 million people still working in the informal sector and some 10 million informal microenterprises lacking credit access in the country, much of its potential remains untapped[26].

To date, academia has drawn little attention to the consideration that rural agriculture's stagnating carry capacities may now be affecting MFIs and their clients. Guided by these general considerations: What is the statistical result of

products offered by an MFI on family farms' resilience capacities? What actions can be bolstered to take better consideration of specific resilience vulnerabilities? The study aims to provide a contextualized assessment of the links between a Brazilian microfinance provider and localized farm-system resilience indicators as the farming systems' desired functions. Using data from the Brazilian Agricultural Census, this paper assesses differences in specific economic indicators, controlling for rural population, that. translates to impact on family farms' resilience before and after introducing the PRONAF Program: Agroamigo.

There are three specific dimensions to think of family farms concerning resilience thinking: Resilience of what, resilience to what, and resilience for what purpose[18]. Using these questions lends to the study to narrow the particular attention taken to the dataset and results. Firstly, the resilience of what? The study pays particular attention to credit access's role in the continuation and development of family farms' productive capacity and economic health. Family farms being defined as farming establishments where the workforce is mainly family members, income derives from the family property, and the head of household manages the establishment. Much of the historically underdeveloped region is rural and sits squarely on rural family farms, neglected farmland, and a lack of economic opportunity and credit access. More than 80% of farms in the Northeast region are currently designated as family farms with varying levels of capitalizations and production capacities[5]. Resilience to what entails the challenges that these family farms face in light of their function. As stated before, many social, environmental, and economic concerns can impede the overall wellbeing and economic viability of these farms that the Brazilian Government and market structure should address. The region itself has a long history of authoritarian politics with a pointedly anti-rural bias; therefore, local government has pushed for public policy to focus on urban centers rather than the sprawling rural regions, leaving many family farms with little to no institutional support. These truths have demanded the recent action of PRONAF and Agroamigo to provide credit access, technical support, and the population this study is focusing on as they create the majority of farming systems and support the most people living in rural areas. These programs, therefore, address resilience for what purpose. According to Agroamigos' mission statement, the program aims to "provide financing for rural areas, adopting its methodology of service, whose premise consists of guided and monitored credit" [27]. Focusing on guided and monitored credit, the program hopes to improve the social and economic portfolio of the people to then allow them to create strong ties to the agricultural market, sustain the economic viability of the family farm while also continuing technical support to adopt new and sustainable technology eventually[27].

The 1995 and 2006 Agricultural census provides statistical information that can shed light on family farms' evolving situation in the region[28][29][30]. Through the analysis of comparable variables, this study seeks to provide an analysis of how the introduction of PRONAF in 1995 to the latest available date of 2006 has impacted the main variables of interest in the region being: number of agricultural establishments, number of animals in those establishments, area harvested (in hectares), labor productivity, and controlling for rural population.

2. Literature Review

Existing literature has centered on evaluating credit programs for low-income people in the agricultural sector. This sector is still the rural poor's primary economic activity. Scholars point out that the fraction of capitalized entrepreneurs increases with wealth, which is typically interpreted as evidence of credit constraints on the poor[32]. On the other hand, a more direct look at the poor reveals that typically only a tiny fraction of the poor can access formal credit. In a survey conducted in 13 developing countries, Banerjee and Duflo found that only about 6 percent of the credit to the poor formally originated. A substantial part of credit among the poor is provided by informal arrangements, which partially substitute for formal financial mechanisms[33][34][35].

The prevailing explanation for the prevalence of these informal credit mechanisms is that they allow community ties to overcome informational asymmetries and difficulties in contract enforcement typical of credit markets. Individuals who know each other well can, at least partially, monitor each other. Also, social pressure and the threat of stigma can discourage non-compliance with previous arrangements. However, such arrangements have limitations, such as dependence on well-established mutual support networks and vulnerability to adverse events that simultaneously affect all individuals in a given community. Moreover, these contracts tend to have very high-interest rates[36]. Given these limitations, several programs have been dedicated to bringing forced credit to needy populations in the last few decades. These programs draw on the innovative methodology of Bangladesh's Grameen Bank, which exploits the same community ties that underpin informal credit arrangements for the formal credit. Indeed, especially since the 1990s, there has been a proliferation of microcredit throughout the developing world, creating multiple public and private programs. Moreover, this proliferation has been followed by a wave of empirical papers on these programs' impacts[37][38].

The general message is that there is significant variability in the degree of success of such programs and must be considered[39]. What should be expected from microcredit on farms and rural households is varied and numerous. In the past years, conventional banks and microfinance institutions have encouraged access to credit to increase farmers' adoption of innovative practices[40][41][42][43][44]. Specifically, we should expect that access to microcredit positively impacts investment in agricultural activities, encourages better-input use, and favors adopting new technologies. Moreover, potentially, because of better investment and/or inputs use and/or access to new technologies, access to microcredit positively impacts family farms' technical efficiency and productivity and then improves farm activities' profitability. Existing literature also highlights both trends, one the one hand high returns to productive finance programs for the poor[45][46][36] and on the other hand, disappointing results (for whom?)[47][48]. This variability may stem from the fact that correlating to different locations there may be different institutional and informational environments. This results in different potentials for microfinance programs. Additionally, it may also result from the significant variability in program design. Studies have also focused on the effects of different policies and target audiences of microcredit programs. For instance, Pitt and Khandker[49], in a study conducted in Bangladesh, find a more substantial positive effect of a microcredit program on women. Other studies, such as Mel, McKenzie, and Woodruff [46], find the opposite effect.

When applying social-ecological resilience theory to microfinance assessment, we must question why farm management needs a resilience framework? Building on the work within social-ecological resilience, farms' resilience is understood as covering buffer capability, adaptive capability, and transformative capability[50][51]. Finally, while resilience thinking highlights farms' ability to adapt in the face of change, their resilience is context-dependent. A farm is linked to the broader territorial and sectoral dynamics, which will necessarily influence – but not determine – the options available to a farm. Indeed, a farm needs to engage in co-evolution with its ecological, social, economic, and political context. Thus, a radical reorganization of political, economic, and social institutions – as was the case in post-socialist countries – will close some options while opening up new opportunities. Farm resilience will be both enabled and constrained by dynamics at a lower scale (e.g., the farm family) and those at a higher scale (e.g., regional dynamics and agricultural policies)[52]. This highlights the role of adequate governance regimes in strengthening farm resilience and indicates that governance failures pertaining to Brazil's National Bank might well erode farm resilience[53][54][55]. At the same time, resilience thinking highlights that for a farm to persevere over the long term, optimizing resource allocation under general conditions will not be sufficient. Today, as there is evidence of the agricultural sector stagnating, integrating resilience thinking can contribute to making research on microfinance operations concerning farm management relevant to farmers' needs and circumstances.

Resilience theory emphasizes change, uncertainty, and systems' capacity to adapt[19]. Therefore, frameworks to analyze resilience go beyond frameworks assessing sustainability. The latter are comprehensive concerning environmental, economic, and social performance. Several resilience frameworks have already been developed and applied to components of farming systems, such as farms[56][57] , food supply chains[58][59[and socio-ecological systems[56][20][60][61] . All of these sources have been grounded in extensive literature reviews and analysis of long-lasting systems that have faced various challenges such as the Northeast of Brazil[39][62], these definitions and studies provide valuable insights into capacities and attributes that enhance or constrain resilience. For instance, Darnhofer[56] stresses the importance of diversity in farm activities, Stone and Rahimifard illustrate that redundancy is a characteristic of resilient food supply chains. However, it is still unclear how these and other attributes are to be assessed at the level of farming systems, where farms might cooperate across sectors, non-farm populations are neighbors with farmers, farmers contribute to multiple value chains, and where required functions change in response to changing consumer and societal preferences[10].

The most critical studies on the demography of rural Brazil show that Brazil has gone beyond the period of large migrations towards urban and metropolitan areas. The social emancipation of populations that today live in poverty, especially in the North of the country, will not come fundamentally from their insertion in the urban economy. Nor is the prospect of revolutionary changes capable of radically altering production techniques and the income obtained from agricultural labor realistic. The professional training, the educational level, the age, the existing labor force in the farms, the attraction of urban labor markets all make it unrealistic to make the current farmers who are members of Pronaf B (the poorest credit recipients) the pillars of extensive assumptions concerning ecological-resilience in the region. However, most research shows that access to credit allows stabilizing the income portion of these families that depend on their economic insertion in the markets. Therefore, even if not through spectacular results, Agroamigo contributes to the emergence of development, as it expands the chances of insertion of its audience's activities in local markets[63]. In this context, this paper does not expect the PRONAF program or Agroamigo itself to fully remedy the multitude of factors that have posited family farms into poverty and degradation. It has shown success in relevant factors for economic productivity; though, may be doing so at the cost of resilience and sustainable development of the sector. Since resilience is not one of the main missions of the program, there may be unintended consequences that

might hinder the development of economic growth for family farms that are Agroamigo's beneficiaries. Therefore by assessing changes in the variables examined, trends and phenomena are deduced which may explain the impact on resilience capabilities of family farms and the larger farming system of the region.

3. Data and Methods

3.1. Data Source

To examine if the Agroamigo agricultural credit access program has been impactful from its inception in 1995 to the most recent agricultural census in 2006, data pertaining to Northeast Brazil from the Brazilian Agriculture Census was posited in an OLS regression model using StataIC. The results were examined to identify the possible statistically significant impacts on farm resilience from 1995 to 2006 and observe the counterfactual. The framework provides an analysis of Agroamigos' operations' impact on specific economic indicators in the table below and an overall analysis of the change to family farms development from 1996-2006. Then, results analyzed will be addressed in the context of farm resilience and long-term implications. Data can be summarized as followed:

The data provided in Table 1.1 allows IBGEs 1996 and 2006 agricultural censuses to be compared and examined if the region gained in economic improvement through the Stata program and is the primary dataset. The focus is not on economic benefit alone; through the resilience framework, the indicators of continued and sustainable growth are paramount for the continued resiliency of family farms.

3.2. Regression Model

The data is posited in an OLS regression model with a combination of time-series and cross-sectional differences comparing the outcomes of the specific resilience indicators chosen across pre-treatment and post-treatment periods of family farms being in the PRONAF Agroamigo program. In this study, the treatment effect can be observed by assessing the change in the number of the variables livestock, area harvested, and the number of agricultural establishments before and after being in the treatment group, controlling for rural population size. The method will allow the examination of the change in the specified agricultural economic indicators before and after the credit access program's proliferation in the Northeast region. Thus, results will be used to assess relevant changes in the resilience capacities of family farms based on the economic variables. The data used for this study was gathered from the Brazilian Institute of Geography and Statistics Agriculture and Population Census from 1995 to 2006. The survey provides information on the total agricultural establishments, the total Area of those establishments, the producers' characteristics, and the establishment's production characteristics. Although the OLS method is intended to mitigate the effects of confounders and selection bias, it may still be subjected to threats that invalidate its causal inference. There could be factors (besides the treatment) that cause a change in one group but not the other at the same time. Various issues could compromise the results. Results may be unable to generalize to other populations or even a longer timeframe. This is possible by making each of the latter mentioned variables dependent on being in the treatment group before and after the principal independent variable and then comparing across time to explain results. The regression model can be defined as:

$$y = \beta 0 + \beta 1 \text{Treat} + \beta 2 \text{Rural Pop.}$$

May combine the following variables :

- Treat: The study's principal independent variable, a dummy variable for being in the treatment group 1 or not 0.
- Number of animals in agricultural establishments
- Area Harvested (MI)
- Number of agricultural establishments
- Labor Productivity per hectare
- Rural Population

3.3. Dataset

Table 1.1 Comparison Of Economic Indicators from Agricultural Census 1995 Vs. 2006

State	PRONAF	Number of Animals in agricultural establishments	Area Harvested (MI)	Number of agricultural establishments	Labor Productivity	Rural Population
Nordeste (1995)	0	201,414,720	3,911,769	4,238,543	3,402.86	14,763,935
Nordeste (2006)	1	228,611,969	5,816,773	3,073,216	4,538.71	14,260,704

Where Animals in agricultural establishments are tabulated regarding all farming activities in the Northeast region for family farms, area harvested is measured in hectares for both 1995 and 2006 statistics. The number of agricultural establishments includes family and non-family farms, and labor productivity is measured in Brazilian Reals per hectare and change in rural population from 1995 to 2006.

4. Results and Discussion

4.1. Principal Regression

Positing multiple regressions with variables as dependent and being in the PRONAF program as the independent variable allows us to observe growth or shrinkage of these variables by ten years. With that in mind, the results are as follows:

As seen in Table 1.1, in theory, the program has raised productive capacity for family farms in the region and may be translating to more income for those establishments and better opportunity for increasing resilience capacities. Although, it appears that the rural population, and therefore the amount of eligible households to enter the credit access program has decreased in the past ten years. Running the first regression, with Area harvested as the dependent variable, the regression coefficient shows that with 99% confidence, the region has seen an increase in Area harvested by 581,677.30 hectares per year. As seen in the following regression, labor productivity has also increased by $113.59. Reals per hectare for each year. Despite this increase in productivity for family farms, alarmingly, the rural population has decreased by 50,323.10 people per year. A possible explanation of this could be the increased mechanization, intensification, and consolidation of the region's agricultural sector. Furthermore there could be the inevitable stresses and natural disasters such as long-winded droughts that force family farms to close and move to other places that have a more robust public policy for the poor, that being urban areas. These results from this study may indicate a more significant issue that the global agricultural poor face: Corporate farming systems.

There is already a long history of land consolidation and disenfranchisement of the working poor in the region by authoritarian politics and market mechanisms. Politically, the Northeast is famous for coronelismo, the dominance of landowners[3]. "Vertical, patron-client relations between dependent camponeses (peasants) and landowners are more pervasive than they are in the more industrial and egalitarian south"[3]. Coronelismo has had a marked and continuing history of consolidating land in the region and forcing once independent family farms into sharecropping positions on land that was once theirs"[3]. Small farmers face barriers that prevent them from fully enjoying private property rights to the land they cultivate. Due to an underdeveloped and politically inept land registration process, many farmers do not hold deeds to their farms[3]. Of the total land area in the Northeast on farms of less than 25 acres in size, only 41 percent of the land is registered; for land on farms between 25 and 125 acres in size, the corresponding figure is 58 percent[3].

This is possible because of lax land laws that ultimately serve these landlords and take land away from family farms over generations. Deeds and grants for land are scarce as there has been no institutional system for providing land grants until recently. Although many of these family farms have been under stewardship for much longer than the implementation of land grants, there is no supporting evidence of ownership that these family farms can access to garner a deed. Small farmers without title to their land are generally unable to obtain credit because they lack collateral;

therefore, they are often unable to boost productivity by purchasing new inputs or adopting more efficient techniques. This has a significant impact on rural poverty because studies show that small and medium-sized farms in Brazil generate far more employment per acre, on average, than large ones. Furthermore, the data can indicate that the PRONAF and Agroamigo program's success could be disproportionately benefitting larger estates, corporations that use sharecropping, and other more capitalized farming systems than the targeted rural and low-income family farms. While large landowners dominate agricultural credit markets, they have used their political power to default on loans at a high rate and have also evaded taxes to a large extent[3]. Default rates on these large loans were exceptionally high in the Northeast, where most Coronelismo have political power and historical sway over the agricultural sector there.

In summary, the political and economic power of Coronelismos is destroying the viability of family farm resilience with an outmoded version of modern plantation agriculture. Therefore, Agroamigo and the Brazilian government may want to find solutions through market-based land reform to ensure that the program's success does not hinge on the consolidation of farmland and, by proxy, the higher capitalized agricultural establishments.

Furthermore, an increase in productive capacity and animals on agricultural lands does not imply these lands' continued resilience. Currently, livestock constitutes the majority of the agricultural sector that Agroamigo is lending to. Livestock such as dairy cattle has accounted for 79% of products financed by Agroamigo[6]. This is alarming as diversification is vital if there is to be a more resilient family farming system as a bad drought, natural disaster, or disease can prove to wipe the entire production capability of multiple family farms and farming systems in the region. Overall, this is to say that the program has done little to improve its customers' most impoverished target population and family farms. Meanwhile, resilience has decreased, as evident in the decreasing population living there and the fact that the portfolio has benefitted larger and more intensive agricultural operations.

4.2. Difference In Difference Analysis

Although, what is the counterfactual? Yes, the program seems to have been successful in increasing productive capacity through credit access, adoption of technical support, and new technology despite population decreasing but compared to what? What would the economic profile of the region be in the absence of this program? Therefore, the continuing results will explore the counterfactual: the alternative state where the Northeast region does not receive support from PRONAF or Agroamigo. Making simple before-after comparisons is somewhat flawed, especially as the region has seen ten years of change to the agricultural sector and implies many other agricultural factors have changed. To know a counterfactual scenario, the income of family farms by group B of the 1995 and 2006 census will be observed in comparison to people' in the most affluent program of PRONAF, designated A by the program (citation needed) in the same time period as they are right at the eligibility threshold and demand less credit support that family farmers in Table 1.1., designated group B, or, the most impoverished group (citation . Both groups, despite their income, are still seen as necessary recipients of the program and the most disparate groups observable. Therefore, the study compares the economic variables of similar individuals and farming systems in the same region in the same time period. In order to acquire a counterfactual, a comparison is made to examine if the change for majority and minority participants over time is comparable. The true impact of the program is determined by subtracting the change in the comparison group (C) from the change in the treatment group (T):

$$(T_{1995} - T_{2006}) - (C_{1995} - C_{2006})$$

If individual data was available, an econometric analysis of the true impact of the program on the most impoverished family farms would be possible and deduced by this equation in multiple regression form. Where B_3 is the true treatment effect, which nets out the time trend, as represented by the comparison group, is given by the coefficient on the interaction term.:

$$Y = B_0 + B_1\text{Time} + B_2\text{Treat} + B_3(X_1 * X_2)$$

To see if this rise in production capacity translates to impacting the income of the most impoverished group, being group B in the program, the table as follows describes the difference in difference algebraically over time according to the types of farming establishments defined in the 1996 Agricultural Census and PRONAF.

Table 2. Algebraic Difference in Difference for Annual Net Monetary Income by Type of Farm

	Annual Income -1995	Annual Income -2006	Annual Income Difference
Group A - Comparison Group	30,333	53,236	22,903
Group B - Treatment Group	5,537	3,725	-1,812
Difference	24,796	49,511	-24,715

Net annual income of group A & B of PRONAF program in 1995 and 2006 in Reals. Data from IBGE, Agricultural census 1995-1996 & 2006 (special tabulations by IBGE based on microdata) and compiled by Guanziroli, Carlos, Antonio Buainain, and Alberto Sabbato. "Family Farming in Brazil: Evolution between the 1996 and 2006 Agricultural Censuses"[30].

The resulting difference proves that microfinance itself has not escaped the pitfalls of capitalization and resulted in the disproportionate benefit of larger farming systems with a large capital base. Firstly, in ten years, larger non-family farms have gained in annual net income of 22,903 Reals. This is a large jump in itself, and when compared to family farms, the target population of the program, there are extreme disparities. Not only that, but it seems that the program has not even pulled the most impoverished family farms out of poverty.An abject failure of PRONAF and Agroamigo. Being in the treatment group is associated with a loss in annual income by 24,715 Reals, compared to the counterfactual and holding other variables constant. Meaning, the disparity between the two has grown by 24,715 Reals in ten years and the most impoverished family farms have even lost 1,812 Reals in net annual income over the ten year period when PRONAF, and Agroamigo, were operating in the region. This is to say, increased productivity has not benefited family farms and economic benefits skews to the benefit of larger farms that are not run by family households, meaning corporate and industrialized farming systems have seen the most benefit as a result of this credit access program. Furthermore, it implies that if one is eligible for the program itself, they will not have seen an increase in their income while if a farm is not then it will have seen significant growth.

In the context of resilience, industrialized farming systems have a larger negative impact on resilience resources as they have higher input cost, use more common good resources, such as grazing land and water), and practice using harmful intensive farming practices. These operations are getting larger due to the operations of the credit access programs and imply that the actions, after ten years, are supporting industries that degrade resilience capacities for the entire region and farming systems. The trend of larger non-family farms consolidating land and resources is at the cost of smaller, more impoverished family farms that have seen very little benefit from the credit access programs themselves. Which results in the conclusion that the program has failed the target population, is exacerbating disparities in income between the rich and poor, and, due to the characteristics of the benefited group, is going to negatively impact resilience of the region over time.

5. Conclusion

This regression study's primary goal is to analyze Agroamigos' operations impact on resilience-enhancing economic indicators concerning the rural populations' family farms. The analysis of these variables from the implementation of PRONAF and Agroamigo from 1995 to 2006 helps contextualize the need for resilience thinking pertaining to microfinance. The lack of consideration the programs have taken for the falling rural population and their portfolio

have created issues that have exacerbated family farms' resilience capacities. Even though it shows that there has been a more efficient use of land and productivity overall, the increase in industrialized farming processes does not contribute to the farming system's long-term resilience. Furthermore, due to the proliferation of capitalization as the main product of PRONAF and Agroamigo, the market structure has disproportionately benefited the already capitalized enterprises. There proves to be little consideration to the distortion of some product chains and markets that have not benefited the overall long-term economic production of the region or rural family farms. The credit program's concentration on dairy farming, a highly intensive industry on the farming system, also proves to be of concern for both the microfinance institution itself and its customers.

In summary, the operations of Agroamigo have done little for resilience even though it has slightly improved the production capacity of the region for rural family farms. The program has failed to provide low-income family farms tools to thrive, annual income, and has seen a loss in eligible households. The credit access program itself contributed to the degradation of family farm's numbers and annual income and exacerbated the region's threat to resilience. Many of the needs that family farms face are much larger than one program's capacities and require the market and government's full support to compensate for the biases of capitalization and historic underdevelopment that has only worsened ecological-resilience and the plight of impoverished family farms in Northeast Brazil.

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