

Rural development and the expansion of non-agricultural activities in the Brazilian Amazon

Desenvolvimento rural e a expansão das atividades não agropecuárias na Amazônia Brasileira

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Abstract: This paper analyzes the employment and income dynamics of rural families in Brazil's North Region, the main representative of the Brazilian Amazon. We use information from the National Household Sample Survey between 2004 and 2015 to create a typology of families based on the members' occupation in agricultural and non-agricultural activities. We hypothesize that the recent increase in employment and income was strongly associated with non-agricultural activities, reproducing the dynamics observed in other developing countries and Brazil's more developed regions. The results highlight that, differently from the rural exodus observed in the other regions of the country, the number of rural households increased in the North Region, attracted by the expanding non-agricultural occupations. As a result, the importance of earnings from non-agricultural activities and non-labor (pensions, cash transfers, among others) to family income has increased considerably, especially among self-employed family farmers. The final discussion highlights the relevance of non-agricultural activities for public policies to increase income in less developed rural areas.

Keywords: rural development, multi-activity, agricultural occupation, Brazilian North Region.

Resumo: O artigo analisa a dinâmica do emprego e renda das famílias rurais na Região Norte, segundo uma tipologia com base na ocupação dos membros familiares em atividades agropecuárias e não agropecuárias. As análises baseiam-se em dados da Pesquisa Nacional por Amostra de Domicílios (PNAD) para o período de 2004 a 2015. A hipótese do trabalho é que as atividades não agropecuárias têm ganhado importância na geração de ocupação e renda para as famílias rurais, reproduzindo o comportamento observado anteriormente em outros países e também nas regiões brasileiras mais desenvolvidas. Os resultados destacam que, ao contrário do êxodo rural observado nas demais regiões do país, o número de famílias rurais cresceu na Região Norte, e esse crescimento foi sustentado pela expansão das atividades não agropecuárias. Com isso, a renda familiar passa a ser composta mais fortemente pelos rendimentos provenientes das fontes não agropecuárias, além da renda proveniente do não trabalho (aposentadorias e pensões, transferências de renda, dentre outras), sobretudo os agricultores familiares por conta própria. A discussão final destaca a importância das atividades não agropecuárias para o direcionamento de políticas públicas de aumento da renda nas áreas rurais menos desenvolvidas da região.

Palavras-chave: desenvolvimento rural, pluriatividade, ocupação agropecuária, Região Norte.

1. INTRODUCTION

The Brazilian rural has undergone profound transformations that have modified the existing productive structure and social relations. The increasing participation of non-agricultural occupations on rural employment and income reflects some of these changes. Families have become more dependent on activities not associated with agriculture, illustrating what



was conventionally called the “new rural” in Brazil. Agricultural activities alone are no longer sufficient to explain the new rural socio-economic dynamics, being necessary to incorporate other elements capable of reflecting this new reality (Graziano da Silva & Del Grossi, 2000; Buainain et al., 2014).

The growth of non-agricultural work in rural areas is a trend also observed in developed countries. In the United States, the share of the rural population dedicated to non-agricultural activities had already surpassed that employed in agricultural activities in the 1940s (Irwin et al., 2010). In the European Union (EU), the adoption of administered prices policy and the community preference principle for the member states’ production ensured the permanence of a significant portion of the rural population in agricultural activities and, at the same time, the access to other income sources as non-agricultural work (Sacco dos Anjos, 2003; Nascimento, 2008).

In Brazil, only in the 2010s, the share of rural households with members engaged in non-agricultural activities reached almost half of the total (Sakamoto et al., 2016). The growth of non-farm jobs in rural areas persisted in the most recent period, which, in a way, contributed to compensate for the continuous reduction of the employment in agricultural activities, thus keeping the rural population relatively stable between 2004 and 2014 (Del Grossi, 2017). Telles et al. (2017) point out that this is not an isolated phenomenon, nor is it transient, being observed in practically all regions and persistently over the last few years.

The North Region, recently incorporated into the agribusiness production chain through the agricultural frontier’s expansion, is undergoing productive, social, and territorial restructuring. As a result, the region has experienced substantial changes in the rural socio-economic structure. Traditional activities (rubber extraction and subsistence agriculture) are rapidly giving way to commercial crops, especially grain cultivation in the region’s southern border. The constitution of the new productive structure, in a way, contributes to the occurrence of essential changes in the rural labor market in the region, notably regarding occupation in more capital-intensive agricultural activities (Lima, 2008; Silva et al., 2010; Herrera et al., 2014).

An important question that arises from this dynamic is what has been the contribution of agricultural and non-agricultural activities in generating employment and income for rural families (and their members) in the North Region? This article aims to analyze the occupation and income dynamics of rural families in Brazil’s North Region from 2004 to 2015. Our central hypothesis is that the rural families’ employment and income sources in this region are increasingly associated with non-agricultural activities, in such a way that agricultural work has been losing prominence as a job and income generator for rural families.

The North Region offers a particular case for analyzing rural households’ non-agricultural occupations, either due to recent rural dynamism in this region or its population heterogeneity. Although still having a significant share of the population engaged in agricultural activities, this region constitutes the new frontier of rural development and the expansion of non-agricultural activities.

We organized the work into four sections, including this brief introduction. In the second section, we review the literature on the multi-activity dynamics in rural areas, emphasizing rural development beyond its agricultural dimension. The third section presents the methodological procedures used to specify the family types based on data from the National Household Sample Survey (PNAD) from the Brazilian Institute of Geography and Statistics (IBGE). The fourth section analyzes the results of the research, followed by our final considerations.

2. THE EXPANSION OF NON-AGRICULTURAL ACTIVITIES

Studies on non-agricultural activities as an alternative source of livelihood for rural families have gained prominence in developed nations' academic debate and, more recently, in developing countries such as Brazil.

The first studies within the European Union (EU) date from the 1980s, focused on part-time farming that enabled farmers to allocate part of their work hours in industrial and services sectors. In the mid-1980s, the overproduction crisis and the social costs of agricultural modernization reoriented the debate under the recognition that different occupations and income sources among rural families in the EU were more frequent than previously thought¹. This context reinforced the concept of multi-activity or pluriactivity² in the political and academic debate at that time. Since then, the research focus has shifted from the rural production unit's head to all the rural family members. Simultaneously, the European organizations reinforced the stimuli to the combination of agricultural and non-agricultural activities by rural families (Sacco dos Anjos, 2003; Mattei, 2008; Schneider, 2009).

Influenced mainly by European researches, the studies on non-agricultural activities in Brazil emerged in the 1990s (Schneider, 1994; Sacco dos Anjos, 1995; Carneiro, 1996; Neves, 1997). They shed light on the significant drop in agriculture participation and the growth of non-agricultural activities in generating employment and income among Brazil's rural population (Graziano da Silva, 1999; Campanhola & Graziano da Silva, 2000).

A series of studies have highlighted the importance of non-agricultural activities for the dynamization of the most varied rural spaces (Del Grossi, 1999; Mattei, 1999; Buainain & Dedecca, 2008; Del Grossi & Graziano da Silva, 2006; Balsadi, 2008; Nascimento, 2008; Maia & Sakamoto, 2014; Maia & Sakamoto, 2016; Escher et al., 2014; Laurenti, 2014; Aquino & Nascimento, 2015; Mattei, 2015; Balsadi & Del Grossi, 2018; Aquino & Nascimento, 2020a; Aquino & Nascimento, 2020b). The literature points out the income diversification and the containment of the rural exodus as the main advantages of the new rural configuration, especially for the segment of undercapitalized farmers who have difficulties integrating themselves into the various agro-industrial chains.

Some studies argue that the industrialization and modernization of the productive structures in the countryside have contributed to the working time shrinkage employed in rural farms, which encourages part of the family workforce to seek an occupation in other activities in both rural and neighboring cities. This trend is possible due to the growing presence of industries in rural areas, such as the agro-industries that transfer their plants to rural zones to reduce costs. Moreover, the interdependence between the rural and urban areas creates synergies that enable alternative sources of occupations and income for the rural population (Graziano da Silva & Del Grossi, 2000; Terluin, 2003; Meurer, Shikida & Vian, 2015; Berdegué & Favareto, 2019).

This new dynamic brought new elements to the countryside daily life. The first element is the commuting (usually from rural residency to urban workplace), resulting from better job opportunities offered in the cities and reduced transportation costs. The second element is that

¹ The Arkleton Trust Project's surveys (Arkleton Trust, 1992) carried out within the European Union scope from 1987 to 1991 showed that 63% of farms had a family member engaged in non-agricultural activities, inside or outside the family production unit.

² Fuller (1990) defines pluriactivity as a broader phenomenon linked to the family unit and the relationship between family members and agricultural and non-agricultural activities inside or outside the farm. The author defines pluriactivity as a broader phenomenon linked to the family unit and the relationship between family members and agricultural and non-agricultural activities inside or outside the farm. For this author, expanding the occupational horizon beyond the family reference person means recognizing the possibilities provided by the combination of activities and income among family members, resulting in socio-economic gains for the whole family. In this article, we use pluriactivity and multiactivity interchangeably.

families are increasingly diversifying their income sources, changing the strategy of counting heavily or exclusively on rural activities' earnings. Finally, a third element is related to recognizing the diversity of rural environment's functions, such as leisure, housing, tourism, fishing, and environmental preservation. This new diversity imposes challenges and opportunities for the rural families' economies and ways of life (Balsadi; 2001; Kageyama, 2008; Mattei, 2015).

Social and productive relations have become more complex in recent years, making it challenging to identify the boundaries between the city and the countryside. In rural areas, a diversity of activities related to industry, commerce, and services are linked to the agriculture. This wide socio-economic heterogeneity contributes to an increasing number of multi-active families that combine, among their family members, agricultural and non-agricultural activities (Aquino & Nascimento, 2015). Nevertheless, the growing number of rural families engaged in non-agricultural activities depends on the dynamics of the socio-economic environment where the farms are located³. The more developed economies can generate jobs with better remuneration than the agricultural activities, stimulating family members to seek jobs outside the farms (Conterato, 2008).

Although non-agricultural occupations have gained momentum and prominence in recent years in Brazil, guiding a diverse range of public policies, few studies have evaluated the North Region case. Research on the dynamics of occupations and income (and multi-activity) of rural families has concentrated in the Brazilian Northeast and South, where the largest contingent of family farming in the country lives. Nevertheless, the North Region offers a particular case for investigating the rural population's socio-economic dynamics, given its recent productive transformations. This work fills this gap, stimulating the debate that contributes to the design of public policies to strengthen non-farm income for rural areas in this region.

The North Region, integrated into the national economy through a modernizing project undertaken by the Military Government during the 60s and 70s (Costa, 2012)⁴, was recently incorporated into the agribusiness production chain with the agricultural frontier expansion. As a result, traditional activities have been gradually giving way to high commercial value crops and heavy use of machinery, equipment, and agricultural inputs. The impacts on family farming are still uncertain; still, the lower demand for work in rural areas and the development of adjacent urban regions could encourage families to adopt other strategies to ensure livelihood, especially in a non-agricultural activity (Lima, 2008; Porkony et al., 2010; Herrera et al., 2014; Lima & Nogueira, 2019). Waquil et al. (2013) also highlight that the North Region's rapid changes would have stimulated the farms to expand plant and animal-based product processing as a way to add value to their agricultural products. The authors highlight the agro-industry's vital participation in this region, boosting other local activities, such as general services, retail, and grocery. The expansion of agro-industry would be another factor in attracting the rural population to non-agricultural occupations.

These facts reinforce the argument that the rural family livelihood depends more and more on a set of non-agricultural activities to support the diversification of income sources hitherto restricted to agriculture. The new rural dynamic imposes policy challenges since the strict sectoral approach seems inadequate to contemplate the rural environment's diverse demands. Therefore, besides the technical and practical actions encouraging agricultural activities, one needs a broader rural development approach encompassing the new rural's multifunctional character. It is vital to overcome the strict rural conception and recognize the

³ For a detailed discussion of the determinants of multiactivity, see Kageyama (1998), Mattei (1999), Schneider (2004, 2009), Sacco dos Anjos (2003), Nascimento (2008), Cardoso (2013).

⁴ Costa (2012, p. 177) describes the 1980s as when the consequences of Amazon's regional development model's failure in the 1960s and 1970s became evident.

role of non-agricultural activities in the rural environment, its new multiple functions, and the mutual dependence between rural and urban spaces (Wanderley, 2000; Schneider & Conterato, 2006; Carneiro, 1996, 2008).

Thus, recognizing rural diversity means admitting the structuring of a new social and economic process, without which it is not possible to define actions focused on Brazilian rural development. Multiactivity could contribute to rural development by offering greater diversification of employment and income sources, guaranteeing food security, reducing pressure on natural resources, slowing rural exodus, and improving family farming performance by providing resources to boost production. Thus, the conventional role as supplier of raw materials and cheap labor force to the urban development has less importance in typifying the rural sector, now composed of a broader range of economic activities and social actors setting a new pace for the production dynamics. In this context, rural development policies must go beyond classic measures such as granting credit, rural extension, and technological innovation (Kageyama, 2001, 2003, 2008; Abramovay, 2009).

3. METHODOLOGY

The analyses are based on PNAD microdata for the North Region from 2004 to 2015. The year 2004 was the first in the PNAD series to incorporate rural areas in the North Region. In 2004, the survey interviewed 2,782 rural households and 8,760 persons. In 2015, the last year of the PNAD series that allows historical comparability with previous years, the survey included responses from 3,488 rural households and 9,833 individuals.

The family typology adopted in this work considers the household as the analysis unit, i.e., it includes people, usually members of the same family, living in the same dwelling⁵. We excluded pensioner residents, domestic employees, and the latter's relatives from the analysis. The families, i.e., households, were classified according to the employment type of their members as follows:

- i) *Employer family*: at least one of the family members declared to be an employer, regardless of the other members' conditions. We assume that the employer condition of one of the members constitutes a good proxy for the social position of the family;
- ii) *Self-employed family*: in the absence of an employer, one of the economically active members declared to be occupied as self-employed, regardless of the other members' conditions;
- iii) *Employee family*: in case there is neither employer nor self-employed, but at least one of its members declared to be engaged in agricultural or non-agricultural activities as an employee;
- iv) *Non-occupied family*: in the case there is none employed member in the PNAD's reference week (usually, the September's last or the penultimate week of each year);

Besides classifying by employment type, we subdivided the households according to the activity sector in which their members were occupied (agricultural, non-agricultural, and multi-active), following the criteria described below:

- i) *Agricultural family*: at least one of the members occupied in farming and no other occupied in a non-farming activity as the main occupation in the reference week;
- ii) *Non-agricultural family*: at least one of the members is occupied in a non-farming activity, and no other is involved with farming;
- iii) *Multi-active family*: at least one of the members is occupied in farming and at least one in a non-farming activity.

⁵ The methodology employed can be consulted in Del Grossi (1999) and Del Grossi & Graziano da Silva (2000).

We adjusted the following log-linear time function⁶ to verify if there is a linear trend in the evolution of the population in each typology:

$$E(Y_t) = \varphi e^{\theta t} \quad (1)$$

In which:

Y_t : the population at the year t

φ : the expected value of Y when $t = 0$

θ : the annual growth rate

The following linear regression model can represent the Equation 1:

$$\ln Y_t = \ln \varphi + \theta t + \varepsilon \quad (2)$$

In which ε is the random error not explained by the model. The average percentage rate of annual growth is given by $(e^\theta - 1) \times 100$. We obtained the estimates using the ordinary least squares method (OLS) with all the years from 2004 to 2015. Independent models were adjusted for 2004-2009 and 2011-2015 to consider structural breaks in the annual growth trend due to changes in the official rural zone delimitation. Since the municipal powers (legislative assemblies) can modify the official urban perimeters in their respective municipalities (which consequently changes the rural area), IBGE updates the rural zones in the Demographic Censuses, a fact that, in our case, occurred in 2010.

4. RESULTS AND DISCUSSION

The Brazilian North Region is characterized by a great socio-economic diversity, which also reflects the dynamics of its rural population. Recently incorporated into the agricultural frontier's expansion process, the region shows a similar pattern identified in other Brazilian regions: an increasing number of rural non-agricultural and non-employed families and a substantial reduction in the contingent engaged exclusively on farming.

Table 1 shows that, from 2004 to 2009 and 2011 to 2015, the total number of families living in rural areas in the North Region grew at average annual rates of 3.1% and 3.6%, respectively. The growth observed in both periods can be explained by increased non-agricultural households, primarily self-employed and employees, and non-employed families.

As pointed out in the literature review, the development of non-agricultural activities in the rural area and the stronger links between the cities and the countryside have enabled families residing in rural areas to develop economic activities in diverse economic sectors. However, this finding cannot be generalized for the entire region, given that many rural areas still suffer from isolation. Even so, these findings seem to be a reality experienced by many who live close to some cities.

Table 2 presents the evolution of agricultural, multi-active, and non-agricultural households in the North Region. *Non-agricultural* and *non-employed* rural families⁷ were the only types that showed a growth trend in both periods analyzed. Non-agricultural households grew by an annual average rate of 8.7% (2004 to 2009) and 6.4% (2011 to 2015), and non-employed

⁶ This log-linear regression model is used to determine growth rates over time and not just between two extreme points in a time series, avoiding possible outlier effects that could lead to underestimation or overestimation of the growth rate, according to Neder (2000).

⁷ Sum of employer, self-employed, and employee non-agricultural families. A similar sum is made with the other two types of employed families.

families by 11.7% (2004 to 2009) and 15.6% (2011 to 2015). While these two types showed a positive trend of increasing relative participation in the composition of family types, strictly agricultural families lost participation in the two periods under analysis.

Table 1: Number and growth rate of families in rural areas by employment type and activity sector, North Region, 2004 to 2009 and 2011 to 2015 (1,000 families)

Household/Family type	2004	2009	Δ (% p.y.)		2011	2015	Δ (% p.y.)	
			2004/2009				2011/2015	
Rural								
Employer with more than two employees	13	10	-10.8		7	7	1.3	
Agricultural	1	0	-	-	1	2	-	-
Multi-active	5	2	-	-	2	1	-	-
Non-agricultural	7	7	-7.8		4	4	2.8	
Employer with up to two employees	42	42	-2.0		17	26	9.8	**
Agricultural	19	19	-1.4		7	11	7.7	
Multi-active	20	14	-9.1		6	8	6.1	
Non-agricultural	4	8	14.4		4	6	17.4	*
Self-employed	587	604	0.9	*	666	722	2.1	***
Agricultural	373	324	-1.8		408	428	1.0	
Multi-active	118	116	0.7		137	137	0.4	
Non-agricultural	97	163	8.5	*	121	156	7.0	**
Employee	303	426	6.9	***	315	354	3.1	***
Agricultural	125	142	3.0	***	140	142	0.1	
Multi-active	38	63	7.3	*	42	47	4.4	
Non-agricultural	140	221	9.7	***	133	164	5.4	***
Non-occupied	34	60	11.7	***	76	134	15.6	***
TOTAL	980	1.141	3.1	***	1.081	1.243	3.6	***
Total family farming	530	474	-1.4		558	585	1.0	*
Agricultural	392	344	-1.8		415	440	1.1	
Multi-active	138	131	-0.5		143	145	0.7	

Source: Instituto Brasileiro de Geografia e Estatística (2018) Microdata. Prepared by the authors. **Notes:** The two dashes (-) indicate the family types with less than six observations in the sample. Asterisks (***, **, *) express significance at the levels of 5%, 10%, and 20% respectively. Total family farming = sum of households with self-employed and employers with up to two employees, both agricultural and multi-active.

Non-agricultural households grew at an average annual rate of 8.7% (2004 to 2009) and 6.4% (2011 to 2015), and non-employed families, of 11.7% (2004 to 2009) and 15.6% (2011 to 2015). While these two types showed a positive trend of increasing participation, strictly agricultural families lost share in the two periods under analysis.

A structural break in the family type's distribution between 2009 and 2011 resulted from changes in the official rural zones. Consequently, the increase of agricultural families' share may be partially due to the exclusion of families living in the hitherto rural areas from our analysis' scope. Despite this structural change and the greater representativeness of agricultural families, the family types' evolution showed the same trends in the two periods, i.e., an increment in non-agricultural and non-employed families' participation on the one hand, and a loss of agricultural or multi-active families' share on the other hand. At the end of each of the two periods, practically 40% of rural families in the North Region corresponded to non-agricultural and non-employed families.

Table 2: Share of families in rural areas by activity sector, North Region, 2004 to 2009 and 2011 to 2015

Place of residence/ Family type	2004	2009	Δ (% p.y.)		2011	2015	Δ (% p.y.)	
		2004/2009				2011/2015		
Rural								
Families (1,000)								
Agricultural	518	486	-0.5		556	584	0.9	
Multi-active	180	195	1.2		187	194	1.6	
Non-agricultural	248	400	8.7	**	261	331	6.4	***
Non-occupied	34	60	11.7	***	76	134	15.6	***
TOTAL	980	1.141	3.1	***	1,081	1,243	3.6	***
Share (%)								
Agricultural	52.9	42.6	-3.5	**	51.5	47.0	-2.6	***
Multi-active	18.4	17.1	-1.9		17.3	15.6	-2.0	
Non-agricultural [2]	25.3	35.0	5.4	*	24.2	26.6	2.7	**
Non-occupied [3]	3.5	5.3	8.3	***	7.0	10.8	11.5	***
TOTAL	100.0	100.0			100.0	100.0		
[2] + [3]	28.7	40.3	5.8	*	31.2	37.4	4.9	***

Source: Instituto Brasileiro de Geografia e Estatística (2018) Microdata. Prepared by the authors. **Note:** Asterisks (***, **, *) express significance at the levels of 5%, 10%, and 20% respectively.

Table 2 shows that multi-active families remained stable in the two periods under analysis. The relative participation of this group reduced by 1.9 and 2 percentage points between 2004-2009 and 2011-2015, respectively. One hypothesis to explain this trend is that new rural families may prefer to abandon the agricultural activities, attracted by better occupational opportunities in non-agricultural sectors.

Table 3 shows the shares' evolution disaggregated by family and employment type. The only family types with significant growth trends, in both periods, were the non-agricultural employee and non-employed families. Self-employed and employee agricultural households, on the other hand, experienced a downward trend in their relative participation, as well as the entire family farming group, which is the sum of households with self-employed and employers with up to two employees, both agricultural and multi-active.

Table 3: Share (%) of family by employment type and activity sector, North Region, 2004 to 2009 and 2011 to 2015

Place of residence/ Family type	2004	2009	Δ (% p.y.)		2011	2015	Δ (% p.y.)	
			2004/2009				2011/2015	
Rural								
Employer with more than two employees	1.4	0.9	-13.5		0.7	0.5	-2.2	
Agricultural	0.1	0.0	-	-	0.1	0.1	-	-
Multi-active	0.5	0.2	-	-	0.2	0.1	-	-
Non-agricultural	0.7	0.6	-10.6		0.3	0.3	-0.8	
Employer with up to two employees	4.3	3.7	-4.9		1.6	2.1	6.0	
Agricultural	2.0	1.7	-4.4		0.7	0.9	3.9	
Multi-active	2.0	1.2	-11.8		0.5	0.7	2.4	

Source: Instituto Brasileiro de Geografia e Estatística (2018) Microdata. Prepared by the authors. **Notes:** The two dashes (-) indicate the family types with less than six observations in the sample. Asterisks (***, **, *) express significance at the levels of 5%, 10%, and 20% respectively. Total family farming = sum of households with self-employed and employers with up to two employees, both agricultural and multi-active.

Table 3: Continued...

Place of residence/ Family type	2004	2009	Δ (% p.y.)		2011	2015	Δ (% p.y.)	
			2004/2009				2011/2015	
Non-agricultural	0.4	0.7	10.9		0.4	0.5	13.4	
Self-employed	59.9	52.9	-2.2	***	61.6	58.1	-1.5	***
Agricultural	38.0	28.4	-4.7	**	37.7	34.5	-2.5	***
Multi-active	12.0	10.2	-2.3		12.7	11.0	-3.1	
Non-agricultural	9.9	14.3	5.2		11.2	12.6	3.2	
Employee	30.9	37.3	3.7	***	29.1	28.5	-0.5	
Agricultural	12.8	12.4	-0.1		12.9	11.4	-3.4	*
Multi-active	3.8	5.5	4.1		3.9	3.8	0.7	
Non-agricultural	14.3	19.4	6.4	***	12.3	13.2	1.8	***
Non-occupied	3.5	5.3	8.3	***	7.0	10.8	11.5	***
TOTAL	100.0	100.0			100.0	100.0		
Total family farming	54.0	41.5	-4.4	**	51.6	47.1	-2.5	***
Agricultural	40.0	30.1	-4.7	**	38.4	35.4	-2.4	***
Multi-active	14.0	11.4	-3.5	*	13.2	11.7	-2.8	

Source: Instituto Brasileiro de Geografia e Estatística (2018) Microdata. Prepared by the authors. **Notes:** The two dashes (-) indicate the family types with less than six observations in the sample. Asterisks (***, **, *) express significance at the levels of 5%, 10%, and 20% respectively. Total family farming = sum of households with self-employed and employers with up to two employees, both agricultural and multi-active.

When considering the family types' participation, according to the activity sector, the trends are similar to those observed in the previous analyzes, that is, an evident increase in the relative participation of non-agricultural families, contrasting with the loss of agricultural families' share (Table 4). In turn, multi-active families showed relative stability in their participation, which may be related, precisely, to the reduction of agricultural families. Likely, many rural families are definitively abandoning farming activities and becoming exclusively non-farming families, which implies a non-growth or reduction trend of multi-activity.

Table 4: Share (%) of family by activity sector within each employment type, North Region, 2004 to 2009 and 2011 to 2015

Place of residence/ Family type	2004	2009	Δ (% p.y.)		2011	2015	Δ (% p.y.)	
			2004/2009				2011/2015	
Rural								
Employer with more than two employees	100.0	100.0			100.0	100.0		
Agricultural	10.0	3.5	-	-	20.1	25.6	-	-
Multi-active	36.9	20.8	-	-	29.3	21.7	-	-
Non-agricultural	53.1	75.7	3.4		50.5	52.7	1.4	
Employer with up to two employees	100.0	100.0			100.0	100.0		
Agricultural	45.1	46.3	0.6		42.5	43.1	-2.0	
Multi-active	46.5	33.7	-7.2		33.7	32.2	-3.4	
Non-agricultural	8.4	20.0	16.7		23.8	24.8	6.9	
Self-employed	100.0	100.0			100.0	100.0		
Agricultural	63.5	53.7	-2.6	*	61.3	59.4	-1.0	*
Multi-active	20.1	19.3	-0.2		20.6	19.0	-1.6	

Source: Instituto Brasileiro de Geografia e Estatística (2018) Microdata. Prepared by the authors. **Notes:** The two dashes (-) indicate the family types with less than six observations in the sample. Asterisks (***, **, *) express significance at the levels of 5%, 10%, and 20% respectively. Total family farming = sum of households with self-employed and employers with up to two employees, both agricultural and multi-active.

Table 4: Continued...

Place of residence/ Family type	2004	2009	Δ (% p.y.)		2011	2015	Δ (% p.y.)	
			2004/2009				2011/2015	
Non-agricultural	16.4	27.0	7.6		18.2	21.7	4.8	**
Employee	100.0	100.0			100.0	100.0		
Agricultural	41.3	33.3	-3.6	***	44.4	40.2	-2.8	*
Multi-active	12.4	14.8	0.4		13.5	13.4	1.3	
Non-agricultural	46.3	51.9	2.6	***	42.1	46.4	2.3	***
Total family farming	100.0	100.0			100.0	100.0		
Agricultural	74.0	72.5	-0.3		74.4	75.2	0.1	
Multi-active	26.0	27.5	0.9		25.6	24.8	-0.3	

Source: Instituto Brasileiro de Geografia e Estatística (2018) Microdata. Prepared by the authors. **Notes:** The two dashes (-) indicate the family types with less than six observations in the sample. Asterisks (***, **, *) express significance at the levels of 5%, 10%, and 20% respectively. Total family farming = sum of households with self-employed and employers with up to two employees, both agricultural and multi-active.

These results for the North Region corroborate, to a great extent, previous studies for other Brazilian regions and states (Schneider, 2004; Del Grossi, 2017; Eder et al., 2017; Aquino & Nascimento, 2020a, Aquino & Nascimento, 2020b) and comparative studies for the Northeast and South regions (Nascimento & Cardozo, 2007; Nascimento, 2009; Cardoso, 2013). Despite the local specificities, these studies attest to the same increasing trend of rural families engaged in non-agricultural activities and reducing trend for those engaged in agricultural activities, showing that the North Region trend would not be isolated nor cyclical.

The growth of the population engaged in agricultural and non-agricultural activities in the rural North reveals a trend similar to that observed for family types (Table 5). While the contingent of the rural economically active population (EAP) in agriculture declined, the rural non-agricultural EAP and the non-employed population (inactive with and without pension) showed strong growth. These data reinforce the idea that rural areas' socio-economic reality in the North Region has changed. In addition to the place where traditional agricultural activities are developed, rural areas have also become the residence for many people who perform non-agricultural activities and retirees, demanding, for this purpose, a set of other actions hitherto restricted to the urban environment.

The rural population's growth trend in non-agricultural activities in the North Region follows the same trajectory observed by Telles et al. (2017) for the Northeast, Midwest, South, and Southeast from 2001 to 2009. Except for the Midwest, the other regions showed a strong tendency to reduce the number of occupations in agricultural activities, especially the South and Southeast. The authors suggest that this dynamic was due to the modernization of productive structures, the reduction of labor supply in agriculture, and the low attractiveness of these activities to the rural population.

Table 5: Distribution and evolution of the rural population aged ten and over, employed and not employed, by activity sector and employment type: North Region, 2004 to 2009 and 2011 to 2015 (1,000 people)

Employment type	2004	2009	Δ (% p.y.)		2011	2015	Δ (% p.y.)	
			2004/2009				2011/2015	
Rural								
Agricultural EAP	1,555	1,273	-3.4	*	1,427	1,316	-1.9	*
Employee	233	259	1.6		240	238	-0.6	

Source: Instituto Brasileiro de Geografia e Estatística (2018) Microdata. Prepared by the authors. **Notes:** The two dashes (-) indicate the family types with less than six observations in the sample. Asterisks (***, **, *) express significance at the levels of 5%, 10%, and 20% respectively.

Table 5: Continued...

Employment type	2004	2009	Δ (% p.y.)		2011	2015	Δ (% p.y.)	
			2004/2009				2011/2015	
<i>Formal</i>	37	43	4.7	*	52	50	1.9	
<i>Informal</i>	196	216	0.8		188	188	-1.3	
Self-employed	490	399	-2.5		537	525	-0.9	
Employer	44	33	-6.4		15	20	4.5	
Subsistence work	290	247	-3.3	**	286	345	6.3	**
Unpaid work	498	336	-7.1	*	349	188	-14.8	***
Non-agricultural EAP	615	825	4.3		635	732	3.4	**
Employee	256	350	6.5	***	229	256	2.8	***
<i>Formal</i>	118	162	7.7	***	84	105	5.3	**
<i>Informal</i>	138	188	5.6	***	146	151	1.2	**
Military	1	2	-	-	0	1	-	-
Statutory civil servant	51	92	15.4	***	69	79	3.9	**
Paid domestic work	64	84	3.7	*	47	69	6.4	
Self-employed	171	225	4.1		194	234	5.0	**
Employer	17	21	-0.6		11	14	9.6	
Self-construction	1	1	-	-	3	3	-	-
Unpaid	53	50	-5.8		82	78	-2.4	
Non-occupied	944	1,225	5.8	***	1,183	1,496	5.6	**
Non-occupied EAP	51	75	3.5		52	52	4.2	
Retiree with pension	91	152	10.0	***	184	290	11.7	***
Retiree without pension	803	998	5.4	***	948	1,154	4.4	**
TOTAL	3,114	3,323	1.4	***	3,246	3,545	2.1	**

Source: Instituto Brasileiro de Geografia e Estatística (2018) Microdata. Prepared by the authors. **Notes:** The two dashes (-) indicate the family types with less than six observations in the sample. Asterisks (***, **, *) express significance at the levels of 5%, 10%, and 20% respectively.

Despite the downward trend in agricultural EAP, Table 6 shows a growth trend in occupations in cattle breeding (3.0% per year), poultry farming (5.2% per year), and growing vegetables, legumes, and others (4.9% per year). On the one hand, these results would reflect the advance of livestock on the new frontier of agricultural development and, on the other hand, the replacement of traditional subsistence crops (such as cassava, beans, rice) with agricultural activities of higher benefit. Gasques & Villa Verde (1990) also observed this trend for the North Region from 1980 to 1988, recently reiterated by Mattei (2015) for the first decade of the 2000s. The authors emphasize that the structural changes of the last decades have caused relevant and differentiated evolution in the productive structure of all Brazil's macro-regions. Although these transformations are not uniform, the replacement of food crops by commercial crops, such as cattle, soy, and corn, is a general trend in most Brazilian regions.

Regarding the non-agricultural EAP, the growth presented in both periods, although not significant from 2004 to 2009, was strongly influenced by activities related to education, health, and social services, trade, repair, and construction (Table 6). Some of the most representative occupations of these sectors in rural areas in the North are teacher, community health agent, carpenter (construction of houses and boats), trader, and driver, again reinforcing the role of non-agricultural activities in the employment creation and income diversification in rural areas.

Table 6: Distribution and evolution of employed rural population, according to activity sector, North Region, 2004 to 2009 and 2011 to 2015 (1,000 people)

Activity branches	2004	2009	Δ (% p.y.)		2011	2015	Δ (% p.y.)	
			2004/2009				2011/2015	
RURAL								
Agriculture	1,555	1,273	-3.4	*	1,427	1,316	-1.9	*
Cassava cultivation	461	301	-3.8		398	335	-2.5	
Cattle breeding	263	247	-1.9		256	292	3.0	**
Poultry farming	182	140	-5.9	***	139	167	5.2	***
Fishing and related services	37	37	-4.4		76	119	7.8	
Permanent crops production	120	57	-13.9	***	70	65	-3.6	
Mixed production: farming and livestock	1	66	-	-	140	60	-21.7	***
Growing vegetables, legumes, and others	41	79	8.8	*	53	59	4.9	*
Agriculture-related services	16	40	21.3		37	36	1.8	
Forestry and logging	43	15	-16.3	**	15	19	0.7	
Other activities	392	291	-5.4	***	244	165	-9.6	***
Non-agriculture	615	825	4.3		635	732	3.4	**
Transformation industry	126	170	0.9		157	155	-0.9	
Trade and repair	122	146	4.6	*	111	139	5.2	*
Education, health, and social services	84	123	5.7	**	92	126	8.4	***
Construction Industry	68	85	8.1	**	70	78	3.7	**
Paid domestic services	64	84	3.7	*	47	69	6.4	
Accommodation and food	27	47	11.7	**	38	44	1.3	
Transport, storage, and communication	30	45	9.2	***	33	37	2.5	
Public administration	34	54	9.3	***	41	32	-4.5	
Other activities	14	14	5.4		17	18	3.7	
Other industrial activities	15	17	3.5	*	10	16	15.7	*
Collective. social and personal services	23	24	2.5		15	15	4.9	
Non-defined activities	9	16	-	-	4	4	-	-

Source: Instituto Brasileiro de Geografia e Estatística (2018) Microdata. Prepared by the authors. **Notes:** The two dashes (-) indicate the family types with less than six observations in the sample. Asterisks (***, **, *) express significance at the levels of 5%, 10%, and 20% respectively.

Indeed, the composition of the rural families' income reflects the heterogeneity of the rural population's activities (Table 7). We should note that, in 2015, *non-agricultural* sources of income (35.5%) accounted for most of the total agricultural family income in the region under analysis. Regarding the total average income, *non-agricultural* families' incomes are higher than those of *agricultura*⁸ families; and, sometimes, higher than those of *multi-active* families. In turn, the changes in the self-employed agricultural household's (family farming) income composition show a relevant increase in the dependence on non-labor income, i.e., pensions (from 17.1%, in 2004, to 28.2%, in 2015) and other types of income (from 6.5%, in 2004, to 14.4%, in 2015).

⁸ The share of non-agricultural income grew more than (and exceeded) the share of agricultural income. If we consider non-labor income (pensions and others), together with non-agricultural income, we can see clearly that the mass of income from agricultural activities becomes comparatively smaller.

Table 7: Composition of total family income and average rural family income, by employment type and activity sector, according to income sources, North Region, 2004 and 2015 (Sep./2015 R\$)

Place of residence/ Family type	2004				Average family income (R\$)	2015				
	Income from work		From non-labor			Income from work		From non-labor		
	Agriculture (%)	Non-agriculture (%)	Pensions (%)	Other (%)		Agriculture (%)	Non-agriculture (%)	Pensions (%)	Other (%)	
Rural										
Employer with more than two employees	54.5	41.6	2.0	1.9	5,479.89	53.0	43.3	3.3	0.4	9,958.36
Agricultural	92.3	0.0	7.7	0.0	5,188.71	70.9	0.0	28.8	0.4	3,282.01
Multi-active	78.9	18.9	1.3	0.9	8,615.11	81.2	18.8	0.0	0.0	26,567.81
Non-agricultural	0.0	94.2	1.6	4.2	3,357.74	0.0	96.5	2.5	1.0	6,356.94
Employer with up to two employees	68.9	20.1	9.1	1.9	2,651.06	56.7	33.2	7.6	2.6	4,829.71
Agricultural	91.7	0.0	5.5	2.8	2,381.68	86.5	0.0	10.6	2.8	5,181.65
Multi-active	62.8	23.4	12.3	1.6	2,884.64	58.3	36.5	0.9	4.3	3,523.48
Non-agricultural	0.0	92.6	7.4	0.0	2,805.89	0.0	92.7	6.4	0.8	5,515.54
Self-employed	49.8	32.5	12.0	5.6	1,306.45	38.5	29.8	20.4	11.3	1,528.98
Agricultural	76.4	0.0	17.1	6.5	971.00	57.3	0.0	28.2	14.4	1,273.49
Multi-active	50.4	33.0	9.7	6.9	1,824.43	36.3	45.9	10.6	7.2	2,295.80
Non-agricultural	0.0	92.2	5.5	2.3	1,867.22	0.0	77.9	13.3	8.8	1,697.03
Employee	28.3	61.9	5.2	4.7	1,227.70	25.9	56.1	11.0	7.1	1,617.04
Agricultural	88.3	0.0	7.3	4.4	847.05	77.6	0.0	12.0	10.4	1,135.66
Multi-active	27.3	60.3	7.8	4.6	1,161.24	25.8	53.9	13.8	6.5	1,867.27
Non-agricultural	0.0	91.6	3.6	4.8	1,582.98	0.0	84.8	9.7	5.6	1,961.59
Non-occupied	0.0	0.0	78.7	21.3	749.81	0.0	0.0	81.2	18.8	1,172.46
TOTAL	44.0	39.0	11.7	5.3	1,358.46	33.6	35.5	21.1	9.8	1,630.58

Source: Instituto Brasileiro de Geografia e Estatística (2018) Microdata. Prepared by the authors.

The reality of a strong dependence on non-labor income sources, especially on pensions, is not a peculiarity of rural families in the North Region. In the Northeast, Aquino & Nascimento (2020a) show that pensions were responsible for 55.7% and 22.0% of the total income of self-employed and employee agricultural households. These percentages are almost double than those observed in the Brazilian North.

On the other hand, studies show a very different panorama in the states of Paraná and Rio Grande do Sul (Staduto et al., 2013; Eder et al., 2017), where the rural families' total income is mostly from agricultural work. Income from non-labor, especially other sources, has limited participation in the average family income in these states.

5. FINAL REMARKS

This article described the dynamics of the family types and income in the North Region's rural areas between 2004 and 2015. The first central contribution is to capture the regional rural

dynamics using a family typology based on family members' agricultural and non-agricultural occupations. Another vital contribution to the analysis of multi-activity is to understand the dynamics of families and income in a period of essential changes in agricultural production in the Brazilian North.

A first finding of the work is that the number of families living in the North's rural areas increased in the period, mainly due to the growth of non-agricultural families. The occupational opportunities in non-agricultural activities in rural and urban areas (in the latter case, allowed by advances in transportation that shorten the distances) have contributed to the increase in the number of families and people employed in diversified work activities. The growth in the number of rural families may also be related to family structure changes (family breakdown) and new settlement cycles in the forest to develop either agricultural or non-agricultural economic activities. The analysis period coincides with the advance of modern, high-added value and laborsaving agriculture in the region. One hypothesis is that this new agricultural pattern would reduce the need for agricultural work. Moreover, this process is under a context where a non-agricultural sector development represents a push factor for younger rural members.

The heterogeneity of occupation and income sources shows that families are becoming less dependent on agriculture to guarantee their livelihood. Rural families living in the North Region depend significantly on income from non-agricultural activities, with a significant share of earnings from non-labor (for example, pensions and public cash transfers), especially among the self-employed family farmers. On the one hand, these results highlight the critical role of population aging (due to the retirees' pensions) and government transfers to reduce poverty. On the other, they reflect the difficulty of livelihood when agriculture is the primary or sole family income source.

In general, the information presented in this article on the diversity of family groups and their occupations and income sources demonstrates that rural development policies for the Brazilian North Region should not be limited to a single sectoral way. It is imperative to integrate and coordinate distinct policies other than agriculture, effectively meeting the rural space's diverse demands through multiple development strategies. In short, the socio-economic heterogeneity among families living in the North's rural areas is the central issue that we seek to highlight in the course of these analyses to give rise to further in-depth studies.

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