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This publication is a result of a partnership between the International Policy Centre for Inclusive Growth (IPC-IG), the United Nations Development Programme (UNDP), the Institute for Applied Economic Research (Ipea) and the International Fund for Agricultural Development (IFAD).

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The International Policy Centre for Inclusive Growth is jointly supported by the United Nations Development Programme and the Government of Brazil.

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POVERTY PROFILE: THE RURAL NORTH AND NORTHEAST OF BRAZIL¹

Sergei Soares;² Laetícia De Souza;³ Wesley Silva;⁴
Fernando Gaiger Silveira² and Áquila Campos⁵

Fortunately, both poverty and extreme poverty have shown a significant decrease in Brazil. According to data from the National Household Sample Survey (*Pesquisa Nacional por Amostra de Domicílios*—PNAD), poverty dropped over 20 per cent between 2004 and 2013, to about 9 per cent of the Brazilian population. Extreme poverty fell from about 7 per cent to 4 per cent over the same period. Much of this decline was due to the expansion of the labour market and the significant increase in transfers to poor households, through both social security and the *Bolsa Família* programme (Rocha 2013).

Unfortunately, this progress has stagnated. Between 2012 and 2013, extreme poverty increased slightly, and poverty remained stable (ECLAC 2014; Mosque et al. 2015). The labour market is deteriorating rapidly, and the fiscal situation has gone from being relatively favourable to a source of great concern. This means that the two main driving forces behind poverty reduction—the labour market and transfers to poor households—are unable to maintain the same pace as in the past decade.

While poverty has decreased, many of its aspects remain the same. Geographically, little has changed. The North and Northeast remain the poorest regions of Brazil, and, within any given region, rural areas are also the poorest (Barros et al. 2006; IFAD 2011; Rocha 2013). This study will discuss poverty and extreme poverty, as well as how they relate to these variables.

Before presenting poverty profiles for the North and Northeast regions of Brazil, we must clarify a few concepts that form the basis of the analysis to come. First, we define and set the poverty and extreme poverty lines; second, we offer an alternative to the official definitions

1. The authors would like to thank the Data Zoom website, which provides Stata packages free of charge for reading the household survey microdata provided by IBGE. Data Zoom was developed by the Department of Economics at PUC-Rio, with funding from FINEP. Access to softwares packages is open to the public, and the goal of the platform is to simplify access to microdata about Brazil. The estimation of all indicators throughout the text referring to 2004–2013 would have been more complicated had it not been for the Data Zoom packages.

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of 'rural' and 'urban' provided by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística—IBGE).

According to IBGE, the North and Northeast regions of Brazil comprise 16 states (seven in the North and nine in the Northeast) and are widely recognised as the poorest regions in a country marked by large regional disparities.

In Brazil, as in most places, poverty is a term largely dependent on one's perspective. In recent decades, three definitions of poverty have been used in Brazil. Of greater historical importance is the definition of poverty in terms of the minimum amount of calories needed for survival. This definition uses monetary poverty lines, often regionalised, estimated according to minimum caloric needs.

Brazil has a long history of poverty estimation by several different researchers, which may explain why there has never been an agreement on a set of lines as the basis for an official poverty line (Soares 2009).

Another popular approach among other Latin American countries involves estimating Unmet Basic Needs Indices, but this has never garnered much attention in Brazil. Such indices are often referred to as 'multidimensional poverty lines'. This, of course, is a contradiction in terms. If something is truly multidimensional, it cannot be a line (or a point) but, rather, an n-dimensional surface. Poverty surfaces are used very rarely because they are overly complicated. A better description of the criteria for measuring poverty through unmet basic needs is provided by 'composite indices'. In any case, they are not popular in Brazil either.

In 2003, the Federal Government—having had enough of the unending disagreement among academics—set a per capita household income of BRL50 and BRL100 as the thresholds for defining extreme poverty and poverty, respectively, under the Bolsa Família programme. Since then, these lines have been used by many scholars as practically official poverty and extreme poverty lines, adjusted only by consumer inflation each year. They are quite useful, as they are commonly close to the lines used in international comparisons: USD1 and USD2 a day, respectively. Under the Brazil without Extreme Poverty programme, in June 2011 the lines of BRL50 and BRL100—which, adjusted for inflation, had become BRL70 and BRL140, respectively—were set as the official extreme poverty and poverty lines by Presidential Decree No. 7,492 of 2 June 2011. These are the poverty and extreme poverty lines adopted in this study.

One peculiarity of Brazil is the fact that 'rural' is a concept just as complex as 'poverty'. If the lack of an official definition of poverty was a problem for a long time, an excessively official definition of rural has also been a problem. It is up to municipal mayors to determine whether their region constitutes a rural area, and IBGE is legally obliged to accept the designation made at the municipal level. If a mayor defines a given area as urban, he/she will be entitled to collect taxes on urban properties. Therein lies the problem. Not only do rural areas yield lower tax revenues, mayors must also share half of the revenue with the federal government (Del Grossi and Silva 2002; Del Grossi 2003).

This arrangement has led to a bizarre and not very trustworthy definition of what is urban and what is rural in Brazil.

In this study, we shall employ four definitions of rurality that use the official municipal rural/urban designation as one of three criteria. The other criteria used in this study refer to our classification of households as agricultural. Households are classified by Del Grossi (2003)

based on household status—agricultural, pluriactive and non-agricultural—according to the type of activity performed by the members of the household.

The definitions of the four categories of rurality used in this study are as follows:

1. *Agricultural households* are defined as any household in which at least one member is employed in the agricultural sector, and 67 per cent or more of the household income comes from agricultural activities.
2. *Pluriactive households* are defined as those in which at least one member is employed in the agricultural sector, but less than 67 percent of the household income is derived from agriculture.
3. *Non-agricultural rural households* are defined as households located in areas officially designated as rural, but without any household members working in agriculture.
4. *Non-agricultural urban households* are defined as those located in official urban areas, without any household members working in agriculture.

The most important disadvantage of this definition (which applies to any conceivable definition of urban and rural) is the fact that the groups are not fixed. People migrate from one category to another with relative ease. This fact must be taken into account when interpreting the results presented in the following sections.

Now that the definitions are clear, what is in this rural poverty profile? First and foremost, a poverty profile should begin with a relatively detailed analysis of poverty according to the two semi-official poverty categories and the four aforementioned rural analytical. In addition to checking whether there has been a decline in poverty and extreme poverty and quantifying this decline, we must also investigate the relationship between the decline and changes in rurality—i.e. demographic changes in the four groups.

Finally, we will estimate a comprehensive set of indicators and their evolution for extremely poor and poor households in each of the four demographic (or rurality) categories. This will be done for the North and Northeast regions and for Brazil as a whole, using PNAD data for the period 2004–2013.

Based on data from the 2010 census, we will generate poverty maps by municipality using the same regional selections (North, Northeast and Brazil). Poverty maps will also be generated for each of the four demographic categories. Additionally, we will also draw from the 2006 Census of Agriculture to characterise the differences in family agriculture establishments between the North and Northeast regions and in comparison with the rest of Brazil. A brief discussion of the immediate causes of poverty will also be provided.

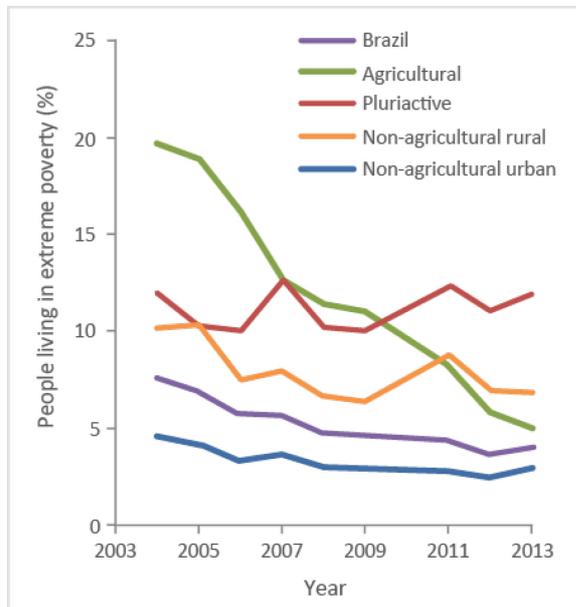
1 THE EVOLUTION OF POVERTY AND EXTREME POVERTY

The most striking fact in the evolution of poverty between 2004 and 2013—in the North and Northeast regions as well as in Brazil as a whole—is the sharp decline in extreme poverty and poverty among agricultural families. The period was quite conducive to poverty reduction in Brazil. Extreme poverty was nearly halved, from 7.6 per cent of Brazilians in 2004 to 4.0 per cent in 2013; poverty decreased by a factor of 2.5 over the same period, from 22.4 per cent

to 8.9 per cent. Even more impressive than the overall decrease in poverty in the country as a whole, however, is the decline in poverty among agricultural households. Suffice it to say that in 2004 extreme poverty in agricultural households was nearly three times the overall rate of extreme poverty; by 2013 the two rates were nearly identical.

FIGURE 1A

Extreme poverty in Brazil



Source: PNAD, selected years.

FIGURE 1B

Poverty in Brazil

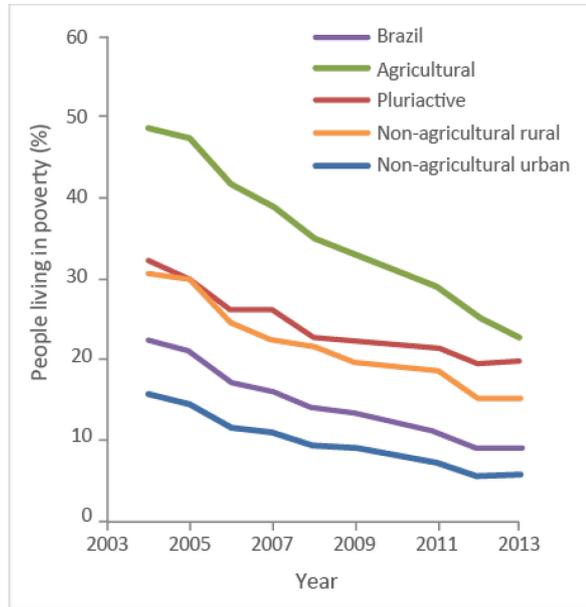
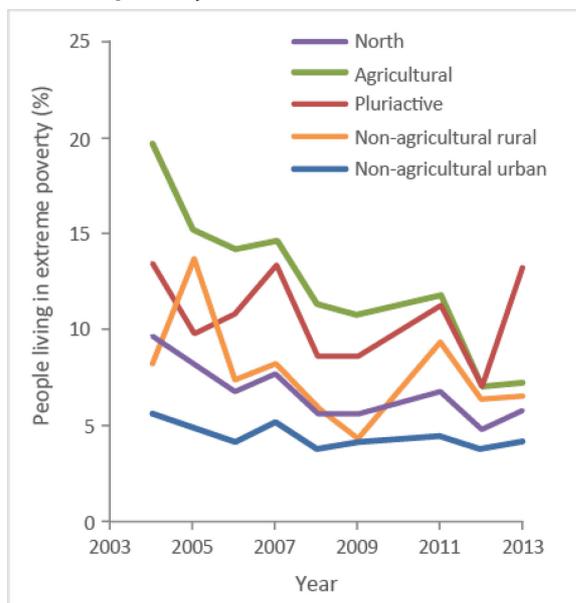


FIGURE 2A

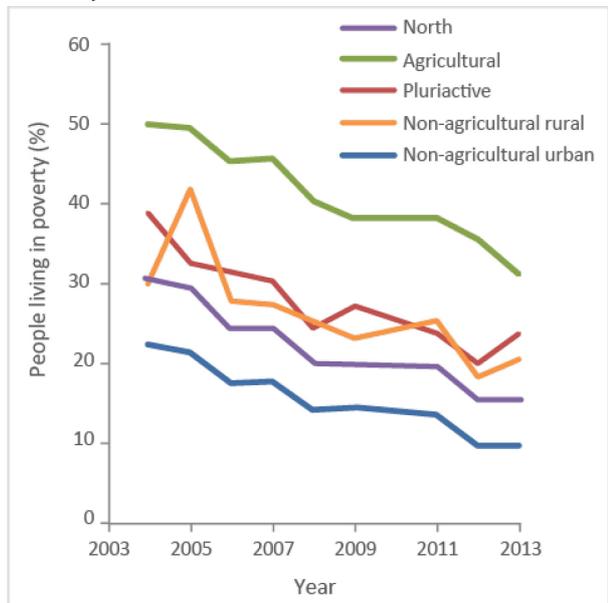
Extreme poverty in the North



Source: PNAD, selected years.

FIGURE 2B

Poverty in the North



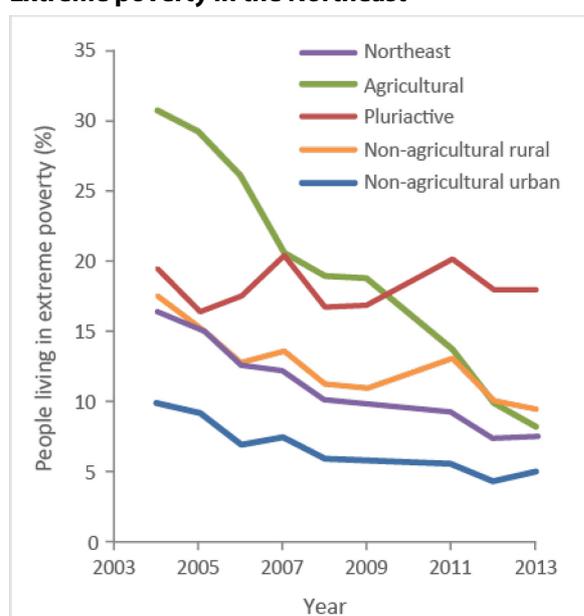
Almost as impressive as the rapid decline in poverty in agricultural households is the stability of poverty rates in pluriactive households. The extreme poverty rate of pluriactive households in 2013 was almost that of a decade earlier, in 2004. As will be seen later in this

study, this may be partly due to migration from one group to another. These are, indeed, families with low incomes derived from agriculture who try to supplement their income through other economic activities. The poverty and extreme poverty rates of non-agricultural urban and rural households follow similar trends as Brazilian households as a whole.

This study will focus on poverty in the North and Northeast. How do these regions compare to Brazil as a whole? The Northeast fared a little better than Brazil, and the North a little worse. However, the lives of the poor showed improvement in both regions.

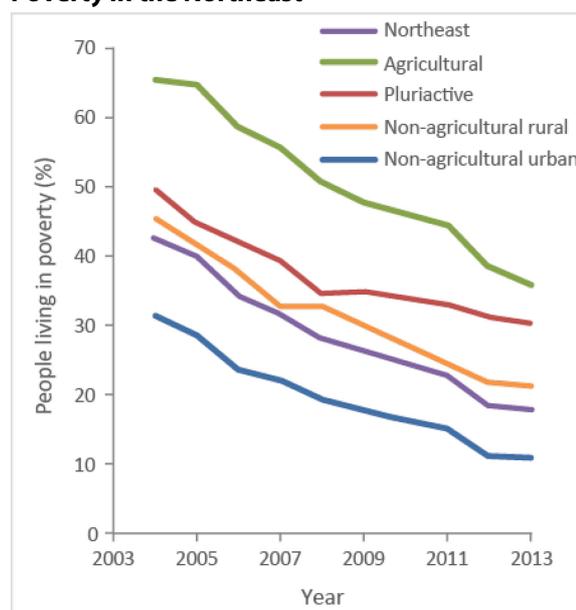
Let us examine what happened in greater detail. Figures 2A and 2B show the evolution of poverty and extreme poverty in the North, and Figures 3A and 3B show their evolution in the Northeast.

FIGURE 3A

Extreme poverty in the Northeast

Source: PNAD, selected years.

FIGURE 3B

Poverty in the Northeast

Poverty declined less in the North than in the Northeast and in Brazil as a whole. The persistence of extreme poverty in the North—particularly among pluriactive and non-agricultural households—is of particular concern. Their poverty rates were almost the same in 2013 as they were in 2004. No doubt this is a worrying trend, considering the widespread (and beneficial) decline of poverty during this period. Although the North is less poor than the Northeast, it has seen slower progress when compared to other regions of the country.

In the Northeast, poverty and extreme poverty declined more than in the rest of Brazil, but the region still lags behind the rest of the country. Poverty among agricultural households fell from 65 per cent to 36 per cent—a fairly significant decline—but many people still remain in poverty. Extreme poverty among agricultural households fell from 30 per cent to 8 per cent, which means that extreme poverty in 2013 was less than a quarter of that recorded in 2004. It is also worth noting that extreme poverty among agricultural households is still higher in the Northeast than in any other region, including the North. The stability of extreme poverty

that plagues pluriactive households in the North and in Brazil as a whole also seems to be a characteristic of the Northeast, where there was hardly any progress.

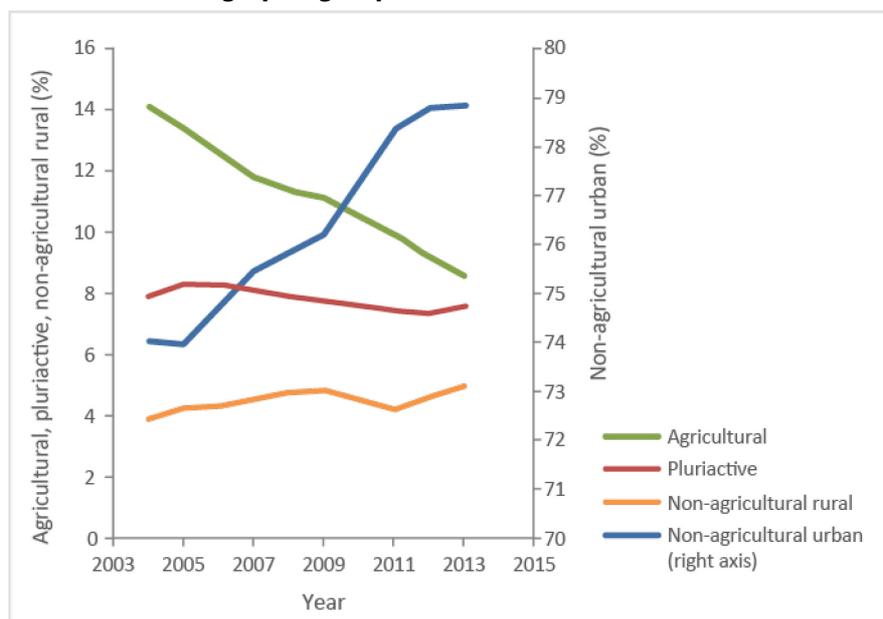
It is obvious that the changes in the population groups analysed in this study may at least partially explain the information presented in these graphs. Pluriactive households may be better off, but changes in their composition may have masked such an improvement. To understand what is happening, we must look closely at the demographic groups.

2 DEMOGRAPHIC CHANGES AND THE DECOMPOSITION OF POVERTY

As previously mentioned, there have been significant changes in the relative sizes of the four groups. How significant were these changes?

FIGURE 4

Size of each demographic group in Brazil



Source: PNAD, selected years.

Figure 4 shows that there has been a sharp decline in the proportion of agricultural households and an increase in the proportion of non-agricultural urban households in Brazil; pluriactive and non-agricultural rural households remain relatively stable as a share of the total population. This suggests two trends.

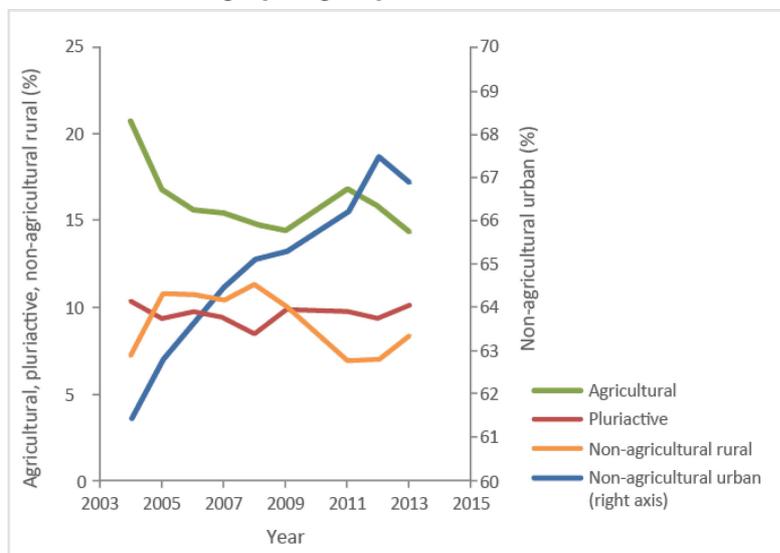
First, pluriactive households do not actually seem to be advancing at the same pace as the rest of the agricultural and rural population, which, in turn, suggests that there must be public policies aimed at these families.

Second, it may be the case that part of the reduction in rural poverty is simply due to the migration of individuals who abandon rural areas or agricultural occupations and head to urban areas and urban labour markets. After all, the percentage of non-agricultural urban households has increased by around five percentage points during the period—a significant change.

What happens when we consider the North and Northeast regions separately in our analysis?

FIGURE 5

Size of each demographic group in the North



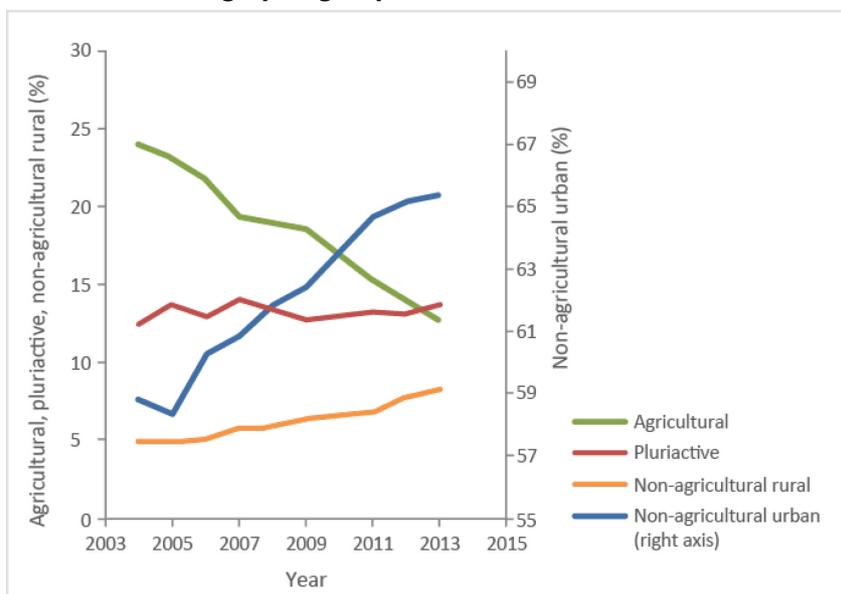
Source: PNAD, selected years.

The North has more families involved in agriculture, more pluriactive families and more non-agricultural rural households. This means that this region has considerably fewer non-agricultural urban households than the rest of the country. In terms of changes, the most notable difference is the fact that the decline in agriculture was much less pronounced in the North than in Brazil as a whole.

Let us look at the Northeast.

FIGURE 6

Size of each demographic group in the Northeast



Source: PNAD, selected years.

We now know that there have been significant changes to the demographic characteristics of the four population groups under analysis. How do we decompose the changes in poverty when households can migrate among four population groups? The answer is a simple decomposition approach for intragroup and intergroup changes.

The overall poverty (or extreme poverty) rate is simply the weighted average of the poverty (or extreme poverty) rates for each group:

$P = \sum_k P_k w_k$ where k represents each group, P represents the poverty rates, and w represents its population weight. Small changes in P can be easily decomposed into two parts:

$$\Delta P = \sum_k P_k \Delta w_k + w_k \Delta P_k$$

The results of this decomposition are shown in Table 1.

TABLE 1

Decomposition of changes in poverty and extreme poverty

Period	Extreme poverty			
	Composition	Internal	Percentage composition	Percentage internal
2004–2005	-0.1%	-0.5%	9.6%	90.4%
2005–2006	-0.1%	-1.1%	9.0%	91.0%
2006–2007	-0.1%	0.0%	73.1%	26.9%
2007–2008	0.0%	-0.8%	4.9%	95.1%
2008–2009	0.0%	-0.1%	22.9%	77.1%
2009–2011	-0.1%	-0.2%	40.8%	59.2%
2011–2012	0.0%	-0.6%	2.7%	97.3%
2012–2013	0.0%	0.3%	4.6%	95.4%
Total	-0.5%	-3.1%	13.0%	87.0%
Period	Poverty			
	Composition	Internal	Percentage composition	Percentage internal
2004–2005	-0.1%	-1.1%	9%	91%
2005–2006	-0.2%	-3.4%	7%	93%
2006–2007	-0.2%	-1.0%	19%	81%
2007–2008	-0.1%	-1.9%	6%	94%
2008–2009	-0.1%	-0.7%	10%	90%
2009–2011	-0.4%	-2.0%	16%	84%
2011–2012	-0.1%	-1.8%	6%	94%
2012–2013	-0.1%	-0.1%	40%	60%
Total	-1.3%	-12.0%	10%	90%

Source: PNAD, selected years.

Through this decomposition, we conclude that much of the decline in poverty and extreme poverty takes place within the groups themselves. Eighty-seven per cent of the change in extreme poverty and 90 per cent of the change in poverty is due to reductions in poverty levels within each group, not to changes in group size. This is not surprising, as 70 per cent of the population belong to a single group (non-agricultural urban

households). If the preponderance of urban settings is driving the results, perhaps if we analyse only rural or agricultural households we will find that changes in group sizes do, indeed, have significant effects.

We can apply the same techniques considering only the remaining three groups. As such, the population will consist of only three groups. This means that people who migrate to non-agricultural urban activities will simply disappear from our database. However, it is possible to decompose changes in poverty only for agricultural or urban families.

Even so, the results remain consistent. Despite considerable migration between groups, 94 per cent of the decline in extreme poverty and 91 per cent of the decline in poverty is the result of changes within groups, not migration between groups.

TABLE 2

Decomposition of changes in rural and agricultural poverty and extreme poverty

Period	Extreme poverty			
	Composition	Internal	Percentage composition	Percentage internal
2004–2005	-0.2%	-0.8%	22.9%	77.1%
2005–2006	-0.1%	-1.9%	6.6%	93.4%
2006–2007	-0.1%	-0.9%	10.5%	89.5%
2007–2008	-0.1%	-1.6%	3.4%	96.6%
2008–2009	0.0%	-0.3%	8.4%	91.6%
2009–2011	0.0%	-0.3%	-15.3%	115.3%
2011–2012	0.0%	-1.7%	-1.8%	101.8%
2012–2013	0.1%	-0.1%	-192.0%	292.0%
Total	-0.4%	-7.6%	5.2%	94.8%

Period	Poverty			
	Composition	Internal	Percentage composition	Percentage internal
2004–2005	-0.5%	-1.1%	32%	68%
2005–2006	-0.3%	-5.0%	5%	95%
2006–2007	-0.3%	-2.0%	12%	88%
2007–2008	-0.1%	-3.1%	5%	95%
2008–2009	-0.1%	-1.4%	4%	96%
2009–2011	-0.1%	-2.7%	3%	97%
2011–2012	-0.3%	-2.6%	9%	91%
2012–2013	-0.2%	-1.1%	16%	84%
Total	-1.8%	-18.9%	9%	91%

Source: PNAD, selected years.

These figures show that, despite significant migration between groups, most of the changes in poverty are due to changes within the groups. This suggests that pluriactive households are a problem. They boast high poverty rates which are not declining. Agricultural households are also a problem, since they remain the poorest category in the North and Northeast regions. The fact that agricultural households in other regions have achieved the same levels of poverty and extreme poverty as the population as a whole and that poverty has declined faster among them than in any other category suggests that agricultural households are also a solution.

3 CHARACTERISTICS OF THE POOR AND EXTREMELY POOR BETWEEN 2004 AND 2013 BASED ON THE NATIONAL HOUSEHOLD SAMPLE SURVEY (PNAD)

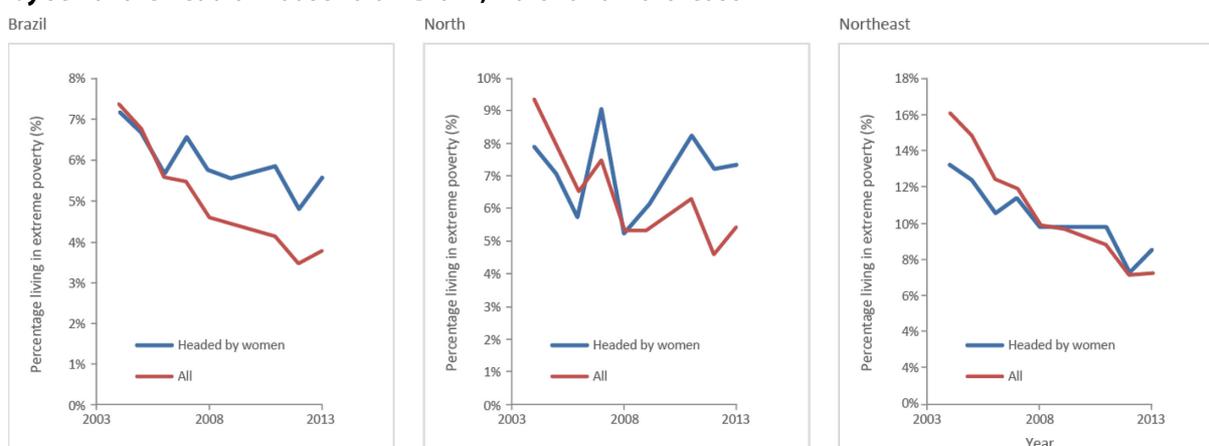
A crucial part of any poverty profile are the characteristics of the poor. This study analyses several tables with demographic data, characteristics of the heads of households, household (private) infrastructure and access to public services (public infrastructure). We will not delve into details about each variable in the following analysis; instead, we shall focus on the most relevant issues. We will compare three years—2004, 2009 and 2013— always using the four demographic categories defined above.

3.1 HEADS OF HOUSEHOLDS, PARTICULARLY HOUSEHOLDS HEADED BY WOMEN

While men and women are, almost by definition, nearly as likely to be living in poverty or extreme poverty (or any other household income group, for that matter), households headed by women comprise a potentially important gender issue. Although much of the literature on the relationship between general income levels and the characteristics of heads of households is ambiguous—there are families headed by women in both the upper and lower income deciles—the information shown in Figure 7 is quite disturbing. It shows that the decline in extreme poverty levels was much more significant in the population as a whole than in households headed by women. Up until 2006, the extreme poverty levels for households headed by women had been the same as for all households, yet from 2007 onwards poverty declined faster among the latter than in households headed by women. This led to an unprecedented feminisation of extreme poverty in Brazil's history (we define feminisation here based on the sex of the head of household).

FIGURE 7

Percentage of households living in extreme poverty (BRL70), by sex of the head of household – Brazil, North and Northeast



Source: PNAD, selected years.

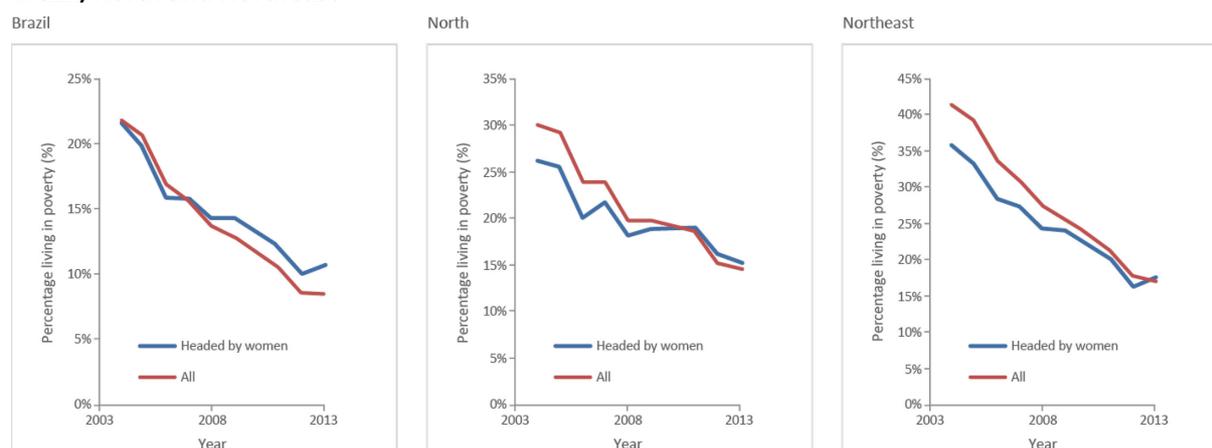
When analysing each region separately, we come across much sampling noise in the North; even so, the results for Brazil seem to apply to this region as well. In the Northeast, the levels of extreme poverty are relatively similar, both in households headed by women

and in all households. In other words, the feminisation of poverty seems to be a phenomenon more prevalent in the other regions of Brazil than in the Northeast.

When analysing poverty (BRL140), we conclude that the feminisation effect does exist but is much less pronounced. In fact, at the end of the period, the poverty levels in the North and Northeast regions seem to be practically the same for households headed by women as for all households.

FIGURE 8

Percentage of households living in poverty (BRL140), by sex of the head of household – Brazil, North and Northeast



Source: PNAD, selected years.

What could be happening? At a time with so many policies geared towards gender equality, why are households headed by women increasingly over-represented in extreme poverty? An assessment of what happens in each population group we have been working with sheds some light on this issue.

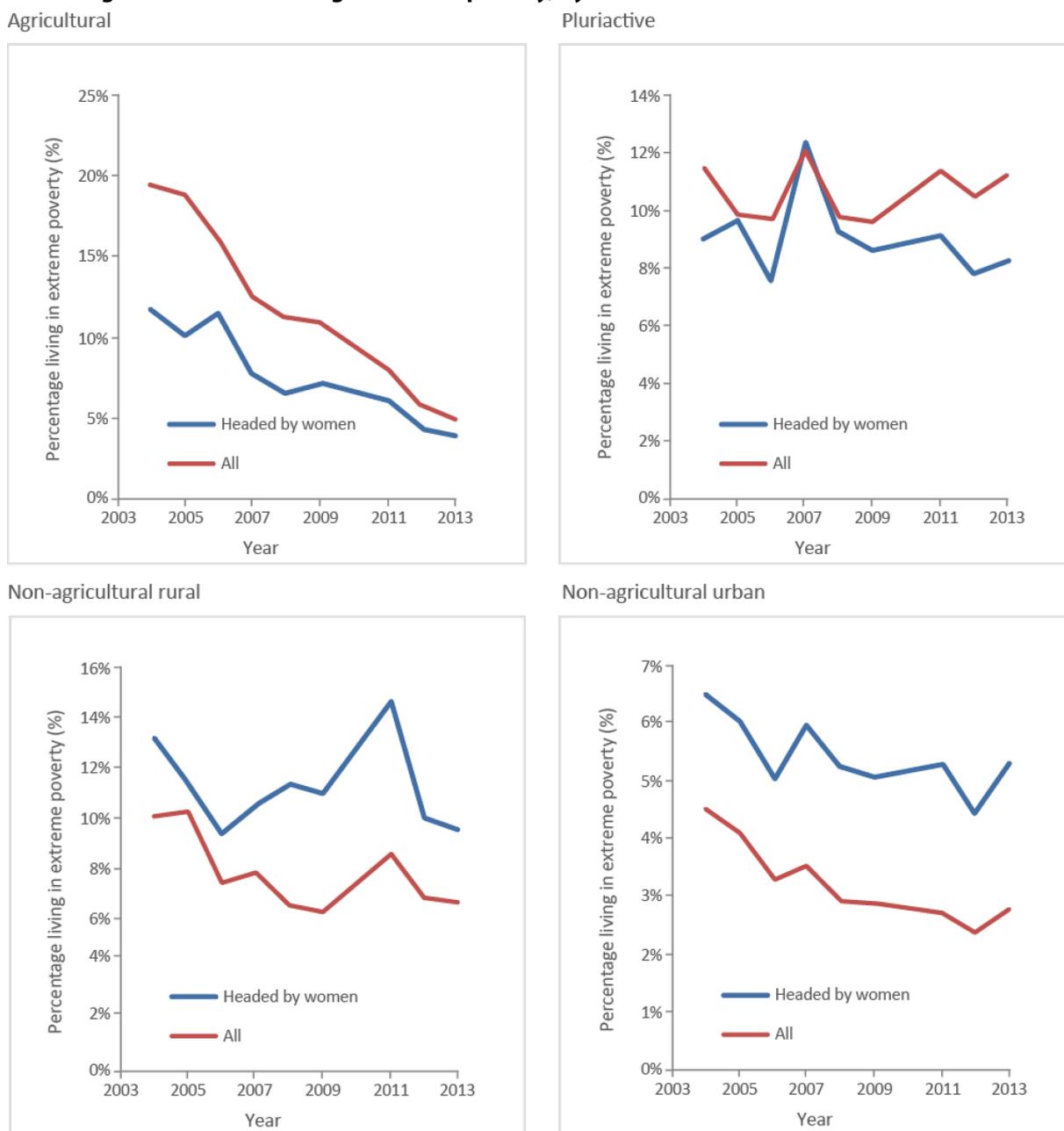
The four panels of Figure 9 show dynamics relevant to all four groups. In 2013, extreme poverty among agricultural households headed by women converged to almost the same level as for all households; in that year, female-headed households showed greatly reduced poverty levels.

Among non-agricultural rural households, extreme poverty is higher—and rising steadily—for households headed by women. Among non-agricultural urban households, extreme poverty has also been higher than for those headed by women and has increased over time. Changes in the population structure with net migration from agricultural households to urban non-agricultural ones alone would lead to the feminisation of poverty.

The only moderating influence has been a growing gap in favour of female-headed households among pluriactive households.

FIGURE 9

Percentage of households living in extreme poverty, by sex of the head of household – Brazil



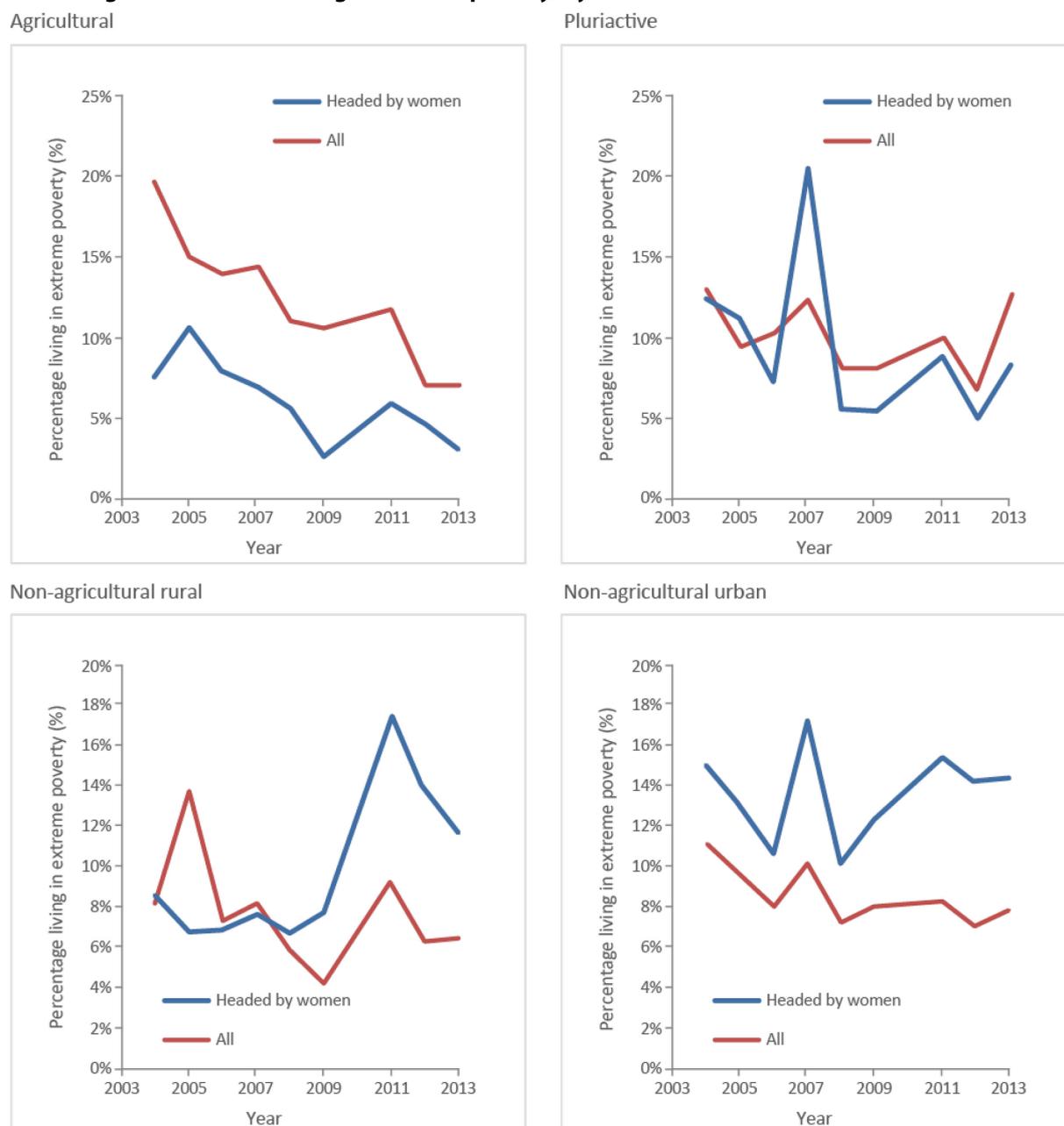
Source: PNAD, selected years.

Essentially, this analysis shows that the feminisation of extreme poverty appears to be a result of migration to urban areas and a reduction in the advantage of female-headed households among agricultural households.

Do these results also apply to the North region? In the North, the landscape is relatively similar. Despite the sampling noise, the same factors are at play from a qualitative perspective. The Northeast has not shown a significant degree of feminisation of extreme poverty, so those graphs will not be included in this study.

FIGURE 10

Percentage of households living in extreme poverty, by sex of the head of household – North



Source: PNAD, selected years.

In summary, although there is no evidence of an increase in the relative poverty of households headed by women compared to other families both in the North and in the Northeast regions, the same cannot be said of extreme poverty. Between 2003 and 2013, there was an increase in the relative poverty of households headed by women in the North. However, we must highlight that we did not observe a feminisation of extreme poverty in the Northeast of Brazil.

3.2 YOUTH

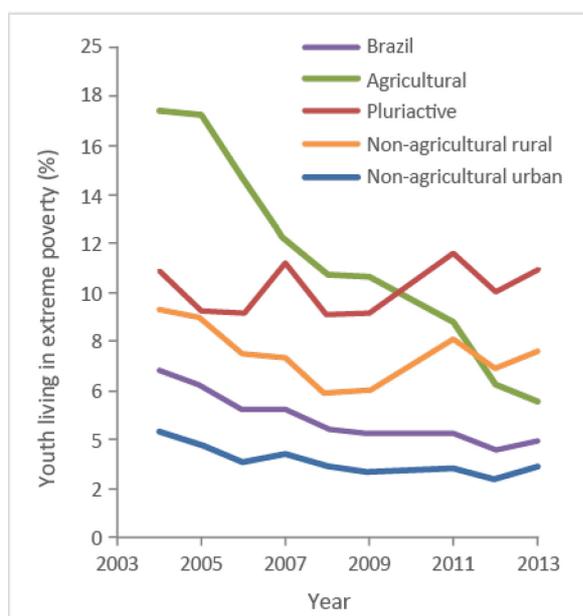
The insertion of youth into the economic system is a global problem; when we look at rural poverty, however, young people do not seem to be more vulnerable than any other group.

Figure 11 shows that the evolution of extreme poverty among young people is very similar to that of the general population. Extreme poverty has declined sharply among agricultural households and non-agricultural urban households and remained stable in pluriactive and non-agricultural rural households. Moreover, the graph for non-extreme poverty among young people is also very similar to that for the general population.

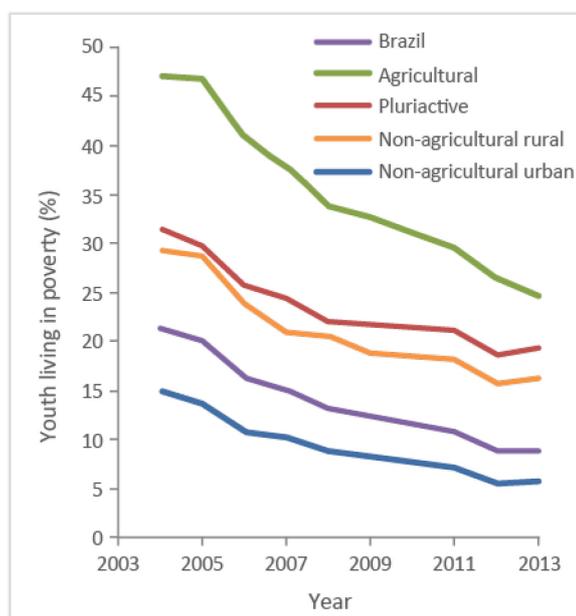
FIGURE 11

Percentage of youth living in poverty and extreme poverty in Brazil

Youth in extreme poverty



Youth in poverty



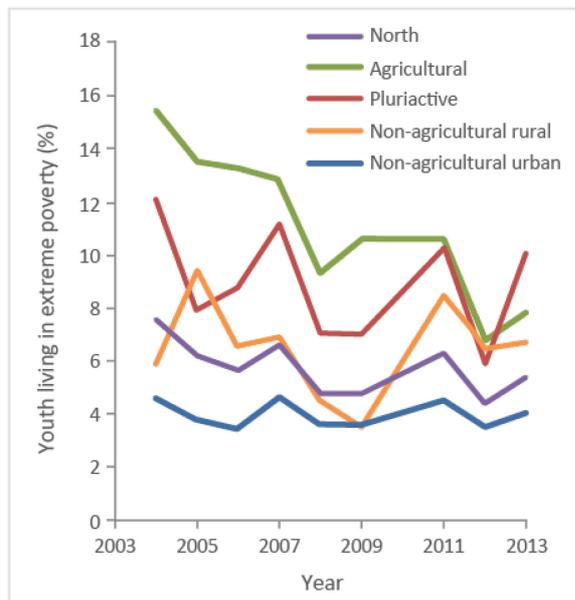
Source: PNAD, selected years.

What do poverty and extreme poverty among young people look like in the North and Northeast?

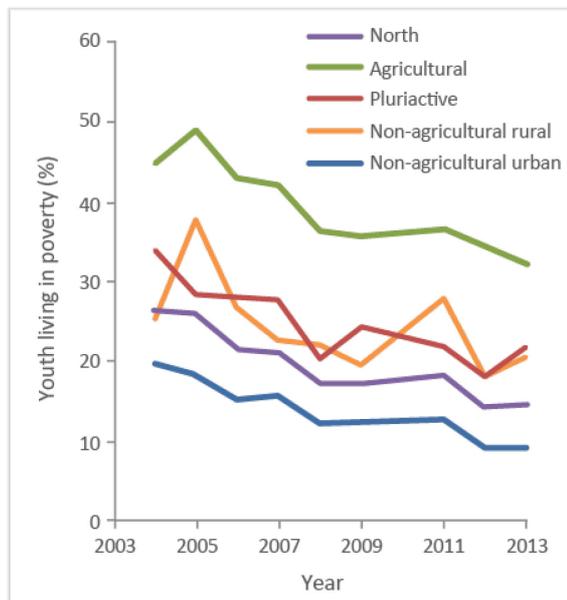
FIGURE 12

Percentage of youth living in poverty and extreme poverty – North and Northeast

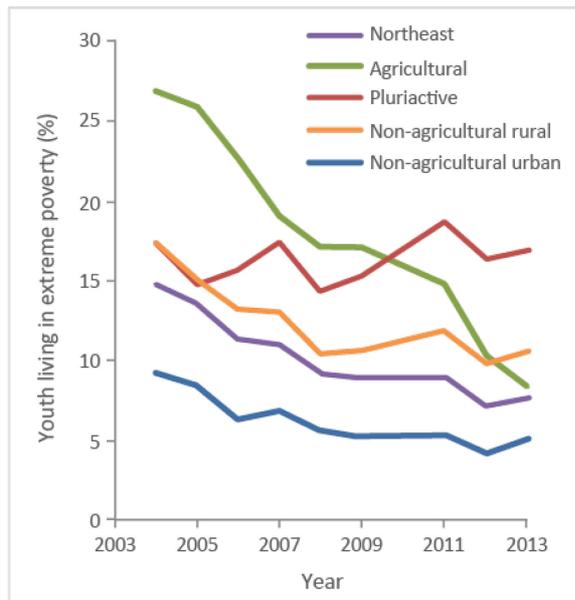
Extreme poverty in the North



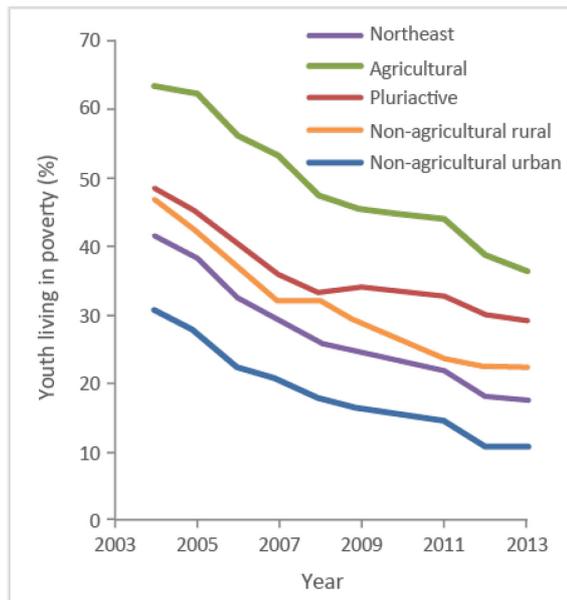
Poverty in the North



Extreme poverty in the Northeast



Poverty in the Northeast



Source: PNAD, selected years.

In the North, the figures begin to get noisy due to the small sample size, but overall the trends are the same as for general poverty. For the Northeast, again, the same analysis applies. The behaviour of poverty and extreme poverty among young people is the same as among the Brazilian population as a whole.

The fact that there are no significant differences in the evolution of poverty and extreme poverty when comparing youth and the general population does not mean that there are no important specificities for young people in the North and Northeast; it just means that they are not directly related to poverty. Young people face significant unemployment problems that highlight the difficulties faced by the economic system in quickly integrating them. Young people face important challenges in education, as the school system has not been able to keep pace with changes in connectivity. As a group, young people are notoriously at risk of certain criminal behaviours. All these issues are important challenges for public policies aimed at the youth but are not directly linked to the *status* of poverty as defined by the poverty lines used here.

3.3 HOUSEHOLD (PRIVATE) INFRASTRUCTURE AND ACCESS TO PUBLIC SERVICES (PUBLIC INFRASTRUCTURE)

We know that defining poverty purely in terms of income fails to account for all that poor people lack. As shown in Figure 13, there are still challenges, both in terms of the Brazilian population's access to certain goods—such as refrigerators and computers—as well as access to public infrastructure services such as sewage and piped water.

We calculated considerably more indicators than will be shown in this section: a total of four public infrastructure indicators and nine private infrastructure indicators. Many of them—such as access to electricity or stove ownership—were nearly universal in Brazil even in 2004. Basically, two public infrastructure indicators and two private infrastructure indicators showed the biggest changes in terms of the population's access to them. However, access to sewage—one of the 'more dynamic' indicators—has changed very slowly.

Figure 13.1 shows the percentage of households with access to public and private infrastructure (sewage, piped water, refrigerator, computer) in **2004**, **2009** and **2013**. Figures 13.2 and 13.3 show the figures for the North and Northeast regions, respectively.

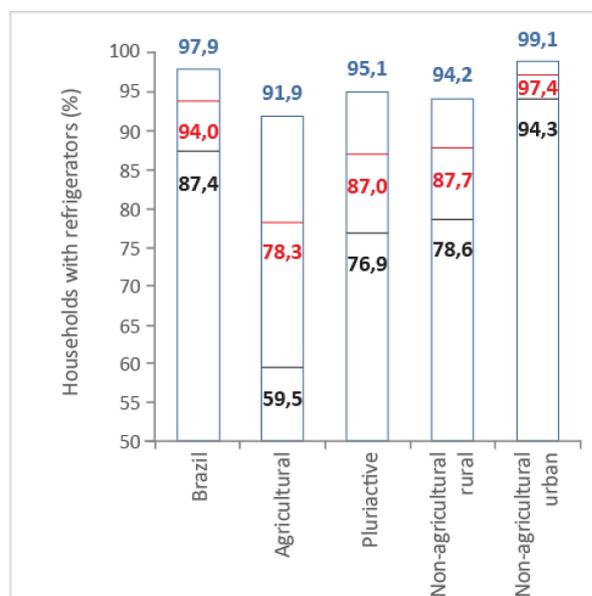
The increase in the population's access to private infrastructure greatly surpasses the increase in access to public infrastructure. Specifically, universal sewage coverage—either by pipe or by means of a septic tank—remains a challenge. The population's access to piped water has progressed more than its access to sewage.

The same pattern holds true in the North: over time, there have been more significant increases in access to private household infrastructure than in access to public infrastructure, with particularly serious deficiencies in the population's access to sanitation. Between 2004 and 2013, the proportion of agricultural households with refrigerators increased from 42 per cent to 78 per cent, while their access to sewage rose from 20 per cent to 26 per cent. The remaining household types demonstrate similar trends, although with greater access to infrastructure—both private and public—than agricultural households.

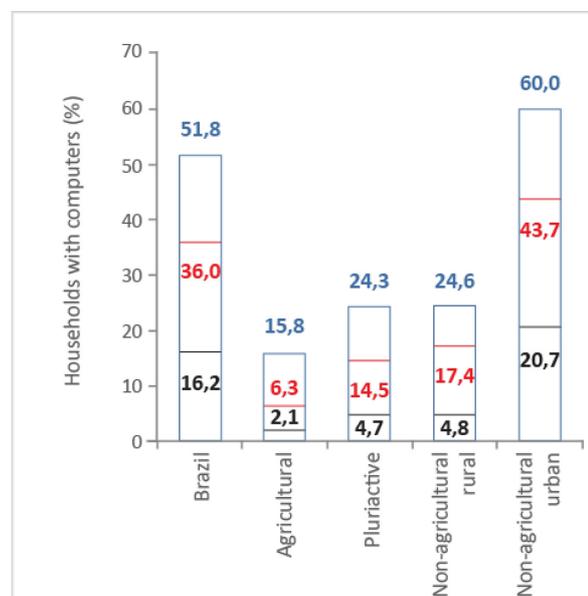
FIGURE 13.1

Public and household infrastructure in Brazil, 2004, 2009 and 2013

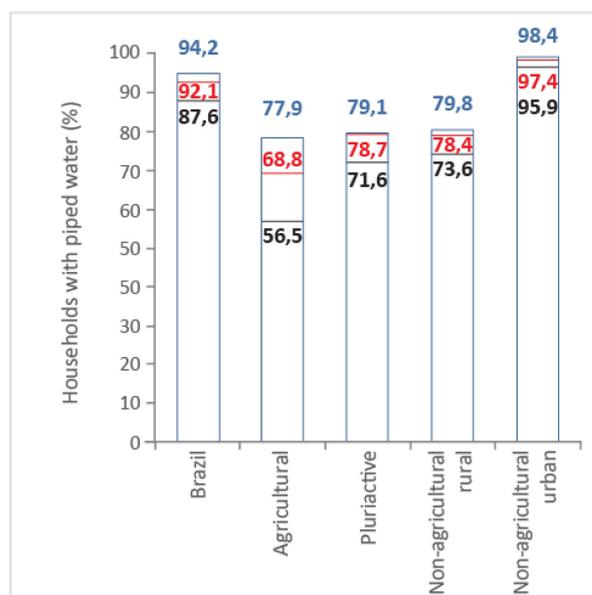
Refrigerator



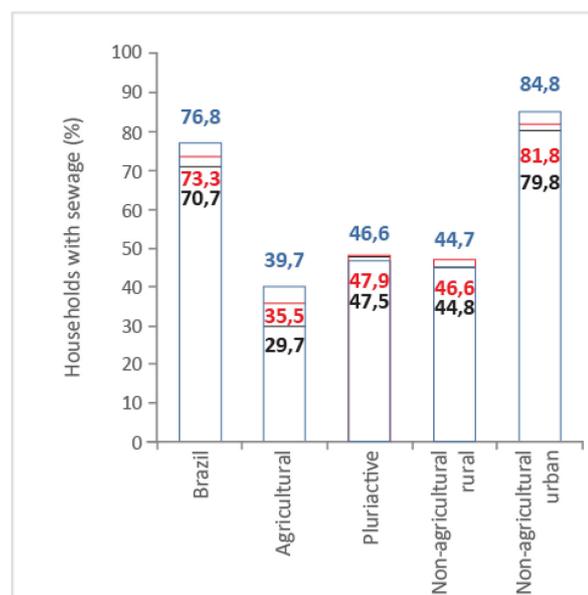
Computer



Piped water



Sewage

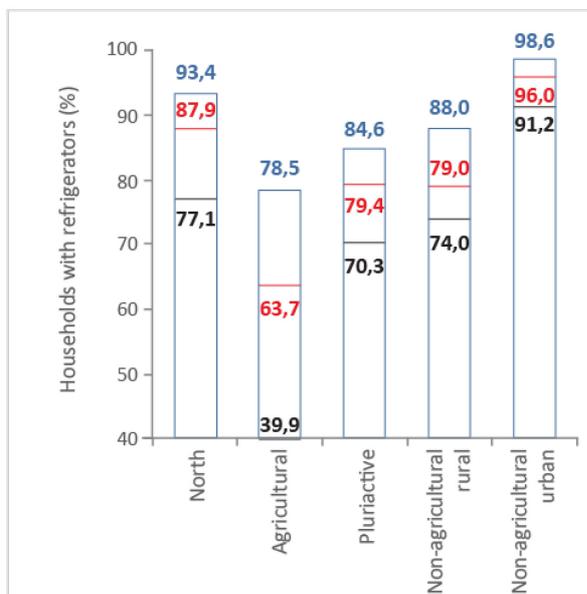


Source: PNAD, selected years.

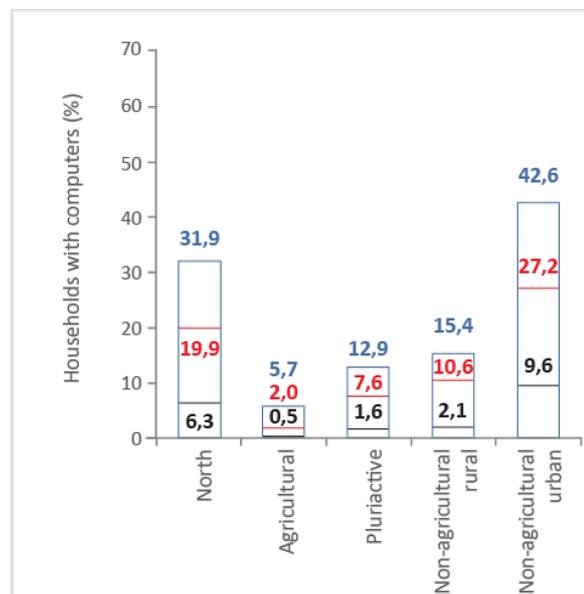
FIGURE 13.2

Public and household infrastructure in the North, 2004, 2009 and 2013

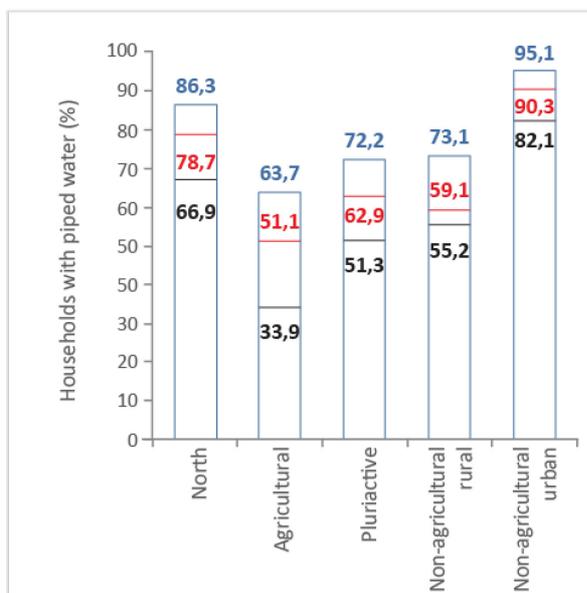
Refrigerator



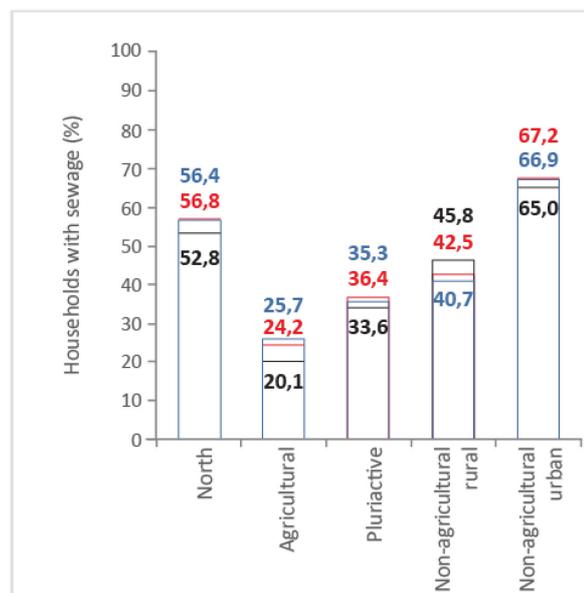
Computer



Piped water



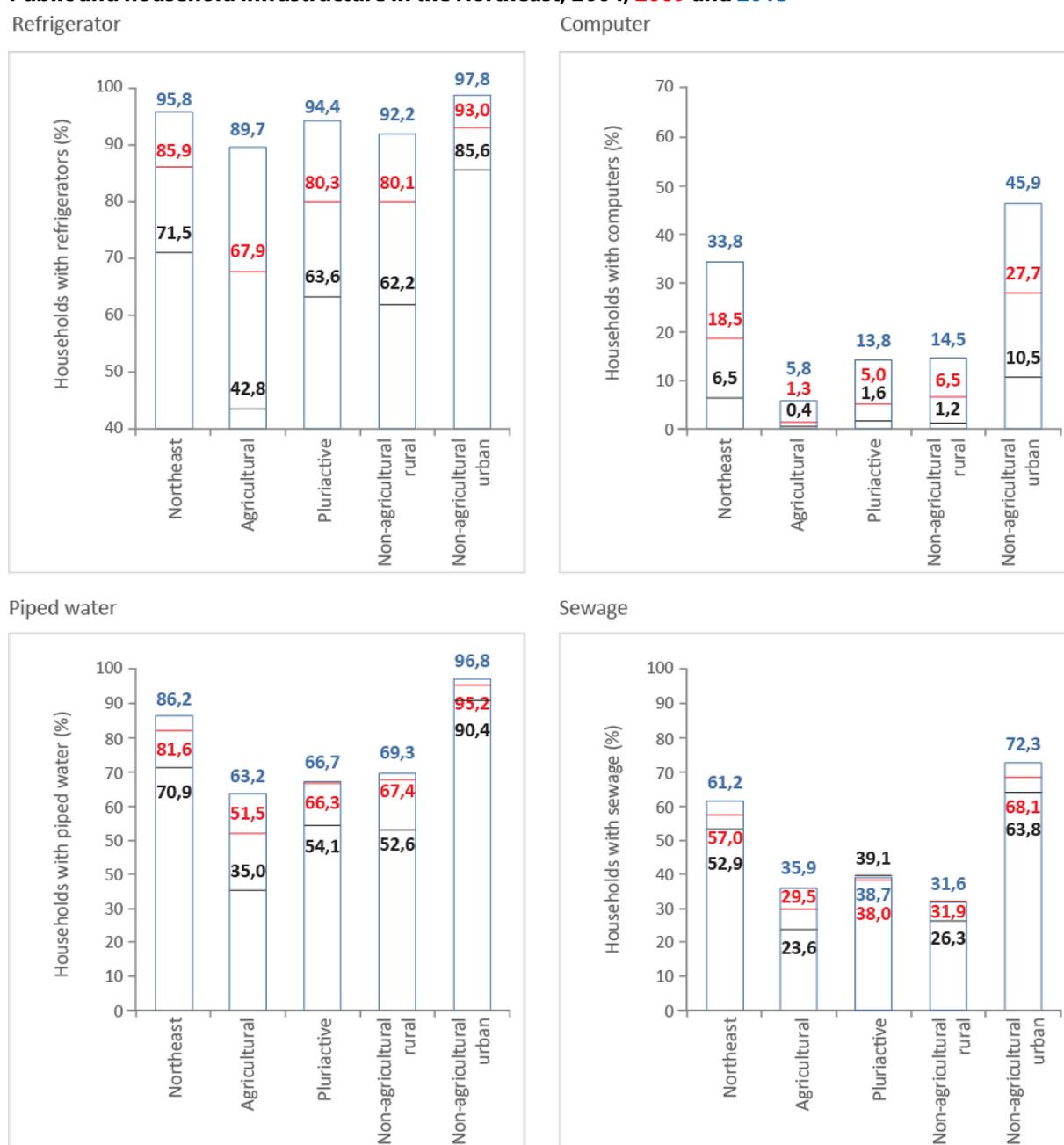
Sewage



Source: PNAD, selected years.

Results were better in the Northeast. This region boasts greater access to public infrastructure than the North, probably because governments in the Northeast do not have to cover the vast distances that governments in the North have to cover. The Northeast also boasts other advances in addition to greater access to public infrastructure. The access of agricultural households to sewage increased from 24 per cent to 36 per cent between 2004 and 2013, placing the Northeast 10 percentage points ahead of the North, which is a relatively richer region. Among urban households, access is at 72 per cent, against 67 per cent in the North. Even so, coverage rates as low as 36 per cent for agricultural households and 72 per cent for urban households are unacceptable for public services.

FIGURE 13.3

Public and household infrastructure in the Northeast, 2004, 2009 and 2013

Source: PNAD, selected years.

The increase in access to private infrastructure in the Northeast is close to the increase seen in the North. In terms of refrigerator ownership, 89 per cent of households in the Northeast own at least one refrigerator; in the North, this percentage is 78 per cent, and in Brazil as a whole, 92 per cent. This difference is slightly larger than the income gap between the regions.

The main conclusion is that access to infrastructure—both public and private—is extremely relevant to people living in poverty and extreme poverty; therefore, access to infrastructure must be prioritised.

3.4 AGRICULTURAL AND PLURIACTIVE HOUSEHOLDS ACCORDING TO THE OCCUPATION OF ITS MEMBERS

In this section, agricultural and pluriactive households are broken down into four categories according to the occupation of their members:

- households with at least one employer;
- those with at least one self-employed individual;
- those with at least one wage-earning employee; and
- households with other types of occupation.

According to this breakdown, agricultural households are divided into three categories (households with an employer; those with a self-employed individual; and those with an employed wage earner), whereas pluriactive households are divided into four categories (households with an employer; those with a self-employed individual; those with an employed wage earner; and households with other types of occupations).

Note that if there is an employer in a given household, for example, it does not preclude the possibility of an employee also living in the same household. As such, we can analyse both the incidence of poverty as well as the main problems that cause it, taking into account, in a sense, the *status* of occupations existent in households engaged in agricultural activities. This analysis is important because one might expect that residents of households with employers would enjoy better socio-economic conditions than those in households without employers, for example. As in the rest of this poverty profile, we must note that our units of analysis are the individuals who reside in these households—and not the households *per se*.

Figure 14 shows the evolution of the incidence of poverty between 2004 and 2013 among residents in agricultural and pluriactive households and their occupational subgroups for Brazil as a whole and for the North and Northeast regions. We did not analyse households with employers for two reasons. This group accounts for an extremely low proportion of the population living in both agricultural and pluriactive households in Brazil (3.23 per cent and 1.83 per cent, respectively), and the incidence of poverty in this group is almost residual.

Figure 14 shows that the decrease in the incidence of poverty among agricultural households (Figures 14.A, 14.C and 14.E) was marked by a greater reduction in poverty for agricultural households with employed wage earners than for households with self-employed individuals. This happened in both the North and Northeast regions. The same situation occurs when we compare pluriactive households with self-employed individuals with those with employees. When analysing the pluriactive households (Figures 14.B, 14.D and 14.F), however, we must highlight the category of households whose members hold other types of occupation (i.e. those who are not employers, self-employed individuals or employees). This is the group that saw the least amount of poverty reduction between 2004 and 2013. To mention one example, while poverty among pluriactive households with employees in the Northeast fell from 47 per cent in 2004 to 10.1 per cent in 2013, among households with other types of occupation the decline was much less significant during the same period (from 57.5 per cent to 41.2 per cent).

FIGURE 14

Percentage of the population living in agricultural and pluriactive households who are poor – Brazil and the North and Northeast regions, 2004–2013

Figure 14.A – Agricultural households – Brazil

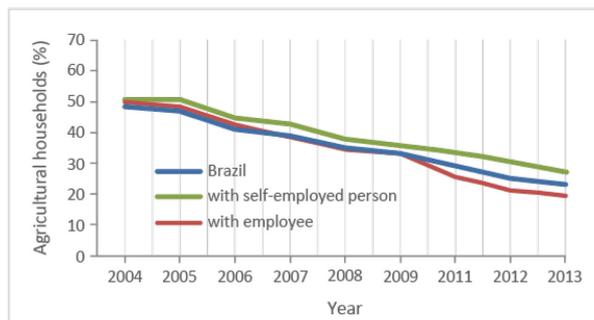


Figure 14.B – Pluriactive households – Brazil

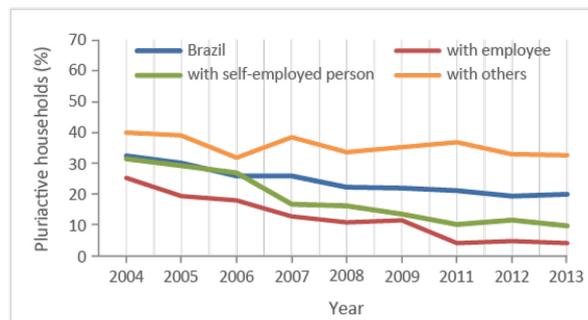


Figure 14.C – Agricultural households – North

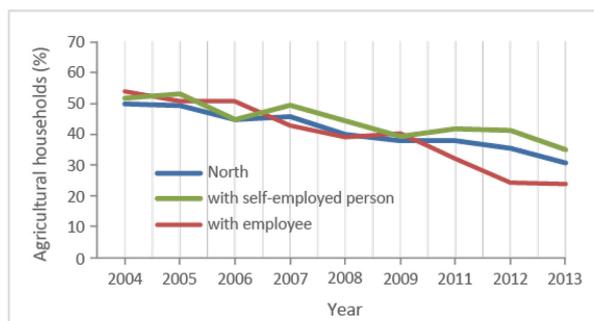


Figure 14.D – Pluriactive households – North

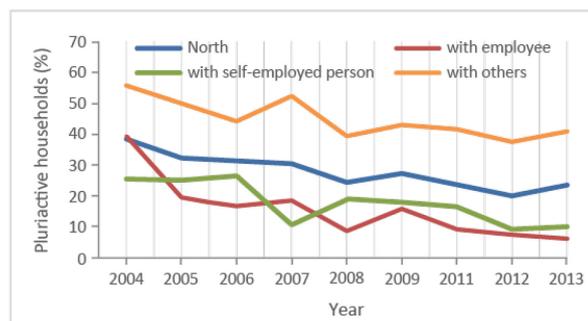


Figure 14.E – Agricultural households – Northeast

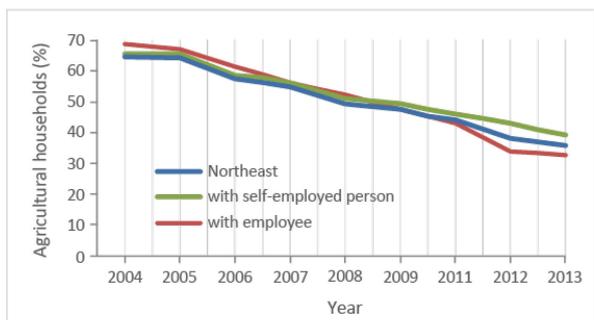
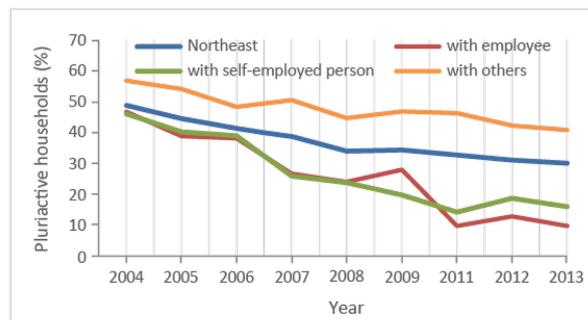


Figure 14.F – Pluriactive households – Northeast



Source: PNAD, 2004 to 2013.

Figure 15 shows the evolution of the incidence of extreme poverty between 2004 and 2013 for residents in agricultural and pluriactive households and their occupational subgroups for Brazil as a whole and in the North and Northeast regions.

FIGURE 15

Percentage of the population living in agricultural and pluriactive households who are extremely poor – Brazil and the North and Northeast regions, 2004–2013

Figure 15.A – Agricultural households – Brazil

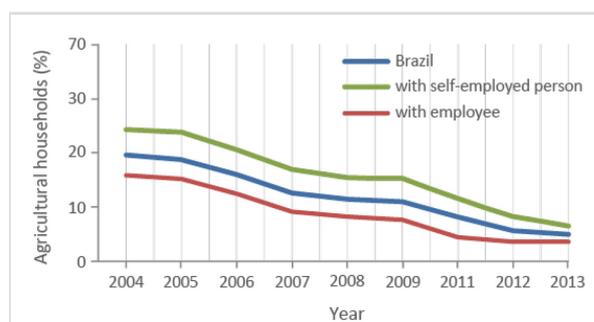


Figure 15.B – Pluriactive households – Brazil

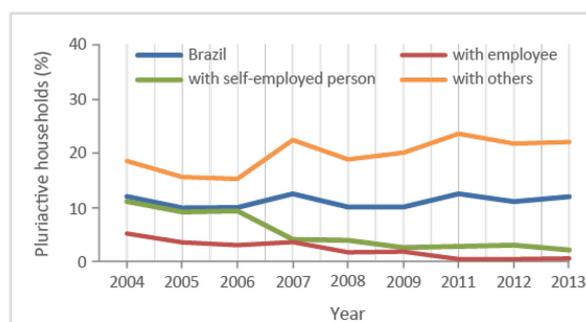


Figure 15.C – Agricultural households – North

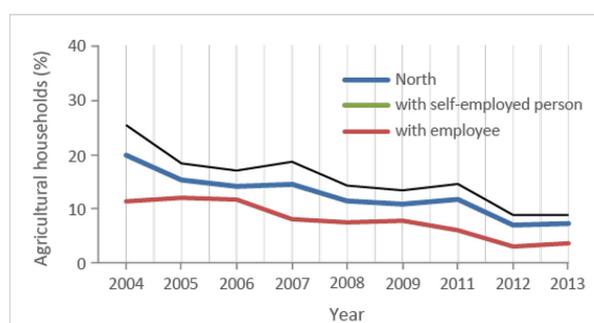


Figure 15.D – Pluriactive households – North

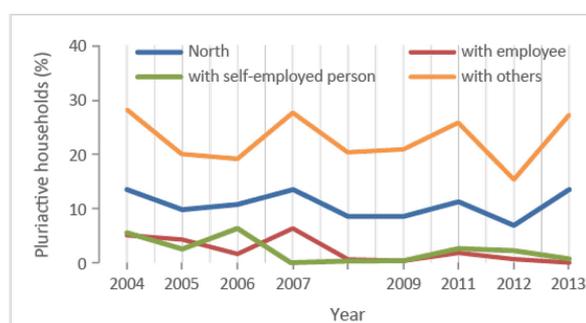


Figure 15.E – Agricultural households – Northeast

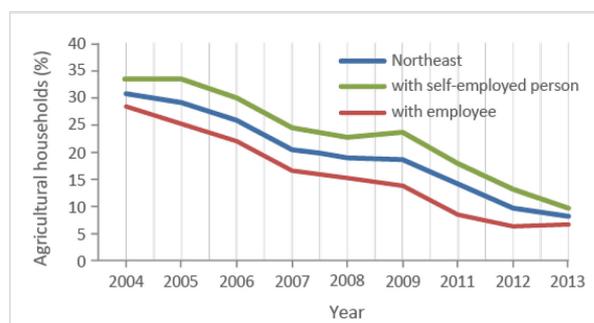
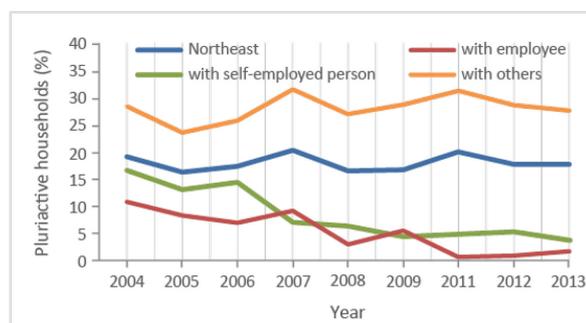


Figure 15.F – Pluriactive households – Northeast



Source: PNAD, 2004 to 2013.

The group of pluriactive households in the 'other' category stands out in the analysis of extreme poverty. This is the only group in which the incidence of extreme poverty not only fails to decline but even shows an upward trend for Brazil as a whole. In the North and Northeast regions between 2004 and 2013 the proportion of individuals living in pluriactive households with other types of occupations (who are not employers, self-employed individuals or employees) who were poor remained almost constant, at around 27 per cent and 28 per cent, respectively, of the population.

FIGURE 16

Agricultural households (all and those living in extreme poverty) according to their main challenges – Brazil and North and Northeast regions, 2004 and 2013

Figure 16.A – Brazil

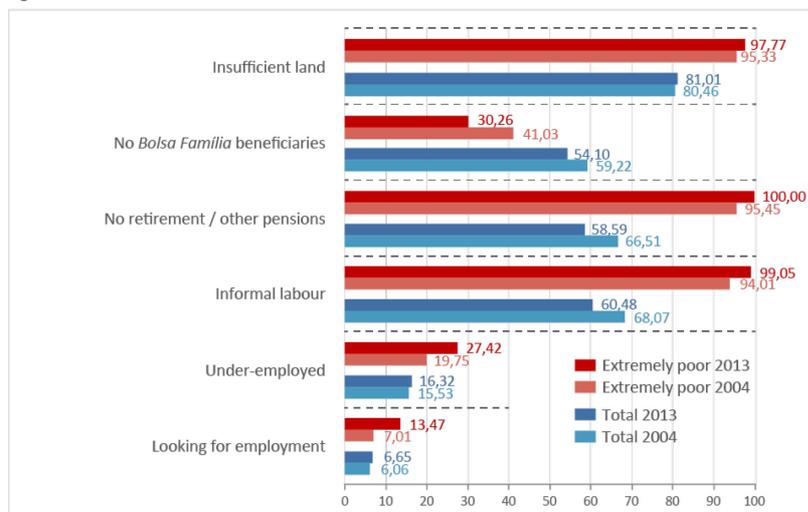


Figure 16.B – North

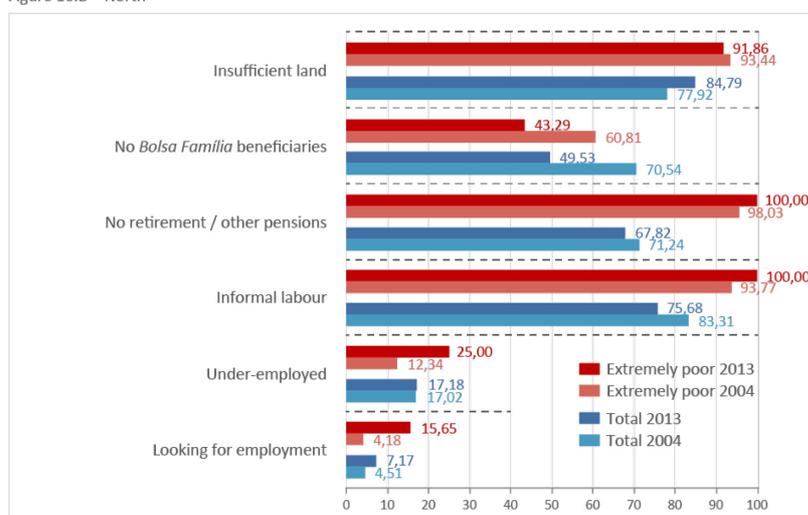
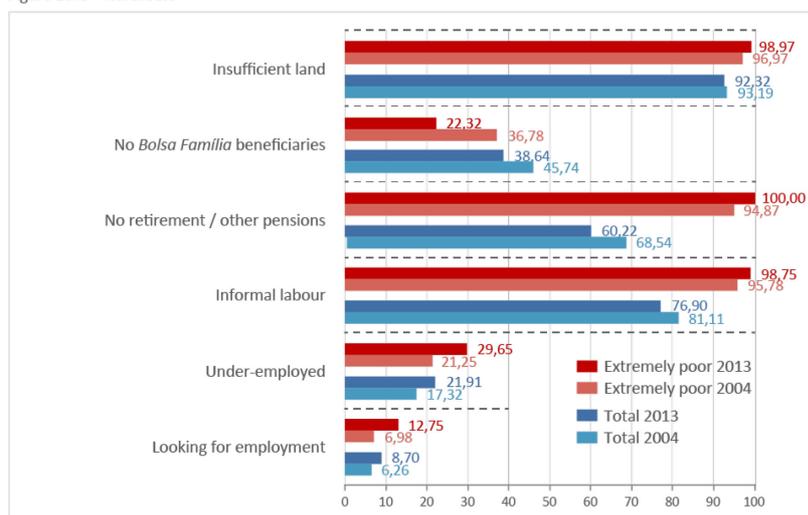


Figure 16.C – Northeast



Source: PNAD, 2004 to 2013.

To better describe the characteristics of poverty, we must briefly characterise the residents in agricultural households who are considered extremely poor according to variables that define their main needs. These variables are: 1) percentage of people living in households with insufficient land (area is smaller than the average Fiscal Module of the State); 2) percentage of people living in households with no beneficiaries of the *Bolsa Família* programme; 3) percentage of people living in households with one or more elderly individual but where no one receives retirement or other pensions from the Federal Government; 4) percentage of people without signed Employment Cards (informal work); 5) percentage economically active persons seeking employment during the reference week.

Figure 16 shows that a lack of access to land is a widespread issue in Brazil: more than three quarters of the population live in agricultural households with land considered insufficient (approximately 81 per cent in both 2004 and 2013). Between 2004 and 2013, there was a decline in the proportion of people living in households without *Bolsa Família* beneficiaries (from 41 per cent to 30 per cent). In the Northeast, this decline was even greater: from 37 per cent to 22 per cent, consistent with the programme's high rate of coverage in the region. Only for households living in extreme poverty is there an increase in the proportion of people living in households with elderly individuals without retirement and/or other pensions; for the total population living in agricultural households, this figure shows a decrease in both regions. This, combined with the high rate of coverage of *Bolsa Família*, may indicate that more is needed in addition to *Bolsa Família* benefits to lift households out of extreme poverty.

Informal labour declined among residents in agricultural households in Brazil (although labour informality remains high: 60.5 per cent in 2013). Among those living in extreme poverty, however, the level of informality is increasing (nearly all of them—99 per cent—worked in the informal market in 2013). With regard to underemployment (people working fewer than 20 hours a week) and the search for employment, once again the extremely poor population in agricultural households is overrepresented. In 2013, 17 per cent of residents in agricultural households were underemployed. This proportion rises to 25 per cent in the case of those living in extreme poverty. The members of extremely poor households are also the people who most sought employment in 2013: 15.7 per cent of them, compared to 7.2 per cent of the total population living in agricultural households.

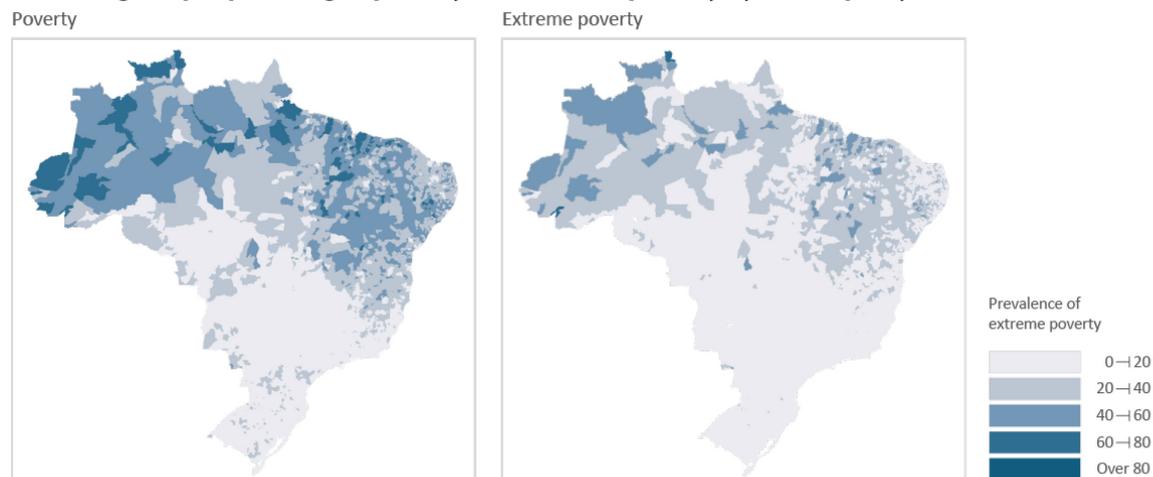
4 POVERTY AND EXTREME POVERTY AT THE MUNICIPAL LEVEL BASED ON THE 2010 CENSUS

When dealing with thousands of municipalities, few tools are as useful and convincing as poverty maps. Colour-coded maps can convey a far more satisfactory idea of where poor households are located than tables or graphs.

Figure 17 clearly shows that poverty is essentially a problem of the North and Northeast regions. Few municipalities in the other three regions of Brazil show poverty rates higher than 30 per cent (5.5 per cent of the municipalities located in the South, Southeast and Centre-West regions), and many have rates lower than 15 per cent (about 26 per cent of these municipalities). On the other hand, in the North and Northeast regions most municipalities show rates above 30 per cent (67 per cent and 86 per cent of municipalities, respectively).

FIGURE 17

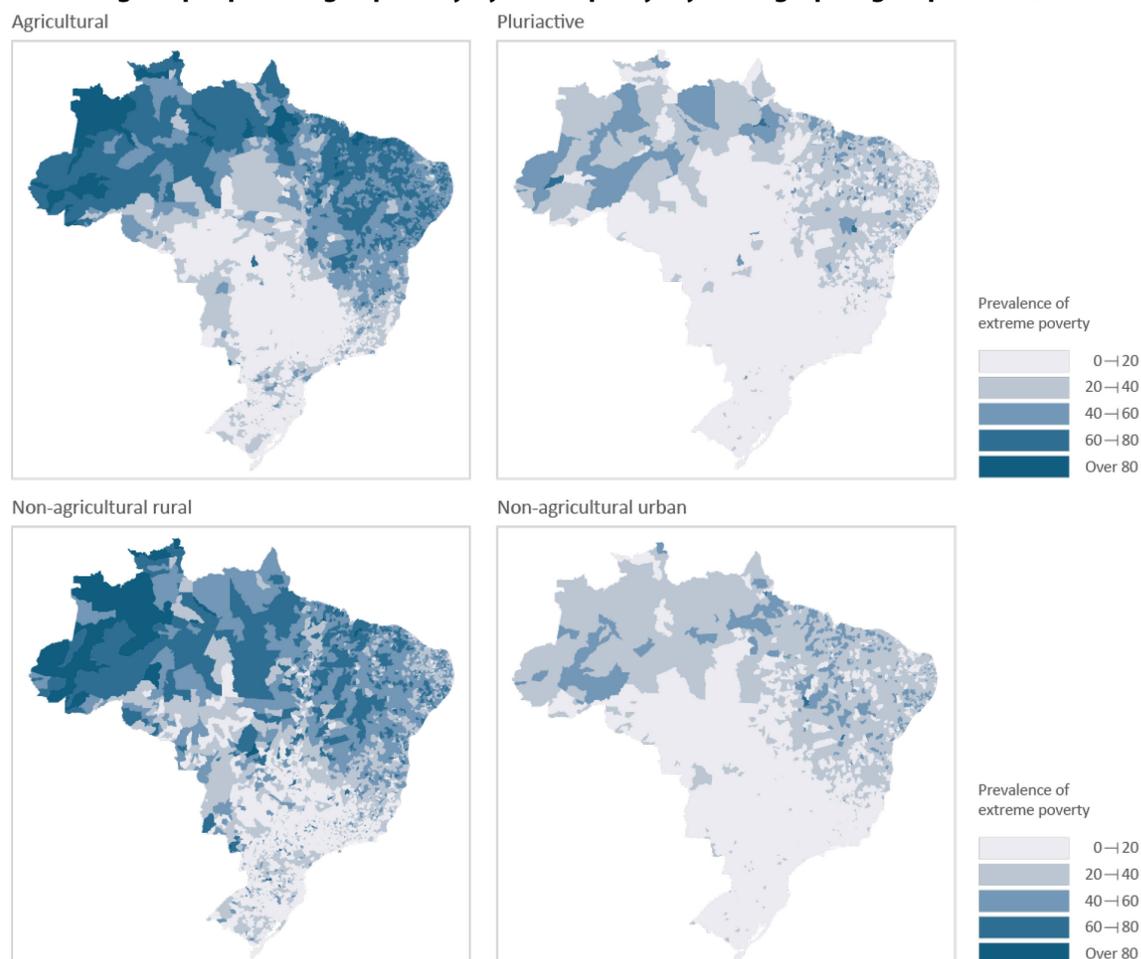
Percentage of people living in poverty and extreme poverty by municipality – Brazil, 2010



Source: Population census 2010.

FIGURE 18

Percentage of people living in poverty by municipality, by demographic group – Brazil, 2010



Source: Population census 2010.

In the North and Northeast, however, the situation is quite different. Many municipalities show poverty rates higher than 60 per cent; in some municipalities they may be as high as 90 per cent. This can be seen in the areas of the map coloured in darker blue in the North and Northeast. Especially notable are the very poor areas in the northwest of the North and the northwest of the Northeast. These are the poorest of the poor areas.

The story of extreme poverty is essentially the same as the story of poverty. The North and Northeast see much more extreme poverty, and the northwest parts of these two regions contain the highest numbers of extremely poor households.

When we analyse the rural dimension, we observe that the differences are even more pronounced in certain cases. The maps show that the differences are very pronounced among agricultural households. The dark blue area in the western Amazon is especially alarming. The state of Maranhão, in the northwest of the Northeast, also shows very high levels of agricultural poverty.

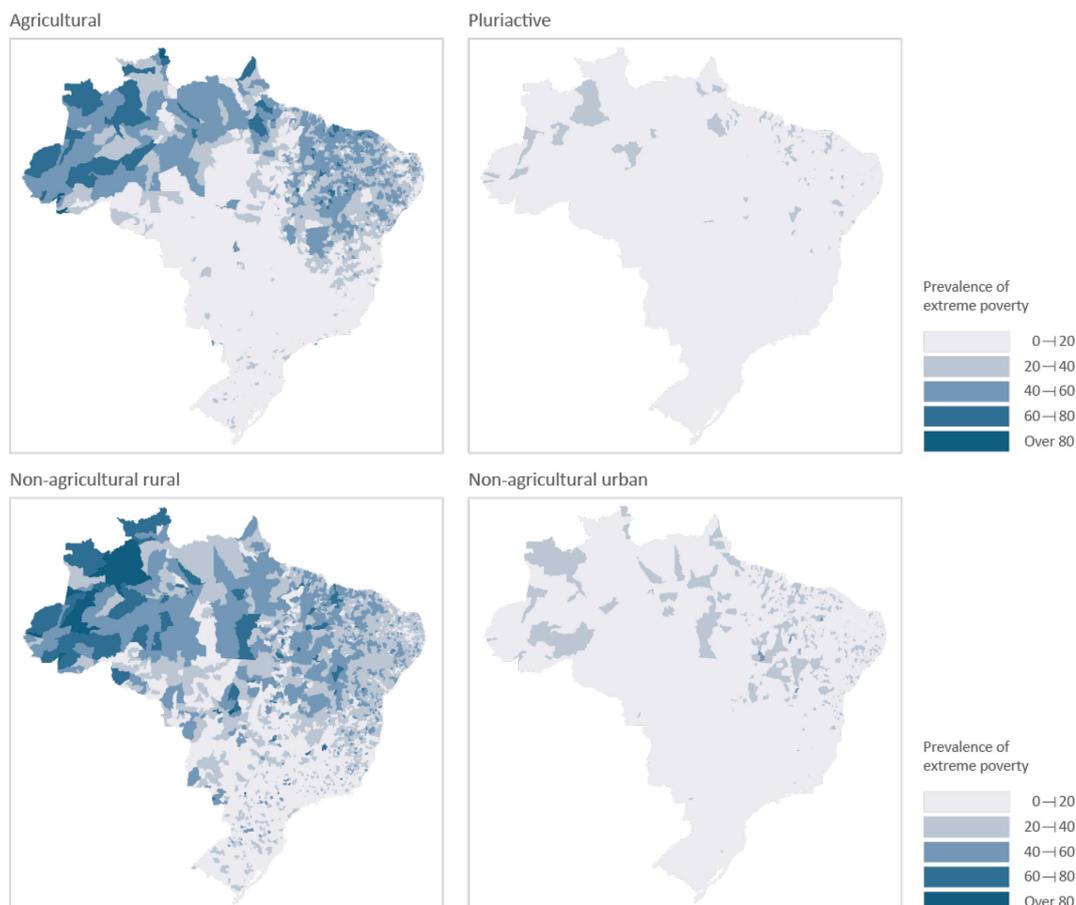
The differences within non-agricultural households are less significant, although they do exist. Of special note is the fact that the differences are much smaller among non-agricultural rural households. Poverty levels of agricultural households in the South and Centre-West are closer to those in the North and Northeast than for other types of households.

Finally, what do the extreme poverty maps look like?

FIGURE 19

Percentage of people living in extreme poverty by municipality, by demographic group – Brazil, 2010

FIGURE 19 - Percentage of people living in extreme poverty by municipality, by demographic group – Brazil, 2010



Source: Population census 2010.

The extreme poverty maps have lighter shades. This is not surprising, since the extreme poverty line is lower, which means that the proportion of extremely poor individuals will always be lower. Disregarding this fact, the main results remain: there are marked differences among agricultural households and greater regional homogeneity in pluriactive and non-agricultural urban households.

These maps clearly show that the problem of rural poverty in Brazil is largely a problem of agricultural households in the North and Northeast. In this sense, it is also important to look into the differences in family farming between the North and Northeast regions and in comparison with the rest of Brazil. We used the information available from the 2006 Census of Agriculture to do so.

So far, this study leads us to the following conclusions: 1) much of the decline in rural poverty is due to the decline in poverty among agricultural households; 2) there are marked differences—both in poverty and in extreme poverty—between the North and Northeast and the other regions of the country; and 3) nowhere are the differences as striking as in agricultural households.

These three findings demonstrate that investing in family farming is of paramount importance to reducing extreme poverty. Figures 1 and 2 show that it can be done, and Figures 18 and 19 show how relevant this is to reducing the differences in poverty rates between regions.

Figure 20 shows what the information available from the 2006 Census of Agriculture tells us about the differences in family farming between the North and Northeast and the rest of Brazil.

FIGURE 20

Capitalisation indicators for family farming establishments – Brazil, 2006

Figure 20.A – Percentage of establishments with funding

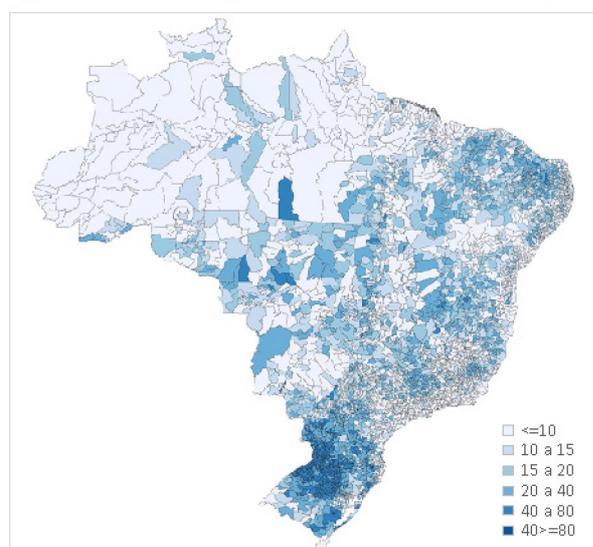
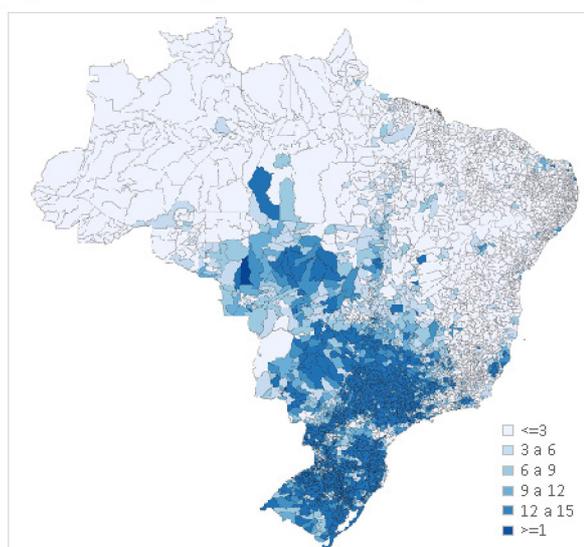


Figure 20.B – Average number of tractors per establishment



Source: 2006 Agricultural Census.

Family farming is undercapitalised in the North and Northeast regions. Figure 20 shows two indicators of capital in agriculture: the percentage of family farming establishments with funding (20.A) and the average number of tractors per family farming establishment (20.B).

These two maps are like mirror images of Figures 18.A and 19.A, which show the rates of poverty and extreme poverty among agricultural households.

In other words, both maps show the importance of capitalising family farming. Although correlation certainly does not imply causation, Figures 20.A and 20.B highlight the enormous importance of capitalising family farming.

4.1 SPATIAL CONGLOMERATES OF POVERTY AND EXTREME POVERTY IN AGRICULTURAL AND RURAL HOUSEHOLDS IN THE NORTH AND NORTHEAST

As we have seen, poverty and extreme poverty in Brazil are markedly more intense in the North and Northeast regions. Based on data from the 2010 census, just over 11 million (about 65 per cent) of the nearly 17 million Brazilians living in extreme poverty (monthly household income per capita below BRL70) live in the North or the Northeast, causing the extreme poverty rate (proportion of people living below the extreme poverty line) in this region to reach 16 per cent, compared to 3 per cent in the South, 5 per cent in the Southeast and about 9 per cent nationwide.

Also of note is the fact that just over 6.5 million (60 per cent) of the 11 million people living below the extreme poverty line in these regions live in households classified as agricultural or non-agricultural households located in rural areas. The rate of extreme poverty in these types of household is 28 per cent, compared to 16 per cent for all households in the region. Similar trends may be observed in the distribution of poor people (monthly household income per capita below BRL140) among these strata of production and/or household status. This highlights the importance of this group of households to the poverty observed in the North and Northeast regions.

Given these observations, the work documented here focuses mainly on families who carry out agricultural activities (the households previously defined as agricultural households and pluriactive households are taken together in the analysis of this section) and non-agricultural households in rural areas. More specifically, the main objective is to describe the spatial distribution of the incidence of poverty and extreme poverty in these strata and to investigate the existence of poverty conglomerates—contiguous sets of municipalities where the rate is higher than in other regions.

The importance of this effort lies in the rationale that the existence of spatial conglomerates (clusters) of a given phenomenon is most likely associated with local causes of various types. This effort was also important for identifying priority regions for implementing public policies that are easy to disseminate to neighbouring municipalities while taking into account the social, political, economic and geographical characteristics of each region.

Research on spatial conglomerates of poverty is nothing new. Collado (2004) uses Kulldorff's scan statistic (1997) to detect poverty conglomerates in Costa Rica. Amarasinghe et al. (2005) conducted a study to detect poverty clusters in Sri Lanka. Medeiros and Neto (2010) use 2010 census data to analyse the spatial determinants of extreme poverty in the state of Ceará and also perform an exercise to detect spatial clusters. Similar works have detected clusters in the Northeast (Silva et al. 2013) and in the state of Minas Gerais (Romero 2006).

Almost all of the papers cited detect spatial poverty clusters using Local Indicators of Spatial Association (LISA) to identify conglomerates. Additionally, most papers focus on poverty in all households. The difference of this study lies mainly in its focus on

non-agricultural rural families and agricultural families. Another difference worth mentioning is its use of an alternative procedure to that used by most researchers, which is advantageous mainly because it is a semi-parametric methodology (with rather flexible assumptions, not 'tied' to normality assumptions of little credibility).

In the following section we shall briefly describe the LISA indicator and the scan statistic for detecting spatial clusters. We will then present the general results and some of the characteristics of the extreme poverty clusters detected among people living in agricultural households—more specifically, compositional and structural data on family farming and PRONAF activities.

Two methodologies were used to identify poverty and extreme poverty conglomerates among agricultural and rural households in the North and Northeast: the scan statistic with circular windows and Moran's spatial autocorrelation indicator, from which the local LISA indicator is derived. The first technique, developed by Kulldorff (1997), came about in the context of epidemic outbreak detection, although it has since been used in various contexts outside epidemiology. It is an intensive and non-parametric computational procedure. Moran's indicator follows the same logic as first-order temporal autocorrelation, but applied to the spatial context.

a) An statistic

As originally proposed, the scan procedure 'sweeps' the map iteratively in search of areas where a given phenomenon occurs with greater probability than in other regions. Each iteration begins in a municipality within the map, from which a window extends and proceeds to encompass other cities. For every new municipality encompassed by this window, a likelihood ratio is calculated. When the window around the municipality contains the maximum number of predefined regions, the process restarts by centring the window on another municipality. The procedure ends when all municipalities have been used as centres for windows.

The likelihood ratio (LR) calculated in each LR zone is given by

$$LR = \left(\frac{c_z}{\mu_z} \right)^{c_z} \left(\frac{C - c_z}{C - \mu_z} \right)^{C - c_z} I(c_z, \mu_z)$$

where:

- c_z is the number of poor people within the window;
- μ_z is the number of poor people that one would expect to find within the region if there were no conglomerate on the map. In this case, $\mu_z = pN$, where p is the poverty rate across the entire map, and N it is the total population;
- C is the total number of poor people in the region; and
- a cluster is defined as the window with the largest LR. However, the possibility exists that this concentration is just a probable fluctuation. To test the statistical significance of this cluster, we have carried out a Monte Carlo experiment generating random values for each municipality based on a Poisson distribution with an average μ_z .

Though this method may be powerful, its accuracy depends largely on the format of the windows defining each zone. The simplest format, used in this study as a preliminary exercise for future enhancements, is a circular window.⁶

b) Moran's global indicator I and LISA indicators

Moran's indicator I is a measure of spatial autocorrelation. It calculates the degree of linear dependence between the value observed in a municipality and the values of its neighbours. The index ranges from -1 to 1. Positive values indicate that regions with the highest poverty rates tend to have neighbours whose poverty rates are also high (and neighbours with low rates tend to have neighbours with values in the same trend). Negative values indicate a pattern in which municipalities with high rates tend to have neighbours with low rates (and vice versa). Moran's global indicator I is given by:

$$I = \frac{n}{\sum_{i=1}^n \sum_{j=1}^n w_{ij}} \frac{\sum_{i=1}^n \sum_{j=1}^n w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^n (y_i - \bar{y})^2}$$

where:

n is the total number of municipalities in the region;

y_i is the poverty (or extreme poverty) index for municipality i ;

\bar{y} is the regional average; and

w_{ij} is defined so that its value is 1 if municipalities i and j are neighbours, and 0 otherwise.

In other words, Moran's global index is a Pearson correlation between the values of municipalities and those of their neighbours. The null hypothesis states that values occur randomly in the map ($I = 0$), with no specific spatial pattern. The significance of the global index can be tested via a parametric method, assuming the normality of the variable in question, or via a Monte Carlo simulation, based on several random orders of the indicator.

The indicator I , however, only shows global correlations and does not indicate regions with positive and/or negative associations. The LISA indicator is used for that purpose:

$$LISA_i = \frac{(y_i - \bar{y}) \sum_{j=1}^n (y_j - \bar{y})}{\sum_{j=1}^n (y_j - \bar{y})^2}$$

6. This method is quite limited, in a way, as there is a high chance that a conglomerate, if it exists, will not necessarily be circular. Nevertheless, there are methods with elliptical windows—Kullidorff et al. (2006)—or even irregular windows—Tango and Takahashi (2005)—available.

The LISA indicator for each municipality is the correlation of its value with those of its neighbours. The local indicator is also statistically tested—parametrically or by simulation—in a fashion analogous to the global indicator I.

c) Moran's mirroring diagram

The mirroring diagram can be used to verify and classify the spatial association pattern. We begin by setting standardised values z_i . Positive values for z_i indicate a poverty rate above the regional average; negative values indicate a rate below the average. Subsequently, we define the lag of z_i as the neighbours' average. The mirroring diagram is an z_i X lag(z_i) scatter plot. Depending on the municipality's position in each quadrant, it will be classified in one of the following groups:

- High-High Group: the municipality has a poverty rate above the regional average, and its neighbours follow this trend, also showing above-average values. This corresponds to the first quadrant of the diagram;
- High-Low Group: the municipal rate is above average, but those of its neighbours are below average;
- Low-High Group: the poverty rate is below average, and neighbours' poverty rates are above average; or
- Low-Low Group: corresponds to the third quadrant of the diagram, for cases in which the municipality has a below-average rate and its neighbours follow this trend.

The main advantage of this method with respect to a circular scan is the fact that here the conglomerate shape is not limited to a circle. Moreover, we can check for the presence of 'negative' clusters, in which the phenomenon under investigation occurs in an opposite direction. It may be limited, on the other hand, due to its parametric nature and to the fact that it was applied (at least here) considering only the first-order neighbourhood. Its power of detection loses strength, as it relies on multiple individual tests with the LISA indicator.

The scan statistic, in turn, has an interesting property: the most likely cluster is still a significant conglomerate regardless of the composition of the rest of the map, while local indicators are strongly influenced by the composition of the rest of the region.

ANALYSIS OF RESULTS

Moran's Global Indices: All maps show significant spatial correlation. In both strata (agricultural and rural households), both the poverty and the extreme poverty rates have a much stronger spatial relationship than when we consider only the North and Northeast regions, thus showcasing the disparity of these regions vis-à-vis the rest of the country. Figures 21 and 22 show the mirroring diagrams (standardised value X average of neighbours) of the indicators observed in the North and Northeast, showing a linear trend between the incidence of poverty and the average of neighbours.

FIGURE 21

Mirroring diagram of poverty and extreme poverty rates among agricultural or pluriactive households in the North and Northeast

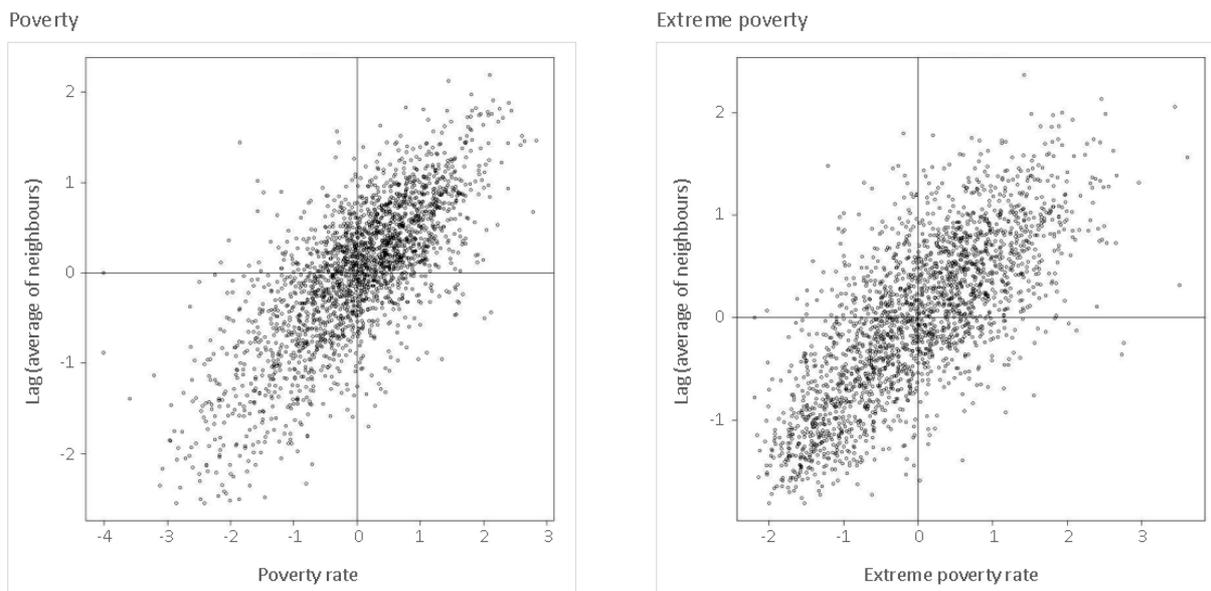
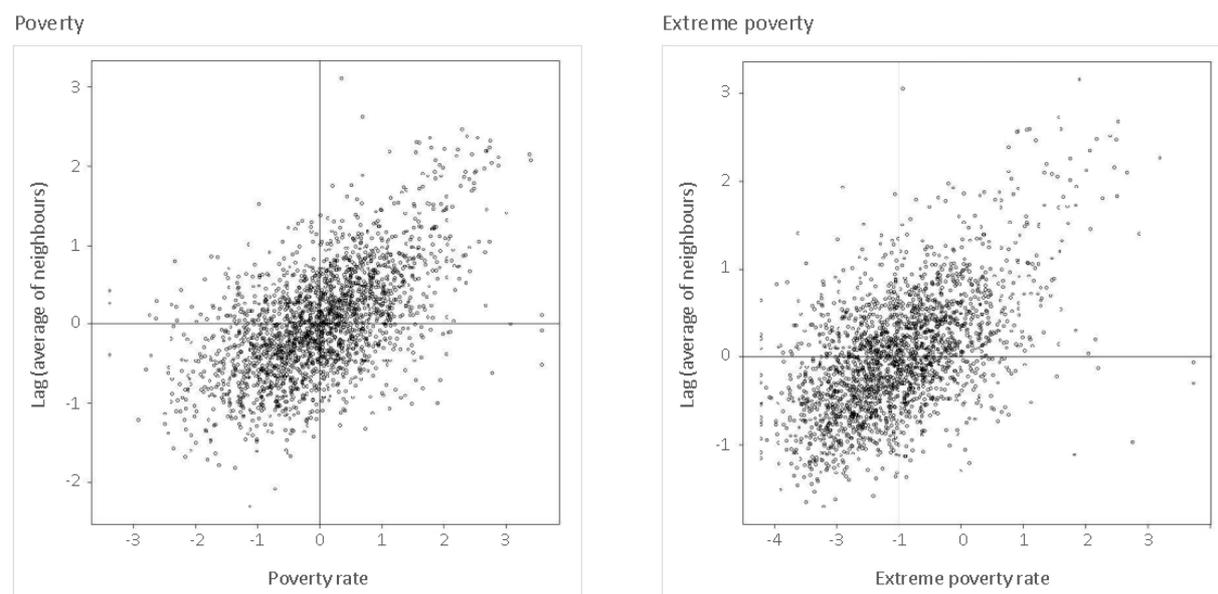


FIGURE 22

Mirroring diagram of poverty and extreme poverty rates among non-agricultural rural households in the North and Northeast



Source: Population census 2010.

Circular scan: To detect clusters using Kulldorff's scan statistic, we first conducted a Monte Carlo simulation to estimate a critical region with a confidence level of 95 per cent. Several clusters were then detected in several scan sweeps. Each result with an LR in the critical region was registered and removed from the map for the purposes of detecting new regions. We predetermined a maximum number of 15 significant windows for detection.

Figures 23 and 24 show the results of this exercise for agricultural or pluriactive households, for the North and Northeast and for Brazil, respectively.

TABLE 3

Moran's global tests for poverty and extreme poverty rates

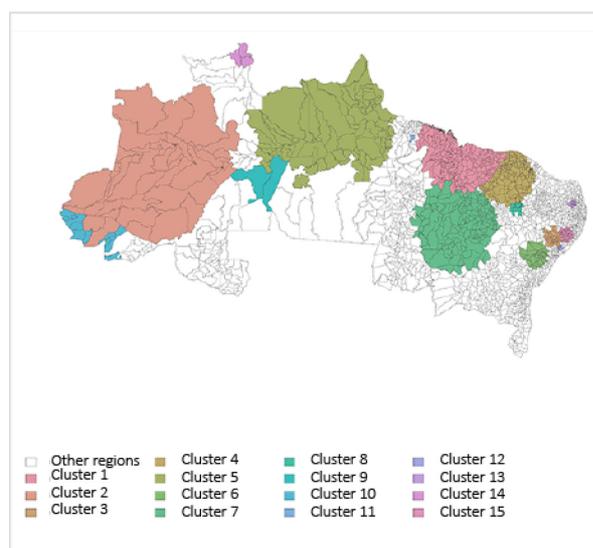
Stratum	Region	Poverty rate (Line set at BRL140)		Extreme poverty rate (Line set at BRL70)	
		Statistic I	P-value	Statistic I	P-value
Agricultural or pluriactive households	Brazil	0.88	< 0.001	0.81	< 0.001
	North and Northeast	0.59	< 0.001	0.57	< 0.001
Non-agricultural rural households	Brazil	0.4	< 0.001	0.38	< 0.001
	North and Northeast	0.7	< 0.001	0.59	< 0.001

Source: Population census 2010.

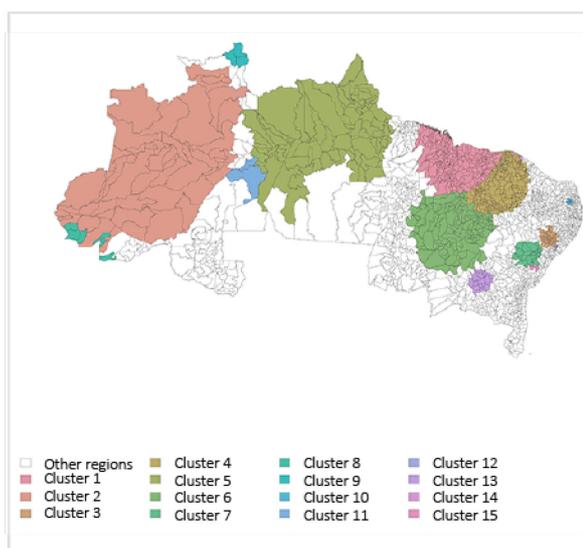
FIGURE 23

Poverty and extreme poverty clusters among agricultural or pluriactive households: circular scan results for the North and Northeast

Poverty



Extreme poverty



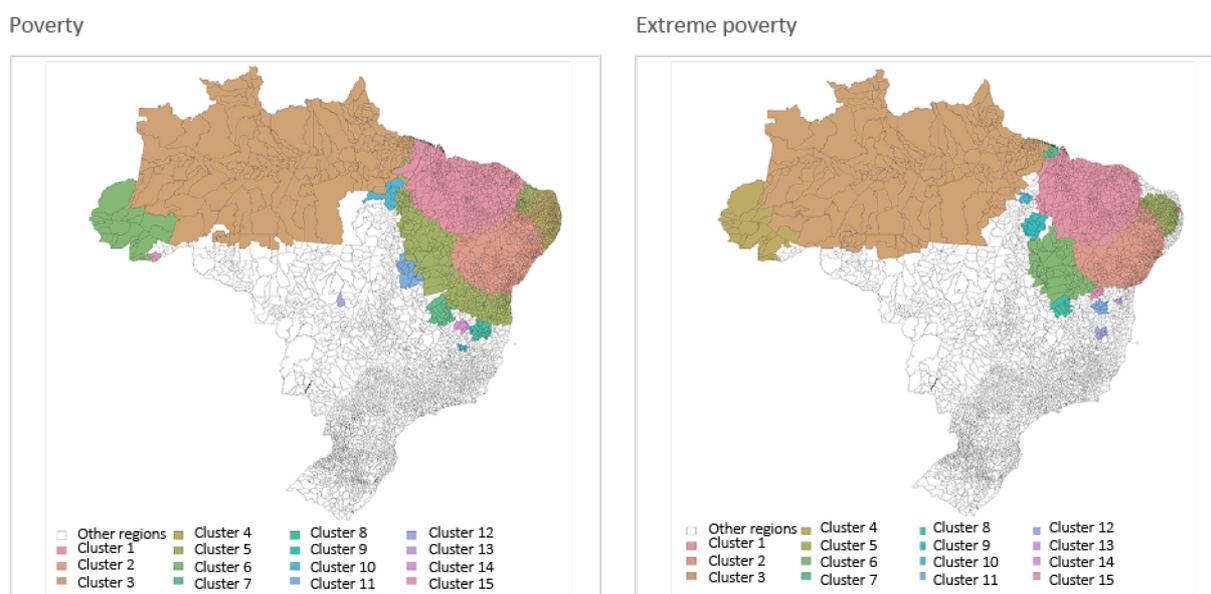
Source: Population census 2010.

The clusters roughly correspond to the dark blue concentrations in the maps presented in Section 4. That is, the Kulldorff methodology yields results that are consistent with one's intuition after looking at the map.

LISAs: Another way to detect poverty conglomerates is through LISAs. All municipalities are classified in one of four patterns of association according to their position on the mirroring diagram (High-High, Low-Low, Low-High and High-Low). However, these classifications are shown on the map only for municipalities in which the LISA was significantly different from zero. Regions with LISAs not significantly different from zero are placed in a fifth category, the uncategorised.

FIGURE 24

**Poverty and extreme poverty clusters among agricultural or pluriactive households:
circular scan results for Brazil**



Source: Population census 2010.

TABLE 4

Extreme poverty by stratum and detected conglomerate

Stratum	Conglomerate	Municipal average	Standard deviation	Rate calculated in the group
Residents in agricultural or pluriactive households	High-High	43.67%	7.86%	42.53%
	High-Low	47.98%	8.12%	55.18%
	Low-High	12.19%	4.22%	10.95%
	Low-Low	9.84%	5.10%	9.77%
	North and Northeast	25.55%	12.39%	25.60%
Residents in non-agricultural rural households	High-High	53.79%	11.92%	52.47%
	High-Low	52.49%	21.11%	48.69%
	Low-High	10.16%	6.98%	13.32%
	Low-Low	14.34%	6.50%	15.22%
	North and Northeast	31.90%	14.38%	33.40%

Source: Population census 2010.

The p-values associated with the LISAs were also obtained through simulation. Based on a 95 per cent confidence level, we applied the Bonferroni correction associated with the number of neighbours of each municipality. The two panels in Figure 25 show the spatial association patterns in the extreme poverty rates for agricultural or pluriactive households and for non-agricultural rural households, respectively. The results for the poverty conglomerates follow a similar pattern.

Red regions represent conglomerates of neighbouring municipalities where the poverty rate is higher than the national average. Conglomerates of low rates of poverty are depicted in blue. Interestingly, when we consider the entire country, there are no areas that follow a Low-Low pattern in the North or the Northeast. This pattern is more highly concentrated in the South and Southeast. These results are consistent with the findings of the circular scan.

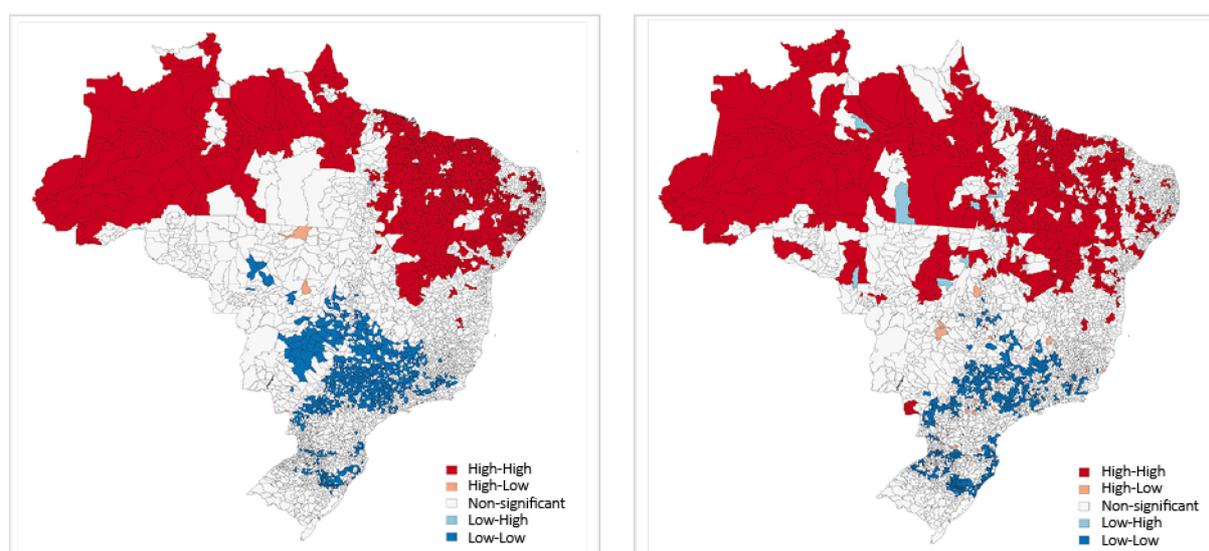
Another intuitive result is that there are almost no regions with High-Low or Low-High patterns, which validates our intuition about the existence of poor and rich regions.

FIGURE 25

Extreme poverty among agricultural or pluriactive households and non-agricultural rural households – patterns of association in municipalities with significant LISAs for Brazil

Agricultural or pluriactive

Non-agricultural rural



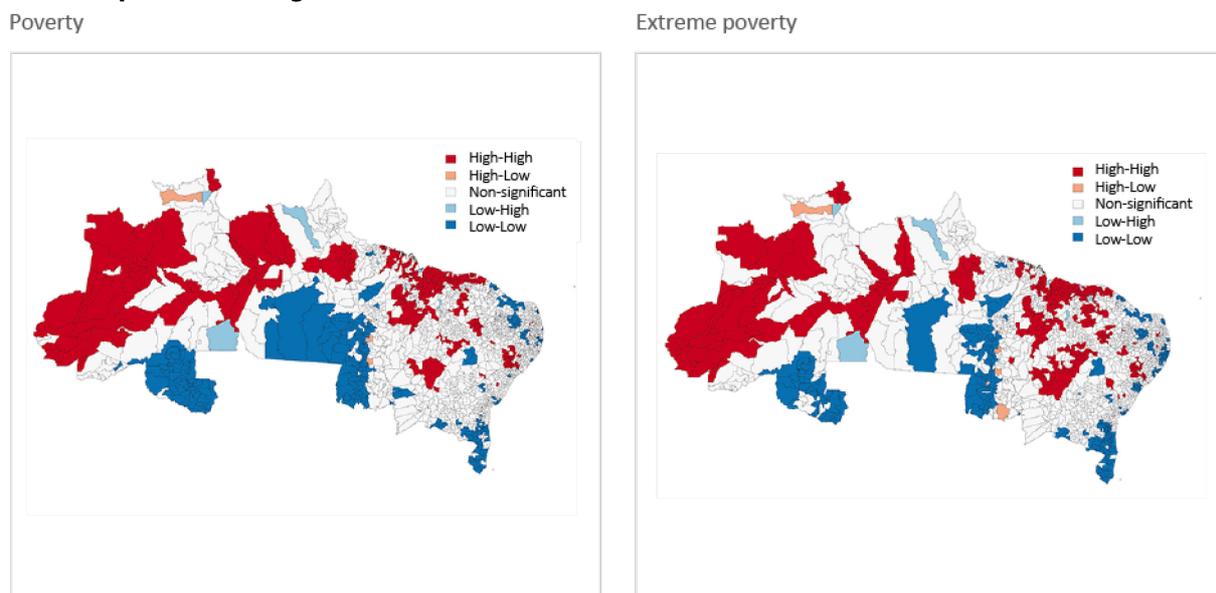
Source: Population census 2010.

Figures 26 and 27 show the spatial association patterns in the North and Northeast regions only. Regarding people living in poverty in agricultural or pluriactive households, the panels of Figure 26 show certain regions that represent clusters with low incidences of poverty—notably the municipalities in the south of Pará, the south and east of Bahia, and most of the states of Rondônia and Tocantins. Conglomerates of high rates of poverty (High-High correlation) can be found in northern Maranhão. The capital, São Luís, is one of the few regions with a Low-High correlation, meaning that it is a municipality with poverty rates below those of its neighbours. Also of note are the poverty and extreme poverty clusters in the north of the state of Amazonas and nearly half of Acre, in addition to scattered regions in the north of the state of Pará.

As for the population living in non-agricultural rural households, the panels in Figure 27 show that nearly the whole of the Amazon region represents a conglomerate of poverty and extreme poverty. Interestingly, some regions in southern Pará—notably the city of Altamira—comprise a Low-Low conglomerate in terms of the incidence of poverty among residents in agricultural or pluriactive households and become a High-High association cluster when we analyse the incidence of non-agricultural rural households.

FIGURE 26

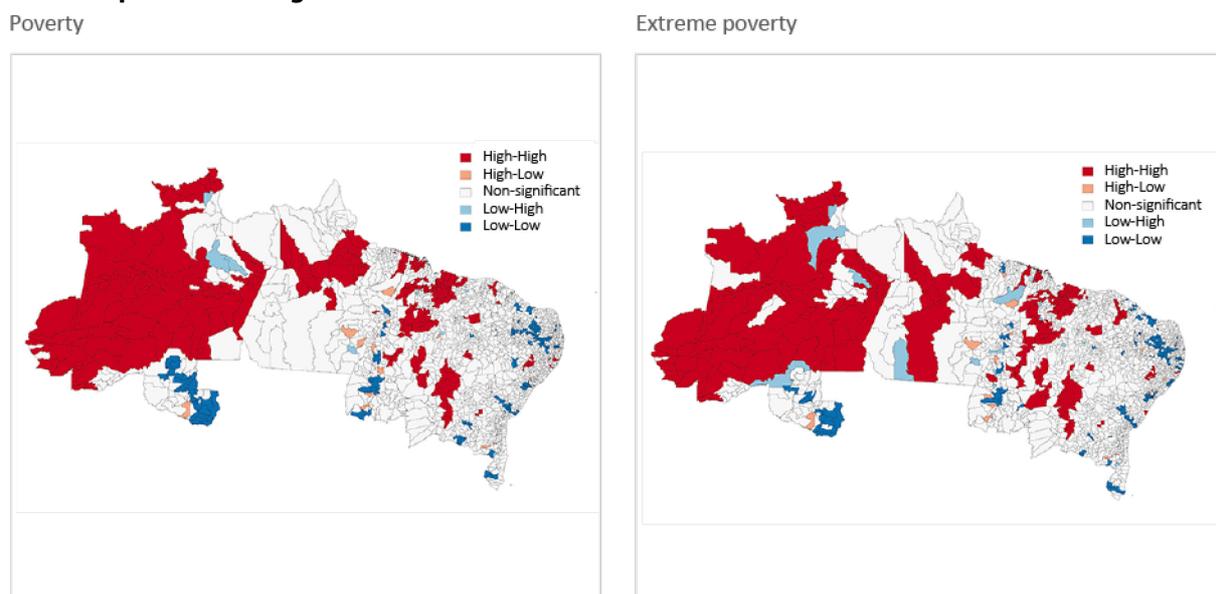
Poverty and extreme poverty among agricultural or pluriactive households – patterns of association in municipalities with significant LISAs for the North and Northeast



Source: Population census 2010.

FIGURE 27

Poverty and extreme poverty among non-agricultural rural households – association patterns in municipalities with significant LISAs for the North and Northeast



Source: Population census 2010.

Municipalities present in High-High and High-Low association conglomerates in extreme poverty are listed in supplementary materials⁷ identifying the mesoregions where they are located. In each mesoregion, municipalities were ranked in descending order according to their estimated extreme poverty rate.

Given these results, the possibility of identifying priority regions with a higher incidence of extreme poverty is of great relevance. We confirmed the same finding when two spatial clustering methods yielded the same result: almost the entire North and Northeast regions represent a conglomeration of poverty and extreme poverty in the country as a whole.

Considering the focus on the households in these large regions, we were able to find large conglomerates of poverty and extreme poverty, for the strata of agricultural families and of non-agricultural rural families—for example, the north and south of Amazonas, the Acre Valley, the Sertão in Alagoas, the São Francisco Valley, and the north of Maranhão, among others. There were also certain areas with low rates of poverty, such as the south and part of the east of Bahia and almost the entire state of Rondônia. Southern Pará is particularly noteworthy. This region was classified as a conglomerate of low poverty rates when considering agricultural households; when considering non-agricultural rural households, however, they reveal clusters of high poverty.

Lastly, we note the importance of family farming in conglomerates with high extreme poverty rates among agricultural families. However, in those same conglomerates we see a much lower level of access to structural factors, such as irrigation and tractor ownership. Moreover, municipalities that receive higher PRONAF investments are, for the most part, located in conglomerates of low poverty.

A few enhancements can be implemented along these lines in the future. It would be interesting to evaluate the clusters detected by the scan statistic using irregular windows (Tango and Takahashi 2005). Another promising development would be an effort to detect spatial clusters of the variation in poverty and extreme poverty rates using the 2000 census data.

5 CONCLUSIONS

This analysis of multiple data sources shows several important trends that must be considered when making investments in agriculture in the North and Northeast regions.

First, poverty and extreme poverty have declined in Brazil as a whole and in the North and Northeast specifically. The decline was greater in the Northeast, but the region is still marked by a slightly higher degree of poverty than the North. Additionally, there are alarming signs that the decline in poverty may have slowed or even stagnated.

Despite the considerable level of migration between groups of households—particularly a significant net migration from agricultural households to non-agricultural urban households—the decline in poverty was driven by reductions within the groups. The decline in the poverty and extreme poverty levels among agricultural households was particularly significant.

7. Available at <http://www.ipc-undp.org/pub/eng/WP138_conglomerates_annex_extreme_poverty>.

When analysing municipal poverty rates, we found marked differences between the regions. The North and Northeast are much poorer than the other regions of Brazil. In an analysis by household type, these differences are more pronounced in agricultural households.

Lastly, when we evaluate which of the attributes of agricultural families seem to be the most important, there is no doubt that capitalisation ranks among them. The level of funding and, particularly, the percentage of family farming establishments that rely on tractors show the same (inverted) data pattern about poverty.

These results leave little doubt that the capitalisation of family farming in the North and Northeast regions is a crucial step towards reducing poverty levels and, most notably, the regional differences among these levels.

REFERENCES

- Amarasinghe, U., M. Samad, and M. Auputhas. 2005. "Spatial clustering of rural poverty and food insecurity in Sri Lanka." *Food Policy* 30(5–6): 493–509.
- Barros, R.P. de, M. De Carvalho, and S. Franco. 2006. "Pobreza multidimensional no Brasil." *Texto para Discussão* No. 1227. Rio de Janeiro: Ipea.
- Cleyber, N., and V. Neto. 2011. "Os Determinantes Espaciais da Extrema Pobreza no Estado do Ceará – 2010." *Texto para Discussão* No. 97. Ceará: Ipece.
- Collado, A. 2004. *Análisis Espacial y Localización Geográfica de la Pobreza en el Gran Área Metropolitana de Costa Rica*. San José, Costa Rica: Academia de Centroamerica.
- Del Grossi, M.E., and J.G. da Silva. 2002. "O uso das PNADs para as áreas rurais." *Texto para Discussão* No. 874. Rio de Janeiro: Ipea.
- ECLAC. 2014. *Social Panorama of Latin America 2014*. Santiago, Chile: Economic Commission for Latin America and the Caribbean. Accessed December 29, 2015. <<http://www.cepal.org/en/publications/37626-social-panorama-latin-america-2014>>.
- IBGE. 2004–2013. "PNADs 2004–2013." Accessed July 15, 2015. <<http://www.ibge.gov.br/home/estatistica/populacao/trabalhoerendimento/pnad2014/default.shtm>>.
- IBGE. 2010. "Censo Demográfico 2010: Resultados gerais da amostra." Accessed July 15, 2015. <http://www.ibge.gov.br/home/estatistica/populacao/censo2010/resultados_gerais_amostra/resultados_gerais_amostra_tab_uf_microdados.shtm>.
- IFAD. 2010. *Rural Poverty Report 2011*. Rome: International Fund for Agricultural Development. Accessed March 8, 2016. <<http://www.ifad.org/rpr2011/report/e/rpr2011.pdf>>.
- Kulldorff, M. 2007. "A Spatial Scan Statistic." *Communications in Statistics – Theory and Methods* 26(6): 1481–1496.
- Mesquita, A.C.S., C.M. Silva, E.R.A. da Silva, and R.M. de Oliveira. 2015. "Capítulo 2: Assistência Social." *Boletim Políticas Sociais: Acompanhamento e Análise* No. 23. Brasília: Ipea.

Rocha, S. 2013. "Pobreza no Brasil: a evolução de longo prazo (1970–2011)." Rio de Janeiro: XXV Fórum Nacional/Instituto Nacional de Altos Estudos.

Romero, J. 2013. "Análise Espacial da Pobreza Municipal no Estado de Minas Gerais – 1991–2000." Caxambu: XIV Encontro Nacional de Estudos Populacionais.

Silva, L., W. Souza, and M. Silva. 2013. "Análise Espacial da Extrema Pobreza na Região Nordeste: uma aplicação para os municípios." Bahia: IX Encontro de Economia Baiana.

Soares, S.S.D. 2009. "Metodologias para estabelecer a linha de pobreza: objetivas, subjetivas, relativas, multidimensionais." *Texto para Discussão* No. 1.381. Brasília: Ipea.



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