




The invisibility of young people in family farming: a gender perspective in the semi-arid region of Ceará, Brazil

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Abstract – The evolution of family farming cannot be analyzed only from the perspective of production. Since it is also a kinship unit, the family farm reveals social tensions that contribute to the migration of young people, especially for young women. This study presents an analysis of the factors that contribute to this migratory process, considering youth and gender variables. The analysis is based on a participatory diagnosis, multisectoral interviews and surveys in thirty-three communities located in the center of the Ceará State (Northeastern Brazil). The research reveals that the main factor of this migratory process is the lack of appreciation of family farming by the qualified rural youth, who participate little in decision-making. When the analysis of the migration is gender-focused, the invisibility of young women productive and reproductive work stands out as the main driver of migration to urban areas and proves to be greater than for young men. Rural youth migration will shape the rural territory and will probably change the format of family farming. Understanding its factors may help to propose public policies more adapted for family farming.

Keywords: rural youth / gender / migration / family farming / Brazil

Résumé – **L'invisibilité des jeunes dans l'agriculture familiale : une analyse par genre dans la région semi-aride du Ceará, Brésil.** L'évolution de l'agriculture familiale ne peut être analysée uniquement sous l'angle de la production. Puisqu'elle est aussi une unité de parenté, l'exploitation agricole familiale révèle des tensions sociales qui contribuent à la migration des jeunes, en particulier des jeunes femmes. Cette étude présente une analyse des facteurs qui contribuent à ce processus migratoire, en tenant compte des variables de jeunesse et de genre. L'analyse est basée sur un diagnostic participatif, des entretiens multisectoriels et des enquêtes dans trente-trois communautés situées dans le centre de l'État du Ceará (région Nord-Est du Brésil). La recherche révèle comme principaux facteurs des migrations, le manque d'attractivité de l'agriculture familiale, pour une jeunesse rurale plus qualifiée, mais qui participe peu aux prises de décision. Lorsque les migrations sont analysées en termes de genre, l'invisibilité du travail productif et reproductif des jeunes femmes apparaît comme le principal moteur de leur migration vers les zones urbaines et s'avère plus importante pour elles que pour les jeunes hommes. L'exode rural des jeunes va façonner le futur du territoire rural et modifiera probablement le format de l'agriculture familiale. La compréhension de ses causes peut aider à réfléchir à la mise en œuvre de politiques publiques plus adaptées à l'agriculture familiale.

Mots clés : jeunesse rurale / genre / migration / agriculture familiale / Brésil

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1 Introduction

The evolution of the concept of family farming reveals the models promoted by public policies and their weaknesses in the face of their new global roles—food production and environmental conservation. In this concept, the family unit and the farm are linked and co-evolve in their economic, environmental, social and cultural functions (Bosc *et al.*, 2015). While the heterogeneity of family farming reflects the multiple relationships with capital and the market (Thirion *et al.*, 2014).

Family farming is characterized by a form of management based on ownership, bonded by kinship ties and subject to intergenerational transfer (Gasson and Errington, 1993). In this sense, family members are the main workers and also managers of the farm (Djurfeldt, 1996). This reveals the life cycle of farms and the challenges in succession processes. However, it does not capture the differentiation of labor by gender in family production units (Pierotti *et al.*, 2022), as well as power relations (Brumer, 2004). The focus on the family unit always gains emphasis on production, due to the conventional economic approach centered on the landowner, who is usually a man (Vidal, 2013).

According to the Food and Agriculture Organization of the United Nations (FAO), family farming is an income-generating activity shared by the family, whose property also serves as housing for its members. The insertion of the term housing exposes social tensions, such as intergenerational, gender, and patriarchal tensions (Camarano and Abramovay, 1999). The search for opportunities for the sons and daughters of family farms is still a recurring theme in several countries. However, when this activity is in semi-arid regions, such as in Northeast Brazil and the Maghreb, it presents similar challenges, such as long periods of drought, water vulnerability, and rural development models, which limit the aspirations of its rural youth (Bossenbroek *et al.*, 2015; Gasmí *et al.*, 2022).

Over the past four decades, Brazil has prioritized agricultural policies over food and nutrition, socio-environmental, and agrarian security policies (Sabourin *et al.*, 2020). Economic improvements have occurred, but unevenly, with gender and youth gaps, and are insufficient to prevent the migration of the future generation of family farmers. This new design of family farming is part of an evolution based on the global context—food supply, prioritizing agricultural policies; without, however, changing the agriculture land ownership structure and power relations, such as gender relations (Herrera, 2019). Mechanization and the increasingly common use of pesticides in family farming are strategies aiming at increasing production: but they reduce labor hiring and bring socio-environmental impacts in the medium and long term (Rigotto and Augusto, 2007). These externalities, which are not exclusive to family farming, show that it is not possible to consider this activity only from a purely productive perspective (Valencia-Perafán *et al.*, 2020).

In Brazil, the institutionalization of family farming emerged with the creation of the program known as PRONAF (National Program for Strengthening Family Farming) (Brasil, 1996). It tried to articulate the necessary instruments for rural development, mainly through a rural credit policy (Grisa *et al.*, 2014).

The various credit modalities of this policy had an impact on the characteristics of family farming, which turned more flexible and heterogeneous. For example, in Brazilian family farming, labor is not exclusively family labor, wage earners can be hired. Also, some additional income can be obtained from non-farm activities. This diversity in the Brazilian family farming categories has generated social heterogeneity, especially in the semi-arid region of Brazil (Valadares, 2022), by inserting other characteristics such as the differentiation of work by gender (Hirata and Kergoat, 2007). In this scenario, women are generally responsible for the productive functions, with occasional participation in decision-making. However, they also participate in the activities of agricultural commodity production for the market (Whatmore, 1991). From this perspective, the microeconomic production of women's labor remains unknown and undervalued because it is not differentiated.

In this article we question how the gender differentiations in the family farming organization are impacted or not by development programs mainly focused on economic and technical dimensions. We take the example of the Pingo d'Água project (Caitano *et al.*, 2015), implemented in the Quixeramobim municipality. This project had as initial goal to offer wells and accessible irrigation technology at low cost to family farmers. It made possible, together with the induction of State policies, the irrigated fruit culture in the region (Amaral Filho *et al.*, 2006). However, it has not prevented the migration among young people, especially the daughters of family farming. This fact has raised questions about the barriers that exist in family farming and in the territory for young people, with a special focus on the young women. A case study conducted in the territory of São Miguel, which was part of the Pingo d'Água project, allowed the identification of the main factors of youth migration (sons and daughters of family farming). The initial hypothesis of the research is that the migration motivations of young people are differentiated by gender, due to their different social roles in the family farming unit (repulsive factors) and their different visions of well-being (attractive factors).

In order to test this hypothesis, we firstly present the methods and the case study, then we discuss the main results on the various constraints and visions of well-being for young women and men.

2 Material and methods

The research initially used a rapid participatory diagnosis of rural territory (Chambers, 1981; Sousa, 2009), based on individual and collective interviews with family farmers, community leaders, teachers and school managers—all of both genders. Then, we conducted surveys about existing means that could support these young people in realizing their vision of the future, in a rural high school, with 214 young students, aged between 15 and 29 years old, all exclusively daughters and sons of family farmers. Then we analyzed the collected information by gender to identify the factors that contribute to youth migration in the rural communities. The data collection period was from August 2019 to March 2020 in the Banabuiú watershed, located in the semi-arid region of the state of Ceará, Northeastern Brazil. Based on the location of the students'

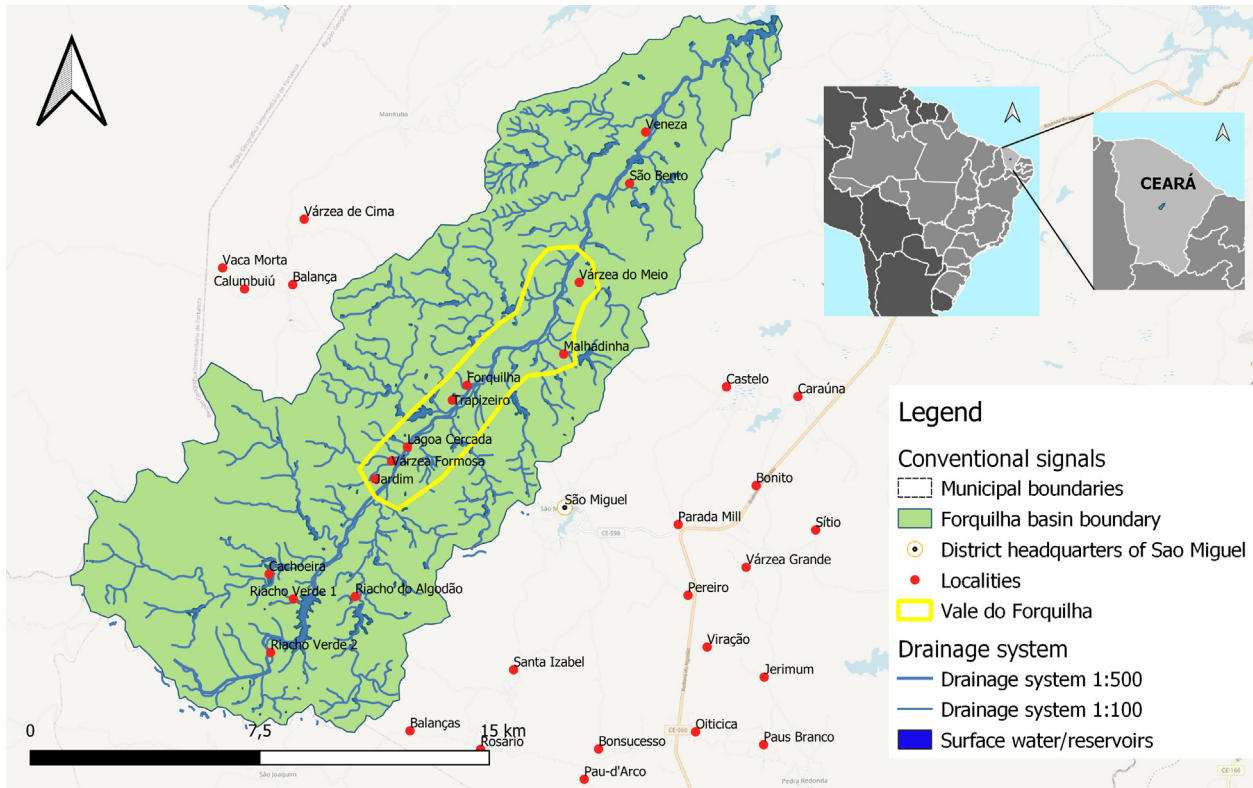


Fig. 1. Territory of São Miguel, Ceará, Brazil.
Fig. 1. Territoire de São Miguel, Ceará, Brésil.

residences, the territory of São Miguel was spatially divided in 33 communities (Fig. 1). This allowed to distinguish the communities having benefited from the Pingo d'Água project (area circled in Fig. 1 and called Vale do Forquilha), as well as those not having benefited (all other communities).

In this paper, the term “young women” is used correspondingly with daughters of family farmers. The same occurs for the male gender, in relation to the term “young men”. While “young people” will be synonymous with daughters and sons of family farmers.

The organization of young people in family farming in this territory was understood by the application of a questionnaire that included five dimensions, with 18 variables of analysis (Tab. 1). The first three dimensions capture the barriers of family farming, while the last two identify the items necessary for well-being in rural areas according to these young people's vision of the future.

The first dimension “work and income” assumes that all the selected young people are part of a family farming unit. We collected information about the amount of family income, through the main economic activity, the form of participation of youth in productive and reproductive activities, the income from labor work, and inclusion in decision-making, given the variables of age and gender. The analyzed variables also sought to understand the factors governing the migration of young people, especially young women. While the interviews with community leaders and family farmers (for the three aspects: production unit, consumption unit, and kinship unit) helped to better understand the communities' functioning.

For the second dimension “education and professional training”, the questions focused on the value of the farming profession as defined by the rural school, as well as issues related to the rural space and the motivations of these young people in dropping out of school. This information was differentiated by gender and age group. In this dimension, the interviews of teachers, school managers, and parents (family farmers) were crossed together with the data from the surveys for a better understanding of the reality.

The third dimension “participation and communication” comprises the degree of commitment of the young people in the associations of family farming, as well as the benefits and challenges of life in a rural community.

The “well-being”, the fourth dimension, addresses the basic needs, found in the territory, through public policies or community actions, by the different generations of family farmers. Special attention was paid to water resources, due to their importance in the agricultural and domestic activities in the context of frequent droughts in the region. The access to water for multiple uses is shaping the territory and the relation between the communities' members in the Forquilha watershed (Gasmi *et al.*, 2022). We triangulated the collected data with secondary data from the Institute for Research and Economic Strategy of Ceará (IPECE), the Brazilian Institute of Geography and Statistics (IBGE), through the 2017 Agricultural Census, and the Observatory of Family Farming of Ceará. Adding a literature review contributed to a contextualization of family farming in the Northeastern semi-arid region, facing the challenges of living with drought.

Table 1. Dimensions scored in the young people questionnaires.**Tableau 1.** Dimensions notées dans le questionnaires pour les jeunes.

Dimensions	Variables	Source
1. Work and income	1. Gender	Brasil (2013)
	2. Age	
	3. Family income	
	4. Economic activity	
2. Education and professional qualification	1. Valuing family farming	
	2. Profession	
3. Participation and communication	1. Do you participate in a association linked to family farming	Ostrom (1990) Sen (1999) Bourdieu (1998)
	2. Challenges in the community	
	3. Positive points existing in the community	
4. Well-being	1. Basic sanitation	
	2. Access to water, energy, heath and media	
	3. Roads and transport	
	4. Infrastructure for culture and leisure	
	5. Habitation	
5. Future vision	1. Items necessary for well-being	
	2. Items necessary for well-being and absent in the territory	
	3. Place where well-being items exist	
	4. Migrate or stay?	

Finally, for the fifth dimension, “visions of the future”, we invited in a workshop the young people, differentiated by gender, to reflect about the desired well-being in the rural environment, especially regarding the need to migrate in search of job opportunities. These data were described in the surveys and then scored in order of importance, by gender.

3 Results and discussion

3.1 The barriers of family farming for young people

According to our research, family farming is not an attractive economic activity for young people and this is the first factor that contributes to the search for other incomes, such as non-agricultural ones.

We noticed a rare presence of young people in the rural communities. In the São Miguel territory, 50% of the young population were daughters of family farmers. However, in the Vale do Forquilha, where the Pingo d’Água Project benefited to the communities and brought better agricultural techniques focused on irrigated fruit farming, 62% of the young population were young men and only 38% were young women. We noticed that the family farming lifestyle, even with the productive and economic advances in the territory, has not fixed the young women.

Young people are induced from a very early age to participate in the economic activities of the farm, as members of the farming family. However, production and reproduction roles are differentiated by gender. The productive activities of young men are generally valued and remunerated, while the productive tasks performed by young women are invisible. In the São Miguel territory, 48% of the young people live in families whose family income is below the minimum wage. In view of this reality, gardening and raising small animals are fundamental for food security; but these are tasks for which young women are not accounted for, even in studies for rural

development planning. In the face of low family income from family farming, a diversity of economic activities, including non-agricultural ones, such as candy factories, was found in the Territory of São Miguel, as well as a variety of family farming practices. In fact, in the Vale do Forquilha, 18% of family farmers supplement their income with non-agricultural activities. However, even in non-agricultural activities, young women are not able to publicly assume responsibility for their work. It is up to the landowner to make the decision and give public recognition to the economic activity, as described by Waltz (2016).

The female gender has difficulty accessing credit. This criticism arises because financing is granted per family unit, and only one member of the family farm can apply for it (Marin, 2020) and, generally, it is not the young women. This detail consolidates the continuity of gender inequalities and emphasizes a rural development based on agricultural production.

The second factor is a better qualification and a better schooling level of today young people than their parents’ generation. As soon as they reach the minimum age, they seek to enter the formal job market.

In the Territory of São Miguel, 96% of the young people are between 15 and 19 years old. Among this figure, 36% were 16 years old, while in the communities surrounding the Forquilha basin, they represented 53%. The age of sixteen is important for young people because it makes it possible to enter formal employment. This age presents a transition phase between continuing in school and finishing their studies, or going in search of work opportunities.

The percentage of young women who finish high school is higher than that of young men. Young women often do not inherit their parents’ farm. In consequence, many of them invest more in education, and in the search for non-agricultural jobs in urban centers. According to field interviews, school dropout is common and more accentuated among young men

and justified by the search for seasonal and agricultural jobs. For young women, education is a differentiating factor in the search for salaried and non-agricultural employment in the cities, as stated by an interviewed director of an educational institution:

“Yes, the young women try to finish their studies! When they finish, they go to the factory. There are many people here who work in the factory, but in general, more young women finish (school) than young men.”

There is no appreciation of family farming in the rural school programs, a fact that motivates young people to look for non-agricultural professions. The existing teaching structure does not contextualize the rural environment or the importance of the role of family farming. The skills taught are geared toward urban spaces. This is evidenced in the professions desired by young people. Among the main professions reported, being a farmer corresponds to only 1%, while being a soccer player (17%) is the profession most desired by young men. For the young women, being a nurse or a teacher (13% each) or a policeman (10%) are among the most desired professions. The territory of São Miguel has no soccer school, technical training institutions, or college, so it can be seen that most of the professions desired by the young people would require migration to the cities, and this fact exposes the financial vulnerability of the families to make the desire of their sons and daughters viable. Even though 13% of the young women and 8% of the young men do not know which profession to choose, the desire to migrate remains. A statement of a young woman confirms this fact: *“I would like to leave here and seek a better life.”*

The third factor of youth migration is the lack of participation in social activities and the non-representation in local associations. In fact, there is a generational and gender fracture with regard to female participation in associations. Young people understand the challenges of family farming and its barriers to entry, which differ by gender, revealing the different roles they play in their unit. The youth's lack of voice is quite remarkable. They were not induced by their parents to participate in the associations. Although they are productive members, they are unaware of the importance of leadership in solving community problems. Without participation allowing to express their opinions and to promote changes, the sense of belonging to the community is, especially for the young women, as low as the satisfaction of their needs. Family farming associations are the main forms of social representation, even with all their structural limitations. Most of these associations are in decline in the state of Ceará. The Vale do Forquilha is an exception, as it has a high number of associations and strong leaders, although there is little or no participation of young women in leadership positions. The participation of women in decision-making in the family farming unit was shown to be almost inexistent. This was reported by a female farmer and wife of a community leader:

“I never leave the house to go to those association meetings. I never go to them! I have things to do at home. I'm the only one who takes care of the house.”

Unemployment (27%) is the biggest challenge in the territory, for both genders. Besides, the lack of non-agricultural jobs is a major challenge for young women. This perception is

supported by many mothers, who do not wish their daughters to continue on this path:

“We, as parents, had never took her to the field. That is why she doesn't stop studying. If she drops out of school, her only option is to work in the field, or get married.”

For the young men, the difficulties they experience also motivate them to seek work in other rural areas or in cities. In this search, when young men migrate, in general, they only change their rural territory, but the work continues to be agricultural and seasonal, such as cutting sugarcane in the south of Brazil. For 16% of the farmer's sons, the poor condition of the roads is a problem to the development of their community. It is noticeable that for the young men, the challenges are tied to their productive role in the family farming. While for the young women, health and care are involved in their reproductive role. For the young women, agricultural practices need to be less impactful on the territories and on human health. As for the socio-environmental challenges, they are also differentiated by gender. The use of pesticides (locally named *veneno*, meaning poison) is a necessary evil carried out by the young men and in favor of economic growth, as evidenced by some of the farmers:

“People are killing themselves and don't even realize it. My father never worked with veneno, people said he should, but he never used it, and I never used it. If I have to work with veneno, I'm out. [...] You can't forbid the use of veneno, because it is that old story, I am using what I get. If people didn't have anywhere to buy it ... but the companies secretly sell it on the premises. (Family farmer).”

It is noticed that agricultural techniques, by fixing family farmers in the territory, can also impact human health and the ecosystem, especially the resources. In this case, the focus on the scarcity of water resources in semi-arid areas also gains the bias of the importance of its quality, in face of contamination, through the use of pesticides. This connection is perceived when these social actors list the items necessary for what they consider well-being in a territory.

3.2 Gendered visions of the future and migration strategies

The challenges for the future of family farming in the region are related on one side, with the items that young people consider important for their well-being (what we call “attractive factors”), and on the other side on barriers, missing elements, etc. (what we call “repulsive factors”). These factors, which are guiding the future vision and strategies, can be very different for young people of both genders. Consequently, the search for places with more attractive and less repulsive factors leads young people of both genders to consider migration as a strategy.

We identified firstly the main factors highlighted by young people of the São Miguel territory as important for their well-being. In the context of a semi-arid area, one of the most cited dimensions of well-being, by both young men and women, is access to water (around 90% of them mentioned this item). For men, access to water is mostly related to water for production, while for women, water is very important in the domestic area. According to young women, water needs to be accessible and of good quality. This is not always the case in the territory of São Miguel, where poor access to water directly impacts

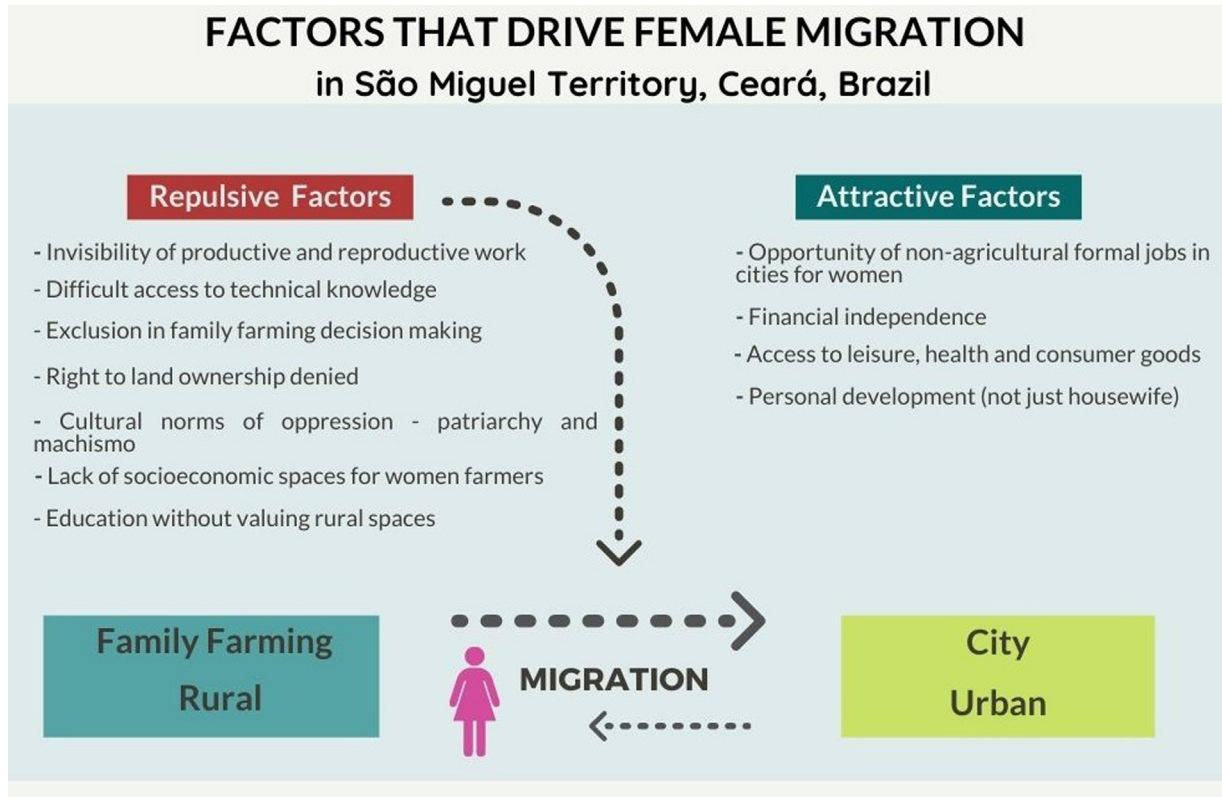


Fig. 2. The challenges of rural communities as seen by the young women.
Fig. 2. Les défis pour les communautés rurales vus par les jeunes femmes.

domestic activities. Over the years, various infrastructures for capturing and storing domestic water were put in place in remote areas of the Ceará state, but water security is still not guaranteed for all rural families. As showed by recent research in the same area (Gasmí *et al.*, 2022), a family unit may manage several water sources and infrastructures in order to deal with water scarcity (*i.e.*, shallow well, deep well, dam, cistern, piped water, and tank trucks). Thus, families develop strategies for maintaining their multiple uses, especially during the dry season, by alternating and/or mixing water sources, as explained by a female farmer:

“Drinking water usually is provided by rain water, that we stock into the cistern. Piped water comes from the [small nearby] dam, and is used for all the others uses. We are using the water from the cistern only for drinking and cooking, because the quality is better. But when we have no more water, we call the tank trucks to bring water from the [big distant] dam.”

Women are particularly sensible to water access issues, from quantitative and qualitative points of view, because they are usually in charge of all the domestic uses (such as cooking and providing drinking water). Water security is even more critical when they have to deal with little kids, during menstruations, during sickness, or more recently, during the COVID pandemic.

A second well-being factor mentioned by young women is the quality of food and of housing, considered as priority items for well-being by 93% of women, while young men are more concerned about housing and energy (87%). Another

significant gendered difference is that school (77%) and employment (76%) are more important for young women than for young men. For young women, the non-farming employment possibility is a priority item, with the right to a salary and social benefits, such as paid vacations and end of the year bonuses. While possessing goods such as clothes (53%) and cell phones (47%) is considered more important by young men. Only some of these material items, such as cell phones, computers, or clothes, considered as necessary for well-being, can be acquired with the income from family farming.

For young women, the most significant “missing factor” is the lack of employment; it is followed by leisure (20%), health (18%), and laptop (15%). Another missing point, mentioned by young men, is the fact that activities of the local associations are less and less important in addressing local problems, such as water access, infrastructure, cultural activities. These missing factors are important in structuring the intention to migrate. This intention appears as the only possible future for not less than 80% of the young women. The ideal place to migrate for the female gender is considered to be the city. This positive image of the city appears in a context where they are more informed about cases of success than failure and difficulties of people who have already left. A young woman expresses her desire for moving, even without having a clear idea of where to go:

“I don’t know where to go, I only know that I don’t want to stay here. (Family farmer’s daughter).”

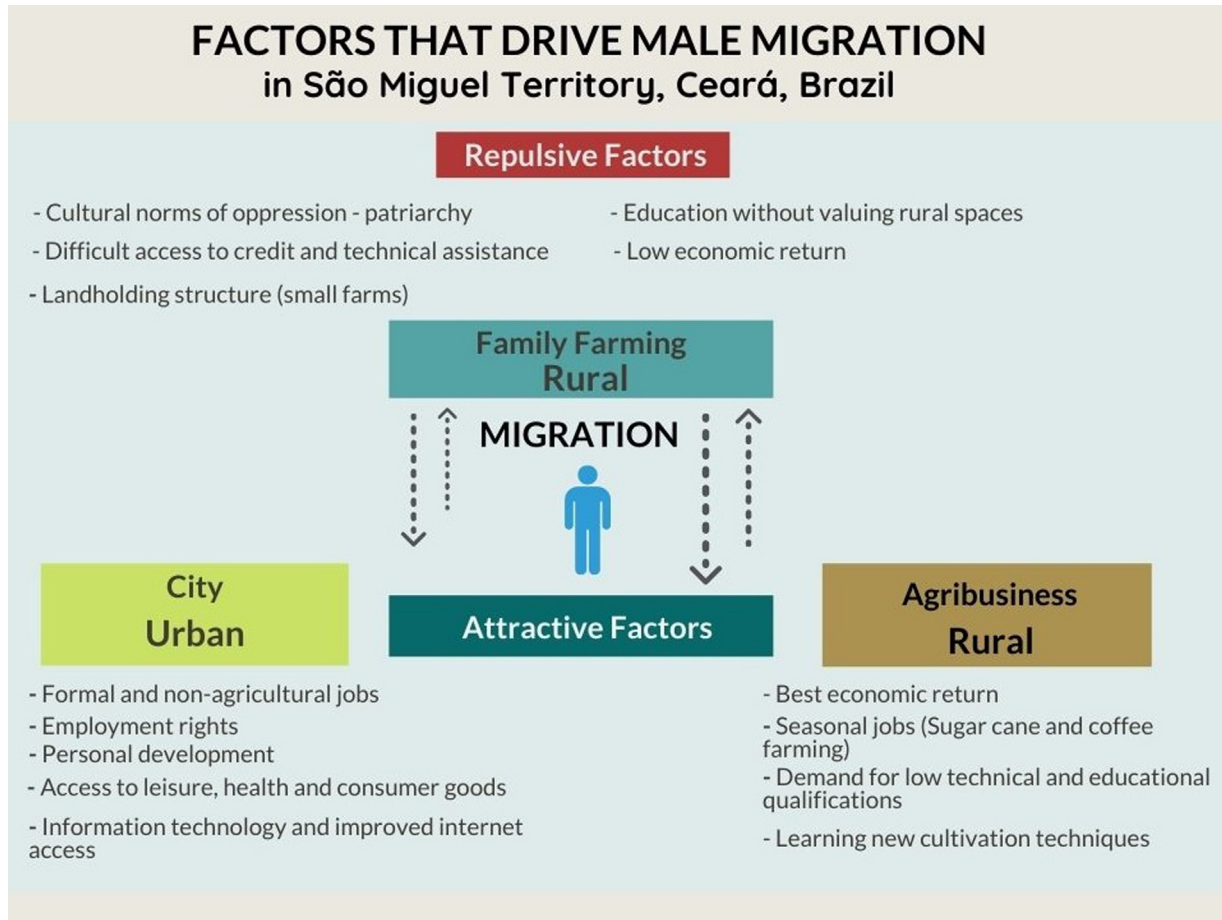


Fig. 3. The challenges of rural communities as seen by the young men.

Fig. 3. *Les défis pour les communautés rurales vus par les jeunes hommes.*

Beyond the well-being factors and the attractivity of the city, the young women determination to leave their family may also be explained by the fact that they face a greater number of “repulsive factors” (Fig. 2). Some of them say that they want to “get out from their social invisibility” and reveal themselves as “important social actors” thanks to urban rural migration. According to the dimensions analyzed, family farming is not an attractive activity for this new generation of young women that claim more symbolical and material recognition of their work. They consider that the cooperation among family members in carrying out the (daily and seasonal) domestic and productive tasks within the family unit are not fairly shared between family members, between men and women. Furthermore, women have to accomplish reproductive functions that prevent them to have a remunerated work. Daughters of family farmers are excluded from all the decisions concerning production, credit or access to technical assistance. This situation is creating a condition of subordination, naturalizing gendered roles assigned in family farming. This situation is reflected by the low percentage (20%) of family farms managed by women farmers in the Ceará state (Ceará, 2020).

If for the young women the main repulsive factor is the lack of recognition, for the young men it is the small size of the family properties, resulting from land structure. This limitation of their development possibilities induces the migration of

young men to other rural territories. They are looking for seasonal jobs in order to earn money and be able to buy some land, in their original community or somewhere else. If young men migration occurs mainly from a rural place to another rural place, urban migration can also take place for those who have pursued studies (finishing high school) and could find a non-agricultural job (Fig. 3).

The second factor is the search of well-being, by a generation of more qualified young people that seeks to have better financial returns and better housing conditions (water access, energy, balanced nutrition, etc.). And finally, given the lack of participation in community institutions, as well as in the decision-making process of the family unit, they have the feeling that they cannot be heard or make changes. These are common items for young men and women that can make them turn to migration strategies.

4 Conclusion

In the rural areas of the state of Ceará, inequality in social relations, based on the division of labor, is a naturalized fact, even by the institutions that promote public policies. This can be observed in the implementation of rural development programs and projects that are mainly based on economic and

technical solutions, and do not explicitly address gender and youth aspects. In this context, the Pingo d'Água project consolidated irrigated fruit farming in the Vale do Forquilha, but because it was not replicated elsewhere on the territory, it centralized economic and technological advances in this limited geographic space. Besides, it legitimated the model of family farming ignoring age and gender issues. However, the current migration strategies of young people (farmers' daughters and sons) are challenging this model.

The research revealed that there are different migration strategies among young women and men, with different reasons. While young women's migration is mainly oriented towards cities, young men are migrating more towards rural areas. In urban spaces, the female gender is seeking non-agricultural jobs and the visibility denied by current development and family models in rural areas. This female migration, more important than male migration, is a real challenge for family farming, since it loses in this way both an important part of the unpaid labor force and its reproductive capacity.

Future development projects and strategies for family farming need to be more concerned with, and inclusive of, people of current and future generations. They must also include the challenges experienced in the family unit and the different perspectives and needs of gender and youth in the territories. If this migration of the daughters of family farmers from the Northeastern semi-arid region continues, the next generation of family farms will have a new shape and will have to redesign the territory, as it will intensify existing social and gender inequalities. Development models need to align socioeconomic and environmental relations in the pursuit of equity, in order to remove barriers for these young people, to allow them to play their rightful role as proactive agents in the transformation and innovation of family farming.

Implementing territorial development projects affects young people's lives from different gender perspectives. In rural areas, family farming inserts patriarchal gender relations, based on a socio-historical construction, which in turn provides a differentiated relationship with the territory. The inclusion of gender issues in public policies and development projects should integrate women in the development process of a territory, and should also facilitate their participation as "subjects of transformation"; and make them able to perceive the problems of the territory and enable them to bring new ways of resolution (Vidal, 2013). For rural development to be sustainable, it must include equitable participation in decision-making processes, in terms of both gender and age.

Authors contribution

Laudemira Silva Rabelo: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing—original draft preparation, Writing—review and editing, Visualization; **Julien Daniel Pierre Burte:** Conceptualization, Methodology, Ressources, Supervision, Project administration, Funding acquisition; **Élie Anatole Simon Boillot:** Investigation, Writing—review and editing, Visualization, Supervision; **Hela Gasmi:** Investigation, Writing—review and editing; **Wellington Romão Oliveira:** Investigation, Writing—review and editing, Visualization; **Fajr Fradi:**

Investigation, Writing—review and editing; **Mariana Machado Rios:** Investigation; Eduardo S.P.R. Martins: Project administration, Funding acquisition.

All authors have read and agreed to the published version of the manuscript.

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