Programa de Pós-Graduação Desenvolvimento Regional mestrado e doutorado

DOI: 10.17058/redes.v29i1.19284

The territorial conditions for family farming's participation in the digital economy [1]

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Abstract
The present study analyzes the territorial requirements for the participation of family farming in the digital economy. The objective is to demonstrate that the main requirements necessary for a good positioning in the digitalization process are related to factors of a territorial nature. What we seek to verify is how the unequal distribution of resources, goods and services in different territories creates difficulties in realizing the potential for taking advantage of the opportunities of the digitalization process by family farming. Using concepts applied to the digital economy, Brazilian rural areas and territorial dynamics, research was carried out through an integrative review of the literature in content that addressed three distinct objects: digitalization, territorial inequality and family farming, which made it possible to define four categories that served as a basis for analyzing the territorial conditions for meeting digitalization requirements: physical; digital; human and social. The results demonstrate that there is an overlap between the territories that are least able to meet the requirements of digitalization and the territories that concentrate the majority of family farming.

Keywords: digitalization of agriculture; digital economy; territorial inequalities, family farming

As condições territoriais de participação da agricultura familiar na economia digital

[1] This article was produced from the master's dissertation approved by the Graduate Program in Territorial Planning and Management at the Federal University of ABC, presented by Jonas Vitor Tolocka, under the supervision of Prof. Dr. Arilson da Silva Favareto and co-supervision of Prof. Dr. Ana Silvia Andreu da Fonseca.

Resumo
O presente estudo analisa as condições territoriais para a participação da agricultura familiar na economia digital. O objetivo é demonstrar que os principais requisitos necessários para um bom posicionamento no processo de digitalização estão relacionados a fatores de natureza territorial. O que se busca verificar é de que maneira a distribuição desigual de recursos, bens e serviços nos diferentes territórios cria dificuldades para que se concretize o potencial de aproveitamento das oportunidades do processo de digitalização pela agricultura familiar. Utilizando conceitos aplicados à economia digital, ao rural brasileiro e às dinâmicas territoriais, a pesquisa foi realizada por meio de uma revisão integrativa da literatura em conteúdos que abordassem três objetos distintos: digitalização, desigualdade territorial e agricultura familiar, o que possibilitou a definição de quatro categorias que serviram de base para analisar as condições territoriais de atendimento aos requisitos da digitalização: físicos; digitais; humanos e sociais. Os resultados demonstram que há uma sobreposição entre os territórios que possuem menos condições de atender aos requisitos da digitalização e os territórios que concentram a maior parte da agricultura familiar.

Palavras-chave: digitalização da agricultura; economia digital; desigualdades territoriais, agricultura familiar.

Las condiciones territoriales para la participación de la agricultura familiar en la economía digital

Resumen
El presente estudio analiza las condiciones territoriales para la participación de la agricultura familiar en la economía digital. El objetivo es demostrar que los principales requisitos necesarios para un buen posicionamiento en el proceso de digitalización están relacionados con factores de carácter territorial. Lo que buscamos verificar es cómo la distribución desigual de recursos, bienes y servicios en diferentes territorios genera dificultades para aprovechar el potencial de aprovechamiento de las oportunidades del proceso de digitalización por parte de la agricultura familiar. Utilizando conceptos aplicados a la economía digital, el campo brasileño y la dinámica territorial, la investigación se realizó a través de una revisión integradora de la literatura en contenidos que abordan tres objetos distintos: digitalización, desigualdad territorial y agricultura familiar, lo que permitió definir cuatro categorías que sirvieron de base para analizar las condiciones territoriales para atender los requisitos de digitalización: físicas; digital; humanos y sociales. Los resultados demuestran que existe una superposición entre los territorios que tienen menos capacidad para cumplir con los requisitos de digitalización y los territorios que concentran la mayor parte de la agricultura familiar.

Palabras clave: digitalización de la agricultura; economía digital; desigualdades territoriales, agricultura familiar

1 Introduction

The Food and Agriculture Organization of the United Nations (FAO-UN) report has good expectations for the digitalization of the agri-food sector and lists these innovations as part of the solution to the demand for food in a world that could reach 9.6 billion inhabitants by 2050, directly contributing to the Sustainable Development Goals (FAO, 2019). For Brazilian family farming, this could mean better information for decision-making, better planning of activities, accident prevention and less

exposure to risks, less training and, ultimately, greater efficiency, whether through optimizing spending and controlling inputs, better management of the relationship between production practices and nature or through the elimination of intermediaries in commercial relations.

However, the literature shows that, as with the Industrial Revolution or the Green Revolution in agriculture, not everyone has the necessary requirements to take advantage of the potential of technological innovations. The better the conditions for meeting these requirements, the better the chances of obtaining good results from the use of Information and Communication Technologies (ICTs). For this reason, the FAO report also warns of the risk of increasing inequalities. One of the concerns raised is precisely the way in which the goods and services needed to take advantage of opportunities are distributed. This concern suggests that the territorial dimension plays a fundamental role in the analysis of the digitalization phenomenon. After all, one of the most significant points of the territorial issue is precisely the unequal distribution of resources, goods and services across society (Galvanese, Favareto, 2019; Santos 2007).

Family farming is part of this scenario that combines technological transformations and territorial inequalities. The digitalization of Brazilian family farming has the potential to be a source of opportunity, allowing access to information, markets, innovations and best practices that can boost the sector's productivity and sustainable development. On the other hand, the increase in inequalities threatens income, commercial relations and causes a reduction in production, which tends to affect families' livelihoods and food security and also limits access to information and the requirements to take advantage of the opportunities opened up by digitalization (Tolocka, 2023).

In Brazil, according to the results of the 2017 Agricultural Census (IBGE, 2019), family farming accounts for 84% of a total of 5,073,324 agricultural establishments and 23% of production, employing more than 10 million people, which corresponds to 67% of the total number of people employed in agriculture and is responsible for the income of 40% of the economically active population in agriculture (Preiss et al., 2020; IBGE, 2023; EMBRAPA, 2023b). Much of the food that reaches Brazilians' tables is known to come from family farming. In addition, a growing group of consumers perceive this segment as a provider of healthy food and products (Gazolla; Aquino, 2021).

These assets, however, are not enough to guarantee a good position in the digitalization process. In contrast to large-scale farming, family farming is made up of small agricultural establishments in which the labor force of family members is predominantly used (IBGE, 2023). In addition, most producers are considered to be extremely poor or intermediate poor (Aquino; Gazolla; Schneider, 2018).

This text focuses on a specific aspect of the condition of Brazilian family farming, the one relating to the territorial dimension of this social group's existence. More specifically, the aim is to understand the extent to which the territorial conditions in which family farming operates block or encourage it to take advantage of the opportunities opened up by the digitalization process.

To answer this question, the research that gave rise to this article looked at the phenomenon of digitalization and its meanings, identified the requirements needed to convert this phenomenon into increased opportunities for economic

inclusion, the specificities of digitalization in agriculture, and why the territory should be mobilized as a central element of analysis for overcoming blockages that prevent inclusion. Based on an integrative literature review, this study used the categories of analysis suggested by Mark Warschauer (2003), who establishes physical, digital, human and social requirements as crucial for observing technological and digital phenomena.

The results highlight the centrality of the territorial component of inequalities, showing that spatial factors are decisive in whether or not the potential to take advantage of the opportunities that the digitalization process opens up for family farming prevails. The final considerations reinforce the need to overcome these territorial inequalities and point to alternatives for tackling some of the existing challenges.

2 Theoretical framework

Digitalization and its requirements

Digitalization comprises socio-technical procedures involving the use of ICTs in the restructuring of social and institutional contexts (Niederle; Schneider; Cassol, 2021) and is an important part of the social changes that have taken place since the popularization of the internet in the 1990s. It is in this context that the process of digitalization has materialized as an unavoidable reality, transforming activities in practically every sector of human life, in much the same way as the process of transformation that took place during the take-off phase of capitalism, but with greater speed. As Thomas Piketty, author of *Capital in the 21st Century*, observed:

> In a way, we are in the same situation at the beginning of the 21st century as the observers of the 19th century: we are witnessing impressive transformations, and it is very difficult to know how far they can go and what direction the distribution of wealth will take in the coming decades. (Piketty, 2014, p. 22).

Stehr (2018) notes that, as in the case of industrial society, the modern transformation is based on changes in the structure of the economies of advanced societies. Stehr is not alone. In the literature, you can find several authors who compare the digital transformation to the impacts on the world caused by the development of electricity, the internal combustion engine, the invention of the telegraph and the telephone. In this universe, large technology corporations, also known as Big Techs, have emerged as the "modern equivalents of the railroad, telephone and electric utility monopolies of the late 19th and 20th centuries" (Plantin et al., 2018, p. 307). For Alves (2021), the similarity between the two processes lies in their unequal and concentrated characteristics, noting that digitalization is also consolidated "at the expense of new inequalities, deprivations and the increased subordination of many groups, classes and social strata".

The Internet of Things (IoT), artificial intelligence (AI), immersive reality, robotics and big data are all part of this universe of technological innovations brought about by the digitalization process and promise new ways of using technology, new business models, workforce optimization, resource savings, agility in carrying out

tasks, a focus on strategic actions, better quality products and services and a broad horizon of possibilities of unimaginable proportions. The new world can be admirable! However, for this to happen, certain requirements are necessary.

The conditions for meeting the requirements of the digitalization process involve issues of infrastructure, education, knowledge, equipment acquisition, technical support, transparency guarantees, forms of organization and public policies (Buainain; Cavalcante; Consoline, 2021; Niederle; Schneider; Cassol, 2021; Warschauer, 2003). And it must be emphasized that there is an interdependence between the requirements: if one is precarious or non-existent, it can compromise several or all of the others.

The use of cell phones is one example. Although most mobile devices can work for a long time without needing to be connected to a power network, there always comes a time when the batteries need to be recharged at the risk of the device "going out". Once the batteries are charged again, a connection can be established, as long as there is a connection capable of linking the device to cyberspace. Even if the device is fully powered and connectivity is working, there is still the risk of the device "crashing" because it can't perform the desired functions, requiring some kind of update, often from the device itself, which is no longer capable of supporting new updates. Power, connectivity and compatible devices are fundamental physical requirements for using the technology.

In addition, there are also digital requirements, content, software and applications that meet people's needs. The content published in cyberspace is almost infinite. Apps offer many kinds of facilities, from a simple calculator, a social network, a messenger, a banking service, a language course, a mobility service or even tools for managing specific production technologies, such as irrigation or input management. Some are paid for, others are part of an already contracted service, there are those offered by sponsors, and then there are those that offer free access if you agree to certain clauses.

None of this is enough if there aren't people with the necessary skills to make the best use of these tools. Among the human requirements are notions of cybersecurity, relationship tools, marketing, image and video editing, digital commerce, data management, social media strategies and how search engines work. Niederle et al. (2021) point out that among the skills required are cognitive skills (creative thinking, memory, speed of reasoning), behavioral skills (personality traits, openness to new experiences, emotional stability, discipline and self-regulation) and technical skills (knowledge of software, knowledge of databases).

In a similar vein, Warschauer (2003) considers that the ability to access and be a user is not enough. You also need to be able to adapt and create new knowledge. This is why education is a fundamental requirement. The acquisition of basic skills for using computers and the Internet is not enough. It is also necessary to understand and interpret the virtual public space, its webs, connections and interconnections and, more than that, an attitude of critical incorporation of technologies is essential, enabling digital action associated with the expansion of civil, social and political rights.

The digitalization process still needs other social requirements. There is the interest of the market, the demand of the population, pressure from social entities, the responsibility of the state, the commitment of educational and research

institutions and the engagement of non-governmental organizations. According to Warschauer (2003) it is these resources, potential or real, that establish the intersection between technology and development. The adverse conditions for meeting the requirements of digitalization generate digital inequalities which, in turn, contribute to creating new inequalities or deepening and reinforcing existing ones. As Amartya Sen (1999) pointed out, inequality in capabilities is a central issue for development. And, he said, these capabilities concern attributes of individuals, but also attributes of the context in which they live.

Digitalization in agriculture

As far as agriculture is concerned, or more broadly agri-food systems, a distinction that is widely used for the purposes of analysis and organization of rural space is the division between large corporate or employer-owned properties and small family-owned or non-employer-owned properties. According to Wanderley (2009, 2019), the prevalence of the political option that defined state support for technological transformations of large property, without affecting the concentration of land ownership, means that only large property can assimilate modernization. For Wanderley (2009, 2019), this concentration acts as a social sieve capable of filtering out who will be the agents of development, which means that the process of digititalization of the agri-food sector takes place at different speeds.

Patronal agriculture is characterized by large-scale farming or livestock farming, growing grains, raising cattle and producing agricultural commodities for export, and corresponds to 1% of all establishments and occupies 33% of the total area (MAPA, 2021). Another characteristic of this segment is the structured way in which it defends its interests in society through its main representative entities, the Confederation of Agriculture and Livestock of Brazil (CNA), the Brazilian Rural Society (SRB), the Brazilian Agribusiness Association (ABAG), as well as a solid parliamentary base that is organized in the Parliamentary Agricultural Front, made up of 300 of the 513 federal deputies and 47 of the 81 active senators.

In this segment, digitalization is generally associated with the use of drones, satellites and sensors that enable the production and transmission of data on crops, animals, natural resources (water, soil, biodiversity, forests) and different agricultural practices. Its use is expanding, and the proposed solutions depend on connectivity between devices which, when associated with the Internet of Things, maximize production processes, reduce costs and can save resources (Ziegler, 2021). Tartaruga and Sperotto (2022) note that in agriculture and food activities, the list can be expanded with biotechnology, bioinformatics, nanotechnology; and, particularly in agriculture, geotechnologies, remote sensing, precision agriculture and agri-environmental modeling.

Digitalization in employer agriculture is driven by private companies, including established input companies, global software companies and startups new to agriculture (Birner; Daum; Pray, 2021). Because they have enough capital to overcome the critical moment and devise positive responses that increase network effects, Big Techs and large companies in the agri-food sector are responsible for the platformization of agriculture (Silveira, 2022). The digitalization of agriculture is giving rise to a new partnership between business agriculture agents and technology

providers (Rizov, 2020). Actions in this direction are becoming increasingly integrated through partnerships between companies, mergers and the acquisition of corporate control (GRAIN, 2021).

At the other end is family farming, which does not have nearly the same financial resources and, besides, it has difficulty accessing credit, whose representative bodies are often stigmatized by the media and find it difficult to use digital platforms. In the National Congress, the Mixed Parliamentary Front for Family Farming has 205 federal deputies and 9 senators. Directly linked to this segment of agriculture are six federal deputies and one senator elected to the 57th legislature.

It should be noted that not all of Brazil's patronal agriculture corresponds to that modern image. There are many establishments in these segments that continue to have low productivity and practice archaic forms of production or land use. But even with this caveat, the contrast is striking. While part of corporate agriculture moves between Big Tech and the farms of the future, family farming has not yet taken the path to overcome the challenges of digitalization to the same extent, even during the Covid-19 pandemic, when the use of digital platforms for marketing family farming products intensified.

The pandemic has brought digitalization to the center of the agenda, as in other sectors. The way out for family farming was to look for virtual solutions to get around the difficulties and this accelerated the digitalization process, causing a growth in marketing via digital platforms (Niederle; Schneider; Cassol, 2021). The newspaper of the Federal University of Rio Grande do Sul (UFRGS) captured in a report the moment when small farmers, who were not frequent users of social networks and apps, also turned to these platforms to try to reduce their losses due to the absence of open-air markets (Costa, 2020). The Landless Movement (MST) also announced the launch of its platform, called "armazemdocampo.shop", with the aim of selling products from its settlements (MST, 2020). The results of a bibliometric study carried out by Oliveria, Souza and Ferreira (2024) indicate that the technological innovations incorporated by family farming are predominantly related to the need generated by Covid-19. According to this study, the technologies most used by farmers were messaging apps, social networks, PIX and debit and credit card machines to market their products.

Gazolla and Aquino (2021) believe that there has been a reinvention of family farming markets. These authors investigated 38 selected websites and digital platforms across Brazil. The research left out websites and platforms that predominantly sell products other than those of family farming, as well as social networks and apps (Facebook, Instagram, WhatsApp, among others). The authors point out that family farming's adherence to the use of digital platforms for food marketing was already happening even before the pandemic. However, the restriction on the usual markets generated by the pandemic has intensified the process. They also observed that the family farmers who invested in platforms were already part of short marketing chains, and most of the platforms analyzed were managed by cooperatives, centrals and associations, which reinforces the importance of an inter-cooperation strategy.

Maciel, Troian and Oliveira (2024) analyzed the case of Santana do Livramento in Rio Grande do Sul and observed that the use of ICTs by family farming in short chains has transformed market entry and marketing, strengthening local commerce

and enabling greater proximity to the consumer. In Bahia, this strategy, adopted by the Central de Comercialização de Cooperativas da Caatinga (Caatinga Cooperative Commercialization Center), provided a very useful material for family farming: the *"Guia prático de comercialização de produtos da agricultura familiar"* (Practical guide to commercializing family farming products), launched in the middle of the pandemic with the aim of helping members of the family farming production chain to get through that difficult time (Lima, 2020). The experience of the inhabitants of the municipality of Antônio Prado, in the Serra Gaúcha, illustrates how local actions and cooperation can help to overcome adversity. In this municipality, a program conceived by the town hall made it possible to install 250 kilometers of optical fiber in 32 rural communities, benefiting around 360 families (Zanrosso, 2022).

While the perception that the internet and ICTs are beginning to be adopted by family farmers in search of new opportunities is correct, it is also noticeable that the internet still has limited effects on their strategies (Conceição; Schneider, 2020). Family farmers perceive and report an increase in demand for their products via the internet, but they are unaware of how much the use of this form of marketing contributes to their monthly income (Feiden; Ramos; Schwanke, 2020). For most family producers, the internet and its derived tools are still used as an accessory for support and consultation, while for the larger ones they have already become planning and management tools (Buainain; Cavalcante; Consoline, 2021).

Castro (2024) observes that a characteristic of family farming in many countries is that it lags behind non-family farming in terms of its technological profile, access to new technologies and innovative mentality. In his studies, this author argues that there is a risk of technological inequality widening between family and non-family farmers in Brazil, especially in regions where the socio-economic profile and support for these two categories of farmers show the greatest differences.

Digitalization and territorial inequalities

The territory is a key element in the digitalization process. It is here that most of the requirements for a good position in the face of digital transformation take shape. Territorial conditions denote the boundaries, geographical features, climate, natural resources and infrastructure available in a given area. These elements play a crucial role in determining the opportunities and challenges for the development of any region. Geographical features, for example, directly influence accessibility and connectivity to economic centers and consumer markets. Climate and natural resources are also decisive in shaping a region's possibilities. It's no coincidence that physical structures such as roads, ports and telecommunications make all the difference in attracting investment and the potential for opportunities to improve the quality of life of a region's inhabitants.

Territorial conditions also directly influence a region's capacity for innovation and economic diversification. Economic diversification and adequate infrastructure strengthen the region, making it better able to react to the negative impacts of a globalized economy and the challenges this brings. Therefore, disparities in territorial conditions promote a type of inequality that becomes a central aspect of broader inequalities (Galvanese; Favareto, 2019). According to Milton Santos (2007), there are

social inequalities that are first and foremost territorial inequalities "because they derive from the place where each one is located".

In Brazil, the unequal way in which resources, goods and services are made available is the result of a historical legacy, political choices and the interests of economic groups. As Maria Adélia de Souza (2019) pointed out, there is no way to discuss inequality without considering the instance of geographical space historicized by the use of territory. This is because, as this author observes, the dispute involves access to land ownership and belonging to a class, making inequalities conceptual, socio-spatial and territorial, existential and historically speaking. This structural heterogeneity, characteristic of the territorial configuration of countries like Brazil, is an important dilemma to overcome (Galvanese; Favareto, 2019).

The literature does not provide a specific definition or concept for territorial inequality. "Territory in any sense," says Haesbaert (2010), "has to do with power" and "concerns both: power in the explicit sense of domination, and power in the implicit or symbolic sense of appropriation". In both cases, inequality is present. The issue of territorial inequality in Brazil is pointed out as a persistent problem, the result of a historical legacy of forms of spatial occupation that have led to a strong dismantling of its organization (Diniz, 2013), with marked differences between regions (Soares et al., 2016), fragmentation (Vainer, 2007), disparate capacities (Mesquita et al., 2015) and poor distribution of the productive structure (Azzoni, 2001).

It is therefore a complex problem that involves many factors, from historical aspects such as the concentration of land ownership, political decisions for the benefit of a few, and mistaken choices of economic and development models. Added to this is the lack of investment in certain territories and the absence of public policies to reduce disparities. Brazil's vast territory makes it difficult for technology and information to reach all locations at the same pace and, as a result, pockets of inequality are created (Garcia; Ribeiro, 2012). The problem is that pockets of inequality always follow the same flow. The less resources are available, the more vulnerable the situation of those who inhabit the territory is. The inevitable process of digitalization does not come to act in the counterflow, which could be really transformative, but ends up aggravating the situation, since it creates demands whose conditions of service are unequal in the different territories. In addition to infrastructure, territorial inequality affects educational conditions, restricts access to markets and business opportunities, limits specialized technical services and support and drives away potential agents of innovation.

3 Method

This research was carried out using an integrative review. This method allows data from theoretical and empirical literature to be combined, providing a more complete understanding of the topic (Ercole; Melo; Alcoforado, 2014; Mendes; Silveira; Galvão, 2008). Firstly, the procedure for searching and selecting the studies was established. The first criterion of interest was content that addressed the three distinct objects: digitalization, territorial inequality and family farming, transformed into keywords.

The research considered content published in various formats, duly registered, already worked on by other researchers (Severino, 2013) and publications referred to as grey literature, which include reports (research, technical reports, institutional and project publications), working documents, government documents and evaluations (Botelho; Oliveira, 2008), as well as the use of literature presented in academic disciplines and captured in participation in related events, such as seminars, symposia, debates, lectures and short courses, promoted by various organizations at national and international level.

A search was carried out in the Scopus, Scielo and Google Scholar databases using the three keywords in Portuguese and English. Based on the results found, a set of relevant publications was organized, making it possible to find new sources based on the references and citations provided. The second step was to extract concepts and data from the selected material in order to establish a starting point and a perspective on the objects observed in this research. To facilitate organization and subsequent analysis, the material was separated into four categories, one for each keyword and a cross-cutting category that included the combination of more than one keyword. This classification into categories allowed for a more careful evaluation of the selected material in order to extract the most pertinent information for the proposed study. At this stage, it was decided to adopt the same categories for analysing ICTs suggested by Mark Warschauer (2003), as a way of classifying the necessary requirements for the digitalization process. This author has organized four categories of analysis of the resources needed to use Information and Communication Technologies (ICTs), grouped as follows: 1) Physical requirements, which cover access to computers (devices) and telecommunications connections; 2) Digital requirements, which relate to the digital materials made available online; 3) Human requirements, which revolve around issues such as literacy and education, including the specific types of digital literacy practices required for computer use and online communication; 4) Social requirements, which refer to the community, institutional and social structures that support access (Warschauer, 2003, p. 47).

The third step began with a critical and reflective reading of the material, identifying the main points, arguments, procedures used, information and data on the distribution of digitalization requirements in the territories in relation to family farming.

4 Results and discussion

The data analyzed in this topic shows that territorial factors interfere with the conditions necessary for family farming to take advantage of the potential opportunities opened up by the digitalization process. There is an overlap between the territories that are least able to meet the requirements of digitalization and the territories that concentrate the majority of family farming. Clearly, the North and Northeast have more structural problems, fewer training options and a smaller supply of innovation agents. It is precisely in these territories that more than half of the establishments identified as family farming in Brazil are concentrated, as shown in Table 1.

Table 1: number of agricultural establishments in Brazil and family farming establishments by region.

Brazil and Greater Region	Total Number of agricultural establishments	Family farming establishments
Brazil	5.073.324	3.897.408
North	580.613	480.575
Northeast	2.322.719	1.838.846
Southeast	969.415	688.945
South	853.314	665.797
Midwest	347.263	223.274

Source: IBGE Agricultural Census (IBGE 2019)

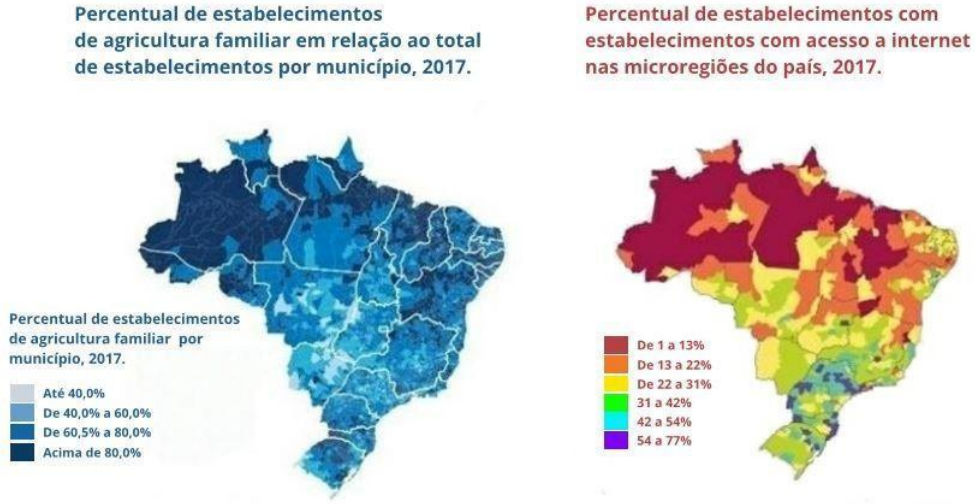
The diversity of family farming is also marked by significant socio-spatial inequality. Aquino, Gazolla and Schneider (2018) note that in family farming, those with the highest incomes hardly appear in the North and Northeast of Brazil, but are more common in the Midwest, Southeast and, above all, the South. The North and Northeast concentrate the extremely poor, and there is also a middle class spread across the Southeast, Midwest and North regions.

The provision of physical resources

Connectivity is a basic requirement for digitalization to take place, but without energy nothing can be done. IBGE data shows that 45.2% of a total of 80,959 rural establishments in Amazonas do not have access to energy (Santana; Santos, 2020).

Information from the Agricultural Census, collected in 2017, shows that 72.2% of agricultural establishments with no more than 50 hectares had no internet access. In the north of the country, this rate is close to 85%, while in the south more than 40% of establishments have internet access (IBGE, 2019). Figure 1 makes it possible to visually identify the similarity between the location of family farming establishments and the areas where the lack of internet access is greatest.

Figure 1: Compared maps: darker left, households identified as family farming; darker right, regions with less internet access.



Source: Agricultural Census (IBGE 2019). *Inclusão Produtiva Brasil Interiorano* Report - Productive Inclusion in Inland Brazil Report (Favareto et. al. 2022)

In 2022, the IBGE website prominently reported that the internet would reach 90% of Brazilian households. But in general, the conditions for using the internet in Brazil are still considered precarious. Data from Anatel shows that the density of fixed broadband is 58.66% in Brazil. In the South the density was 65.82%; in the Southeast 63.39%; in the Midwest 50.17%; in the Northeast it fell to 28.5% and in the North, it was 27.16% (MINISTÉRIO DA CIÊNCIA TECNOLOGIA E INOVAÇÕES, 2022). However, in rural areas, the proportion of households with internet connection rose from 57.8% to 74.7% between 2019 and 2021 (IBGE, 2022a), a connection largely attributed to cell phones with mobile broadband.

For rural areas, the challenge is even greater: a study by the Luiz de Queiroz College of Agriculture at the University of São Paulo (Esalq-USP) showed that only 5% of the country's arable land is connected to the internet (Cozman; Plonski; Neri, 2021). In addition, the quality of access is also a problem, with large differences in territorial distribution of the type of technology made available and the quality of the companies offering it (Buainain; Cavalcante; Consoline, 2021). Data from the National Telecommunications Agency (Anatel) reveals that 30% of Brazilian municipalities do not have fiber optic technology for internet access. The highest levels of lack of this technology are found in the Northeast (59%) and North (54%) of the country (ANATEL, 2020). In rural areas, access exclusively by cell phone corresponds to 78%, while in urban areas it represents 59%. Even so, according to the Ministry of Science, Technology and Innovation (2022), the territorial differences in mobile coverage in

rural areas are high - while the Federal District has coverage of 89.48% of its residents, in Roraima this percentage is only 2.67%.

Offer of digital resources

What characterizes digital resources is precisely the extensive range of content and services that are made available and made operational through internet connections. There are countless applications and software aimed at agricultural producers. The possibilities are many: land management, climate information, business management, pest control, marketing and so on. Studies indicate a trend towards increased interest in the subject on the part of Brazilian agricultural producers. Research carried out in 2020 indicated that 71% of farmers use digital channels on a daily basis for farm-related issues and the instant messaging app WhatsApp (belonging to the Meta Platforms group, which also includes Facebook and Instagram) is used daily by 85% of Brazilian farmers for agriculture-related purposes. According to the survey, this rate is maintained even among the less literate group (MCKINSEY & COMPANY, 2020).

In the survey conducted by Bolfe et al. (2020), 84.1% of the participating farmers said that they use at least one digital technology in the production process. The use of cell phone applications or computer programs for obtaining information or dissemination is 57.5%, while 22.2% said they use cell phones or computer programs for property management and production. The main interests reported by the farmers surveyed are: information and planning of farm activities (66.1%); farm management (44.3%); buying and selling inputs, products and production (40.5%); mapping and planning land use (32.7%); and forecasting climate risks, such as frost, hail, summer and heavy rain (30.2).

The main applications and software related to the agricultural sector can be grouped into three blocks. The first includes those that provide solutions for problems that are not on the farm, but which are necessary for production, such as buying inputs, machinery, pesticides and simulating credit, for example. For "inside the gate", the second group offers solutions for everything needed for production, i.e. planting, management, irrigation control, input control, climate information, management platforms, image monitoring and content platforms. The third group offers storage, marketing and logistics solutions, i.e. everything "from the farm gate outwards".

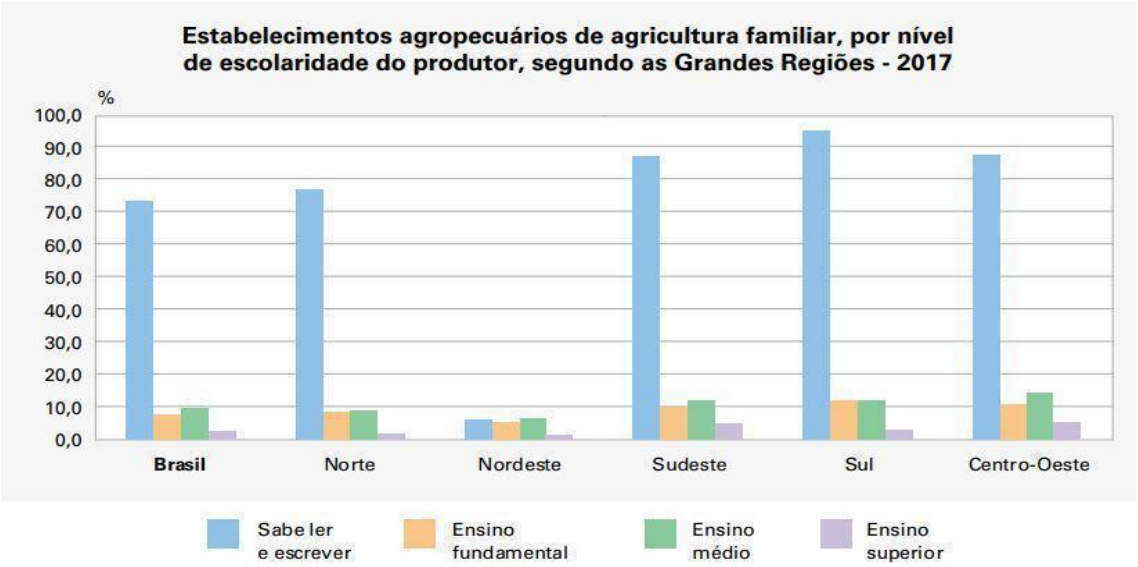
The problem pointed out by 40.9% of farmers, as shown in the survey by Bolfe et al. (2020), is the lack of knowledge about the most appropriate technologies. In addition, for 34%, training to deal with these new digital tools is an issue to be overcome in order to make better use of the digital resources available.

Training human resources

Training is a central issue because it involves precisely the ability to gain access to information and transform it into knowledge, which also needs to be expanded to rural areas (Bernardes; Torres, 2010). A first challenge is to overcome the low level of schooling in family farming, where only 2.7% have higher education, 12.4% have completed high school and 26.4% are illiterate (Aquino; Gazolla; Schneider, 2018).

Data from the IBGE (2022b) highlights territorial inequalities, revealing that the South, Southeast and Center-West tend to concentrate the highest proportions of family farmers who can read and write, who have completed primary and secondary school, and who have completed higher education.

Figure 2: Level of schooling in family farming by major region



Source: IBGE (2019). Atlas of the Brazilian countryside (2022b)

Another important aspect concerns Technical Assistance and Rural Extension (ATER) services. The 2017 Agricultural Census showed that only 20.7% of agricultural establishments in Brazil received some kind of technical guidance. Among family farmers, the figure is even lower: 18.2%. The regions with more advanced and modern agriculture recorded higher percentages of technical guidance than the more backward regions: in the Northeast only 8.4% of establishments reported receiving guidance, while in the South the percentage was 50.2% (IBGE, 2019). The data also shows that among the 18.7% of establishments identified as family farming that received some kind of technical guidance, 43% received government assistance and 26% received it from cooperatives. Government guidance was used by 76% in the North, 67% in the Northeast, 40% in the Midwest, 38.9% in the Southeast and 32% in the South. Guidance from cooperatives was requested by 37.2% of family farmers in the South, 24.4% in the Southeast, 18.6% in the Midwest, 8.5% in the Northeast and only 3.9% in the North (Pereira; Castro, 2021).

One of the explanations for the low rate of use of ATER is the cost. Niederle, Schneider and Cassol (2021) argue that digitalization itself can be an alternative to traditional face-to-face technical guidance. The internet makes it possible to bring rural extension services with important information on technologies, prices and climatic conditions to the poorest farmers, where face-to-face private technical assistance services have no interest in reaching and public systems cannot. However, these same authors note that, contrary to the recommendations that many governments claim to follow, there is a greater concern with reducing costs through digitalization than with empowering actors.

Agents of innovation

In other times, the Brazilian state was essential for technological innovation in the agri-food sector. This gave rise to the Brazilian Agricultural Research Corporation (Embrapa), which has been a key player in the technological development of Brazilian agriculture ever since. In contemporary Brazil, other agents of innovation have begun to establish the insertion of technology. Buainain, Cavalcante and Consoline organized the innovation macro-system into five nuclei innovation agents:

> 1.Large companies producing machinery, equipment and inputs, responsible for developing and introducing some of the key technologies that anchor agriculture 4.0;
> 2.The ecosystem of agro startups and AgTechs, made up of a large number of small technology-based companies, most of them emerging, is rapidly consolidating its position as one of the pillars of the digital transformation in agribusiness;
> 3.Universities and research centers/institutes, which remain another of the pillars and which directly and indirectly feed the other nuclei of the ecosystem;
> 4.State agencies, civil society and corporate organizations that support innovation hubs;
> 5.Investors. (Buainain; Cavalcante; Consoline, 2021, p. 29)

It is interesting to note that the large companies mentioned in the first item are often the same as those in the chemical-pharmaceutical sector and are responsible for selling chemical fertilizers, seeds (some of which are transgenic) and pesticides (Bombardi, 2022). Bearing in mind that these companies are organized in an oligopolistic way, this author has identified that a considerable number of companies in the agrochemical sector are committed, at a global level, to promoting connectivity between hardware, software and agricultural equipment.

With regard to the AgTech ecosystem, it is worth noting that in 2021 Brazil already had 1,574 AgTechs, 199 of which operate before the farm, i.e. buying inputs, fertilizers, inoculants, credit, insurance, etc.; 657 within the farm, with emphasis on management systems, control of drones, machinery and equipment, pest detection, product control, etc.; 718 after the farm, where there are services and products for innovative food and new food trends, platforms for negotiating the purchase and sale of products, control of storage and logistics, etc. It is important to highlight the high concentration of these companies in spaces where the experience of innovation is stimulated by different agents, facilitated by their proximity to technology hubs and universities. Territorial inequality is also easily seen in the distribution of AgTechs. No less than 62% of these companies in the development phase are located in the Southeast. The South has 25%, the Midwest 6%, the Northeast 5% and the North only 2% (Figueiredo; Jardim; Sakuda, 2021.

Figure 3: Distribution of AgTechs by region and federative unit

Source: Radar Agtech Brasil (2021)

Although they are no longer the sole protagonists, the role of Embrapa, other research institutes and universities remains extremely important, especially for agricultural production models that are not embraced by corporate bosses. Embrapa has 46 research centers, and a broad portfolio of applications developed to meet various demands, including specific cultural and regional information. Information on the climate, insurance and technical questions can be found in Embrapa's apps, which seek to give more weight to the needs of producers than to the demands of the market (Buainain; Cavalcante; Consoline, 2021). The company has a specific catalog of apps for family farming. These applications are available to producers on the Embrapa website (EMBRAPA, 2023).

Universities, especially public ones, and federal institutes also play a leading role in disseminating innovations, especially in rural areas. The federal network is the largest provider of professional education in rural areas, with 45,000 enrolments (MINISTÉRIO DA CIÊNCIA TECNOLOGIA E INOVAÇÕES, 2022). Research, extension and study initiatives in different courses seek to promote the necessary interdisciplinary approach, resulting in academic activities that in their most varied formats promote dialogue with society. But there is no satisfactory integration between this network of higher education institutions and the networks dedicated to assisting farmers, especially the poorest ones. The expansion of the public higher

education network has not been accompanied by a policy for the deconcentration of local ecosystems capable of promoting the deconcentration of AgTechs or the creation of local networks aimed at those segments not currently served by such technological innovation structures (Favareto et al., 2022b).

The involvement of Non-Governmental Organizations (NGOs), associations and trade associations can also make a difference. CNA, through its National Rural Apprenticeship Service (Senar), offers more than 120 free courses - some can be taken at a distance and others in person. The "Digital farming" course is 100% online, 100% free, certified, lasts 30 days and has a workload of 24 hours. The course syllabus is divided into five modules: 1: Evolution of farming; 2: Hardware technologies available for farming; 3: Computing used in digital farming; 4: Digital currencies and contracts; 5: The new economy. There is nothing similar on the platforms of CONTRAF-BRASIL/CUT or CONTAG, the main organizations representing family farmers.

There are several organizations working to support innovation hubs, some of them international. The Inter-American Institute for Cooperation on Agriculture (IICA), for example, in its report on rural connectivity in Latin America and the Caribbean, reports on some of the actions it has been developing in Brazil, including the evaluation of alternatives for the development of a business plan to expand internet connectivity in the Alto Solimões micro-region in Amazonas; the alliance with Precision Agriculture for Development (PAD) to incorporate digital agricultural services for technical assistance and rural extension; the Virtual Hubs Project, which aims to improve access to information on technological innovations for family farmers in the Northeast and will finance the creation of virtual centers for technological innovation; and the Digital Territories project, in partnership with the Brazilian government (Ziegler; Segura, 2022).

Cooperatives can also play a leading role in technical assistance and the adoption of digital technologies. In the case of family farming, studies have shown that the creation of digital strategies is not possible on an individual basis, requiring the search for collective solutions, especially via cooperatives and associations (Gazolla; Aquino, 2021). Cooperatives that provide a basket of services offer technical assistance, covering production operations such as georeferenced mapping for planting alignment, fertilizer and pesticide application, fertilization, soil correction and irrigation, etc.; organization and control for purchasing inputs; and marketing, including product traceability, which has been a growing demand from the consumer market (Buainain; Cavalcante; Consoline, 2021).

Unfortunately, as the same authors point out, data from the last Agricultural Census reveals that only 579,000 producers were associated with cooperatives. Again, there is a discrepancy between the regions. The highest number of associated producers is in the South with 36.7%, followed by the Southeast with 17.09% and the Midwest with 13.29%. In the North and Northeast, the rate is less than 4%, with 3.5% in the North and only 1.5% in the Northeast.

Public policies for the digitalization of agriculture

The absence, inefficiency or poor application of public policies is recurrent in the literature. A survey by Souza and Bidarra shows that there are in fact several

initiatives to promote the digitalization of agriculture in Brazil. The main ones are: the establishment of the CT-Agronegócio; the Legal Framework for Science, Technology and Innovation; the General Data Protection Law; the National Internet of Things Plan; the creation of the Precision and Digital Agriculture Commission; the ATER Digital Program; the Agro 4.0 Program and the Agro 4.0 Chamber. In addition to these, the authors also mention the BNDES IoT Pilot and the actions of Embrapa Informática Agropecuária (Agricultural IT), created in 1985 to develop information technology projects. The Agro 4.0 Program alone, launched in 2020, has invested R$4.8 million in 14 pilot projects for the adoption and dissemination of digital technologies in large-scale agriculture (Souza; Bidarra, 2022).

There is nothing similar for family farming. Family farming is not represented in any of these mechanisms set up by the government. One of the findings of Gazolla and Aquino's (2021) investigation into the use of digital platforms by family farming was precisely the finding that there was no specific public policy for this segment towards digitalization. In another study, these authors point out that there is a serious digital debt in the Brazilian countryside and find that the state has hardly mobilized to come up with solutions and public policies focused on tackling the problem (Gazolla; Aquino, 2024). A similar statement is made in Favareto et al. (2022b), with explicit references both to the need to reduce the deficit in energy and internet infrastructure in less-favored regions, and to the importance of creating innovation ecosystems by making better use of the potential of the recent expansion of the network of higher education institutions.

It's time to think about some form of public support that will help to overcome the bottlenecks identified and encourage a wave of digital innovation among this public, based on their specific characteristics. The regulation of the Telecommunications Services Universalization Fund (FUST), which took place in 2020, is considered a step forward by international organizations such as IICA and could benefit family farming. In the institute's opinion, the revenue from this fund, created to stimulate the expansion, use and improvement of the quality of telecommunications networks and services, reduce territorial inequalities and stimulate the use and development of new connectivity technologies, should be invested in public policies through programs, activities and policies for technological innovation of telecommunications services in rural areas, coordinated by Anater (Ziegler; Segura, 2022.

IICA's suggestion deserves a lot of attention from the executors and recipients of these public policies. After all, digitalization promises to save resources, reduce costs, improve quality and increase productivity. This implies the need for more qualified and specialized workers and producers, which requires public policies and research aimed especially at small and medium-sized producers (Souza; Bidarra, 2022).

Resende argues that the impacts of public policies are not territorially neutral and therefore strengthen the geographical concentration of economic activities. Understanding this mechanism is fundamental for territorial planning and deciding where and how available resources should be invested, in order to improve results and raise people's standard of living in different areas of the country (Resende, 2014).

5 Final Thoughts

The path taken in this study has shown that digitalization is an unavoidable process with no turning back, and that it affects all sectors of society. However, the fact that it is inevitable does not mean that the opportunities and solutions presented would be available to everyone at the click of a button. On the contrary, the digitalization process requires certain requirements: physical, digital, human and social. The conditions of these requirements define the quality and efficiency with which the opportunities of digitalization are appropriated.

Furthermore, the digitalization process is happening at very different speeds in the Brazilian agri-food sector. On the one hand, corporate farmers are making great use of modern technologies, investing in training, having the issue assimilated by their representative bodies, articulating specific public policies and allied with the world's major technology corporations. At the other end of the spectrum is family farming, whose main use of technology is WhatsApp, which is unable to invest in training, whose representative bodies have not taken up the issue, and which does not demand a specific public policy, although it does have the support of international organizations.

In addition to the specific attributes of each social group and its agents, the territory is a central point in the digitalization process, since it is there that many of the requirements of digitalization are established and materialized. The data collected in this study shows that territorial inequalities are detrimental to family farming. There is an overlap between the territories that are least able to meet the requirements of digitalization and the territories that concentrate most family farming. Clearly, the North and Northeast have more infrastructural problems, especially in terms of access to energy and the internet, have fewer options for training, and live with a smaller supply of innovation agents; as has been said, it is precisely in these territories that most of Brazil's family farming is concentrated. Overcoming territorial inequalities is fundamental if the potential for taking advantage of digitalization opportunities is to be achieved in family farming. The relationship between territorial inequalities, technological transformations of this kind and the conditions for the inclusion of the most vulnerable farmers in the development of these regions is therefore clear.

As we can see, the aim of overcoming inequalities will not be solved by technological appropriation alone. Economic and political conditions need to be created for this to happen. Investments in public goods and services are necessary to create a more equal environment for regional development, conducive to the inclusion of family farming in the context of digitalization. The strategic intervention of the Brazilian state, at various levels, must take place in order to create public policies that combat the determinants and blockages caused by the digital debt that afflicts the majority of the country's farmers on the threshold of the 21st century. Added to this is the need to promote arrangements, creating new regional innovation ecosystems in the different territories, with the participation of a greater diversity of actors committed to ensuring that Brazilian family farming has the objective conditions to access, manage and fully benefit from the benefits spread by digitalization.

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