Programa de Pós-Graduação Desenvolvimento Regional mestrado e doutorado

DOI: 10.17058/redes.v29i1.19273

What are digital food markets? Definitions in a context of sustainable and inclusive development

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Abstract
The objective of this article is to present a rough conceptual framework for new digital food markets inscribed in a context of increasing digitalization and which should be understood through the lens of sustainable development and sociotechnical inclusion. Methodologically, the work is based on review of relevant national and international literature, as well as on results and reflections arisen from some of our previous studies conducted within the scope of different research projects. As a result, digital food markets are conceived and conceptualized as new marketing channels based on sociotechnical interfaces that allow transactions between consumers and farmers, preferably within the markets referred to in the literature as social proximity and/or territorial. The work also points out challenges, recent research findings and some innovations found in investigations on the subject, highlighting the Brazilian State's prominent role, at various territorial levels, in promoting digitalization and food markets.

Keywords: sustainable development; food; food markets; digitalization.

O Que São Mercados Alimentares Digitais? Definições Em Um Contexto De Desenvolvimento Sustentável E Inclusivo

Resumo
O objetivo deste artigo é apresentar um quadro conceitual aproximado para novos mercados alimentares digitais inseridos em um contexto de digitalização e que devem ser compreendidos sob a ótica do desenvolvimento sustentável e da inclusão sociotécnica. Metodologicamente, o trabalho está alicerçado em revisão de literatura nacional e internacional sobre o tema, bem como em resultados e reflexões oriundos de alguns estudos anteriores conduzidos no âmbito de diferentes projetos de pesquisa. Como resultado, os

mercados alimentares digitais são concebidos e conceituados como novos canais de comercialização, que se utilizam de interfaces sociotécnicas para que as transações entre consumidores e agricultores aconteçam, preferencialmente, dentro dos mercados denominados na literatura como de proximidade social e/ou territoriais. O texto também aponta desafios, resultados de pesquisas já realizadas e algumas inovações que foram encontradas em investigações sobre o tema, ressaltando o importante papel que cabe ao Estado brasileiro, em vários níveis territoriais, na promoção da digitalização e dos mercados alimentares.

Palavras-chave: desenvolvimento sustentável; alimentação; mercados alimentares; digitalização.

¿Qué son los mercados alimentarios digitales? Definiciones en un contexto de desarrollo sostenible e inclusive

Resumen
El objetivo de este artículo es presentar un marco conceptual aproximado para los nuevos mercados digitales de alimentos insertados en un contexto de digitalización y que deben ser entendidos desde la perspectiva del desarrollo sostenible y la inclusión sociotécnica. Metodológicamente, el trabajo se basa en una revisión de la literatura nacional e internacional sobre el tema, así como en resultados y reflexiones derivadas de algunos estudios previos realizados en el ámbito de diferentes proyectos de investigación. Como resultado, los mercados digitales de alimentos se conciben y conceptualizan como nuevos canales de comercialización, que utilizan interfaces sociotécnicas para que las transacciones entre consumidores y agricultores se realicen, preferentemente, dentro de mercados referidos en la literatura como de proximidad social y/o proximidad territorial. . El texto también destaca desafíos, resultados de investigaciones ya realizadas y algunas innovaciones encontradas en las investigaciones sobre el tema, destacando el importante papel que juega el Estado brasileño, en varios niveles territoriales, en la promoción de la digitalización y los mercados de alimentos.

Palabras clave: desarrollo sostenible; alimento; mercados de alimentos; digitalización.

1 Introduction

The use of digital tools underwent such an expansion to the extent that these devices now appear in every dimension of social life (Niederle; Schneider; Cassol, 2021). In the case of agriculture and food systems, the digitalization processes are no different. Its dissemination is witnessed in agricultural and food activities – although permeated by contradictions and inequalities between social groups, productive activities and economic sectors – simultaneously promoting new opportunities and exclusions. In rural Brazil, digitalization has mostly advanced in the segments of new 'agritechs' and of the so-called 'smart farming' and agriculture 4.0, which comprise 'new' sociotechnical movements, although linked to the technological standards of agricultural modernization (MASSRUHÁ; LEITE, 2018; LEZOCHE et al., 2020; BORBA et al., 2021).

In the case of family farming (FF), the implementation of digital agricultural knowledge and information systems has been advancing on various types of digital

platforms, for provision of Technical Assistance and Rural Extension (TARE) services, for agri-food and products marketing using Information and Communication Technologies (ICTs) and different technological instruments (platforms, social networks, delivery apps, etc.) (ROLANDI et al., 2021; FIDA, 2021).

It is worth considering, however, that digitalization processes have not equally reached all actors in the food system. For example, in the case of Brazilian farmers, those establishments characterized as non-family farming (NFF) and also the better-off family farmers (FFs-V) who are better structured and equipped (Variable Group in the census data) are more able to embark on this technological *treadmill* and access different digital technologies. On the other hand, the poorest family farmers (Group B in the census data), who comprise most of Brazilian farmers (53.68%), have great difficulty in accessing and incorporating digital advances into their farming systems (GAZOLLA; AQUINO, 2024; ABRAMOVAY, 2020).

In any case, in recent years, there has been an acceleration in the development of digital food markets, which have emerged as a creative commercial alternative, both for large economic and corporate groups, as *marketplaces* such as Alibaba, Amazon, and others, but also for small and more vulnerable social sectors such as FFs and their social organizations (DA COSTA, 2020; HLPE, 2020; KENNY; SERHAN; TRYSTAM, 2020; REARDON; SWINNEN, 2020). Research by Cubides Zuniga and Lugo Montilla (2020) on family farming sales platforms during the COVID-19 pandemic in Latin America and the Caribbean shows that nearly 30% of sales are made via websites and platforms, second to messaging applications (e.g., WhatsApp), which are the most widely used technological tools in over 70% of cases.

Research in Brazil indicates that digital food markets are developing as an extension of physical territorial markets, with sales carried out through platforms. In many cases, these digital markets maintain the social relations and consumers of physical markets, functioning as a new sociotechnical short supply chain mediated by ICTs. The construction of family farming digital food markets is collaborative, mostly conducted by cooperatives, associations or solidarity consumer groups (GAZOLLA; AQUINO, 2022).

In view of the above discussed, this article is intended to present a brief outline of a conceptual framework for defining and understanding the new digital food markets that are inscribed in a context of digitalization and should be understood through the lens of sustainable development and socio-technical inclusion. To this end, the work is structured in three sections, in addition to this introduction and the final considerations. The first discusses digitalization in the light of sustainable and inclusive development. The second discusses what are food markets within family farming and, the third section discusses digital markets.

2 Sustainable and inclusive development and digitalization: the role of the State

Sustainable development means the efforts to develop, over time and across social spaces, conditions that both allow for individuals to achieve social and economic well-being and substantive freedoms, and to protect and regenerate environmental resources and ecosystem services based on sustainable strategies (ABRAMOVAY, 2010; SACHS, 2011). In this sense, sustainable development must be pursued by both public and private organizations and its pursuit should be currently

based on the societal paradigm of the seventeen (17) Sustainable Development Goals (SDGs), as recommended by the United Nations (UNDP, 2021).

Furthermore, when development is conceptualized in accord with social inclusion, both private actors and public policies, in a given society or social group, should seek to enhance individuals' capacities to develop socioeconomically (SEN, 2000). Here we mobilize the term 'inclusive development', meaning a development process concerned with including social actors who are alienated from digitalization processes, especially family farmers, but also consumers of their products. It is also necessary to consider that digital exclusion, in many cases, is a repercussion of broader processes of social exclusion to which these social actors have been historically subjected, what makes them unable to access digital tools.

Studies by international organizations point to digitalization as an irreversible and essential process for sustainable development. These studies recognize its benefits, such as reduced transaction costs, support for economic growth, creation of new businesses and rapid access to production and technological information, and greater connectivity between equipment and people. However, such studies also warn that digitalization can also produce increasing social and economic inequalities, especially among the poorest populations. International literature labels this process as 'digital divide' (WORLD BANK, 2016; OECD, 2019; FAO, 2020; ECLAC, 2020).

In this regard, the Inter-American Institute for Cooperation on Agriculture (IICA, 2020) points to a digital gender gap. The aforementioned report revealed that, in this region, the number of women without access to a cell phone exceeds that of men, especially in rural areas. This less connected group is made up of women with low levels of education (Rotondi *et al*., 2020). The lack of connectivity directly affects their ability to access information, what leads to the need to reduce this disparity. Cunha and Schneider (2021) emphasize that this would improve women's living conditions, facilitating their access to markets, and contributing to their human development.

A major challenge to social inclusion lies in the access to the internet, since only around half of the world's population has access to the world web (54%) and an even smaller percentage is not yet included in the so-called 'digital economy' (only 40% of the world's population) (WORLD BANK, 2016; FAO, 2020). Obviously, these general data are even more contrasting in developing countries, such as Brazil and other Latin American nations, where social and economic disparities are historic and affect predominantly workers engaged in low and medium technology sectors.

By reviewing the literature on digitalization in agriculture and rural areas focused on the European Union, Rolandi et al. (2021) highlight its impacts in four domains: governance, social, economic and environmental. Regarding the economic domain, its main impacts fall on the following aspects: organization, working process and management of production activities; value chains, including the various stages in the supply chain, but also additional activities, such as marketing, sales and services; markets, places where sellers and buyers meet to exchange goods and services, setting their prices. This latter aspect identified by the authors in their review is in line with our research object, although this is more specific, since it deals with food markets.

In the domain of natural resources, the authors highlight animal welfare, ecosystem services (such as pollination and clean air), use of natural resources and

management of environmental risks. Regarding governance, digitalization improves functioning of bureaucratic and legal procedures, accelerating access to regulatory and administrative information. Finally, in the social domain, the effects include self-advancement, increased social interaction, protection of labor rights, increased social capital and better data control and security.

Some of these impacts of digitalization in the context of sustainable development processes have been mentioned by other authors, reinforcing the findings by Rolandi et al. (2021). This is the case of Reardon et al. (2021) who argue that the digitalization of food systems will unfold into four trends: a) *e-commerce* will more vigorously enter value chains; b) retailers will integrate *e-commerce* into their supply chains; c) new delivery intermediaries will proliferate, co-pivoting new e-commerce businesses; and d) small and medium-sized retail and food service companies will increasingly incorporate e-commerce and deliveries.

In the case of rural development processes in Brazil, digitalization is still in its infancy and must advance in several of the aspects raised at the European Union context. For example, in terms of rural structure, most farmers still are not connected to the internet. Data from the latest Agricultural Census (IBGE, 2019) show that around 3.64 million (71.8%) Brazilian agricultural establishments are disconnected from the world wide web. Furthermore, research already carried out shows that being connected does not suffice; managing digitalization processes (for example, websites and platforms) requires specific knowledge, as well as owning electronic devices (smartphones, notebooks, desktops, etc.) suitable for connection – most farmers (especially the poorer ones) lack both (DEPONTI et al., 2020).

In this sense, there is also a consensus that getting people online and including them in digitalization processes must be accompanied by efforts to build other human and cognitive capabilities that are fundamental to overcoming the digital divide, especially among the poorest. These capabilities range from knowing how to navigate the internet, access platforms and content, handle electronic devices, cognitive skills to deal with databases, software, technical knowledge in ICTs, safe navigation, data protection, critical thinking for filtering out fake news and scams on the internet, among other skills essential for inclusion in the 'new digital world' (SEN, 2000; NIEDERLE; SCHNEIDER; CASSOL, 2021).

On the other hand, in Brazil, the State has failed to present effective solutions to the huge inequality in digitalization. The proposal to digitalize technical assistance and rural extension services (TARE) did not go beyond the design phase in the states, having only few functioning experiences. Some authors argue that, without taking into account the cognitive and technological capacities of social actors, results will be inconsequential (TORERO, 2013; FIDA, 2021).

If the Brazilian State were to design public policies aimed at reducing digital inequalities, especially regarding the construction of food markets, these could be basically directed at three major fronts: a) expansion of the connectivity infrastructure in rural areas and for urban consumers, assuring quality services and competitiveness between providers; b) improving access to computer equipment and ICTs for farmers and consumers; c) promotion of training and formation in the use of the internet, connection equipment and ICTs for development of cognitive and human skills.

This latter front could rely on previous national programs such as, for instance, the National Program for Access to Technical Education and Employment (PRONATEC). As regards the second front, it could be addressed through initiatives such as that once taken by the Ministry of Education (MEC) in support of students enrolled in public schools, by allocating/financing computers and tablets to family farmers and disadvantaged consumers. Clearly, these policies could be operated and guided by other ministries, such as the Ministry of Social Development (MDS), the Ministry of Agrarian Affairs and Family Farming (MDA) or the Ministry of Science, Technology and Innovation (MCTI). In turn, the first front, that of providing connectivity to rural areas, could be put into practice through financing via rural credit or, as some local experiences have shown, through public-private partnerships involving local/regional innovation ecosystems (universities, incubators and technology hubs, service providers, city halls, etc.) (OTERO, 2020; GAZOLLA, AQUINO, 2024).

A study published by the Economic Commission for Latin America (ECLAC) brings a chapter on digitalization in Brazil (BUAINAIN; CAVALCANTE, CONSOLINE, 2021), which observes the structural limitations of digitalization processes and the low penetration of the internet in rural areas. The authors, nevertheless, make the case for the paradigm of agriculture 4.0 and agritech enterprises (new technology companies, startups) as the main paths for the digitalization of agribusiness – two technological movements that entail the deepening of the pre-existing pattern of agricultural modernization, disregarding collective concerns about making digitalization viable in a more inclusive and sustainable way.

The same research cites smart farming as a successful example of digitalization, as it can increase agricultural production by 50% to 80% and reduce production costs by 20% to 40%. It also notices the existence of a large number of agritechs in regional agriculture (450 new startups), 84% of which are located in Brazil and Argentina, and discusses the case of the Brazil Agro 4.0 Chamber as a successful case of rural digitalization.

Another recent study by FAO (2021) enumerates risks involved with digitalization, such as increased inequalities in rural areas and communities, deepening of asymmetric power relations between actors, increased labor productivity and automation/use of artificial intelligence/robots, which can generate technological unemployment (estimates suggest that digitalization can affect 40% to 60% of jobs in the region), violation of rights, trafficking and misuse of data of digital systems and platforms users.

As examples of successful food markets, the document cites the cases of two Chinese marketplaces, Pinduoduo and Alibaba, highlighting that the former had a turnover of 256 trillion dollars in 2020, 42 trillion out of which came from food products sales. According to FAO (2021), through these food markets, farmers earn 30% higher prices and consumers can save up to 75% on their food expenses. The document makes the case for farmers' and consumers' participation in large corporate digital food markets, providing solely an economic and partial analysis of its results in favor of digitalization, without indicating any dividends to sustainable development processes and socio-technical inclusion of disadvantaged actors.

Among the above-mentioned international organizations, IICA (BERT, 2021) seems to adopt the most appropriate language when addressing the issue of

digitalization. A first difference that stands out is the use of the term 'food systems' instead of 'agriculture' or 'rural' like other international organizations, stating that 'digital transformation is the main opportunity for changing food systems' (p. 5). Furthermore, the document states that digitalization can help food systems transform in five ways: becoming guarantors of access to healthy and nutritious food, supporting the adoption of sustainable consumption patterns, supporting sustainable farming in harmony with nature, promoting equitable livelihoods, and building resilience in the face of vulnerabilities and tensions.

According to IICA (2021), the digital transformation of food systems should focus on (at least) two efforts: a) promoting the development of digital technologies adapted to the needs, contexts and cultures of different stakeholders, to ensure the increased availability of relevant solutions; b) facilitating the means and processes necessary for the full use of available technologies, including everything from eliminating barriers to access to connectivity, devices and applications to building digital skills, capabilities and experiences.

In short, reports and studies produced by various international organizations to date propose incremental digital solutions that do not break with existing paradigms and problems regarding access, use and appropriation of technologies, especially by the most vulnerable and poor populations. In the case of agriculture, most of the proposed paths for digitalization are 'doing more of the same', in the sense that the proposed solutions only deepen the mainstream strategies to technological development through agricultural modernization (new *startups*, precision agriculture, *smart farming*, agriculture 4.0, etc.), which has historically increased inequalities and caused social, environmental and economic problems, as already extensively evidenced by the abundant literature in the area.

3 Food markets and family farming markets

In theoretical terms, the market has been historically understood as the meeting of supply and demand, having prices as the mechanism for self-regulating and adjusting exchanges, balancing them. Such approach assumed that information was perfect, actors behaved fully rationally and actors negotiated in terms of obtaining the greatest possible benefits in transactions. This is the understanding of market in the sense given by classical and neoclassical economics, an approach still prevalent in market studies, although being under pressure from other definitions and schools of thought (GRANOVETTER, 2005).

The main criticisms that have emerged come, in the field of Economics, from evolutionary institutionalist approaches and, in the field of Sociology, from scholars dedicated to economic sociology. Within Economics, studies have shown that markets are historical and co-evolve, changing over time in different societies, whose rules and norms that govern them change (institutions change). Furthermore, markets are permeated with conflicts and opportunism, while information and human rationality are not as complete as neoclassicals suggest, leading to the need of contracts, regulations by the State, formal and informal negotiations and agreements between economic agents (NORTH, 1990).

However, it was the work by Polanyi (2000), *The Great Transformation*, that allowed the understanding that markets do not work exactly in accordance with the

neoclassical formulation and the role of society and social actors is active in their contours. Polanyi demonstrates that markets are social, historical and institutionalized constructions and that, for most of human history, markets were based on the social principles of reciprocity and redistribution. It was with the advent of capitalism that this new and specific type of market, which aims only at economic exchanges and the accumulation of profits, began to take shape along the lines that neoclassical economics understands it and in a singular sense: the market.

Polanyi launched the basic formulations for understanding markets, which have been developed by other authors in Economic Sociology, who always take them as plural and social constructions by involved actors. According to this approach, the construction of markets is based on actors' skills, resources, knowledge, social networks, among other sociocultural, political and economic aspects. The issues of asymmetrical power relations, inequalities between actors regarding conditions and resources, disputes over markets and other sociological topics are also present in their formulations. In short, with these new perspectives from Economics and Sociology, it became clear that markets should be understood as social constructions historically negotiated in various ways by actors who are rooted in their social contexts (GRANOVETTER; SWEDBERG, 1992).

For understanding markets operating in rural areas – agricultural, family farming, agri-food markets – the approach is no different. These theoretical assumptions underpin the construction of more critical definitions, analyses and even typologies of food markets. Some examples are the theoretical constructions by Maluf (2004) and Wilkinson (2008) in Brazil, in the early 2000s, and, more recently, the contribution by Schneider (2016), who defines and presents a typology of food markets and family farming, drawing on the set of theoretical elements briefly mentioned above.

According to Schneider (2016, p. 95), 'markets are social relations established between economic agents who may be producers or consumers and who are interested in trading goods, merchandise, resources or other assets. The existence of a market relationship presupposes the existence of exchanges, which are generally motivated by multiple interests of the agents. Markets influence people's values, culture and routines.' Insofar as social relations and interactions occur through mediation of markets, these latter assume a decisive role in the organization of everyday economic life and sociability, influencing attitudes, values and individual action.

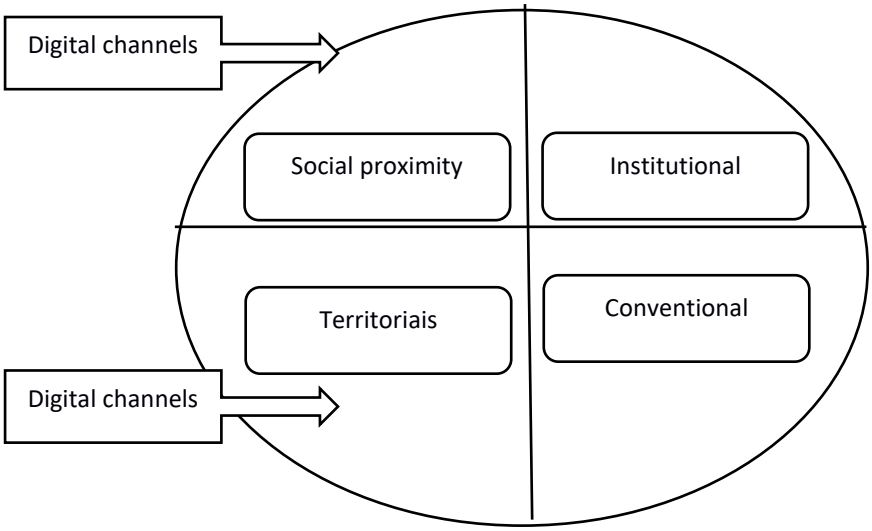
Schneider identifies four types of food markets: a) social proximity markets; b) territorial markets; c) institutional markets; d) conventional markets. The first type of markets is that in which food and products exchanges generally occur more directly between farmers and buyers and consumers, and in which social and spatial values are present in the regulation and dynamics of marketing channels. Brazilian and international literature on short supply chains as a whole shows how these markets work (GAZOLLA; SCHNEIDER, 2017; BELLETTI; MARESCOTTI, 2020). The second type of markets are the so-called territorial markets, which comprised marketing channels through which farmers sell their produce to social actors operating within regional and territorial scopes, such as cooperatives, supermarkets, intermediaries, companies, etc. The dynamics and governance of these markets

would be agreed upon between the different actors and under different forms, including relationships of trust, contracts, etc.

Institutional markets, in turn, comprise public purchases of food and other agricultural products directly from farmers by the State. These markets are regulated through laws, procurement processes and rules originating from the institutional framework. Examples of these markets in Brazil are purchases for the Food Acquisition Program (PAA) and the National School Feeding Program (PNAE). Finally, conventional markets are those in which economic exchanges are primarily aimed at profit. They are regulated by prices, quantities and contracts, approaching to the neoclassical economic notion of market. Products traded in these markets are generally grains and agricultural commodities (SCHNEIDER, 2016).

Figure 1 below presents the typology of food markets, based on Schneider's (2016) approach. It shows the four types of markets from which the so-called digital food markets emerge. According to studies conducted in Brazil, these digital markets are formed out of digital marketing channels that emerge, mostly, although not exclusively, within social proximity and territorial markets as a new marketing channel that adds to the physical channels that form these two types of markets, coexisting with and complementing them in terms of sales and marketing in the initiatives of family farmers. It should be noted that, in this context, digital markets are not understood as a new type of market, but rather as a new (digital) channel that contributes to the general conformation of the markets, as elaborated by Schneider (NIEDERLE et al., 2021; GAZOLLA; AQUINO, 2022).

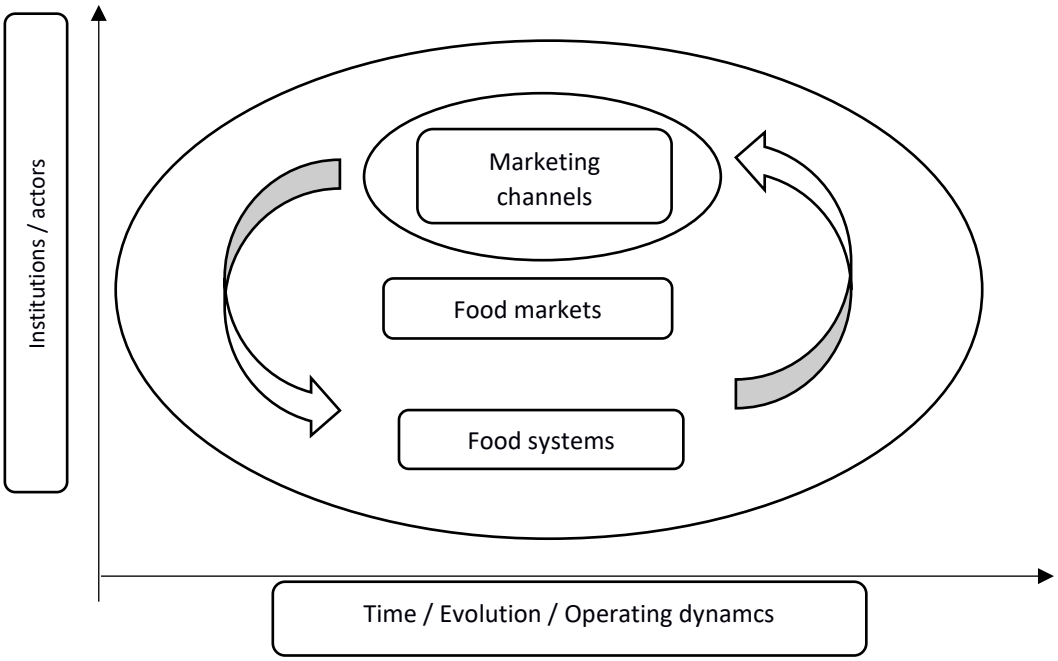
Figure 1: Typology of food markets highlighting the origin and preferred location of family farming digital channels.



Source: Constructed by the authors (2024) based on Schneider (2016).

From an analytical point of view, food markets can also be defined as a meso-analytical level, in the field of food, agriculture and rural and regional development processes, as represented in Figure 2. Given this, they are positioned between supply channels and food systems.

Figure 2: Food markets made up of marketing channels, forming food systems.



Source: Prepared by the authors (2024).

Marketing channels would be the micro-analytical level, being considered the basic cells that form markets, in the sense that the same market would comprise and be empirically identified by its marketing channels, which can be one or more in number and present heterogeneous dynamics over time, locations and types of food (BELLETTI; MARESCOTTI, 2020). Furthermore, these channels have diverse forms of operation and typologies in terms of the number of links, involved actors, structuring levels, length of chains (short, long), institutionalities and socio-spatial and technological dynamics (SCHNEIDER, 2016).[1]

Food systems, then, would constitute the macro-analytical level, being comprised of the aggregate of strategies of various actors and social groups, and the technological artifacts; and structured by institutional rules and norms in force in their different dimensions (production, commercialization, consumption, legislation, logistics, State, among others) (CARON et al, 2018). Food systems connect with each other and communicate with other societal systems such as economic, political, social, technological, among others, as predicted by systemic theory (MORIN, 2005). Finally, it is worth noting that the three levels represented in Figure 2 are interconnected, evolving, mutually and contradictorily, over time and across social spaces in line with the dynamics of the institutions, groups and social actors that build and dispute them as a result of different power relations, mobilized resources and sets of knowledge (LONG, 2006; WISKERKE; PLOEG, 2004).

[1] Marketing channels are either physical or digital social spaces of exchange, through which products are marketed. The channels have farmers at one pole and end consumers at the other, and in between there may be a wide range of other agents, geographic spatialities and links that make them up (BATALHA, 2021).

4 Food markets and digitalization of marketing

According to Niederle et al. (2021), what is defined as digital food markets refers specifically to virtual platforms and websites on which food is offered and/or demanded, even if the transaction is completed (delivery/payment) through other mechanisms, whether virtual or physical. This definition can also include social networks and applications which have proven to be comprehensive in the offer and sale of food and other farmers' products, communicating directly with consumers and social groups (CUBIDES ZUNIGA; CUBIDES ZUNIGA, LUGO MONTILLA, 2020).

Digital food markets for selling food and other family farming products can be defined as a specific type of local and regional marketing channel that is usually embedded in social and/or territorial proximity markets (although it can also occasionally occur in conventional and public markets) (BELLETTI; MARESCOTTI, 2020). Thus understood, these markets can be defined, in most cases, as a short food supply chain that directly links family farming produce to urban consumers and buyers, in which the sales interface is no longer only social in the territories, but technological (sociotechnical), since transactions and (re)connections between social actors are mediated by innovative devices based on new information and communication technologies (ICTs) (PLOEG, 2008; BOS; OWEN, 2016; REARDON; SWINNEN, 2020).

This new short food chain, anchored in digital tools, can be defined as a (commercial) novelty built by social actors involved in the initiatives along with family farmers (KENNY; SERHAN; TRYSTRAM, 2020; DA COSTA, 2020). Novelties are conceptualized as new practices by actors that, in interactions with different types of knowledge and experiences, build creative sociotechnical solutions in their local contexts, with their own resources and aiming to change for the better or to solve problems that routinely affect their social life or work processes.

Novelties reveal the agency of actors in creation processes in which they take proactive attitudes to social construction of new practices and techniques. Novelties are multifaceted and can take several forms: a new social network, markets, technologies, different knowledge, new products and processes, innovative services, cooperatives, among others. The novelties most often seek to increase actors' autonomy and the sustainability of constructed social practices (WISKERKE; PLOEG, 2004; GAZOLLA, 2020). In the case of new digital food markets, they are commercial novelties created by farmers, their social organizations and consumers to sell and buy food and other products, but also serve to enable marketing operations, as announcing available food products, informing about their quality, offering products and carrying out commercial and financial transactions.

A few and diverse studies reiterate some of the characteristics of digital markets conceptualized as commercial novelties, as described above. A first feature is their innovative nature, since family farming and their social organizations until recently had not resorted to this form of commercialization and most of the initiatives in course are still a pilot and/or being accelerated (SCHWANKE, 2020; SCHNEIDER et al, 2020). In digital sales, interactions are mediated by ICTs, implying that family farmers must develop skills to demonstrate on such channels their reputation in food production, using marketing techniques to communicate food

quality, attract consumers and try to retain them (CARVALHO; SANTOS; CARVALHO, 2015; DEPONTI et al, 2020).

On the demand side of digital food markets, ease and simplicity in purchasing products on a website stand out, in addition to the convenience of receiving them at home (CARVALHO, 2015; ALVEAR et al., 2020). A survey on the digital platform Comida da Gente, in Rio de Janeiro, concluded that technology facilitates the conscious consumption of organic products. However, it pointed out that there is a need for customers to adapt to these new consumption possibilities, for example, learning how to access, search for products, pay, etc. (ARAGÃO, 2019). In turn, Schwanke (2020) found that the demand related to e-commerce for purchases from family farming is much greater than the supply capacity, revealing a misalignment between digital supply and demand.

A classification of these digital food markets was proposed by Niederle et al. (2021), as shown in Table 1. It ranges from large corporate marketplaces to websites run by private companies or owned by farmers and their social organizations such as cooperatives and associations, to public or institutional platforms, websites that simply organize consumer demand, to personal or group pages on various social networks and messaging apps, the best known and most used of which are Facebook, Instagram and WhatsApp, among others.

Table 1: Typology of digital food markets.

Platform	**Examples**
Marketplace platforms that offer and/or sell products from different producers	Amazon, Submarino, Americanas, iFood, OLX, Facebook Marketplace
E-commerce websites or applications where companies resell products they have purchased	Mundo Verde, Mãe Terra, Mais Quitanda
Websites or applications of central or network cooperatives and associations that offer and/or sell products from different producers	Alimento de Origem, GiraSol, AmazôniaHub, Biobá, Central do Cerrado, Junta Local, Produtos da Terra
Websites of producers (farmers, companies, cooperatives) which sell their own products (or that of associates) to other businesses or directly to the consumer	Agreco, Ecobio, Organnica, Orgânicos da Fátima
Websites of producers (farmers, companies, cooperatives) that offer/advertise their own product (or that of associates), but transactions takes place in other virtual or physical spaces	Econativa, Ecocitrus, Cooperativa Terra Livre
Institutional platforms that offer/advertise products, but sales occur in other virtual or physical spaces	Feira Virtual da Agricultura Familiar (Fevaf), Vitrine da Agricultura Familiar, Vitrine Virtual RN
Platforms that organize buyer demand, but sales occur in other virtual or physical spaces	Consumer group order lists; Rede de Orgânicos Osório
Social networks through which farmers, companies and cooperatives offer products, but sales take place in other virtual or physical spaces	Facebook and Instagram pages and profiles, Direct contact via WhatsApp
Plataforma	**Exemplos**
Plataformas de *marketplace* que ofertam e/ou vendem produtos de diferentes produtores	Amazon, Submarino, Americanas, iFood, OLX, Marketplace do Facebook
Sites ou aplicativos de *e-commerce* onde empresas revendem produtos que elas adquiriram	Mundo Verde, Mãe Terra, Mais Quitanda

Sites ou aplicativos de centrais ou redes de cooperativas e associações que ofertam e/ou vendem produtos de diferentes produtores	Alimento de Origem, GiraSol, AmazôniaHub, Biobá, Central do Cerrado, Junta Local, Produtos da Terra
Sites de produtores (agricultores, empresas, cooperativas) que vendem o próprio produto (ou de associados) a outros empreendimentos ou diretamente ao consumidor	Agreco, Ecobio, Organnica, Orgânicos da Fátima
Sites de produtores (agricultores, empresas, cooperativas) que ofertam/divulgam o próprio produto (ou de associados), mas a transação ocorre em outros espaços virtuais ou físicos	Econativa, Ecocitrus, Cooperativa Terra Livre
Plataformas institucionais que ofertam/divulgam produtos, mas a venda ocorre em outros espaços virtuais ou físicos	Feira Virtual da Agricultura Familiar (Fevaf), Vitrine da Agricultura Familiar, Vitrine Virtual RN
Plataformas que organizam a demanda de compradores, mas a venda ocorre em outros espaços virtuais ou físicos	Listas de pedidos de grupos de consumo; Rede de Orgânicos Osório
Redes sociais por meio das quais agricultores, empresas e cooperativas ofertam produtos, mas a venda ocorre em outros espaços virtuais ou físicos	Páginas e perfis do Facebook e Instagram, Contato direto via WhatsApp

Source : Niederle et al (2021, p. 39).

In the case of large marketplaces, which dominate a large part of products' circulation in digital food markets around the world, their main characteristics are establishing unequal power relations with their suppliers, operating on a large scale, and experiencing frequent market disputes (acquisitions, mergers). In addition, they are easily found by consumers in any internet search and have great visibility in the digital world, given the data manipulation and algorithms of customers profiles, despite most of them being unaware of such manipulation by corporations (CHONG et al., 2017; WRIGHT et al., 2019).

Similarly to marketplaces, delivery has grown significantly as a type of food market. Its importance is due to the scale of food supply and to its financial turnover. The retail sector, especially supermarkets, was already implementing digital delivery solutions, via online shopping and delivery for consumers. With the Covid-19 pandemic, this type of digital market has further grown, so that even small and medium-sized retailers in small municipalities have ended up implementing this type of technological solution. Those who were unable to build a website resorted to apps like WhatsApp, for instance, to allow for customers to place orders.

Another type of delivery that had been growing significantly before the pandemic and further expanded with its advent are those of product ordering apps, as iFood and others in this category. These digital markets are known for fast deliveries, providing cheap and processed food, exploiting (outsourced) delivery people and operating from so-called 'dark kitchens' (low-cost co-working kitchens that operate with mass production of food, which has dubious sanitary origin and are located in precarious facilities that offer low rental prices in the city) (GUIVANT; SPAARGEN; RIAL, 2010; REARDON et al, 2021). In fact, recent research states that almost 30% of the kitchens of a famous app in Brazil would be classified as dark kitchens (MOIÓLI, 2023).

The inclusion of family farmers in the above described two types of markets is controversial, although some initiatives have made use of delivery apps to serve their customers, such as the Rede Xique Xique de Comercialização Solidária (Xique-Xique Collaborative Marketing Network) (CUNHA, 2022). If, on the one hand, their products

can gain greater visibility and increased demand, on the other hand, their integration into these markets will not differ from the largely discussed inclusion of farmers in traditional food retail in Brazil (such as supermarkets), which is permeated by conflicts, small earning margins in sales and numerous requirements to meet (continuous supply, standardized products, quality requirements, packaging, payment of fees to place products on the shelves, non-payment of leftover/spoiled food, etc.) and regulatory adequation (sanitary, legal, tax, etc.), practically making the integration of most family farmers and their businesses unviable (GAZOLLA; SCHNEIDER; BRUNORI, 2018; PERES; MATIOLI, 2020).

From consumers' point of view, the advantage of these food markets based on marketplaces and deliveries is the ease of locating products on the internet or by downloading their apps, the available variety of products, including food products, and time saving in finding sought items on their virtual shelves. However, in the case of food supply, particularly, offered products are mostly processed or super-processed food, which come from large national and even international food industry and lack quality differentials regarding environment (e.g. agroecological food) or even healthy and fresh food, although some of these marketplaces have been signaling the sale of such products in recent years, as a new business and profit opportunity, rather than a legitimate concern about environmental sustainability or even healthier diets for consumers (TRICHES, 2021).

Regarding other types of platforms, especially family farmers' individual websites, public/institutional platforms and collaborative platforms such as those of cooperatives, recent studies in Brazil have shown that they tend to function as a new extension of social and spatial proximity physical markets, known as short supply chains. Following the health crisis, there is a growing trend among family farmers of using websites or platforms to offer their products, channels that constitute a technological or sociotechnical interface with regular consumers and even for drawing new urban and regional buyers in. Research by Gazolla and Aquino (2022), in thirty-eight national websites and platforms, found that around ¼ of them operate as above described (25.43%).

According to the same authors, other striking characteristics of these platforms and websites is that most of the offered food products differ significantly in quality from those offered by marketplaces and traditional deliveries. Over 90% of food offered on those websites and platforms are fresh, non-processed, artisanal, organic or on-farm processed. These data are also corroborated by Preiss et al. (2020) who, in a survey carried out in five regions of Rio Grande do Sul state, focusing on direct markets for family farming, identified a great expansion in the use of digital marketing tools and indicated a high demand for products of special quality.

Furthermore, their organizational structure stands out – more than half of the studied cases (52.63%) is organized through cooperatives, cooperative centers or associations, revealing the importance of collective action in the collaborative construction of these markets (GAZOLLA; AQUINO, 2022). The cooperative organization seems to be associated with four major issues: a) social organizations and cooperation become a way to overcome lack of internet in rural areas for family farmers; b) creation, maintenance and financial (taxes and fees) costs can be shared collaboratively; c) logistical costs can be reduced, being shared among farmers, covered by the cooperative or shared with consumers; d) collaborative social

organizations also help to overcome the lack of access to information on how to use devices.

This latter aspect appears as an important issue to understand and to further investigate, since research evidence shows that building digital markets for family farmers is quite a difficult task for individual rural enterprises and farmers alone. Such task requires specific ICT knowledge and skills to manage and update the website, to carry out product marketing and advertising, to integrate payment system on the platform, to secure users data, among other internet and digital skills and knowledge that most farmers do not have (DEPONTI; KIRST; MACHADO, 2017; ODAME; ALEMU, 2018; BELIK, 2020).

The research by Gazolla and Aquino (2022) also revealed the absence of public policies or initiatives by the State aimed at encouraging the construction of digital food markets. The investigation showed that in 18.42% of studied cases, the platforms or websites originate from public initiative, either by universities, federal institutes or rural extension agencies; or even from a relationship with other public policies, such as those on Local Productive Arrangements (LPAs) and entrepreneurship in some territories, corroborating findings of other studies, such as the research by Tonin (2022). In this sense, it is essential to question what would be the role of the State regarding public policies to strengthen digitalization processes in rural areas broadly? And, more specifically, in the construction of digital food markets?

In another study, Lauremann (2023), in the farthest west region of Santa Catarina state, highlighted the prominence of digital markets built through the use of social networks and messaging applications. The author concluded that 42.30% of all food and other products sold by farmers who own family agrienterprises are sold through digital channels via WhatsApp, Facebook, and Instagram, and that within the family group, women appear to be the ones leading digital initiatives. This is relevant finding because it shows that even in the countryside where farmers are unable to build sales platforms, they are digitally creative in taking advantage of resources they already have for free: messaging applications and social networks.

In a study conducted in northeastern Brazil involving family farmers associated to Xique-Xique Collaborative Marketing Network, Cunha (2022) observed widespread use of messaging apps and social media in the marketing process. Research data indicate that 93.3% of respondents were already using WhatsApp before the Covid-19 pandemic to advertise and sell products, thus facilitating productive inclusion of these farmers. WhatsApp audio tool is widely used by farmers, even those with low levels of education or who are illiterate. This function has not only helped keep contact with friends and family but also facilitated the marketing process, becoming an inclusive tool for this peopole. However, such inclusion can be considered reversed, since farmers need training to improve their participation in digital markets.

Another study, conducted by Niederle et al. (2021), on three digital food sales platforms in Rio Grande do Sul (RS) (Girassol, Comafitt and Alimento de Origem) corroborates the relevance of the issues pointed above. First, it shows that all of them follow the principles of solidarity economy and are cooperatives, reinforcing the collaborative logic of these markets. In addition, the research demonstrated that the platforms have problems of scale and reduced number of consumers when they operate in smaller towns, what has been overcome by keeping the connection with

pre-existing physical markets (e.g., open-air markets). Some farmers, in addition to this, sell directly to consumers via WhatsApp, which is easy to use and at no additional cost, thus maintaining diversified food marketing channels.

Still according to Niederle et al. (2021), the main difficulty affecting the researched platforms is the high costs involved in both their construction and management (although all those researched received external support), and there is no consensus among the social actors engaged in the initiatives about what would be the best model of collaborative platform for digital sales. Cooperative logistics seems to have made them viable, reducing costs and enabling the inclusion of farmers who otherwise would not place their products in these markets (for being unable to cover transport and distribution costs). For the involved cooperatives, however, logistics seems to increase costs, because they operate with formally contracted employees to not fall into precarious work, a usual practice among delivery services via apps.

According to the same study, in terms of productive inclusion of the most vulnerable actors, findings show that the best strategic path would be one that combines state action with social organizations such as cooperatives and associations in digital food markets initiatives. Lacking this, any strategy for digitalizing family farmers' food products marketing, to benefit both farmers and consumers, would hardly be achieved. In short, advances in digitalization of these markets should involve multivariate institutional arrangements of both public and private actors and social organizations, as also indicated in reports on the subject by international organizations (CEPAL, 2020; FAO, 2021).

Regarding food purchasing on platforms, a few issues are worth discussing, such as strategies to attract and retain consumers. In large urban centers, consumers generally are already accustomed to buying on Internet and interact more frequently with ICTs, what eases their access to digital food markets, especially marketplaces and deliveries. However, for a platform of family farmers or of small cooperatives to become popular within this immense sea of consumers, significant barriers must be overcome, as they do not manage *big data* and do not appropriate search data or consumer profiles on the internet (REARDON; SWINNEN, 2020).

In small towns and the countryside, the number of consumers is smaller, educational levels and ICT skills are generally lower, and food purchasing are normally done through physical markets, all of which can discourage social actors from creating platforms and other digital sales tools (TONIN, 2022; SILVA; BRANDÃO, 2023). In these localities, what may work best is creating digital marketing channels initially aimed at customers of specific physical markets (e.g., a cooperative's store or a farmers' market) and invite them to use the virtual form of purchase as a complement to the physical markets. In this case, digital markets are an extension of the physical markets that consumers already know and trust, and their adherence will be facilitated by prior knowledge of the products, farmers, experiences or brands that they already know (BOS; OWEN, 2016).

In this sense, it is also worth highlighting the importance of using social media, such as Facebook and Instagram, as strategies for disseminating information about products quality. Cunha and Schneider (2024), when presenting the strategies used by the Xique-Xique Network, point out that the organization usually publishes posts emphasizing topics such as agroecology, organic production, and certification,

always accompanied by photos to allow reconnecting producers and consumers, and also replicates posts from consumers satisfied with their organic baskets. Tariq *et al* (2019) point out that realistic photos and videos influence the decision to purchase organic products online in China, increasing trust. Therefore, posts are effective marketing strategies that can attract new consumers and generate credibility. Satisfied consumers share positive consumption experiences on their social networks, influencing other consumers, shifting from "traditional word-of-mouth" to "online word-of-mouth" (CUNHA; SCHNEIDER, 2024).

The problems in reaching consumers and building their loyalty would perhaps be different if the digital marketing initiatives by family farming were initially focused on socially conscious consumers – social actors who adopt mindful purchase decisions, buying food from short chains, farmers markets, ecological farming, solidarity experiences and/or from inclusive social organizations (PORTILHO, 2020). However, in Brazil. this 'ideal' type of consumer is still uncommon and, in many remote regions and small towns, they are completely absent, what often coincides with the regions where more farmers need to market their produce. In this sense, Brunori, Rossi and Guidi (2012) make an interesting suggestion: to start 'food activism' with socially conscious consumers, but without disregarding other consumer groups (conventional, not mindful, who buy at marketplaces and supermarkets, etc.), seeking to influence them through the formers to win them over gradually and by disseminating the digital sales experience.

Gazolla, Aquino and Szpak (2024) analyzed digital markets in Brazil during 2020 and after the pandemic, in 2022, and concluded that the growth of digital food markets is expressed in some unmistakable data. In their research, the authors found an increase in the number of initiatives from 2020 to 2022 (from 38 to 44 platforms and websites), in the volume of food products sold (an increase of 13.06%), in the number of family farmers, which more than tripled within the initiatives (an increase of almost 290%) and in the enterprises that comprise these initiatives (an increase of almost 50%), in which cooperatives and associations stand out – what seems to endorse that collaborative platforms are the best format for family farmers. Broadly speaking, these data reinforce what the international literature has called 'scale up' of food market initiatives.

As regards innovations, existing research shows that there is a lot of creativity involved in digital marketing relationships between farmers and consumers. A first example is the creation of digital sales tools, which show a wide diversity and heterogeneity of formats, operations, ways of selling, paying and delivering food, among other aspects. In this sense, understanding, differentiating and typifying the implemented innovations is already a major research challenge to be pursued in the coming period.

As an example, the research carried out by Tonin (2022) in two territories of Rio Grande do Sul, Litoral Norte and Médio Alto Uruguai, points to the use of three different tools: instant messaging applications (such as WhatsApp), websites (of a cooperative or association) and collective platforms (in which several cooperatives share the same platform, likewise a marketplace do). From a comparative point of view, although the three tools are used to digitize markets, there are various particularities that go beyond the technical aspects intrinsic to their construction, namely: accessibility and handling by farmers and consumers, storage of orders and

data in general, inventory updating, payment and delivery methods, capacity to incorporate other services or to serve as a platform capable of being operated by several family farming marketing centers. Such specificities, which reflect the context, the actors and their different skills, differentiate one tool from another and highlight the heterogeneity of digital tools in food markets.

Furthermore, literature has highlighted the new forms of governance of these digital markets, which operate with multiple actors, cooperatively, and practically without the State's support, relying on the enterprise of the engaged social actors. Such literature reveals important social innovations guided by farmers, consumers and their organizations. In terms of logistics, there are also interesting innovations, since these markets operate collaboratively, managing to reduce transportation, storage, delivery and transaction costs (BELIK, 2020). Productive innovations occur, since the food offered generally has quality differentials as compared with those of large food retailers, highlighting new and more sustainable production practices, such as ecological farming (REARDON et al., 2021).

While there are innovations in digital food markets, the challenges they face are even greater, and some of these are addressed in the different papers that make up this dossier. The main ones include: a) keeping scale, scope and stability of supply and demand in the markets; b) competition with large marketplaces, retailers and delivery apps; c) including poorer consumers and farmers in the initiatives; d) the high costs of implementing and maintaining the platforms; e) the formalization of businesses to offer food on the platforms (agri-enterprises); f) gaining consumer loyalty and attracting buyers in small towns and countryside; g) promoting conscious consumerism and diets to keep consumers loyalty; h) defining the role of the State and public policies in building these markets; i) data protection and user security against scams and unauthorized data capture.

In brief, there is a huge list of challenges that goes far beyond these example. Identifying them in the different types of platforms and digital food markets becomes fundamental and also constitutes a fruitful agenda for future research (DEPONTI et al., 2020; GAZOLLA; AQUINO, 2021; NIEDERLE; SCHNEIDER, CASSOL, 2021; PREISS et al., 2021; EHLERS; HUBER; FINGER, 2021).

5 Final remarks

This article sought to present a rough conceptual framework of what new digital food markets would be, which are inscribed in a context of digitalization and which must be understood through the lens of sustainable development and socio-technical inclusion.

The topic of market digitalization has been gaining ground in a wide variety of discussion forums over the last decade, when large retail chains began to expand their sales environment to virtual environments, reproducing their physical stores on their own websites. Over time, marketplaces were created in which various suppliers can use the structure and guarantees of large retail chains to sell their products, paying for this service. Food markets also became part of this process, as a series of delivery apps began operating in Brazil. However, such system of market digitalization was not yet accessible to family farmers. The Covid-19 pandemic has

triggered this process, as several cooperatives, associations, and even individual farmers began to use digital devices to sell and distribute their food produce.

The heterogeneity of these new marketing channels does not allow to conceive them as a singular entity, as a digital market. On the contrary, the specificities of each tool and, especially, the way it is integrated into food systems need to be well understood in order to identify their potential contribution to sustainable and inclusive development. The cases analyzed in this work show that, when it comes to family farming, the role of collective action is central. This is because cooperatives and associations have a great capacity to take on the responsibility of coordinating food markets, creating possibilities and giving farmers more autonomy.

It is also worth noting that the initiatives promoted by collective action are usually based on short marketing chains, which take form preferably in local and territorial markets, what has contributed significantly to boosting the local economy and stimulating sustainable development processes as it fosters an economy sustained by products and actors from the territory itself. However, this work has also made it clear that the participation of the State is a fundamental condition for supporting the new dynamics of marketing and consumption, built with the efforts of civil society, whether addressed to farmers, consumers or even the cooperative initiatives.

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