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CASE STUDY

COVID-19 and the fragility of Brazilian small farming resilience

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ABSTRACT

Goal: The paper aims to investigate the insights of the resilience mechanisms of Brazilian small farms facing COVID-19.

Design / Methodology / Approach: The research path involves three cases studies: two small but relevant producers of fruit and vegetable and a cooperative of family farmers in Rio de Janeiro through semi-structured interviews and concept maps. We also made data triangulation using literature review.

Results: We observed that the main challenges for resilience in agro business are: 1) tight budgets and difficulty in accessing credit, 2) Many producers are in an informal fiscal situation, 3) Lack of human resources, 4) Low-technology methods, 5) Difficulty in adding value to "raw" products. Besides, we have also identified a dangerous reduction in federal investments in family farming incentive programs in recent years, which may have worsened the weaknesses of these businesses in the face of COVID-19

Limitations of the investigation: Since this is a qualitative study for preliminary investigation of the topic through mental models, the sample of focal respondents was small (three cases).

Practical implications: This study enables the analysis of the Brazilian small farms challenges to survive in times of growing uncertainty.

Originality / Value: This research lays the foundations for future research to explore the underlying theory and practice involved, with the aim of creating resilient local supply chains.

Keywords: COVID-19; Short food supply chains; Resilience; Fruit and vegetable value chains.

1. INTRODUCTION

The global pandemic COVID-19 (Belhadi et al., 2020) has worsened the risk of increasing hunger and malnutrition along food supply chain (Fan et al., 2020). Lal (2020) points out that the number of people under food insecurity may double from 135 million in January 2020 to 265 million by the end of 2020. In Kenya, households food insecurity increased 8 percentage points within 30 days of the implementation of COVID-19 restrictions (Huss et al., 2021). Francesconi et al. (2021) highlights that even rural communities with zero cases of COVID-19 can have labor shortages causing delays in harvesting activities and aggravating the hunger and food insecurity.

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In this context, Lawson-Lartego and Cohen (2020) recommend that agri-food supply chain (AFSC) should be considered as an essential service to ensure food security. Zhu and Krikke (2020) argue perishable food supply chain (PFSC) are especially threaten by shortages during pandemic outbreaks, due to product's short lifetime. In India, PFSC claims 80% of food supply, evidencing the relevance of the issue (Reardon et al., 2020). In 2017, Brazilian AFSC was responsible for 13% of the national GDP, with fruits exports representing US$ 946.79 million. However, COVID-19 has threatened PFSC (Farias and De Araújo, 2020). For example, in Shanghai, approximately 60% of the vegetable consumed are produced outside the city, so the pandemic has greatly impacted the logistic of vegetables since many products could not be shipped in time due to traffic restrictions (Gu and Wang, 2020).

Therefore, more direct chains between producers and consumers could improve the supply chain (SC) resilience (Cordeiro et al, 2021; Stecke and Kumar, 2009), improving food traceability, minimizing the costs for the customer and providing fairest trade rules for the producers (Elghannam et al., 2020). In this vein, Cappelli and Cini (2020) highlight that consumer's behavior is likely to change after COVID-19, favoring short food supply chains and local productions, which is less vulnerable to shortages during crisis event. Lal (2020) points out that home garden could also be an alternative to deal with food insecurity.

Considering this background, a detailed analysis of the ongoing crisis impacts over small farms needs to be carried out. Therefore, we have investigated the insights of how local food systems are facing COVID-19 in Brazil based on three case studies: two small farms and a cooperative of family farmers located on Rio de Janeiro. We used Strategic Option Development and Analysis (SODA) to translate the farmers' interviews into a graphical framework (Cochran et al., 2011). Then, we discussed the framework, comparing our finding with scientific literature and official reports.

The paper is structured as follows: Section 1 presents justification and main purposes of the research. In Section 2, the Brazilian context of small farms is discussed. Section 3 provides the methodological procedures developed in this research. Section 4 presents the three case studies main information. Section 5 synthesizes the interviews' results in a graphical framework. Section 6 outlines the reflections and hypothesis proposed based on Section 5. Finally, the paper ends in Section 7 with some concluding remarks.

2. BRAZILIAN CONTEXT OF SMALL FARMS

The 1990s marked the beginning of family farming incentive programs in Brazil, with the development of public nationwide policies, such as the National Program for Strengthening Family Farming (PRONAF), Family Farming Insurance (SEAF) and Program of Assurance of Prices in Family Farming (PGPAF) (Berchin et al., 2019).

According to the law No 11,326, from July 24, 2006, family farming in Brazil is characterized by (Brasil, 2006):

I - Area smaller than four fiscal modules. Fiscal models vary according to the Brazilian municipalities. They should be enough for a family to have income, survive, and thrive;

II - Predominantly family labor;

III - Has a family income predominantly originating from economic activities linked to the establishment itself;

IV - Family-run establishment.

PRONAF was created in 1994 by an agreement between the United Nations Food and Agriculture Organization (FAO) and the Brazilian's Government's Institute for Colonization and Agrarian Reform (INCRA). PRONAF was the first national policy to strengthening family farming in Brazil and until now the program provides credit to small farms expenses (Guanziroli and Basco, 2010). Furthermore, PRONAF opened doors to the emergence of other national policies aimed at family farming. For example, the Family Farm Support Price Program (PGPAF) ensures that family farms products are bought by a price that reflects the average production cost in the region, offering a fair price to the producer (Guanziroli and Basco, 2010). In 2004, the Family Farming

Insurance (SEAF) was created to cover indemnity to family farmers during catastrophic events, such as weather related disasters (Flexor and Grisa, 2016).

Since 2009, family farms became part of the Brazilian National School Feeding Program (PNAE). PNAE and the Food Purchase Program (PAA) are the main public instruments for the purchase of products from of family farming in Brazil. From 2011 to 2017, 77% of the Brazilian municipalities (288) integrated the PAA, with approximately US$ 754 million invested (Bocchi et al., 2019). In addition to the benefits of a fresh food diet for students, the inclusion of local family farming as suppliers of PNAE has greatly encouraged the small producers. The program feeds more than 40 million students of basic education in Brazil and 30% of the budget is transferred by the Federal Government for local family farmers (Mossmann et al., 2017).

Nowadays, Brazilian family farms correspond to more than 80% of all the agricultural units in the country, being responsible for a wide variety of products in the domestic consumption market (Berchin et al., 2019). This sector is responsible to US$ 27 billion of the Brazilian GDP (Graeub et al., 2016). However, these values do not reflect an equal income distribution in the countryside. According to Alves and Rocha (2011), less than 10% of the family farmers in Brazil generate 84.89% of family farming production with monthly income of up to 10 national minimum wages; 18.86% family farmers, generate 11.08% of family farming production and live on monthly income between 2 and 10 minimum wages. Lastly, the vast majority of small landowners, around 70% of the total, cannot survive only on agriculture, often depending on government cash transfer policies (e.g. Bolsa Família) to supplement incomes (Alves and Rocha, 2011).

In the face of the income inequality in the countryside and the current scenario of uncertainties created by the spread of the SARS-CoV-2 virus, the debate on the resilience of production chains under the farmer's perspective gains fundamental importance (Assunção et al., 2020). According to Futemma et al. (2020), up to 70% of Brazilian small farmers interviewed in the states of Amapá, Pará and São Paulo did not have access to special lines of credit during the pandemic. Besides, 84% of these producers did not receive any support from municipal policies to face the crisis and 62% reported losses in sales. Taking this, our research aims to deepen the debate about the resilience mechanisms of Brazilian small farms facing COVID-19.

3. METHODS

3.1. Subject

According to Yin (2017), a case study research is recommend when (1) the main research questions are "how" or "why" questions, (2) there is no control over behavioral events, and (3) the phenomenon studied is contemporary. Since COVID-19 outbreak is still ongoing and the uncertainties regarding the spread of the virus are high (Ceballos et al., 2020), we selected the case study approach to investigate insights of how local food chain systems are facing COVID-19, especially perishable food, since they have a shorter shelf life (Matzembacher et al., 2020).

3.2. Data collection

Data collection was performed by interviews based on three case studies. The case studies were conducted in two farmers and in a cooperative of family farmers in Rio de Janeiro State, Brazil (Figure 1). The respondents were advised that the interviews would be used to structure their perceptions and experiences about small farms resilience facing COVID-19 (Cochran et al., 2011). In order to prevent the risk of contagion by COVID-19, all interviews were done remotely using a web conference software.

We used the Strategic Option Development and Analysis (SODA) to translate the interviews into concept maps. Two formals interviews were conducted with each respondent, one for the elaboration of the map and another for its validation (Cochran et al., 2011). The interviews had an average duration of 01:20 h. Besides, there were also informal talks to clarify eventual doubts between the first interview and conceptual map validation. Then, the concept maps were simplified into a graphical framework.

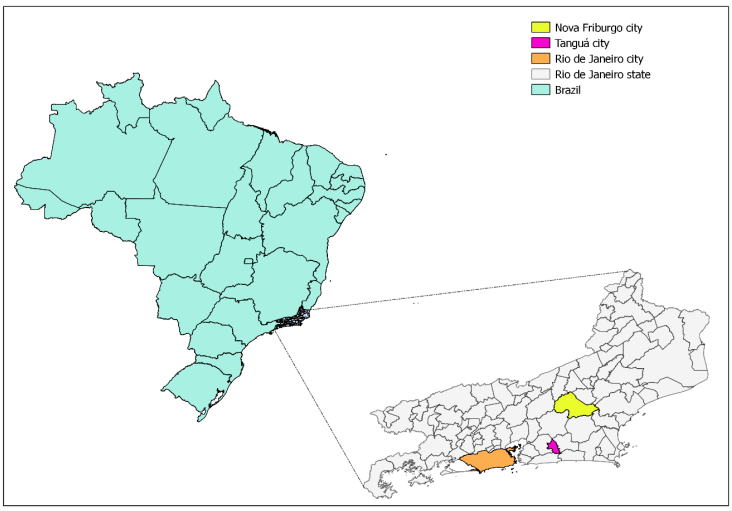

Figure 1. Case studies locations in Brazil, Rio de Janeiro, in the municipalities of Nova Friburgo (Case 1-yellow) and Tanguá (Case 2 and Case 3 - pink). In Blue, Rio de Janeiro city, the main consuming market of the farmers under investigation (Case 1, Case 2 and Case 3).
Source: Designed from (Instituto Brasileiro de Geografia e Estatística, 2020; Núcleo de Economia Regional e Urbana da Universidade de São Paulo, 2020)

3.3. GRAPHICAL FRAMEWORK

The following steps guided the graphical framework structure:

1) Developing a focus question to be answered by the concept map, as opposed to all possible questions (Derbentseva et al., 2007). Our focus question was defined as "**how small farms are facing challenges in COVID-19 context?**", since our objective is to investigate the insights of the resilience mechanisms of Brazilian small farms facing COVID-19.
2) Transcripts the farms interviews and identification of the pertinent concepts to the focus question (Cañas and Novak, 2014; Lima and da Silva Müller, 2017).
3) Selection of the best linking words to connect the concepts in good propositions, forming the concept map (Cañas and Novak, 2014).
4) Validation of the concept maps with the interviewed person, adding extra information when needed (Cochran et al., 2011).
5) Simplification of the concept maps into a graphical framework.
6) A triangulation protocol using additional data sources, such as scientific papers and government reports for generalization of concept maps hypotheses in the Brazilian context (Diefenbach, 2009).

We used the software CmapTools, version 4.11, developed by the Institute for Human and Machine Cognition (IHMC) of the University of West Florida to represent farms knowledge as concept maps (Cañas et al., 2004).

4. CASE STUDIES

4.1. Case 1

Case 1 producers (C1) are located in Nova Friburgo, a municipality in the mountains regions of the state of Rio de Janeiro (RJ), Southern Brazil (Figure 1). Nova Friburgo is one of the major agricultural poles in RJ (Oliveira et al., 2019). C1 are a family farming company for over 50 years on the market. The farm has 5 ha, being 2 ha for fruit and 3 ha for vegetables. The company's management is currently under the responsibility of the 2 generation of founders. However, there is no prospect of business continuity for the third generation, since according to current managers, the agribusiness sector is devalued.

The administration of the business is concentrated in the hands of two of the brothers of the second generation. While one takes care of agricultural production and harvesting activities, the other takes care of transporting and marketing operations. In addition, three other people from the family work on the farm as sharecroppers, which means that these families receive a plot of land for cultivation and share the result of production with the landowner. There are also three workers with a formal contract. As highlighted during the interviews, landowners would like to hire two more workers with a formal contract to assist in crops, but there is a lack of qualified labor in the region. The farm has only one farm tractor to prepare the fields for planting. Then, most of the planting is done manually, which requires a lot of man-hours and effort. The harvest is transported by two own trucks, and the products are mainly sold in the Rio de Janeiro Supply Center (CEASA-RJ). CEASAS are Brazilian retail and wholesale markets which primarily target fruit and vegetable commercialization (Farias and De Araújo, 2020).

4.2. Case 2

Case 2 producers (C2) stay in Tanguá city, in the metropolitan region of the State of Rio de Janeiro (Figure 1). The region has several small farms run by families (Class et al., 2020). This case study focuses on the cultivation of tomatoes (1 ha). Increasing awareness of consumers and society about the possible risks from the use of pesticides has incentive agricultural supply chain to improve farming methods (Yu and Rehman Khan, 2021). In C2, tomatoes are grown using the tomato sustainable production system (Tomatec) developed by the Brazilian Agricultural Research Corporation (Embrapa). The system encompasses a set of good practices on tomato crops (Rosa et al., 2020). For example, the adoption of the Tomatec principles can reduce the use of pesticides by up to 50% in tomato farms (Ferreira et al., 2014).

According to C2 interview, despite the advantages of the Tomatec system, “Tomatecanas” crops still find it difficult to position themselves on the market, since the product does not fit either as a traditional crop or as an organic crop. The product cannot be identified as organic, as it admits the sustainable use of chemical fertilizers. It also does not fit as a traditional product due to the reduced amount of pesticides in cultivation (Ferreira, 2007).

During the harvest, part of the production that has small damages in the surface that do not compromise the quality of the product but make it visually less attractive, is destined to produce tomato sauces. This solution helps to reduce losses in the production process, in addition to increasing the product's useful life, since according to our interviewer these tomato sauces can be stored for up to one year.

The farm harvest is transported by an own dump truck with 1.6 ton capacity per trip and driven by members of the owning family. As the exposure to the sun can accelerate the deterioration of products, the trips are preferably made at night. With regard to tomatoes, the main selling point is the distribution center of a large supermarket chain in city of Rio de Janeiro. Tomatoes are also sold to fairs, municipal schools and individual buyers.

4.3. Case 3

Case 3 (C3) refers to the Association of Citriculturists and Rural Producers of Tanguá (ACIPTA). Citrus-fruit has a fundamental relevance in Tanguá, since it is the second largest orange producer in Rio Janeiro (Santos and Carlos, 2020). ACIPTA was created in 2004 and currently has 22 members. As of 2017, ACIPTA's activities have intensified in helping to regularize the documentation of small producers, such as rural land tax, land regulation, property registration certificate, invoice issuance and retirement. Furthermore, ACIPTA assists in the adoption of traceability systems throughout the product life cycle in compliance with the current Brazilian legislation and the large supermarket chains demands.

In December 2020, in order to foster good management practices and add value to oranges produced in Tanguá, the Agriculture Secretariat in partnership with ACIPTA submitted a dossier to the National Institute of Industrial Property (INPI) for registration of the seal of geographical indication (GI) of origin for oranges in the Tanguá Region (Tanguá, 2020). GI can

be used for market orientation in farming activities, since the seal certifies that the quality of some products from certain regions was better owing to their geographical origin (Fagundes et al., 2012).

Besides, during the COVID-19 pandemic, ACIPTA helped to sell members' products intermediating the collective sale of products. In the future, the association intends to act strongly in negotiating collective sales. However, it is necessary that small producers ensure continuity of supply, in other words, they do not concentrate the entire harvest in a single moment and ensure a high standard of quality.

4.4. GRAPHICAL FRAMEWORK

Based on the three case studies, we elaborated a graphical framework (Figure 2).

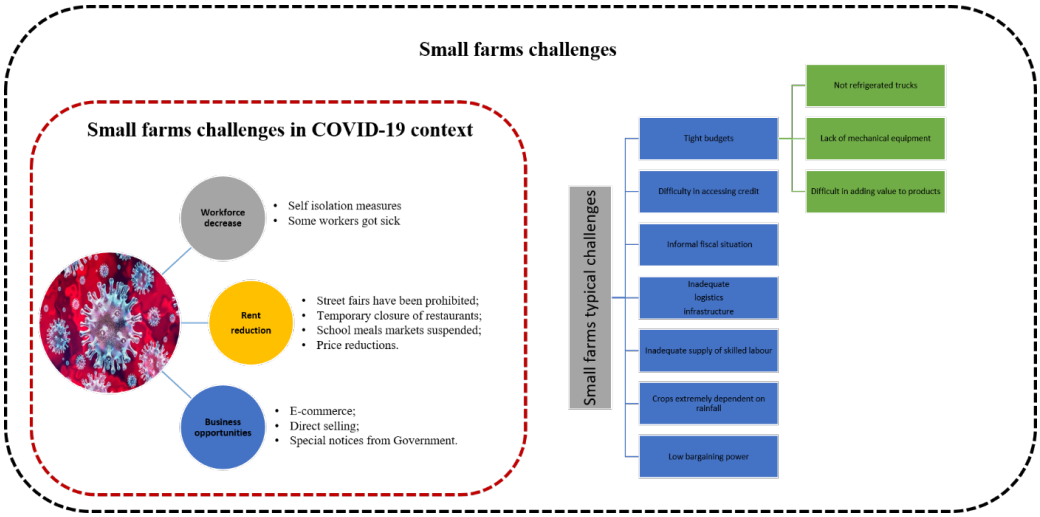

Figure 2. Conceptual framework based on the three case studies (C1, C2 and C3).
Source: Designed from cases studies interviews (2020).

5. RESULTS AND DISCUSSION

Based on the conceptual framework (Figure 2), we formulated 6 hypothesis containing the main challenges faced by small farming to survive in times of uncertainty, such as COVID-19 pandemic: 1) Tight budgets and difficulty in accessing credit restrict the adaptability of small business, 2) Many producers are in an informal condition, 3) Digital marketing are still at early stages, 4) Field has lack of human resources, 5) Low-technology production methods, and 6) Difficulty in adding value to the products.

5.1. Tight budgets and difficulty in accessing credit restrict the adaptability of small business

Figure 2 points out the difficult in regularizing small family business, making the access to credit, and consequently resilience in times of uncertainty, difficult. The pandemic has made financing from the bank even more difficult, since the uncertainties in the market unable most of the small farmers to get through the repayment ability assessment (Yu and Rehman Khan, 2021). In this context, public policies can play a crucial role supporting investments in family farmers. For example, during COVID-19 pandemic, the European Commission has provide a financial support to the fruit and vegetable sector to compensate for fluctuations in producers' income (Hance, 2021). Karnali Province, in Nepal, has received about 4 million dollars from federal government to combat food insecurity during COVID-19 (Adhikari et al., 2021)

Yamaguchi et al. (2020), based on survey with young rural entrepreneurs in Santa Catarina, Brazil, argue the main difficulties of rural entrepreneurship are economic, including high production costs and access to credit. In recent years, Brazil has experienced a reduction in family farming incentive programs, leaving the country in a vulnerable situation in the face

of the pandemic. For example, the budged target by Federal Government to family farming decreased 24.2% from 2014 to 2017 (Souza et al., 2019)

In Brazil, Food Acquisition Program (PAA) ensure direct acquisition by the government of assorted products sold by family farms. Farmers in PAA have 6-month contracts, providing producers with more resilience to market uncertainties (Blesh and Wittman, 2015). PAA's already consolidated structure might be used to mitigate the economic and social impacts of COVID-19 in Brazil. However, it should be noted that the amount applied in this program reduced from R$ 1006.8 million in 2011 to R$ 232.7 million in 2018, undermined its benefits (Sambuichi et al., 2020).

School nutrition programs are the primary source of food of over 10 million children in Latin America and the Caribbean (Altieri and Nicholls, 2020). Likewise, Brazil has school food programs that are responsible to provide free meals for over 40 million students using small farmers' products. Many of these students live in extreme poverty (Soares et al., 2017). During COVID-19 pandemic the schools have been closed and students attended web-based classes, affecting the meals markets for small farms and also food security (Berchin et al., 2019; Canabarro et al., 2020). To deal with this, Brazilian Law 13.987/2020 and Resolution N ° 2, of April 9, 2020 have been launched to send food baskets to low-income students enrolled in public schools through public biddings to farmers (Brasil, 2020; Ribeiro-Silva et al., 2020).

However, there was no mandatory obligation in the distribution of acquired foodstuffs kits, not even a standardization of the eligibility criteria for the aid, leaving the decision to each municipality (Pereira et al., 2020). During the pandemic, the federal government's denial of the seriousness of the disease made it difficult for public policies to be uniform. In the absence of efficient federal government leadership, municipal leadership have to emerge in the wake of the crisis, often acting in a diffuse manner (Ortega and Orsini, 2020). Therefore, despite creating an alternative to combat food insecurity, Federal Government failed to manage universal access to food.

5.2. Many producers are in informal fiscal situation

The public biddings usually require the issuance of invoices (Minas Gerais, 2020), which not all small producers are able to do, given that many of them are in an informal fiscal situation. This reinforces the need to regularize small producers to expand their business opportunities. In uncertain times, when traditional routes of commerce such as street fairs are suspended, resilience is linked to the business's ability to diversify (Meuwissen et al., 2019). It should be noted that street markets are the second Brazilian favorite place to buy food. Therefore, the temporary close of it, direct affected the farmers budget (Preiss, 2020). In this context, Francesconi et al. (2021) points out that rural cooperative organizations can help smallholder-members access new markets. Nevertheless, the success of these cooperatives is directly associated with their level of maturity.

As described on C3 interview, ACIPTA helped associated producers with irregularities in documentation during COVID-19 by issuing invoices through the cooperative. In addition, the cooperative assisted producers by mediating collective bargaining for foodstuffs. As we can see, agricultural cooperatives can improve bargaining power and reduce costs of the members. Nevertheless, coordinate the cooperative is not an easy task and the success is directly affected by the member's behavior, in other words, whether cooperation or competition dominates the relationship of them (Zhong et al., 2018).

In the opposite way of ACIPTA experience, the interviewed farmer in C1 reported an unsuccessful cooperative attempt 15 years ago. According to the reports, the leaders of the cooperative themselves failed to comply with the agreement signed between farmers in the region, lowering the prices of the goods to reach the market. During the pandemic, the existence of this cooperative would facilitate the negotiation of collective sales and the vulnerability to large corporations, one of the biggest problems reported in C1. Community-level trust must be cultivated as a plant that becomes stronger and more resilient over the

years. For this reason, unsuccessful experiences as in C1 end up aborting the chances of success of the cooperative system (Riley et al., 2018).

5.3. Digital marketing is still at early stages

Both cases C1 and C2 reported that they leveraged the use of social media as sales channels during the pandemic. In C2, all kaki production, a sweet and extremely perishable species of tomato, was sold using social media. Without this resource, the production would be lost. Digitalization of agricultural value chain has shown itself a very efficient tool to avoid outbreaks and food waste in agro supply chains. More recently, it has been evident in the literature that e-commerce is a worldwide trend to deal with the temporary closure of open fairs in order to contain the virus from spreading (Leone et al.., 2020).

For example, agri-food e-commerce platform increased almost 6% in Taiwan, with special emphasis on fresh fruit and vegetables (Chang and Meyerhoefer, 2020). Following this line, more quantitative studies dimensioning the impact of e-commerce in small farming would be of great value. The use of digital platforms represents a paradigm shift in the field, giving small producers greater autonomy. The modernization of producer-consumer relations are expected to continue even after the end of the pandemic, perhaps contributing to increase the attractiveness of agribusiness for young people (Hobbs, 2020).

This new way of organizing the food supply chain, in addition to ensuring greater financial security for the producer, can be very useful in popularizing more sustainable foods, such as organic. For example, the purchase of organic products directly from the producer through digital platforms can make the product cheaper up to 400 times (Preiss, 2020). Nevertheless, in Brazil, supermarkets are still the main distribution channel for organic foods accounting more than 60% of total sales before COVID-19 (Medaets et al., 2020), but this situation can be changed in post pandemic scenario. In this regard, a free e-commerce platform would accelerate the connection between farm and fork (Preiss, 2020).

5.4. Lack of human resources in the agro-food chain

Cases C1 and C2 farmers complained about workforce supply in the field. The rural exodus and the low valuation of fieldwork make agribusiness unattractive for younger people. The difficulty in obtaining qualified labor is also pointed by Yamaguchi et al. (2020). According to them, the adoption of technological innovations can avoid rural exodus. In addition, COVID-19 can aggravated the lack of workforce in the field, since the restrictions in the workers mobility decreased the seasonal labor supply (Bochtis et al., 2020).

The farmer in C1 also reported that there is no perspective of business continuity for the next generations of the family due to not satisfactory rural income in view of the requirements of the business. This point of view is in line with Foguesatto et al. (2020), since they highlight the lack of successors to rural properties in Brazil. According to these authors, the lack of family encouragement and high opportunity costs are the main reasons for the lack of interest of young people in the countryside.

Because of successors to rural properties problem, the average age of farmers is increasing. This phenomenon compromises the adoption of more sustainable practices and innovations in the field, since older farmers tending to be more averse to changes (Foguesatto et al., 2020). Besides, young farmers tend to use information technology to improve the field productivity and resilience, reacting better to situations of uncertainty (McKillop et al., 2018).

5.5. Low-technology production methods

Another obstacle to innovation smallholders business pointed in Figure 2 is the lack of equipment with the appropriate dimensions, since traditional facilities are usually designed for large crops, as also argued by Kornecki & Reyes (2020). The efficiency in the field involves increasing productivity through technological innovation to target higher value-added jobs to

field workers. However, unfortunately, small farms usually operate with labor intensive production practices in land preparation, weeding and harvesting, which decreases the attractiveness of field work (Mujawamariya and Kalema, 2017). Lastly, during COVID-19, field mechanization would enable the best use of available labor, in addition to reducing the risks of labor shortages and food insecurity (Singh et al., 2020).

5.6. Difficulty in adding value to the products

Increasing field profitability may also include adding value to products, for example, as described by the farmer from C2, tomatoes with minor blemishes could be made into sauces. The positive impact of adding value to foods goes beyond increasing market price, it also avoids food waste (Alonso, 2011). In Australia, a survey with 43 horticultural associations identified that over than 10% of production can be rejected by consumers for been partly blemished or small size. Without value-added activities, all that food is simply thrown away (Hingley et al., 2013).

Besides, during the pandemic, vegetables and fruits were under great pressure by large retailing companies to reduce prices (Harris et al., 2020). In Brazil, one of the reasons for it was that street markets were temporary interrupted (Sambuichi et al., 2020). In view of that, the improvement of products could be an alternative to increase the useful life of them and guarantee greater bargaining power to the small producer. Nevertheless, financial constraints are still a big obstacle to the implementation of a system for processing agricultural products (Donkor et al., 2018).

Another positive point identified in C2 was the adoption of agroecological cultivation practices (“Tomatecanas crops”). The adoption of sustainable practices in supply chains has become an increasingly strong trend in the last years (Khan et al., 2021). The COVID-19 pandemic has shown that less dependence on external inputs, such as fertilizers and pesticides, makes the agroecological chains more resilient to disruptions. Furthermore, these chains are shown to be more environmentally sustainable, attracting the attention of consumers (Altieri and Nicholls, 2020). Besides, several empirical cases suggest that agroecological practices are economically efficient ways of adding value to products. For example, family farmers’ income can be upward up to 70% with these sustainable practices (van der Ploeg et al.., 2019).

The seal of geographical indication (GI) in process of registration by C3 can be another way to adding value to agro products. GI labeling main economic effects are (1) increased incomes and (2) resilience, since the consumers recognize a real advantage for them when buying the product (Vandecandelaere et al., 2020). Therefore, Malacarne et al. (2019) highlights that GI can be used by small farmers to prove the quality of their products against major competitors. In times of uncertainty, this will be an important competitive advantage for small producers in Tanguá.

6. CONCLUSION

Brazilian family farms correspond to more than 80% of all the agricultural units in the country, been responsible to US$ 27 billion of the Brazilian GDP. In Brazil, family farming plays a central role in the food security of children and adolescents, ensuring healthy school meals in public schools for up to 40 million students. Many of these young people live in a vulnerable situation and school meals are the only balanced meal to which they have access. This paper has looked at the insights of how local food systems are facing COVID-19 in Brazil based on two small farms and a cooperative of family farmers located on Rio de Janeiro.

During the pandemic, many businesses were impacted. In the case of small farming, (1) the closure of street fairs and restaurants, and (2) remote classes, with the consequent suspension of school meals were the major challenges. In addition, lockdown measures had a negative impact on product distribution times. In the case of perishable goods, such as fruits and vegetables, the loss can be even greater. There was also an ineffectiveness of public

policies to support small products. Despite some promising initiatives such as Brazilian Law 13,987 / 2020 and Resolution N ° 2, of April 9, 2020 for the distribution of basic food baskets to underprivileged students, the implementation failed due to the lack of guidance from the federal government.

At least, the pandemic has generated changes in the way farmers relate to the final consumer, narrowing the bond between them. For example, the use of social media and digital platforms has boosted sales in the field. In addition to allowing the end consumer to trace the origin and history of the food consumed, the tendency is that this close contact between producers and consumers remain in the post-pandemic, favoring local food production. In this sense, training initiatives for small farmers in digital marketing would be of great use. Agro-entrepreneurship is a promising field both for resilience in the field and for more sustainable relationships with nature and local communities.

However, this advance comes up against the difficulty of accessing credit, depending on effective public policies to become a reality. Unfortunately, in recent years, investment in programs such as PAA and PNAE has been drastically reduced. Seen in these terms, new studies in the post-pandemic scenario would be interesting to measure the evolution of the situation. Perhaps the crisis has attracted attention to the lately neglected family farming in Brazil.

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BIBLIOGRAPHY

Adhikari, J., Timsina, J., Khadka, S.R. et al. (2021), “COVID-19 impacts on agriculture and food systems in Nepal: Implications for SDGs”, *Agricultural Systems*, Vol. 186, pp. 102990.

Alonso, A.D. (2011), "Farmers' involvement in value-added produce: the case of Alabama growers", *British Food Journal*, Vol. 113, No. 2, pp. 187-204.

Altieri, M.A. and Nicholls, C.I. (2020), "Agroecology and the reconstruction of a post-COVID-19 agriculture", *Journal of Peasant Studies*, Vol. 47, No. 5, pp. 881-898.

Alves, E. and Rocha, D.D.P. (2011), “Ganhar tempo é possível”, *Ciencias Agrarias*, pp. 31-32.

Assunção, M.V.D., Medeiros, M., Trump, L.N.R. et al. (2020), "Resiliência das cadeias de suprimentos brasileira com os impactos da Covid-19", *Holos*, Vol. 36, No. 5, pp. 1-20.

Belhadi, A., Kamble, S.S., Khan, S.A.R. et al. (2020), ""“Infectious waste management strategy during COVID-19 pandemic in Africa: an integrated decision-making framework for selecting sustainable technologies”, *Environmental Management*", Vol. 66, No. 6, pp. 1085-104.

Berchin, I.I., Nunes, N.A., de Amorim, W.S. et al. (2019), "The contributions of public policies for strengthening family farming and increasing food security: The case of Brazil", *Land Use Policy, Elsevier*, Vol. 82, pp. 573-84.

Blesh, J. and Wittman, H. (2015), "'Brasilience:' assessing resilience in land reform settlements in the Brazilian Cerrado", *Human Ecology*, Vol. 43, No. 4, pp. 531-46.

Bocchi, C.P., Magalhães, É. S., Rahal, L. et al. (2019), "A década da nutrição, a política de segurança alimentar e nutricional e as compras públicas da agricultura familiar no Brasil", *Revista Panamericana de Salud Pública*, Vol. 43, pp. 1.

Bochtis, D., Benos, L., Lampridi, M. et al. (2020), "Agricultural workforce crisis in light of the COVID-19 pandemic", *Sustainability (Switzerland)*, Vol. 12, No. 19, pp. 8212. http://dx.doi.org/10.3390/su12198212.

Brasil. (2006), “Lei nº 11.326, de 24 de Julho de 2006.” Estabelece as diretrizes para a formulação da Política Nacional da Agricultura Familiar e Empreendimentos Familiares Rurais, *Diário Oficial da União*, Brasília, available at: https://legis.senado.leg.br/sdleg-getter/documento?dm=4080268&disposition=inline (accessed 19 April 2021).

Brasil. (2020), “Lei nº 13.987, de 7 de Abril de 2020”. Altera a Lei nº 11.947, de 16 de junho de 2009, para autorizar, em caráter excepcional, durante o período de suspensão das aulas em razão de situação de emergência ou calamidade pública, a distribuição de gêneros alimentícios adquiridos com recursos do Programa Nacional de Alimentação Escolar (Pnae) aos pais ou responsáveis dos estudantes das escolas públicas de educação básica, *Diário Oficial da União*, Brasília.Canabarro, A., Tenório, E., Martins, R. et al. (2020), "Data-driven study of the COVID-19 pandemic via age-structured modelling and prediction of the health system failure in Brazil amid diverse intervention strategies", *PLoS One*, Vol. 15, No. 7, pp. 1-8.

Cañas, A.J. and Novak, J.D. (2014), “Concept mapping using CmapTools to enhance meaningful learning”, *Advanced Information and Knowledge Processing*, pp. 23-45.

Cañas, A.J., Hill, G., Carff, R. et al. (2004), “CmapTools: a knowledge modeling and sharing environment”, *Concept Maps: Theory, Methodology, Technology*, in *Proceedings of the First Int. Conference on Concept Mapping*, Vol. 1 No. 1984, pp. 125-135.

Cappelli, A. and Cini, E. (2020), "Will the COVID-19 pandemic make us reconsider the relevance of short food supply chains and local productions", *Trends in Food Science and Technology*, Vol. 99, pp. 566-7.

Ceballos, F., Kannan, S. and Kramer, B. (2020), ""Impacts of a national lockdown on smallholder farmers’ income and food security: Empirical evidence from two states in India”, *World Development*, Vol. 136, pp. 105069.

Chang, H.H. and Meyerhoefer, C.D. (2020), "COVID-19 and the demand for online food shopping services: empirical evidence from Taiwan", *American Journal of Agricultural Economics*, Vol. 103, No. 2, pp. 448-465.

Class, C.S.C., Silveira, R.L., Palmer, J.P.S. et al. (2020), "Research and extension action for parasitic control in pig breeding families located in Tanguá, Rio de Janeiro", *Brazilian Journal of Veterinarv Research*, Vol. 40, pp. 739-49.

Cochran, J.J., Cox, L.A., Keskinocak, P. et al. (2011), “Cognitive Mapping and Strategic Options Development and Analysis (SODA)”, *Wiley Encyclopedia of Operations Research and Management Science*, https://doi.org/10.1002/9780470400531.eorms0974.

Cordeiro, M.C., Santos, L., Angelo, A.C.M., et al. (2021). "Research directions for supply chain management in facing pandemics: an assessment based on bibliometric analysis and systematic literature review", *International Journal of Logistics Research and Applications*, pp. 1-21. https://doi.org/10.1080/13675567.2021.1902487.

Derbentseva, N., Safayeni, F. and Cañas, A.J. (2007), "Concept maps: experiments on dynamic thinking", *Journal of Research in Science Teaching*, Vol. 44, No. 3, pp. 448-65.

Diefenbach, T. (2009), "Are case studies more than sophisticated storytelling?: Methodological problems of qualitative empirical research mainly based on semi-structured interviews", *Quality & Quantity*, Vol. 43, No. 6, pp. 875-94.

Donkor, E., Onakuse, S., Bogue, J. et al. (2018), "Promoting value addition among farmers in the cassava food value chain in Nigeria", *British Food Journal*, Vol. 120, No. 9, pp. 2047-65.

Elghannam, A., Mesias, F.J., Escribano, M. et al. (2020), "Consumers’ perspectives on alternative short food supply chains based on social media: a focus group study in Spain", *Foods*, Vol. 9, No. 1. http://dx.doi.org/10.3390/foods9010022.

Fagundes, P.D.M., Padilha, A.C.M., Sluszz, T. et al. (2012), "Geographical indication as a market orientation strategy: An analysis of producers of high-quality wines in Southern Brazil", *Journal of Database Marketing and Customer Strategy Management*, Vol. 19, No. 3, pp. 163-78.

Fan, S., Si, W. and Zhang, Y. (2020), "How to prevent a global food and nutrition security crisis under COVID-19", *China Agricultural Economic Review*, Vol. 12, No. 3, pp. 471-480. http://dx.doi.org/10.1108/CAER-04-2020-0065.

Farias, D.D.P. and De Araújo, F.F. (2020), "Trends in Food Science & Technology Will COVID-19 affect food supply in distribution centers of Brazilian regions affected by the pandemic ", *Trends in Food Science & Technology*, Vol. 103, pp. 361-6.

Ferreira, P. (2007), “Um tomate mais livre dos agrotóxicos”, *Revista de Manguinhos*.

Ferreira, M. T. A., Aquino, A.M., Macedo, J.R. et al. (2014), “Uso do ensacamento no cultivo de tomate orgânico no sistema TOMATEC®”, in *Resumos do IV Seminário de Agroecologia do Distrito Federal e Entorno* 2014 outubro 7-9, Unb, Brasília, pp. 1-4.

Flexor, G. and Grisa, C. (2016), "Contention, ideas, and rules: The institutionalization of family farm policy in Brazil", *Canadian Journal of Latin American and Caribbean Studies, Routledge*, Vol. 41, No. 1, pp. 23-37.

Foguesatto, C.R., Mores, G.V., Dalmutt Kruger, S. et al. (2020), “Will I have a potential successor? Factors influencing family farming succession in Brazil”, *Land Use Policy*, Vol. 97, pp. 104643.

Francesconi, N., Wouterse, F. and Namuyiga, D.B. (2021), "Agricultural cooperatives and covid-19 in southeast africa. The role of managerial capital for rural resilience", *Sustainability (Switzerland)*, Vol. 13, No. 3, pp. 1-13.

Futemma, C., Tourne, D.C.M., Andrade, F.A.V. et al. (2020), "A pandemia da covid-19 e os pequenos produtores rurais : superar ou sucumbir ", *SciELOPreprints*, Vol. 967, pp. 26.

Graeub, B.E., Chappell, M.J., Wittman, H. et al. (2016), "The state of family farms in the world", *World Development*, Vol. 87, pp. 1-15.

Gu, H.Y. and Wang, C.W. (2020), “Impacts of the COVID-19 pandemic on vegetable production and countermeasures from an agricultural insurance perspective”, *Journal of Integrative Agriculture*, Vol. 19 No. 12, pp. 2866-2876.

Guanziroli, C.E. and Basco, C.A. (2010), “Construction of agrarian policies in Brazil: the case of the National Program to Strengthen Family Farming (PRONAF)”, *Comuniica Magazine*.

Hance, T. (2021), “Impact of the COVID-19 pandemic on apple orchards in Europe”, Vol. 190, 103097. https://doi.org/10.1016/j.agsy.2021.103097.

Harris, J., Depenbusch, L., Pal, A.A. et al. (2020), ""Food system disruption: initial livelihood and dietary effects of COVID-19 on vegetable producers in India”, *Food Security*, Vol. 12, No. 4, pp. 841-51.

Hingley, M., Duarte Alonso, A. and Northcote, J. (2013), "Investigating farmers' involvement in value-added activities: A preliminary study from Australia", *British Food Journal*, Vol. 115, No. 10, pp. 1407-27.

Hobbs, J.E. (2020), "Food supply chains during the COVID-19 pandemic", *Canadian Journal of Agricultural Economics*. http://dx.doi.org/10.1111/cjag.12237.

Huss, M., Brander, M., Kassie, M., Ehlert, U. and Bernauer, T. (2021), “Improved storage mitigates vulnerability to food-supply shocks in smallholder agriculture during the COVID-19 pandemic”, *Global Food Security*, Vol. 28, pp. 100468.

Instituto Brasileiro de Geografia e Estatística. (2020), “Malha Municipal”, available at: https://www.ibge.gov.br/geociencias/organizacao-do-territorio/15774-malhas.html?=&t=downloads (accessed 2 January 2020).

Khan, S.A.R., Yu, Z., Golpira, H. et al. (2021), "A state-of-the-art review and meta-analysis on sustainable supply chain management: Future research directions", *Journal of Cleaner Production*, Vol. 278, pp. 123357.

Kornecki, T.S. and Reyes, M.R. (2020), "Equipment development for small and urban conservation farming systems", *Agriculture (Switzerland)*, Vol. 10, No. 12, pp. 1-16.

Lal, R. (2020), ""Home gardening and urban agriculture for advancing food and nutritional security in response to the COVID-19 pandemic”, *Food Security*. http://dx.doi.org/10.1007/s12571-020-01058-3.

Lawson-Lartego, L. and Cohen, M.J. (2020), ""10 recommendations for African governments to ensure food security for poor and vulnerable populations during COVID-19”, *Food Security*, 12, 899-902. http://dx.doi.org/10.1007/s12571-020-01062-7.

Leone, L.A., Fleischhacker, S., Anderson-Steeves, B. et al. (2020), "Healthy food retail during the COVID-19 pandemic: Challenges and future directions", *International Journal of Environmental Research and Public Health*, Vol. 17, No. 20, pp. 1-14.

Lima, V.A. and da Silva Müller, C.A. (2017), “Why do small businesses innovate? Relevant factors of innovation in businesses participating in the Local Innovation Agents program in Rondônia (Amazon, Brazil)”, *RAI Revista de Administração e Inovação*, Vol. 14, No. 4, pp. 290-300.

Malacarne, A., Nunes-Silva, L. and De-Bortoli, R. (2019), "Geographical indication as a tool for regional development: an opportunity for small farmers to excel in the market", *International Journal of Social Science and Humanity*, Vol. 9, No. 2, pp. 22-5.

Matzembacher, D.E., Vieira, L.M. and de Barcellos, M.D. (2020), "An analysis of multi-stakeholder initiatives to reduce food loss and waste in an emerging country – Brazil", *Industrial Marketing Management*, Vol. 93, pp. 591-604.

McKillop, J., Heanue, K. and Kinsella, J. (2018), "Are all young farmers the same? An exploratory analysis of on-farm innovation on dairy and drystock farms in the Republic of Ireland", *Journal of Agricultural Education and Extension, Taylor & Francis*, Vol. 24, No. 2, pp. 137-51.

Medaets, J.P.P., Fornazier, A. and Thomé, K.M. (2020), "Transition to sustainability in agrifood systems: Insights from Brazilian trajectories", *Journal of Rural Studies*, Vol. 76, pp. 1-11.

Meuwissen, M.P.M., Feindt, P.H., Spiegel, A. et al. (2019), "A framework to assess the resilience of farming systems", *Agricultural Systems*, Vol. 176, pp. 102656.

Minas Gerais (2020), "Intenção de Compra Emergencial - COVID 19 Aquisição de Cestas Básicas Conforme Solicitação da Secretaria de Educação", Secretaria Municipal de Educação, Minas Gerais.

Mossmann, M.P., Teo, C.R.P.A., Busato, M.A. et al. (2017), "Interface between family farming and school feeding: Barriers and coping mechanisms from the perspective of different social actors in Southern Brazil", *Revista de Economia e Sociologia Rural*, Vol. 55, No. 2, pp. 325-42.

Mujawamariya, G. and Kalema, E.P. (2017), "Limited usage of mechanical equipment in small-scale rice farming: A cause for concern", *Journal of Agriculture and Environment for International Development*, Vol. 111, No. 1, pp. 5-21.

Núcleo de Economia Regional e Urbana da Universidade de São Paulo. (2020), "Shape files do Brasil", available at: http://www.usp.br/nereus/?dados=brasil (accessed 2 January 2020).

Oliveira, S.F., Prado, R.B. and Monteiro, J.M.G. (2019), "Climate change impacts in ecosystem services under the perception of small farmers and rural actors in agricultural sector of Nova Friburgo – RJ", in *V Biosystems Engineering Workshop - WEB 5.0 November 05-07, 2019*, Niterói - RJ, Brazil.

Ortega, F. and Orsini, M. (2020), "Governing COVID-19 without government in Brazil: Ignorance, neoliberal authoritarianism, and the collapse of public health leadership", Global Public Health, Taylor & Francis, pp. 1-21.

Pereira, A.S., Campos, F.M., Santos, C.R.B. et al. (2020), "Desafios na execução do programa nacional de alimentação escolar durante a pandemia pela covid-19", *Brazilian Journal of Development*, Vol. 6, No. 8, pp. 63268-82.

Preiss, P.V. (2020), "Challenges facing the COVID-19 pandemic in Brazil: lessons from short food supply systems", *Agriculture and Human Values*, Vol. 37, No. 3, pp. 571-2.

Reardon, T., Mishra, A., Nuthalapati, C.S.R. et al. (2020), "Covid-19's disruption of India's transformed food supply chains", *Economic and Political Weekly*, Vol. 55, No. 18, pp. 18-22.

Ribeiro-Silva, R.C., Pereira, M., Campello, T. et al. (2020), "Covid-19 pandemic implications for food and nutrition security in Brazil", *Ciencia & Saude Coletiva*, Vol. 25, No. 9, pp. 3421-30.

Riley, M., Sangster, H., Smith, H. et al. (2018), "Will farmers work together for conservation? The potential limits of farmers' cooperation in agri-environment measures", *Land Use Policy*, Vol. 70, pp. 635-646.

Rosa, I., De Jesus, D., Cristina, P. et al. (2020), "Work issues on Tomatec - a tomato sustainable production system", in *1st ISATA – International Symposium on Agricultural Technology Adoption: Studies, Methods and Experiences*, pp. 121-122.

Sambuichi, R.H.R., de Almeida, A.F.C.S., Perin, G. et al. (2020), "The food acquisition program (Paa) as a strategy to face the challenges of covid-19", *Revista de Administração Pública*, Vol. 54, No. 4, pp. 1079-96.

Santos, R.A. and Carlos, R.M.S. (2020), "Tourism and leisure in São Gonçalo, RJ: an analysis of touristic offers", *Revista Brasileira de Estudos do Lazer*, Vol. 7, pp. 42-68.

Singh, B., Shirsath, P.B., Jat, M.L. et al. (2020), "Agricultural labor, COVID-19, and potential implications for food security and air quality in the breadbasket of India", *Agricultural Systems*, Vol. 185, pp. 102954.

Soares, P., Davó-Blanes, M.C., Martinelli, S.S. et al. (2017), "The effect of new purchase criteria on food procurement for the Brazilian school feeding program", *Appetite*, Vol. 108, pp. 288-94.

Souza, L.E.P.F., De Barros, R.D., Barreto, M.L., et al. (2019), "The potential impact of austerity on attainment of the Sustainable Development Goals in Brazil", *BMJ Global Health*, Vol. 4, No. 5, pp. 1-7.

Stecke, K.E. and Kumar, S. (2009), "Sources of supply chain disruptions, factors that breed vulnerability, and mitigating strategies", *Journal of Marketing Channels*, Vol. 16, No. 3, pp. 193-226.

Tanguá. Prefeitura. (2020), "A Secretaria de agricultura em parceria com a ACIPTA, celebram a entrega do dossiê ao INPI, para registro do selo de indicação geográfica de origem para as laranjas da Região de Tanguá", available at: https://tangua.rj.gov.br/home/index.php/2020/12/12/a-secretaria-de-agricultura-em-parceria-com-a-acipta-celebram-a-entrega-do-dossie-ao-inpi-para-registro-do-selo-de-indicacao-geografica-de-origem-para-as-laranjas-da-regiao-de-tangua/ (accessed 27 January 2021).

van der Ploeg, J.D., Barjolle, D., Bruil, J. et al. (2019), "The economic potential of agroecology: Empirical evidence from Europe", *Journal of Rural Studies*, Vol. 71, pp. 46-61.

Vandecandelaere, E., Teyssier, C., Barjolle, D. et al. (2020), "Strengthening sustainable food systems through geographical indications: evidence from 9 worldwide case studies", *Journal of Sustainability Research*, Vol. 2, No. 4. http://dx.doi.org/10.20900/jsr20200031.

Yamaguchi, C.K., Stefenon, S.F., Ramos, N.K. et al. (2020), "Young people's perceptions about the difficulties of entrepreneurship and developing rural properties in family agriculture", *Sustainability (Switzerland)*, Vol. 12, No. 21, pp. 1-12.

Yin, R.K. (2017), *Case Study Research and Applications: Design and Methods*, 6th ed., SAGE Publications, Thousand Oaks. https://doi.org/10.1177/109634809702100108.

Yu, Z. and Rehman Khan, S.A. (2021), "Evolutionary game analysis of green agricultural product supply chain financing system: COVID-19 pandemic", *International Journal of Logistics Research and Applications, Taylor & Francis*, Vol. 0, No. 0, pp. 1-21.

Zhong, Z., Zhang, C., Jia, F. et al. (2018), "Vertical coordination and cooperative member benefits: Case studies of four dairy farmers' cooperatives in China", *Journal of Cleaner Production*, Vol. 172, pp. 2266-77.

Zhu, Q. and Krikke, H. (2020), "Managing a sustainable and resilient Perishable Food Supply Chain (PFSC) after an outbreak", *Sustainability (Switzerland)*, Vol. 12, No. 12, pp. 1-11.

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