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# The resilience of short food supply chains during the COVID-19 pandemic: a case study of a direct purchasing network

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**Introduction:** The COVID-19 pandemic has presented challenges to global food supply chains. Since the beginning of the pandemic researchers have studied various food supply chain issues influenced by the COVID-19 crisis, including impacts on consumer behavior, and logistical and organizational changes to food supply chains. Despite the proliferation of studies on food supply chains during the pandemic, only a few researchers have focused on short food supply chains and their resilience. Therefore, the aim of this study was to explore the resilience of short food supply chains during the COVID-19 pandemic using a direct purchasing (DP) network as a case study. The study considered three research questions. (1) How has the functioning of the DP network changed during the COVID-19 pandemic? (2) What role do resilience elements (i.e., readiness to shocks, responsiveness to disruption, and recovery from the crisis) play in the short food supply chain response to the COVID-19 crisis? (3) Which innovations in the short food supply chain would further the recovery process, and thus resilience, after the crisis?

**Methods:** This article presents a case study of a direct organic food purchasing network in Latvia. The analysis of economic data regarding the dynamics of organic product demand and supply in the DP network was supplemented with an analysis of qualitative data gathered through semi-structured in-depth interviews with representatives of three groups of DP network participants: consumers, producers, and DP network organizers.

**Results and discussion:** From the consumer and producer experiences, the DP network was a flexible short food chain that could adapt quickly in a crisis. While the number of DP distribution points and total number of purchases decreased during the pandemic, a statistically significant increase in the number of product units sold compared to the pre-COVID-19 period was observed. From the perspective of food chain resilience elements, the reactive strategies of the DP network as a short food supply chain were highlighted. During the COVID-19 pandemic, the organizational and product innovations introduced in the DP network played a key role in enhancing the resilience of the short supply chain in the context of the wider food system.

## KEYWORDS

short food supply chains, COVID-19 pandemic, direct purchasing, organic food, organic farmers, food network, resilience, Latvia

## Introduction

The COVID-19 pandemic has strongly influenced and changed the way food supply chains work. In many countries measures to control COVID-19 outbreaks have affected food supply chains (United Nations, 2020) at various food production stages (Galanakis, 2020). Many of the effects of the COVID-19 pandemic on food supply chains were due to restrictions on people's mobility and labor shortages that influenced food production and the harvesting of crops (Coluccia et al., 2021), as well as deliveries (Hobbs, 2020). The COVID-19 pandemic was also characterized by a shift in customer preferences (Butu et al., 2020) and food purchase behaviors from food service to food retail (Coopmans et al., 2021). Many restaurants and cafes were closed, forcing people to prepare more food at home. As a result, food chain actors had to adopt new distribution and logistics strategies (Marusak et al., 2021), implement technologies for placing online orders (Butu et al., 2020), and introduce automation and digitalization into food supply chains (Hobbs, 2021). Thus, the COVID-19 pandemic exposed vulnerabilities in markets and systems (Migliore et al., 2021; Rivera-Ferre et al., 2021) but also encouraged discussions about the resilience and flexibility of food supply chains (Coopmans et al., 2021; Ozdemir et al., 2022). Thus, the COVID-19 pandemic as a worldwide real life crisis depicted the fragility of the global food systems and the fact, that they can be disrupted easily (Béné, 2020). Therefore, during the COVID-19 pandemic, the role of short food chains as well as local and regional food production was reconsidered (Cappelli and Cini, 2020). Researchers consider less globalized food systems to be less vulnerable compared to global food systems (Rivera-Ferre et al., 2021) and the ability of short and regional food supply chains to respond more adeptly to the changes and demands imposed by the COVID-19 pandemic has been highlighted (Marusak et al., 2021; Thilmany et al., 2021), but the resilience of short food supply chains during COVID-19 pandemic remains largely unexplored (Michel-villarreal et al., 2021). Thus, this research aims to strengthen the knowledge about the resilience of short food supply chains specifically during the COVID-19 pandemic by exploring the ways specific short food supply chain actors responded and adapted to the global challenge of the COVID-19 pandemic. The results of the research are based on a practical, real-life crises experience thus strengthening the lacking evidence of what contributes to the resilience of food chains (Coopmans et al., 2021).

Although various researchers have conceptualized supply chain resilience in different ways, previous research has placed an emphasis on the elements of responsiveness, readiness, and recovery (Chowdhury and Quaddus, 2016; Han et al., 2020; Ali et al., 2022). There is still an inconsistency regarding which of these elements are crucial for dealing with the COVID-19 pandemic (Ali et al., 2022). Measuring the abilities of food systems to absorb and recover from disruptions provides a valuable insight into their areas of strength and weakness, and can assist in directing future planning and efforts accordingly (Golan et al., 2020). Simultaneously, as local food supply chains are not automatically more sustainable and resilient than global ones (Brunori et al., 2016), in this research we have focused on short food supply chains specifically. The resilience of food chains depends on the context

and particular resilience aspects, therefore this article examines the processes of adaptation and transformation of short chains in crisis situation.

In this study, we have analyzed food chain resilience using the three elements of responsiveness, readiness, and recovery. The resilience of short food supply chains during the COVID-19 pandemic was explored using a direct purchasing (DP) network as a case study. The study considered three research questions. (1) How did the functioning of the DP network change during the COVID-19 pandemic? (2) What role did the resilience elements (i.e., readiness to shocks, responsiveness to disruption, and recovery from the crisis) play in the short food supply chain response to the COVID-19 crisis? (3) Which innovations in the short food supply chain can further the recovery process, and thus resilience, after the crisis?

The research addresses the knowledge gap resulting from the lack of studies on short food supply chain resilience during the COVID-19 pandemic as well as the responses of these chains after the pandemic. The findings will improve our understanding of the resilience of short food supply chains during the COVID-19 pandemic and specifically the role of the elements of responsiveness, readiness, and recovery as well as provide an insight into how they are manifested practically in short food supply chains and their resilience.

## Conceptual approach

In this section, we first define the conceptual approach regarding short food supply chains and then focus on the resilience of food chains.

## Short food supply chains

The significance of short food chains has been stressed not only in the context of the COVID-19 pandemic but has also been discussed at the European Union (EU) level. The need for more sustainable food systems is recognized by the EU (European Commission, 2020) and short food supply chains can be viewed as a form of sustainable supply chain (Paciarotti and Torregiani, 2021).

In this study, short food supply chains were defined by referring to three types of proximity: (1) physical distance, i.e., the closeness of farmers (producers) to consumers; (2) organizational distance, i.e., the number of intermediaries in the chain; and (3) social distance, i.e., the relationship between farmers and consumers (Malak-Rawlikowska et al., 2019).

A short physical distance means that the distance between the point of production and consumption is shorter than in multi-actor food supply chains (Kiss et al., 2019). When referring to short food supply chains, the defined physical distance usually varies from 30 to 100 km, but can be longer, e.g., 160 km in the UK and 250 km in Sweden (Paciarotti and Torregiani, 2021). A short physical distance in food chains is also closely connected to the locality of food (Chang et al., 2022), food freshness and a shorter shelf-life (Kiss et al., 2019), as well as the seasonality of the products (Doernberg et al., 2022).

Organizational distance in short food supply chains refers to a reduction in the number of intermediaries between farmers and consumers (Jarzobowski et al., 2020), which could be just one or even none (Galli and Brunori, 2013; Malak-Rawlikowska et al., 2019). A reduction in both physical and organizational distance can improve the economic situation of farmers by increasing their earnings (Kiss et al., 2019). When referring to the proximity of organizational distance, it is crucial that not only the number of intermediaries should be taken into account, but also the diffusion of relevant information (González-Azcárate et al., 2021), e.g., details about the products and farming methods. Previous studies have shown that one of the most important benefits of short food supply chains is the possibility of obtaining information about the products (Vittersø et al., 2019), which is also closely connected to the proximity of social distance. Social proximity refers to the communication and relationship between farmers and consumers, which involves trust and familiarity between individuals (Dubois, 2018), thus allowing feedback to be given and received regarding aspects of food quality as well as ethical and social values (Galli and Brunori, 2013).

The specific types of short food supply chains range from farmers' markets, roadside sales, and home deliveries to cooperative shops and solidarity groups (Tiganis et al., 2023). Specific initiatives and their significance vary from country to country in the EU, e.g., in Sweden, a crucial role is played by REKO rings, which is a network of local food markets that connects local food producers and consumers (Fuentes and Fuentes, 2022); in Italy, solidarity-based purchase groups (GAS) have gained popularity, which are self-organized consumer groups that have direct relationships with farmers (Chiffolleau et al., 2019); while in France, since late 2000 (Lamine et al., 2019) a participatory food system (AMAP) has developed, in which small-scale farming and direct links between farmers and consumers are promoted (Chiffolleau et al., 2019; Medici et al., 2021).

## Resilience of food supply chains during the COVID-19 pandemic

Since the 2000s, when the concept of resilience was introduced to supply chains (Ozdemir et al., 2022), it has been widely used in food chain research to describe the ability of food systems to withstand and recover from internal or external disturbances or shocks (Grigorescu et al., 2022), e.g., natural disasters (Singh et al., 2021), geopolitical instability (Hendry et al., 2019), or pandemics. Thus, resilience pertains to the ability of systems to manage unfavorable situations without having long-term negative effects on their overall wellbeing or functionality (Béné, 2020; Ozdemir et al., 2022). To achieve resilience, the ability of food supply chains to respond to shocks is crucial (Ali et al., 2022). During the pre-COVID period, studies of food system resilience focused on a specific disruption scenario (Golan et al., 2020), but Hooks et al. (2017) reported that the true measure of resilience can only be assessed during times of crisis. Thus, the COVID-19 pandemic, as a specific crisis, severely impacted the resilience of many food systems and at the same time presented an opportunity

to identify and verify key aspects and factors that contributed to their resilience (Alam et al., 2023).

In recent years, especially since the COVID-19 pandemic started, food chain resilience has been conceptualized in different ways. In this research, we applied a concept in which the resilience of food systems consisted of three elements: readiness, responsiveness, and recovery (Chowdhury and Quaddus, 2016; Han et al., 2020; Ali et al., 2022). Readiness refers to the preparation and planning that is necessary to respond effectively to disruptions (Han et al., 2020), thus enabling a quick reaction in times of crisis (Kazancoglu et al., 2021). Readiness is often connected to proactive actions (Ali et al., 2022). Responsiveness refers to the ability of the food supply chain to quickly identify and respond to disruptions and consumer demand (Azaron et al., 2020; Chiffolleau et al., 2020; Kazancoglu et al., 2021). During the COVID-19 pandemic, it was observed that responsiveness, as a resilience element, was not a characteristic of all food systems (Kazancoglu et al., 2022).

Recovery refers to the process of restoring the food supply chain to its original, or even a better-adapted, state following a disruption (Chowdhury et al., 2021). A capacity for recovery allows the focus to be on the continuation of operations as well as the minimization of long-term effects (Ali et al., 2022). The rapid introduction of innovations could also help organizations cope with a crisis (Galanakis, 2020), thus strengthening the ability of food systems to recover (Rowan and Galanakis, 2020).

Previous studies have stated that supply chains need to have a specific level of readiness in the pre-disruption phase in order to reduce the effects of the disruptive event. Simultaneously, supply chains need to have the ability to respond and recover to reduce the impact of the disruptive event (Ponomarov and Holcomb, 2009; Chowdhury and Quaddus, 2016). Various researchers have concluded that a holistic approach to the analyses of all three resilience elements, i.e., responsiveness, readiness, and recovery, should be adopted in food supply chains (Chowdhury and Quaddus, 2016; Ali et al., 2022).

## Methodology

In this section, we define the research object, i.e., the DP network, and the main analytical categories, and also present the methods used for data collection and analysis.

### Methodological approach: the case study

This study was based on the evaluation of a short food supply chain, a DP network, using an embedded case study and a mixed-method approach. The main research object, a specific DP network with clear boundaries, was selected as a case study because all the DP distribution points<sup>1</sup> and farms involved in the network had common historical, political, economic, and social conditions of origin and evolution.

1 Place (usually a room in an office, community centre, private garage, or basement), to which farmers bring the ordered products at the pre-arranged time and the consumers, congregating at the specific spot, gather the products they have ordered.

The case study had three research stages. During the first stage, an investigation of the historical evolution of the DP network was conducted, including a brief socio-technical description and key milestones in its evolution up to the onset of the COVID-19 pandemic and then during the crisis. During the second stage of the research, economic data regarding organic product demand was obtained through the DP network online system and then analyzed for the periods before and during the COVID-19 pandemic. The third stage of the research included a qualitative investigation of the DP network, including interviews with the DP network actors, farm visits, and participant observations, while the researchers also participated in the operation of one of the DP network distribution points in Riga.

## Research object: the DP network

The research object, i.e., the DP network in Latvia, is a specific network of organic farms and product distribution points and includes three main groups of actors: organic farmers, consumers, and DP distribution point organizers. The DP network has clear boundaries, which are defined by the commonly used online product ordering system. The distribution points and organic farms using the specific product ordering system participate in the DP network. At the beginning of 2020, there were 88 organic farms and 18 product distribution points, situated mainly in the towns and cities involved in the DP network, 11 of which were situated in the capital of Latvia, Riga, with another seven in small towns in central Latvia.

The DP network is a self-managing system. Through an online ordering system, consumers can order products from organic farms once a week, and on a pre-arranged day and time they collect and pay for them at one of the DP distribution points. During this process, all consumers are directly involved in the different stages of selling–buying activity in the network. The consumers are responsible for receiving products from farmers, and then sorting and distributing them. Once every 6–8 weeks, each consumer has to participate in the process. All consumers can buy fresh, local, organic food for a reasonable price, but they have to dedicate a few hours of their time as a volunteer in the DP network every few weeks.

## Main analytical categories of the research

During the research, various analyses were conducted based on the research questions and literature review. These included determinations of the following.

- The dynamics of the DP network before and during the pandemic.
- The resilience elements of the DP network during the COVID-19 pandemic.
- Innovations in the DP network during the COVID-19 pandemic, and their role in the recovery of the DP network.

The dynamics of the DP network before and during the pandemic were analyzed to determine if the specific network

withstood the disruptions of the COVID-19 pandemic. By investigating the specific resilience elements it was possible to understand how the network responded to the specific disruption and the role of each element in the recovery of the DP network. Specific attention was given to the aspects of innovation in the DP network because they could further the recovery of the network after the disruption.

## Data collection and analyses

A mixed methods approach was adopted in the study. Quantitative data were gathered through the online DP ordering system, which retained information about all the purchases made through the network. Quantitative data were obtained from the online system developer and maintainer, with a specific agreement reached regarding the purpose and conditions of the data use. Data from the 2018–2021 four-year period were used, i.e., including data from the period before and during the COVID-19 pandemic. The data collected included the number of DP distribution points and product orders, weekly product demand (product units sold, i.e., liters or kilograms depending on the type of product), and all purchases made during this period. Data from 2018 and 2019 were used to analyze the dynamics of the DP network before the COVID-19 pandemic, while data from 2020 to 2021 were compared to that from 2019 to identify any new tendencies during the COVID-19 pandemic. Data, gathered from the online DP ordering system, were spatially analyzed and depicted by employing a geographical information system (GIS) approach using the ArcGIS Pro software.

To assess whether the changes in the DP network regarding the number of DP distribution spots, purchases done in the DP network as well as the number of sold products might be related to the COVID-19 pandemic, we compared the average values between two groups—the pre-COVID-19 pandemic period (March 2019–February 2020) and during the COVID-19 pandemic (March 2020–February 2021). The difference between the groups was measured with Student's *t*-test.

To match the information gathered quantitatively and to obtain a deeper understanding of the values and attitudes of the participants involved in the DP network, qualitative data were collected. Data were obtained through in-depth interviews and supported with material from visits to farms and observations made during the author's participation in the DP network at one of the distribution points in Riga. The sample of interviewees included three groups: DP farmers, DP consumers, and DP organizers. A total of 16 in-depth interviews were conducted during March–May 2022, of which six interviews were carried out with DP farmers, six were with DP consumers, and four were with DP organizers, who were at the same time also DP consumers.

Four interviews with DP farmers were conducted at their farms, one was conducted in Riga when the farmer delivered products to the DP distribution points, and one was conducted online due to COVID-19 safety considerations. The interviewed farmers were stratified by three categories: regularity of involvement in DP networks (all farms were delivering their products to DP network points at least once a month), the farm profile (three farms were producing specialized produce, while three were multi-functional),

and geography (the farms were from different regions of Latvia, i.e., Kurzeme, Latgale, and Vidzeme). Five interviews were conducted with one representative of the farm, while in one case both farm owners (husband and wife) took part in the interview.

The interviews with DP consumers and DP organizers were conducted in the participants' living spaces, workplaces, or at DP network points. The interviews with DP consumers were stratified by three categories that were customized to the characteristics of the whole DP network: duration of involvement in the DP network (from 3 months to 10 years in the DP network), geography (five participants/organizers from DP network points in Riga, and five from DP network points outside Riga), and family and household composition (eight families with young or teenage children, one family without children, and one family with a grown-up child). The interviews with DP organizers included interviews with both the person who established the DP movement in Latvia in 2008, as well as the managers of specific DP distribution points.

For each group of interviewees, the questions were prepared and grouped under three sections: DP trends (of food purchasing practices) during the COVID-19 pandemic, drivers of change during the COVID-19 pandemic, and future innovations and long-term changes/recovery in the DP network during the COVID-19 pandemic. The interviews were 25–70 min long. All interviews were recorded and later transcribed.

The transcribed interviews were reviewed and coded based on the trends and changes in the DP network during the COVID-19 pandemic and innovations in the network during the COVID-19 pandemic. Cross-interview codes were identified during a process of inductive coding. The codes of responsiveness, readiness, and recovery were then introduced and were modified and restructured as further themes emerged.

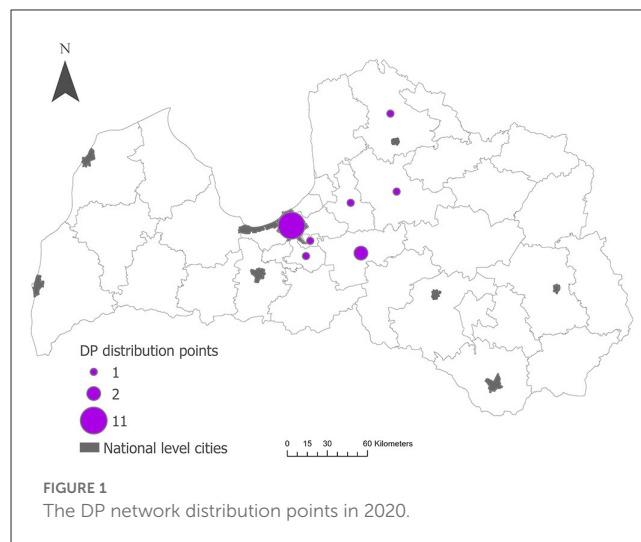
The results obtained from the farm interviews and observations made during the author's participation in the DP network at one of the distribution points in Riga helped to establish a close relationship with the actors of the DP network. This strengthened the mutual trust between the researcher and interviewees and enabled the interviews to be conducted productively. The results obtained during the farm visits and observations were used to deeply understand the attitudes of respondents.

## Results

In this section, we describe the historical development of the DP network as a short food supply chain and present our findings regarding the dynamics of the network before and during the COVID-19 pandemic in the context of food supply chain resilience i.e., its potential for responsiveness, readiness, and recovery.

### The DP network as a short food supply chain: historical development and key milestones

The DP network was established in 2008 as an initiative of a young family who intended to acquire fresh, organic, local food for themselves and later for their friends. Organic food was a novelty in

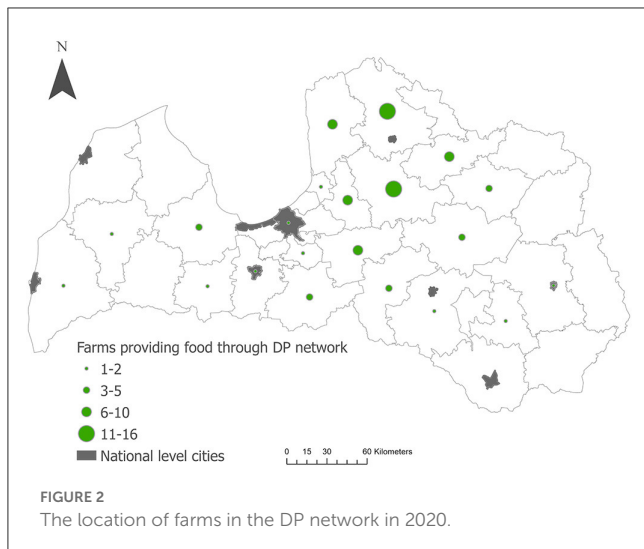


Latvia at that time, with organic agriculture in Latvia only starting to grow rapidly after Latvia acceded to the EU in 2004 (Pawlewicz et al., 2020). The number of farms practicing organic agriculture continued to grow through to 2007 (Melece, 2010). The first organic farmers' market initiative was developed in the capital city of Latvia in the early 2000s (Šumane, 2010), but even by 2008, organic products were not easily accessible to consumers. Therefore, the DP developers started to look for alternative ways to buy local organic products. The DP network started as a small-scale collaboration between one family and a few organic farmers, developing into a fully functioning food provisioning network with organic farms, consumers, and distribution points (Bankovska, 2020).

After the establishment of the first distribution point in Riga, the DP network developed rapidly and new distribution points opened in other parts of the city and in other towns in Latvia. In all cases, there were a few key people, or even just one, who led the process, identified a location for the distribution point, attracted new consumers, and negotiated with farmers. Initially, the orders to farms were made by directly calling the farms, loading the orders into "Excel" files, and forwarding them to the farms. As the network grew, the ordering process using "Excel" files became inconvenient and mistakes often occurred as orders became more complex. Thus, a turning point was reached and an online product ordering system was developed in 2014, which is still being used by all consumers and farms involved in the DP network.

The main actors in the DP network were the organic farmers and consumers. It was intended for this network to function as a self-organizing system, but there was usually one "organizer" of each DP distribution point who accepted new members into the network. There are about 20–40 consumers involved in each distribution point, buying food for their family (four persons on average).

The network provided consumers with the opportunity to buy seasonal, organic, local food. At the beginning of 2020, 88 organic farms were participating in the DP network (Figure 1). These farms delivered products at least twice a year to 18 product distribution points (Figure 2), 11 of which were situated in Riga and other smaller towns concentrated in the middle–northern part of Latvia.



Most of the farms were located 30–120 km distance from their main markets, i.e., the DP distribution points, while there were also a few farmers traveling up to 240 km to the DP distribution points in Riga.

The product categories offered by the farms included greens and vegetables, dairy products, meat and eggs, cereal products, and processed and ready-to-eat products. The variety of products offered expanded over time. Within the DP network, there were both specialized farms, offering specific products (e.g., eggs or dairy products), and multifunctional farms, offering a wide range of products (vegetables, eggs, and meat). Some farms also offered processed products.

Most consumers in the DP network were women aged 25–45 years. They were mainly educated and knowledgeable, married with one to three children, and had an average or below-average income (Bankovska, 2020). The consumers purchased products for the whole family. The interviewed consumers and DP organizers purchased 20–90% (mainly 40–50%) of all the food their families consumed through the DP network.

The farmers delivered their produce directly to the distribution points, with no intermediaries between the farmers and consumers in the DP network. However, there was still a need for paid labor or volunteering to enable the network to function. Thus, the self-organization of the network was achieved through volunteering. Volunteering occurred only on the consumer side of the system, with volunteers taking part in the distribution of the products at the DP network distribution points. For the network to function, volunteering had to be accepted and supported by the consumers.

The DP network was also characterized by direct contact and communication between farmers and consumers. The DP network organizers and consumers reported a feeling of community due to the DP network and social interaction was a crucial aspect of the DP network for them. In the interviews, respondents admitted that direct contact with the farmers was crucial and had changed their attitude toward the products and their value. Seeing how the produce was grown and hearing directly from the farmers about the difficulties they had to overcome during this process contributed

to the consumers' appreciation of the back story of food and led to them treating food with more respect: "About twice a year a wonderful part of this process [DP] is that you drive to the farm, that in the summer you can organize those drives (...) I have been a lot – two, three years ago. And it's the kind of experience that changes [product] ordering afterwards because somehow... you've seen the person and you know their story, when it's... that's the wonderful thing about that direct purchase that you know the ones [farmers]... yes, the one in that direct contact... it makes a big difference, it does. Then that product has another value – you see that face, you know that job, you know that story, and the problems they [farmers] often have...". Direct contact in the DP network was appreciated not only by consumers but also by farmers: "Then, in the direct purchase, I like this particular contact with a person (...) they call me and tell me: 'Your tomato juice is such that you feel like you are drinking tomatoes'. Balm for the soul..".

## Purchasing dynamics in the DP network during the COVID-19 pandemic

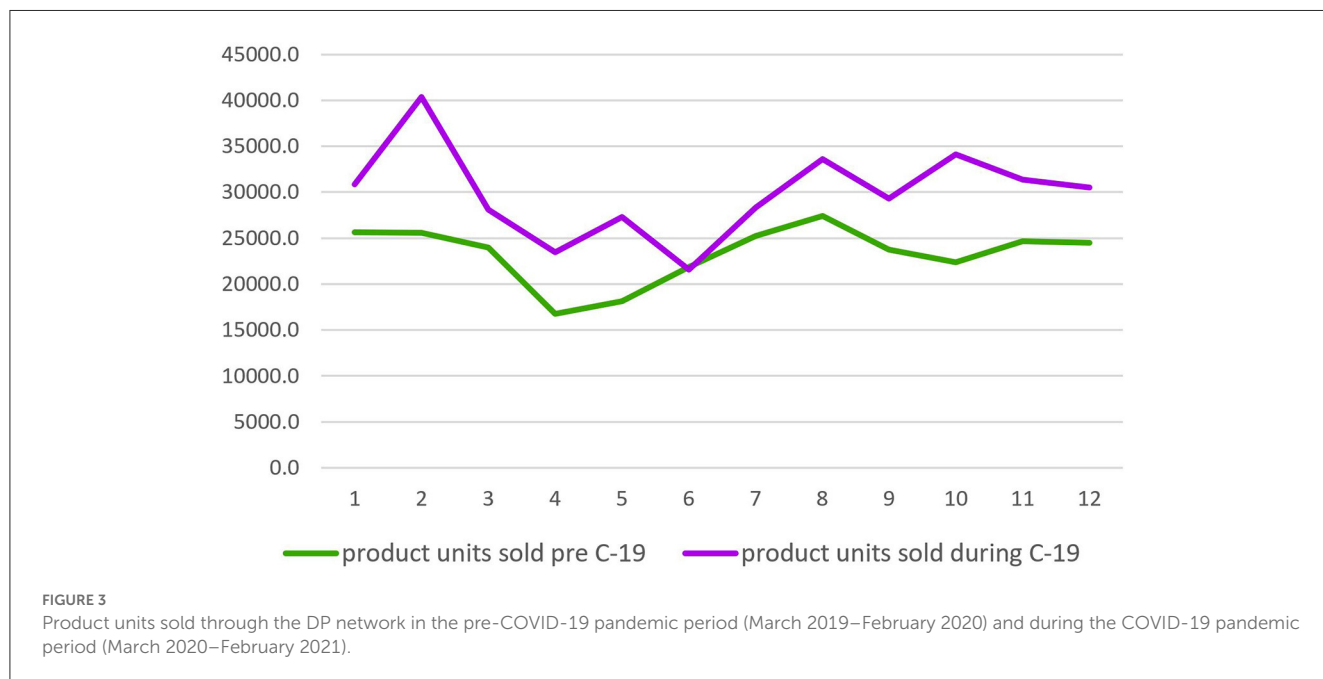
Up until the beginning of the COVID-19 pandemic, the development of the DP network had stabilized, with the number of DP distribution points, consumers at each location, and the product units purchased each week/month tending to decrease by a few percent on average per year.

The trends in the number of product units sold tended to recur from year to year and were characterized by a decrease in spring and summer and an increase in autumn. In summer, more fresh products, including greens and vegetables, were available on farms, but at the same time, consumers from the cities tended to travel to the countryside or spend vacations abroad and therefore did not buy as much food through the DP network. In autumn, they returned to the cities, children returned to school, and a variety of vegetables were harvested, therefore September was the month when the number of product units sold through the DP network was highest. Another characteristic of the DP network was an increase in trading through the DP network before holidays, e.g., Christmas and Easter, and then a decrease in the following week. These tendencies changed as soon as the COVID-19 pandemic began.

At the beginning of the COVID-19 pandemic restrictions were introduced in Latvia that included strong containment measures (e.g., school closures and border controls), which lasted from 13 March to 9 June 2020 (Webb et al., 2022). The product purchasing habits through the DP network changed during this time. The total number of purchases done through the DP network compared to the same period in the previous year decreased (Table 1), whereas immediately after the COVID-19 pandemic started the total product units sold increased rapidly compared to the pre-COVID-19 period (Figure 3). The DP network economic data for the later period during the COVID-19 pandemic was characterized by ups and downs (Figure 3), which was a consequence of both the product availability from farms and the COVID-19 restrictions during the summer 2020 and 2021 being loosened in Latvia, whereas at the end of October 2020,

TABLE 1 Trends in the DP network in the pre-COVID-19 (March 2019–February 2020) and during COVID-19 (March 2020–February 2021) period.

	Pre-COVID-19 pandemic (n = 12)	During COVID-19 pandemic (n = 12)	P-value
DP distribution points	18.	17.8	0.0001
Purchases made in the DP network per month	443.9	416.3	0.0021
Product units sold through the DP network per month	23,321.6	29,905.9	0.1911



they became much stricter. The total number of DP network distribution points also decreased during the COVID-19 pandemic (Table 1).

The changes in the DP network between the pre-COVID-19 and during the COVID-19 periods in terms of purchases made and product units sold were statistically significant, while the data did not show statistical significance in the changes in the number of distribution spots (Table 1).

The rapid increase in the product units sold just after the beginning of the COVID-19 pandemic, i.e., during the first wave of COVID-19, was confirmed by all interviewed farmers and most of the interviewed consumers (Table 2). Farmers mentioned overloaded transport vehicles due to the high product demand, very long hours of work, and the need for additional manpower at the beginning of the COVID-19 pandemic: “As soon as it [COVID-19 pandemic] started, a terrible panic arose, there were terrible, extremely large orders. Let’s say that for me, it was positive it was even very positive that many people didn’t go to the stores and... And the very first spring [of the pandemic] (...) generally such unrealistic orders – my husband asked me how should I put it all in the car?”. The increase in product units sold through the DP network is closely connected to the aspects mentioned in the interviews regarding the switching from grocery stores to the DP network due to the restrictions, more demand, and supply of easy-to-prepare products as well as the introduction of new products in the DP network.

The period of the COVID-19 pandemic in the DP network was characterized not only by changes in food purchasing trends but also by changes in social interaction between the actors in the DP network that was mentioned by most of the interviewed consumers of the DP network (Table 2). The change in social interaction in the DP network included a reduction in direct contact and communication, less frequent common events, and a shift from direct to online communication channels. During the pre-pandemic period, specific activities took place at each DP network distribution point (e.g., meetings, events, farm visits, or working on farms). During the pandemic, these activities were reduced due to the restrictions. This had a direct impact on communication, the feeling of community, and friendship: “This means that we will no longer communicate so much individually with the farms (...) I think that the cherry on top of the DP is that there is also direct communication. I, on the one hand, don’t want to lose it, that direct communication disappears. And it seems to me that...that’s exactly the power that DP has(...) I think this is such an important aspect”.

As it was mentioned in Section 4.1—most consumers in the DP network are women, purchasing food for the whole family. During the COVID-19 pandemic food provisioning and family practices changed with more men becoming involved in the process. This happened due to both the restrictions (the volunteers were not allowed to work together with their usual colleagues from other households, therefore members from one household did the work

TABLE 2 Perceived effects of the COVID-19 pandemic on the DP network.

Themes	Consumers (n = 10), %	Producers (n = 6), %
<b>Food purchasing habits</b>		
Buying more food through DP	40	100
Switching from grocery stores to DP network	30	17
More demand for an easy-to-prepare product	20	33
More family members involved in the food purchasing/the DP network	20	0
<b>Social interaction in the DP network</b>		
Reduction of direct social interaction	90	50
Shifting from direct to online communication	40	0
Less frequent common events	30	0
<b>Innovations in the DP network</b>		
Introduction of digital payments	80	33
New products	10	33

of volunteers) and the weight of the increasingly large orders: “It’s really interesting to see how they [men] come after the orders, then they look up and wonder what it is. They very often are... used as a transport. They are the ones coming to take the products. Then they wonder what it is... don’t understand what it is that they [their wives] have ordered there. Well, so they examine those jars. But the decision-makers are women”. Thus, the men were more often involved in the food provisioning practices in the DP network during COVID-19. Simultaneously, their involvement was more technical and the women were still the main food provisioning planners, taking the main responsibility in the family of this process.

## Resilience of the DP network during the COVID-19 pandemic

Several aspects of the DP network that were manifested as resilience during the COVID-19 pandemic directly affected the network and its functioning. They were also closely connected to the response of the network to the COVID-19 pandemic as well as its recovery.

### Readiness to shocks

The period of the COVID-19 pandemic was characterized by waves of strict and looser restrictions that controlled social interaction not only between adults but also between children. There were periods in the spring and autumn of 2020 when schools switched to distance learning and many places of work also converted to remote working. These periods were characterized by new daily routines when food supply and preparation switched completely to individual homes. Because cafes and restaurants were

closed and school catering was not available, the only option was to order ready-made food or to prepare meals at home. Thus, more produce was needed at home to prepare food for the family several times a day, which also affected the product units sold through the network.

During the COVID-19 pandemic varying degrees of restrictions applied to store visits: the number of customers at any one time was limited, a minimum number of square meters per person was determined, and later only individuals who had recovered from or were vaccinated against COVID-19 were allowed into shops. These restrictions motivated consumers to change their shopping habits. People did not visit grocery stores as often but rather obtained more food through the DP network. These changes were feasible due to the readiness of the DP network to react quickly at the beginning of the COVID-19 pandemic.

During this period, the readiness of the DP network was manifested through the actions implemented before the COVID-19 pandemic. Several practical measures, such as the development of the online product ordering system, enhanced the readiness of the network, as well as the emotional attachment to the network that had developed over time. This system was developed and implemented to facilitate the product ordering process, thus benefitting farmers and consumers. As soon as the COVID-19 pandemic started, this system allowed products to be ordered remotely, thus the direct contact restrictions during the COVID-19 period did not affect sales.

Another practical measure taken by the DP network that enhanced its readiness for the pandemic shock was the digitalization of payments. The introduction of digital payments was possible due to the proactive actions of farmers and consumers regarding digital payments in other areas of their lives. Before the COVID-19 pandemic, most payments to farmers for products sold through the DP network were made in cash. The interviewed consumers and organizers revealed that after the start of the COVID-19 pandemic, their distribution location had digitalized the payment system and had started to accept payments and make payments to the farms via electronic bank transfers. This restricted social interaction and avoided the inconveniences of operating with cash. One distribution point organizer commented that: “People come in the evening, and then there are those situations that there is no change to give and it’s evening, and absolutely everything is closed – the pharmacy is closed, the shops are closed, and then they run and try [to split up a large banknote]. And then someone has forgotten [to withdraw cash], then he runs to the ATM, and there is always such a mess... Therefore, from this point of view, it is much easier to pay by bank transfer”.

Readiness was also manifested through the customers’ emotional attachment to the DP network. Several consumers referred to the role of the pre-COVID-19 pandemic period interaction with farmers, and the feeling of care toward them and reliance on them as trusted food providers. Thus, they continued to buy products through the DP network and did not switch to the remote delivery of food from supermarkets. Consumers and DP organizers reported that they took care of and felt responsible for the farmers. During the COVID-19 pandemic the feeling of reciprocal care even intensified, according to interviewees: “Again, to a certain extent, I also care about that farmer that...I even



sometimes wonder, but you feel like the ‘Little Prince’, that you have tamed something, that you feel a bit responsible, that you are there with your consumption and somehow ensure the cash flow, because those people [farmers], they are already counting on you [your order]”. A reliance on farmers was apparent when consumers discussed the unpredictability and fear at the beginning of the COVID-19 pandemic. The customers of the DP network admitted they were aware of the farmers’ difficulties due to the pandemic restrictions, and they wanted to show solidarity. This awareness enhanced trust in the DP network as a secure and reliable food supply under the specific circumstances: “No matter what happens, the family will be fed, even if they don’t allow us in the supermarket, even if everything is locked, there will always be the DP network, because the farmers are milking the cows, regardless of the day, date or world events. The cow is milked, the bread is baked, and the vegetables are grown. And this awareness somehow helped to maintain a sense of unity, a sense of security [during the COVID-19 pandemic]”. Other customers stated that they felt a large sense of responsibility toward farmers as food providers. Therefore, they continued to buy products in the DP network during the COVID-19 pandemic, despite limits on social interactions and other restrictions: “Sometimes it happens that I feel exhausted and it seems that we still have some food, we might not order more this time, but there is some kind of responsibility toward the farmer and then I think – he is planning, how many carrots he has to grow/will grow, he is planning how many potatoes he will grow or how much milk he will process this week”.

## Responsiveness to disruption

Responsiveness in the DP network was manifested through the quick response to changing trade regulations and consumer food acquisition conditions. As soon as COVID-19 restrictions were introduced, new internal rules were developed at most DP distribution points. Once the COVID-19 pandemic started, a warning about responsible handling of food products due to COVID-19 restrictions was placed on the DP product ordering platform. The actual interpretation and implementation of the COVID-19 pandemic trade rules were the responsibility of each DP product distribution point itself. Many of the interviewed DP consumers as well as the organizers confirmed that their DP distribution points developed a product distribution system that was more precise in terms of product collection time. Before the COVID-19 pandemic, consumers could visit the distribution point at a time of their choosing within a predetermined 2- or 3-h (depending on the distribution point) interval, but once the COVID-19 pandemic started at many DP distribution points every customer received a specific time at which they could collect their products. Usually, time slots with 7-min intervals were predetermined: “A schedule for receiving products was created. It seems to me that everyone has their slot that is calculated from the number of orders for that day, for each one approximately seven minutes, I think”.

In several DP distribution points a contactless product receipt was introduced. This enabled farmers to bring products to the entrance of the DP distribution point and leave them outside the door. A volunteer then brought the products inside, sorted

them by order, and based on the list of specific products and their collection time for each customer, placed the orders outside. Thus, a process of contactless product receipt and distribution was established. This process operated only while the restrictions were in force.

During the COVID-19 pandemic, many of the interviewed customers indicated that they had made changes in their daily meal preparation habits at the household level due to remote learning and working conditions. This, in turn, affected their food acquisition practices through the DP network, with an increase in the demand for easy-to-prepare products. Farms responded quickly and offered different ready-to-cook or ready-to-eat products, such as peeled and sliced vegetables or ready-made salad.

Another aspect of responsiveness was an increased demand for immunity-boosting products. New vitamin-rich products were rapidly developed by the farmers (e.g., fresh juices) and offered through the DP network, while similar products that were available before the COVID-19 pandemic were purchased more often than before: “I noticed that (...) products appeared to strengthen immunity, such as fruit and berry juices. New products were created, e.g., from cranberries or garlic”. The growing importance of healthy products during the COVID-19 pandemic was also confirmed by the interviewed farmers, who, as a result, expanded their offerings of this kind of produce.

## Recovery from the crisis

The pandemic was an ongoing crisis for more than 2 years. The recovery of the DP network was also an ongoing process that started just after the first wave of the pandemic and continued for some time in response to the new challenges brought by the intermittent waves of COVID-19 infections. The elements of recovery during this period were associated with changes in the DP network management, operational practices, the relationships between consumers and producers in terms of increased social proximity, and the introduction of digital marketing tools and solutions in the network.

The rapid growth in the number of products sold in the network during the first wave of the pandemic stopped after the restrictions were loosened and the number of purchases became similar to that during the pre-pandemic period. There was still a small increase in the number of products sold that could be attributed to the product innovations introduced in the DP network.

Opportunities for personal interaction between farmers and consumers decreased due to COVID-19 restrictions and the establishment of contactless product distribution. The usual face-to-face socialization in the DP network was partly substituted by online social events and connections. Some distribution points developed online communication groups in social networks (e.g., WhatsApp, Facebook) that were used to discuss news related to restrictions and product ordering systems. As the restrictions were lifted, some of the DP distribution points abandoned the principle of a specific time slot for product distribution. Some DP distribution points continued this practice because it was found to be more convenient for volunteers and was a more time-effective way to operate. However, this practice has restricted opportunities for consumer interaction.

The introduction of digital payments proved to be an effective form of operation in most DP distribution points, with only one returning to payment by cash. In most DP distribution points electronic money transfer was found to be a much better payment method than cash, as acknowledged by a distribution point organizer: “*I think it’s a privilege of today that we can use remote payment, make life easier for ourselves, save time and do things that we like instead of counting money for a whole hour every Thursday*”, while in another DP distribution point the opposite view was held: “*I don’t think we’ll go back to that [money transfers] until the world goes completely virtual. As long as there’s cash, we’ll stick with cash*”. The organizer of this distribution point considered the process of digital payment to be more time-consuming, and therefore she decided to return to cash payments after the first wave of the pandemic. The attitude of the farmers proved to be diverse, with some accepting the convenience of payment by bank transfer, while others asked to return to the pre-COVID-19 pandemic payments in cash.

## Discussion

We explored the resilience of a short food supply chain during the COVID-19 pandemic using the DP network as a case study. First, we focused on the dynamics of the DP network before and during the pandemic to determine if the specific network withstood the disruptions of the COVID-19 pandemic. Then, we analyzed the specific resilience elements, i.e., readiness, responsiveness, and recovery, to investigate how the network responded to a specific disruption. We also focused on innovations in the DP network because they could further the recovery of the network after the disruption.

Our findings suggested that food purchasing practices through the DP network differed before and during the COVID-19 pandemic in two main ways: (i) the starting phase of the pandemic was marked by rapid growth in the amount of food purchased through the network, and (ii) the pandemic furthered the demand for easy-to-prepare products as well as the introduction of product innovations in the network. Other studies of food shopping practices during the COVID-19 pandemic have confirmed the tendency for consumers to buy more food directly than before the pandemic (Chenarides et al., 2021; Pappalardo et al., 2022), as well as switching from supermarkets to online shopping and/or small local stores (Thompson et al., 2022). The pandemic also resulted in a strong orientation toward local products that could be purchased directly from farmers (Brum et al., 2022) and through short food supply chains (Baptista et al., 2022).

We analyzed the resilience of the DP network by focusing on the three elements of readiness, responsiveness, and recovery. The readiness of the DP network to the pandemic shock was manifested through several practical actions implemented before the COVID-19 pandemic, i.e., an online product ordering system, the introduction of digital payments, and an emotional attachment to the network. Emotional attachment is an intangible benefit of short food chains (Medici et al., 2021). Our results were consistent with those of other studies that also revealed that trust between consumers and producers had a specific role in demonstrating resilience during the COVID-19 pandemic (Atalan-Helicke and Abiral, 2021).

Previous studies assessed the readiness of supply chains through their ability to recognize, anticipate, and prevent risks before damage occurs (Chowdhury and Quaddus, 2016; Han et al., 2020), thus referring to readiness as a proactive resilience strategy that allows threats to be avoided (Hendry et al., 2019). Readiness is also connected to the planning process, thus furthering the mitigation of disruption (Chowdhury and Quaddus, 2016). In the case of the DP network, readiness was not a specific proactive strategy, implemented due to formal planning and risk analysis procedures, but was rather an *ad hoc* and coincidental activity that was managed through the crisis. Thus, we stress the ambiguous nature of readiness as a food chain resilience element.

The responsiveness of the DP network to disruptions caused by the COVID-19 pandemic was manifested through rapid adaptation to restrictions and adjustments to new patterns of consumer demand. This was characterized by activities such as the imposition of new rules in the DP network, changes in the product distribution system, and the introduction of new products. These novel activities in the network were undertaken largely by introducing organizational and product innovations. Responsiveness, along with readiness, were the main attributes that allowed the network to respond to the disruption and continue the food provisioning practices through the short food supply chain during all waves of the COVID-19 pandemic. Other researchers have also confirmed the crucial role of responsiveness in ensuring the resilience of food systems (Rajesh, 2021).

As a response to consumer demands, innovative food products such as ready-to-eat, ready-to-cook, and immunity-strengthening products were introduced in the DP network. When referring in more detail to product innovation in the network, the issue of product diversity is crucial. In our study sample, multi-functional farms could rapidly respond to new consumer demands, thus fostering even greater product diversity. The crucial role of product diversity in the resilience of food systems has been emphasized previously, e.g., in terms of the variety of crops and landscapes (Bajželj et al., 2020), the plurality of producers involved in the food chain (Atalan-Helicke and Abiral, 2021), and the diversity of food production and marketing practices (Coopmans et al., 2021).

The introduction of organizational and social innovations in the DP network was crucial to ensure its responsiveness to the pandemic shock. Other researchers have stressed the role of innovation as a factor in recovery that promotes long-term changes in food systems (Meixner et al., 2022). We agree that innovations are crucial in the implementation of long-term changes, but it should be stressed that their introduction is often a response to disruptions in the system. In our study, product innovations were introduced as a response to the disruption of food provisioning practices and the changes in daily lives. Recovery was also manifested through the return to the previous practices of direct communication and interaction of the DP network actors. Thus, the recovery was manifested through innovation, but conversely, also by returning to previous practices.

All three resilience elements, i.e., readiness, responsiveness, and recovery, were manifested in the short food supply chain and analyzed in this study. They were all reactive strategies to the COVID-19 pandemic, while in other studies the role of proactive strategies in food supply chain resilience has been stressed (Marusak et al., 2021).

## Conclusions

There were statistically significant short-term effects observed in the DP network regarding food purchasing practices in the COVID-19 pandemic period, compared to the pre-COVID-19 pandemic period. The perceived effects of the COVID-19 pandemic by the actors of the DP network included changes in food purchasing practices, a decrease in direct social interaction, and innovations in the DP network. The changes in food purchasing behaviors through the DP network during the COVID-19 pandemic were closely connected to the shifts in everyday life, such as new daily routines, shifts in food purchasing habits from supermarkets to the DP network, and emotional reactions to the crisis, resulting in intense food buying at the beginning of the COVID-19 pandemic to build-up food stocks in homes. Because the time needed to adapt to the new circumstances for the DP network actors was very short, the DP network demonstrated itself to be a food chain that was flexible and able to adapt quickly in a crisis for both consumers and producers.

The beginning of the COVID-19 pandemic was characterized by food system readiness for the specific shock, which in the case of the DP network was manifested through a previously developed product ordering system, digital payments, and emotional attachment to the DP network. The responsiveness to disruption was manifested as the ability of the DP network to respond quickly to the new circumstances and product demand, which were affected by changes in rules, the product distribution system, and product innovations. The recovery from the crisis was associated with changes in the DP network management, operational practices, and the relationships between consumers and producers.

From the perspective of the food chain resilience elements, the reactive strategies of the DP network as a short food supply chain should be highlighted. Our data provided indications that the readiness of the network was due to coincidence rather than a proactive strategy to strengthen the resilience of the network. The introduction of innovations appeared as a response to the disruption, and their subsequent role in the recovery was then estimated.

There have been few other studies of short food supply chain resilience during the COVID-19 pandemic that are based on analyses of the different resilience elements. This study provided insights into how the elements of responsiveness, readiness, and recovery are practically manifested in short food supply chains, ensuring their resilience.

The main limitations of the study were connected to the time scale of the research. Because the data were gathered during the period when the COVID-19 restrictions were still ongoing the future impacts were not known, and the final recovery of the DP network was still not completely clear. There is a cyclical nature of resilience that develops during the response to a series of disturbances (Hendry et al., 2019), thus we present our research

as an insight into a specific time period of the COVID-19 pandemic. Future research should consider long-term changes and the recovery aspects of short food supply chains in the post-pandemic period.

## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

## Author contributions

MU and TT: conceptualization, methodology, and writing—review and editing. MU: investigation, formal analyses, writing—original draft preparation, visualization, funding acquisition, and project administration. Both authors have read and agreed to the published version of the manuscript.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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