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Resilience of French organic dairy cattle farms and supply chains to the Covid-19 pandemic

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ABSTRACT

Context: Identifying and developing resilient farming and food systems has emerged as a top priority during the Covid-19 pandemic. Many academics suggest that farming and food systems should move towards agroecological models to achieve better resilience. However, there was limited evidence to support this statement during the Covid-19 pandemic.

Objective: Our objectives were to report evidence for the resilience of French organic dairy cattle farms and supply chains to the Covid-19 pandemic and to discuss the features of those farms and supply chains that promoted resilience.

Methods: We combined online surveys with farmers, semi-structured interviews with supply chain actors and a review of the gray and technical literature, and whenever possible, we compared this qualitative data against quantitative industry data. We also asked farmers to rank 19 pre-identified risks according to their likelihood and potential impacts.

Results and conclusions: We showed the pandemic had zero to moderate impacts on most farms. Among respondents, 38 farmers reported no impacts, another 43 experienced minor impacts on aspects such as their income and workload while only 5 faced major impacts, such as the closure of sales outlets. Most farms were family farms and were not greatly affected by worker availability issues. Moreover, the vast majority of these farms were nearly autonomous for livestock feeding and none reported input supply shortages or related impacts on farm functioning and productivity. The pandemic had moderate impacts on supply chains. Despite staff reductions, supply chains continued producing sufficient amounts of dairy products to meet consumer demand. To do so, they narrowed the scope of products manufactured to concentrate on a basic mix: milk, cream, butter and plain yogurt. Logistics were also adapted by hiring retired drivers to keep up with milk collection and reorganizing the delivery of products by shunting usual sub-level platforms that were saturated. Consequently, even after this pandemic, farmers remained more concerned with climate change-related risks on their farms than by sanitary risks. Several resilience factors were identified that promoted buffer and adaptive capacity at the farm level and that favored adaptive capacity at the supply chain level.

Significance: These findings confirm the relevance of agroecological models in achieving resilience in farming and food systems against shocks such as the Covid-19 pandemic. This preliminary work carried out at the end of the first lock-down period needs to be pursued in order to understand the impacts of the Covid-19 pandemic over longer time horizons.

1. Introduction

In today’s volatile, uncertain, complex and ambiguous world (Darnhofer, 2020), infectious diseases caused by bacteria, viruses, parasites or fungi occur more frequently (Smith et al., 2014), as illustrated by the recent Covid-19 pandemic. For farmers and supply chain actors, the risks related to these diseases are hard to predict both in terms of likelihood and expected impacts. To hedge against these emerging risks, many articles published during the Covid-19 crisis called for more resilient farming and food systems (Worstell, 2020; Darnhofer, 2020), i.e., systems displaying an ability to cope with shocks or slow-onset changes by absorbing disturbances (buffer capacity), adjusting practices and organization without modifying farm structure (adaptive capacity) or radically changing farm structure, practices, or production.
To achieve this resilience, several authors (Altieri and Nicholls, 2020; Jumba et al., 2020; Darnhofer, 2020; Gemmill-Herren, 2020) concurred that farming and food systems should no longer be specialized, intensive, and overly focused on increasing efficiency and reducing production costs. Instead, these systems should evolve towards more agroecological models that: rely on agricultural diversity (of crops, animals, semi-natural elements, etc.), replace synthetic inputs with ecosystem services thanks to interactions among the components of this diversity, and are embedded in territorial food systems (Magrini et al., 2019). Such systems involve the collaboration of multiple stakeholders across organizational levels, and especially farmers and supply chain actors.

Despite these numerous claims, we did not find articles reporting evidence for the resilience of agroecological farms and/or supply chains during the Covid-19 pandemic. Agroecology and organic agriculture are quite similar in principles and practices (Migliorini and Wezel, 2017). Conversion to organic farming has proved to be an option to improve dairy cattle farmers’ adaptive capacity by, among other things, offering higher prices for organic milk and reducing farmers’ workloads (Bouttes et al., 2018a). Organic conversion also reduces farm vulnerability in today’s unpredictable world by improving not only technical and economic performances (Bouttes et al., 2018b) but also farmers’ satisfaction (Bouttes et al., 2020).

Evidence for low vulnerability or high resilience of organic dairy cattle farms has thus been reported with regard to regular climatic and economic shocks and changes. In contrast, the Covid-19 pandemic was unprecedented for most farmers around the world and had repercussions at all levels, from individual farms to whole supply chains (Stephens et al., 2020). Thus, our objectives are to report evidence for the resilience of French organic dairy cattle farms and supply chains to the Covid-19 pandemic, especially during the first lockdown period (March 17 to May 11, 2020 in France) and to discuss the factors that promoted farm and supply chain resilience.

2. Materials and methods

2.1. Methodological framework

To assess the resilience of farming systems, Meuwissen et al. (2019) proposed a framework, which included nested levels such as supply chains where relevant. According to this framework, resilience should be specified regarding the following: Of what? To what? For what purpose? Based on what resilience capacities? On which resilience factors? We adapted this framework for the purpose of the present study and predefined the boundaries of the studied system. We assessed the response of French organic dairy farms and supply chains (of what?) to the Covid-19 pandemic (to what?). During the Covid-19 crisis, the purposes of the farms and supply chains were mainly to continue producing responsibly (Sustainable Development Goal (SDG) 12) in accordance with organic standards, and to provide consumers with a sufficient amount of organic dairy products to meet demand (SDG 2), while ensuring decent income and working conditions for farmers and supply chain actors (SDG 8) (See Fig. 1).

Hereafter, we will focus on the resilience displayed by the studied farms and supply chains and on their resilience factors. We used a mixed approach combining qualitative and quantitative data. We relied on surveys and interviews to assess subjective resilience (Jones and Tanner, 2017): farmers and supply chain actors were asked about their perceptions of farm and supply chain resilience. Whenever possible, these perceptions were compared with industry data (e.g., monthly amount of milk collected at the national level), which reflected objective resilience. Farmers and supply chain actors also reported their perceived opportunities created by the pandemic and the adaptations that should be adopted at farm or supply chain level to better cope with future similar pandemics. Finally, as this crisis was recent and quite unique in the careers of most farmers, we asked them to rank a list of risks to production in order to assess how they positioned the different shocks and changes they might face. Following Huet et al., 2020, we distinguished between the likelihood and expected impacts of these risks.

Farm and supply chain resilience was analyzed based on resilience factors for farms (Cabell and Oelofse, 2012) and supply chains (Hosseini et al., 2019) (Table 1). Natural resources and processes managed in agricultural systems were not immediately impacted by the pandemic, whereas human resources, capital and production processes were (Stephens et al., 2020); thus, we focused on resilience factors related to the latter. We excluded ecological factors supporting farm and supply chain resilience, such as functional diversity and redundancy (i.e., ecosystem services provided by diversity of plants and animals, which provides buffer capacity) or building of local natural capital (i.e., building natural capital in terms of soil organic matter, diverse genetic resources, etc.) (Cabell and Oelofse, 2012).

Farm resilience was seen as relying on social self-regulation (i.e.,

Table 1

| Level  | Resilience indicators and drivers | Reference |
|--------|----------------------------------|-----------|
| Farm   | Socially self-organized, Ecologically self-regulated, Appropriately connected, Reflective and shared learning, Globally autonomous and locally interdependent, Honors legacy, Builds human capital, Reasonably profitable | Cabell and Oelofse, 2012 |
| Supply Chain | Agility, Visibility, Flexibility, Collaboration, Information sharing | Hosseini et al., 2019 |

Factors in bold specifically refer to data collected during the surveys conducted for this study.

Fig. 1. Conceptual framework for the analysis and successive research stages.
feedback mechanisms making the system capable of adapting), connectivity (i.e., dynamic relationships between components within a system and between systems), response diversity (i.e., ability to withstand shocks and changes through multiple technical and organizational options), careful exposure to disturbance (i.e., exposure to shocks and changes to achieve desired effects of resilience building), reflective and shared learning to build human capital (i.e., learning from past experiences and sharing this knowledge), autonomy and local interdependency (i.e., autonomy regarding knowledge, genetic resources, energy, finance, and collaboration with local systems), and reasonable profitability (i.e., meeting farmers’ needs) (Cabell and Oelofse, 2012; Tittonell, 2020).

Supply chain resilience was seen as building on agility (i.e., ability to respond quickly and cost-efficiently to shocks), visibility (i.e., identity, location and status of entities transiting the supply chain captured in timely messages about events, along with all the necessary information about those events), flexibility (i.e., ability to adapt to the changes of the environment induced by the shocks with minimal time and effort), collaboration (i.e., capacity to work effectively together towards shared goals) and information sharing to mitigate risks (Hosseini et al., 2019).

2.2. Data collection

In 2019 in France, there were 4565 certified organic farms and 106 dairies (Agence Bio, 2020), with 5 of those collecting 83% of the milk produced and 10 collecting a total of 90% of the milk produced (Baron, 2020). The market is thus concentrated among few dairies, with the largest one accounting for about 30% of production and 1400 farms. Due to large differences in population size (i.e. the number of organic farms and the number of organic dairies) and economic weight of the different farms/dairies, we proceeded differently with farmers and supply chain actors.

At the farm level, an online industry survey (Table 3; provided by InterBIOccitanie) was distributed in the Occitanie region (southern France) via chambers of agriculture and farmers’ associations. This survey aimed at understanding how all types of organic farms (not only dairy cattle farms) coped with the crisis. It was completed by 54 farmers, including 28 organic dairy cattle farmers, in May 2020. This survey asked farmers to report on the work and economic impacts of the Covid-19 pandemic on their farms, the problems they dealt with during the lockdown, the support they received to cope with those problems, and the opportunities—especially market opportunities—created by the crisis. We retrieved the full dataset from the survey administrator. This dataset presented several shortcoming for the purpose of the present study. It covered a rather limited sample of farms and not all questions asked were relevant to the organic dairy sector. Also, there was no question aimed at comparing farmers’ perception of sanitary risks (e.g. a new pandemic) with other risks.

To complement this survey in terms of geographic coverage, number of respondents and topics covered, we (INRAE) designed an online survey guide (thereafter called ‘INRAE survey’ using the platform framaforms.org) that was sent to farmers via other chambers of agriculture and farmers’ associations. The survey was completed by 58 organic dairy cattle farmers in Brittany, Normandy (northwestern France) and Auvergne Rhône-Alpes (central France) over the July-August 2020 period. The two surveys provided a sample of 86 respondents (Table 2).

| Survey               | Respondents | Deliverers | Cheese-makers |
|----------------------|-------------|------------|---------------|
| InterBIOccitanie     | 28          | 22         | 6             |
| INRAE                | 58          | 51         | 7             |
| Total                | 86          | 73         | 13            |

Table 2 Overview of the total number of respondents per survey and of the number of respondents delivering 100% of their milk to a dairy (called Deliverers) or processing all or part of their milk (called Cheese-makers).

Table 3 Questions included in the InterBIOccitanie survey.

| Impacts of the pandemic                                                                 |
|-----------------------------------------------------------------------------------------|
| How would you rate the impact of the crisis on your professional activity? Neutral / Positive / Negative |
| How high is the impact of the crisis on your professional activity? On a scale of 0 to 5, from no impact to high impact |
| How has your turnover evolved compared to usual? Increase / Stable / Marginal loss (<10%) / Significant loss (10 to 50%) / Substantial loss (>50%) |
| How would you rate your resilience or adaptability? On a scale of 0 to 5, from none to strong |

| Problems faced                                                                                   |
|--------------------------------------------------------------------------------------------------|
| Overall, what has been the impact of the crisis on the people working on the farm?                |
| What kind of difficulties did you encounter? No difficulty / Inputs and supply / Provision of services / Reduction in product demand / Increase in product demand / Product storage / Cash flow, financial management, etc. / Workload, employee management / Health, family (childcare, etc.) / Application of the Covid health rules / Other: |
| As an employer, have you had any difficulties managing your workforce? I have no employees / No particular difficulty / Difficulty in retaining staff / Difficulty in recruiting / Difficulty in applying Covid health rules / Difficulty in employee management (childcare, etc.) / Other: |

| Support received                                                                                   |
|--------------------------------------------------------------------------------------------------|
| Have you mobilized support systems? None / Deferral of payments and taxes / Deferral of bank annuity / Cash flow assistance / Reduced business activity / Request for solidarity fund support (for loss of income) / Regional Support Pass / Application for a guaranteed loan / Replacement aids / Other: |
| Have you found or mobilized external support? None / Professional solidarity / Personal solidarity / Support of farmer organizations / Accounting firms / Customers / Suppliers / Local authorities / Other: |

| Opportunities created by the pandemic                                                             |
|--------------------------------------------------------------------------------------------------|
| Have your market opportunities changed during this crisis?                                     |
| Has the loss of certain opportunities been compensated for by the development of new markets? Yes / No / No opinion |
| Following this crisis, are you considering making changes in your farm (supply, production, organization, marketing, etc.)? |

The main French dairy production regions were thus covered with both online surveys (FranceAgriMer, 2016) (Fig. 2). The INRAE survey (Table 4) was designed to gather farmers’ perceptions of their farms’ resilience to the Covid-19 pandemic based on its impacts on farm functioning and performances, on the opportunities created by the Covid-19 situation and on the required adaptations to be made to their farms. We also asked farmers to rank a list of 19 risks to organic dairy cattle production identified based on reports from focus group discussions with farmers and literature on the topic (Meuwissen et al., 2001; Platen et al., 2005; Belhenniche et al., 2009; Résilait consortium, 2017). Following Mohammad et al., 2014, we distinguished between external and internal risks resulting from factors over which farmers have at least limited control (e.g., technical failures, worker relations) or no control (e.g., climate change, market prices), respectively. Following Huet et al., 2020, farmers had to rank the 19 risks according to their likelihood and expected impacts (Table 4) on a scale of 1 to 5 (from unlikely to very likely and from little to high, respectively). The INRAE survey also
Table 4
Questions included in the INRAE online survey.

| Description of the 58 respondents to the INRAE survey and their farms. | Table 5 |
| --- | --- |
| Introduction Gender – Age – Legal status of the farm – Utilized agricultural area (UAA) – Herd size – Percentage of corn in the UAA – Date of conversion to organic – Presence of on-farm processing of milk – If yes, percentage of total production processed on the farm |
| Impacts of the pandemic and crisis management • Has the pandemic resulted in a decrease in your turnover (compared to previous years)? If yes, how high are your economic losses? • Did you receive any incentive related to the Covid-19 context to reduce the volumes of milk delivered to your dairy? If yes, in what proportions? Who asked for it? • If you had not been encouraged to reduce the volumes of milk produced, would you still have chosen to reduce your production? • Have you had any communication from your dairy or farmers’ association on the evolution of the Covid-19 crisis? • Climate hazards and change – Health problems (animal disease outbreak) – Health problems (others) – Technical problems – Drop in milk prices – Reduction in public subsidies – Raising and tightening of organic standards – Increase in feed costs – Increase in production costs – Adverse governmental actions – Changes in consumer preferences – Indebtedness, cash flow problems – Excessive workload – Sickness or disability of the person(s) working on the holding on a daily basis – Difficulties finding a replacement at work – Lack of local labor – Degradation of relationships among associates – Degradation of relationships among family members – Difficult access to land – Difficulties with the transitioning of the farm |
| Farmers’ risk perceptions • How fearful are you of the following risks to your operation? On a scale of 1 (very little fear) to 5 (very fearful) • What is the likelihood of these risks occurring on your farm? On a scale of 1 (very low probability) to 5 (very high probability) • Climate hazards and change – Health problems (animal disease outbreak) – Health problems (others) – Technical problems – Drop in milk prices – Reduction in public subsidies – Raising and tightening of organic standards – Increase in feed costs – Increase in production costs – Adverse governmental actions – Changes in consumer preferences – Indebtedness, cash flow problems – Excessive workload – Sickness or disability of the person(s) working on the holding on a daily basis – Difficulties finding a replacement at work – Lack of local labor – Degradation of relationships among associates – Degradation of relationships among family members – Difficult access to land – Difficulties with the transitioning of the farm |
| Opportunities created by the pandemic • Are you considering implementing adaptations on your farm following the Covid-19 pandemic? • Are you considering implementing collective adaptations following the Covid-19 pandemic? |
| Concluding remarks Would you like to add more information on the impact of this pandemic on organic dairy farms or what strategies do you think would help to mitigate the current and future impacts of this pandemic? |

To assess the resilience of farms and supply chains, we plotted quantitative and categorical data on the overall impact of the pandemic. We searched for effects of farmers’ or farms’ characteristics (Table 5) using Chi squared tests. We then delved deeper into the overall assessment to more fully understand the impacts of the pandemic, the adaptations implemented at the farm and supply chain levels, and the opportunities created by the pandemic. We performed a deductive content analysis (Elo and Kyngas, 2008) of available qualitative content (i.e. survey answers and interview discourse). This type of analysis gathered information to characterize respondents and their farms (size, experience with organic farming, marketing type, etc.) (Table 5).

At the supply chain level, we interviewed two supply chain actors, one from the umbrella organization for the dairy industry, one from a development institute supporting this industry. We also included in the results quotes from experts interviewed in the professional press. They were asked about their perceptions of the impacts of the pandemic on input supply, workers and supply chain productivity, how those impacts were managed and the opportunities they created (Table 6). Questions on the management of the pandemic aimed to address the various resilience factors applying to supply chains (Hosseini et al., 2019).

We complemented these surveys and semi-structured interviews with a review of articles on the topic from the gray and technical literature. Whenever possible, both farmers’ and supply chain actors’ responses were compared with industry data and reports for the first half of 2020.

2.3. Data analysis

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Table 6
Questions included in the interviews of supply chain actors.

| Impacts on input supply | Did the lockdown and closure of borders cause input shortages? If so, what strategies were adopted? |
| --- | --- |
| Impacts of the pandemic on workers | Were there any staff reductions? If yes, what were the impacts? |
| Impacts of the pandemic on chain productivity | Were the production chains saturated? How long did it take to find a new, unsaturated pace to meet demand? |
| Management of the pandemic impacts | Did any dairies close to keep others running at full capacity? |
| Opportunities created by the pandemic | Were there meetings among stakeholders to agree on a common crisis management strategy? |
| Concluding remarks | How was the communication on crisis management? Who was it for? |

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| --- | --- |
| Gender | Male | Female |
| Nb. of farmers | 50 | 8 |
| Age (years) | < 25 | 25–35 |
| Nb. of farmers | 0 | 6 |
| Utilized Agricultural Area (UAA) (ha) | <50 | 50–100 |
| Nb. of farms | 4 | 37 |
| Number of livestock units (LU) | <20 | 20–40 |
| Nb. of farms | 0 | 3 |
| Conversion to organic farming (years) | Ongoing | < 5 |
| Nb. of farms | 3 | 13 |
| Share of maize in UAA (%) | 0 | <5 |
| Nb. of farms | 22 | 12 |
| Share of milk sold in short circuits (%) | 0 | <5 |
| Nb. of farms | 51 | 1 |

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consists in organizing responses into several content-related categories enhancing understanding of the data and then developing a structured analysis matrix based on prior knowledge, such as resilience factors applied to farms (Cabell and Oelofse, 2012) and supply chains (Hosseini et al., 2019). Stakeholders’ responses are reviewed and coded for correspondence with the identified content-related categories (i.e. the structured analysis matrix). This method enables highlighting the predominant elements in farmers’ answers and verifying if the factors and indicators of resilience mentioned are in line with the scientific literature.

Our risk analysis followed the approach proposed by Huet et al. (2020). For each of the 19 risks assessed by the farmers, we calculated the average score (from initial scores on a 1 to 5 scale) for each expected impact and likelihood. The average scores were then used to build a classical risk matrix (ranking risks according to likelihood of the risk on the x-axis and to expected impact on the y-axis) and to rank risks according to farmers’ perceptions. To synthesize this information, we added a third variable, “level,” which is the product of expected impact and likelihood.

3. Results

3.1. Farm resilience against the Covid-19 pandemic

Most farms experienced zero to moderate impacts from the pandemic: a total of 38 farmers reported no impacts, another 43 experienced minor impacts on aspects such as their income and workload, and only 5 had to contend with major impacts (Fig. 3a). This was well confirmed by industry data. The mean amount of milk collected per farm at the national level followed a seasonal pattern similar to the 5 previous years (Fig. 3b) with production peaking from early spring (i.e., March). Over January-April 2020, the amounts were higher (+2000 L/month/farm) than in 2015–2019. Yet it can be noted that this extra production per farm nearly disappeared in May (+100 L/month/farm) and June (+200 L/month/farm) to return to the 2019 levels. As a result, with a milk price equivalent to the previous year and an increasing multi-year trend (Fig. 3d), the majority (54) of farmers reported no impacts on their turnover (Fig. 3c) and another 12 were unable to answer at the time of the survey. Among the 18 farmers who reported turnover decreases, 12 estimated it at less than 10%, another 5 in the range of 10%–50% and one said that it was over 50%.

Chi square tests did not reveal any statistically significant effect of farmers’ and farms’ characteristics on perceived impacts. However, the moderate to no overall impacts concerned nearly all the farms that delivered all their milk to dairies (73 out of the 86 farmers delivered their milk to a dairy and 64 out of those 73 reported moderate to no impacts).
overall impacts). As a preventive measure against the risk of rupture in the supply chain, the main French dairy asked its farmers to reduce the milk production by about 5%. Weather conditions also contributed to return to 2019 production levels. One farmer reported that “the drop in volume coincided with late fall 2019 to spring 2020” weather hazards that naturally reduced the amount of milk produced. These two factors explain the drop in extra milk production per farm observed in May and June 2020 (Fig. 3b). Because farmers were paid by their dairy for unproduced amounts (€150/1000 L unproduced milk), 49 farmers (out of the 73 who delivered all their milk to a dairy) had no turnover loss, 10 farms had a moderate loss (10%) and 3 farms had a high loss (>10%). Turnover loss was unknown at the time of the survey in the remaining 11 cases. Most farmers were thus satisfied with the decisions made by their dairy leaders and other actors: “The management of the sector at the national level was judicious.”

The highest overall impacts were reported by farms processing part or all of their milk on the farm. They all had to deal with a range of issues. Farmers’ markets were cancelled and customers could not reach most farms, resulting in reduced demand for products in several cases. In one case, farm turnover dropped by up to 50% due to the loss of direct selling. In other cases, the opposite was observed due to fast reorganization of sales channels: one farmer noted that “We were able to react very quickly thanks to our collective organization and community-supported agriculture, which provided support from consumers and collective farmers’ shops.” It resulted in a high workload for farmers (Bargain, 2020) and in several cases increased turnover. Impacts were also reported by farms that had a parallel agrotourism activity. One such farmer said that “the Covid-19 crisis had no impact on our dairy production, but there was a significant one on agrotourism.”

Most farms were family farms (two full-time workers on average according to the industry survey), with fewer than 100 ha and 100 cows for 70% of the farms (INRAE survey). As a result, they were not greatly affected by worker availability issues. Nevertheless, in four instances, farmers reported such problems, in two cases due to employees being absent: “Our two employees have children and spouses who have continued to work.” Another unique case was when farmers had to self-isolate: “We had symptoms of Covid-19, so our son had to take our place in order not to contaminate the milk delivery man or other suppliers.”

Also, the vast majority of these farms relied mainly on pastures for livestock feeding (38% of the farms in our online survey did not cultivate corn fodder at all, while only 59% of those farms corn accounted for less than 5% of the utilized agricultural area (UAA)). Thus, none of them reported input supply shortages or related impacts on farm functioning and productivity.

3.2. Supply chain resilience against the Covid-19 pandemic

To anticipate and prevent the potential negative effects of the Covid-19 pandemic, a crisis cell dedicated to organic production was set up under the umbrella of the French National Interprofessional Center for the Dairy Economy (CNIEL). Its aim was to make decisions at the sector level and keep farmers and supply chain actors informed. For example, in its March 31, 2020, letter to supply chain actors, CNIEL wrote, “Given the seriousness of the situation, we wish to implement interprofessional measures to smooth milk production” (CNIEL, 2020a) and provided information about the planned compensations for farmers. Fifty farmers (out of 58 respondents to our online survey) answered that they received official communications on the evolution of the pandemic impacts on organic dairy supply chains either from their dairies or from farmers’ organizations through emails, personal phone calls and/or professional press. CNIEL also communicated to consumers that there would be no shortages (CNIEL, 2020b) because the chain was adapted to cope with the pandemic impacts. Thus, one expert reported that the whole sector had displayed good information sharing at all levels.

The pandemic had moderate impacts on supply chains. At the upstream level, there were staff reductions of 10%–15% due to sick leave, childcare issues, etc. (Harel, 2020; Pruilh, 2020). Yet, supply chains continued producing sufficient amounts of dairy products to meet consumer demand. As the amount of organic milk collected at the national level increased, the amounts of products manufactured increased as well (Fig. 4a). This relative increase fell slightly just before and throughout the lockdown period (6.6% across the whole range of products versus 16.4% for the June-December 2019 period), and especially in May 2020 due to the reduction in the extra amount of milk collected at the national level (Fig. 3b).

The relative variations depended on product types. They were highest for cream (up to +50% in April 2020) and cheese (+15% over the lockdown period) and tended to decrease for fresh milk desserts (−0.4% over the lockdown period). This was partly related to dairies’ decision to narrow the scope of products manufactured in order to avoid interventions on production lines that operated with a just-in-time approach or at a slightly reduced speed. One industry representative explained, “We worked on our industrial optimization and the product lines so as to not have any stock-outs in stores.” (Harel, 2020). Thus, most efforts were focused on providing the most basic products—milk, cream, butter and plain yogurt—at the expense of products with more complex recipes. “It was no time to innovate,” said another expert.

At the logistics level, supply chains proved efficient in reorganizing. Confronted with the absence of milk deliverymen, some of the dairies hired retired drivers to keep up with milk collection. Small dairies also collaborated together and made special arrangements to adjust milk quantities to their respective processing capacities. Adaptations were also made for product delivery. Until the lockdown, most dairies delivered to sub-level logistic platforms, which then distributed dairy products to the various stores. As explained by one industry representative, “Some were too busy with the inflow of orders, so we set up a delivery system directly to the stores […] to take some of the pressure off” (Harel, 2020). Again, the system was set up to operate just in time but was well organized to quickly adapt.

Exceptions concerned small dairies selling their products to supermarkets and institutional and school catering operations. To optimize just-in-time logistics, mass distribution refocused its offer on essential references from major suppliers (so-called 20/80 strategy). As a result, it stopped offering products from small dairies. Other dairies that had contracts with institutional and school catering operations reported issues due to sudden cancellation of orders when offices and schools were closed. Those events led to (i) new manufacturing strategies, with farmers turning their milk into cheese: “We even had to invest in new equipment for the aging cells” and (ii) rerouting products towards new points of sale. As reported by one farmer, “we quadrupled our sales at the farm store where we provide all the recommended sanitary measures. We developed, in two days, a drive-up service. People can order on our website and come and pick up their products.” (Ermienier, 2020). However, implementation of those strategies sometimes did take time and were unable to prevent all turnover losses.

As a result of actions taken at the upstream and logistics levels, supply chains succeeded in meeting increased consumer demand for organic products (Fig. 4b). Consumption of organic dairy products has been rising over the years and this was true until the lockdown period (+19% on average for drinking milk, cheese, cream, butter, yogurt and fresh milk desserts). A sudden increase was then observed, especially in April (mainly period P04/20 in Fig. 4b: +32% across the same products) and across nearly all types of products (except yogurt in May –P05/20 in Fig. 4b), confirming the capacity of supply chains to satisfy consumer demand despite the complex pandemic context.

3.3. Farmers’ ranking of risks to production after the Covid-19 pandemic

The 58 farmers who completed the survey including the risk ranking tended to be more concerned with external than internal risks (Fig. 5). Even after the spring 2020 Covid-19 crisis, climate-related risks...
appeared as the major risks for farms. Mean scores for expected impact and likelihood of climate risks were as high as 4.29 ± 0.67 and 4.24 ± 0.68, respectively. Farmers ranked the reduction of public subsidies second, with a mean expected impact of 3.5 ± 1.0 and a mean likelihood of 3.62 ± 1.0. Risks related to replacement at work and milk prices were third and fourth, with means above 3 for both expected impact (3.30 ± 1.15 and 3.21 ± 0.87 respectively) and likelihood (3.16 ± 1.09 and 3.03 ± 0.79, respectively). Raising and tightening of organic standards appeared to have less of an impact (2.89 ± 1.13) than the previously mentioned risks, although was still viewed as probable (3.21 ± 1.02). Increases in production costs, changes in consumer preferences, adverse governmental actions, difficult access to farmland, and health risks for both animals (e.g., blue tongue disease) and humans (e.g., Covid-19 pandemic) were ranked closely as medium to low risks. Among internal risk, farmers ranked the risk of increased workloads as the highest one (mean expected impact = 3.12 ± 1.14 and mean likelihood = 2.91 ± 1.10). That risk was followed by sickness or disability of the person(s) working on the farm on a daily basis, risks related to a difficult transitioning of the farm and risks related to indebtedness and cash flow, which were medium risks (mean expected impact in the range 2.5–2.9 and mean likelihood in the range 2.5–2.9). The three lowest risks ranked by farmers were technical issues and degradation of relationships among farm associates or family members involved in the farming activity, with both expected impact and likelihood below 3.

3.4. Opportunities created by the Covid-19 pandemic at the farm and supply chain levels

For many farms, the pandemic was an opportunity to adapt and plan for future changes. When confronted with the closure of points of sale (e.g., stores, farmer markets), farms processing milk into cheese and other dairy products had to quickly adapt and find new business opportunities. Many of them developed or even created new short sales channels like drive-up farm services (where consumers come to the farm to retrieve their pre-paid online orders) (Guiziou, 2020; Réussir, 2020) or “farm tours” (where a farmer provides home delivery of orders). Thus, some farmers saw the crisis as a development opportunity. One farmer said, “This has accelerated our development, so we may be hiring sooner than expected.” Four farmers delivering all their milk to a dairy mentioned that they intended to develop on-farm processing and/or direct selling of their products or those of their dairy.

The crisis also seemed to have guided farmers’ planning of adaptations and changes to increase their farms’ resilience through diversification and autonomy. Diversification applied either to on-farm processing of milk and direct selling, growing food crops and enlarging the range of customers to avoid putting all their eggs in one basket: “We want to keep as many different customers as possible for our farm.” Other farmers sought to increase the autonomy of their farms by reducing their dependency on inputs: “I want to continue simplifying the way I farm to be the least dependent on the outside world as possible.” This included moving towards more autonomous pasture-based grazing systems: “More grass, stop corn.”

During the lockdown, French consumers tended to return to cooking (Santé publique France, 2020) and rediscovered the pleasure of homemade food. The resurgence of this interest in home cooking based on produce, including dairy products, was seen as an opportunity for supply chains, as reported by Philippe Henry, president of the French Agency for the Development and Promotion of Organic Agriculture (Agence Bio): “One thing I think is key is the fact that we cooked at home for two months. Children learned how to cook. I am convinced that something will remain of it. As soon as you start cooking, you inevitably ask yourself what you are putting on your plate” (Ouvrard et al., 2020). Thus, the Covid-19 pandemic was perceived by supply chain actors as an accelerator of organic produce sales in general, and organic dairy
In addition to being resilient to regular climatic and economic shocks and changes (Bouttes et al., 2018a; Bouttes et al., 2018b; Bouttes et al., 2020; Perrin et al., 2020), the vast majority of French organic dairy cattle farms and supply chains proved resilient to the Covid-19 pandemic over this study’s short time period (a few months). By buffering and adapting to the impacts of the pandemic, they continued producing responsibly (SDG 12) in accordance with organic standards and provided society with a sufficient amount of organic dairy products (SDG 2). Moreover, both income and working conditions for farmers and supply chain actors remained decent (SDG 8). This confirms the relevance of claims from several authors (Altieri and Nicholls, 2020; Jumba et al., 2020; Darnhofer, 2020; Gemmill-Herren, 2020) that farming and food systems should evolve towards more agroecological models, and for more policies to develop the organic sector to be implemented, such as the European Green Deal, which aims to have 25% of total European farmland be certified organic by 2030 (European Commission, 2020). This could enhance French and European farming and food systems’ resilience to future crises and external shocks.

The farms and supply chains that were resilient to the Covid-19 crisis displayed a range of intrinsic features. At the farm level, the majority of farms were autonomous family farms delivering all their milk to dairies. They did not have to deal with absent employees and were able to self-regulate their human resources to continue farming during the lockdown. Little input supply shortages were reported. Indeed, previous studies showed that French organic dairy cattle farms are highly autonomous in terms of their feed needs (supplying 90% of the total dry matter used, (Madeline and Vallas, 2018) and that this autonomy promotes farm resilience (Perrin et al., 2020). The majority of farmers delivered their milk to large, well-established and well-organized dairies that were well connected to supermarkets whose sales account for 82% of bottled organic drinking milk and 64% of organic dairy products produced (Agence Bio, 2020). Despite the risk associated with having a single customer (i.e., their dairy), the economic reliability, work organization and efficient processes of those dairies combined with incentives to reduce milk production protected farmers from additional risks. Previously reported profitability of organic dairy cattle farms (Grémillet and Fosse, 2020) remained steady, with few to no economic impacts, thereby highlighting those farms’ buffer capacity (Darnhofer, 2014).

The minority of farms processing their own milk and selling their production via short channels were more greatly impacted by the pandemic, either positively or negatively. Those farms generally had a diverse range of customers, which is usually regarded as a risk spreading factor (Hosseini et al., 2019). However, following the closure of farmers’ markets and most catering customers, which were major outlets for those farms, they mobilized their adaptive capacity (Darnhofer, 2014; Bouttes et al., 2018a) to quickly reorganize. They developed a diversity of new short sale channels (e.g., drive-up services, tours) that required building or strengthening (i) local interdependency with other farms to be able to offer a large range of products at a single collection point for customers, and (ii) connectivity with customers who consumed more locally than usual. This clearly underlines the necessity for agroecological farms to be embedded in territorial food systems that provide the necessary knowledge and networks (Magrini et al., 2019) to deal with shocks like the Covid-19 pandemic.

At the supply chain level, the different sector actors (farmers, dairies, food processors, etc.) collaborated to collectively evaluate and manage risks under the umbrella of CNIEL. Their discussions led to the decision of encouraging slight reductions in milk production in order to regulate the quantities collected and processed and to avoid wasting milk while still satisfying consumer demand thanks to a good structuring of the sector. This illustrated the key role of information sharing and collaboration along the supply chains at the time of shocks (Hosseini et al., 2019). Such efforts were possible because of an efficient system implemented by both CNIEL and the Ministry of Agriculture, which monitors the flows of products at all levels of the supply chains, from farms to outlets. These actions also provided the necessary visibility in real time to adapt the chains to evolutions in the surrounding environment (Vroegindewey and Hodbod, 2018; Hosseini et al., 2019).

These decisions were made easier by previous risk management experience. According to experts (Ouvrard et al., 2020), the adaptive capacity of French organic dairy supply chains can best be explained by the strong connection between production and consumption: ‘There is a structural and physical link with consumption. This is essential. This is one of the fundamental reasons why organic supply chains are so
resilient. Needs and production are perfectly matched.” To offset the sharp increase in the number of dairy cattle farms that achieved certified organic status in 2019, and to avoid any drop in milk prices by preserving this balance, the largest dairy had encouraged (and compensated in return) its farmers to reduce their milk production during the spring of 2019. This decision led farmers and supply chain actors to manage a reduction in milk production per farm and most likely contributed to achieving unplanned effects of building resilience by creating the necessary conditions for learning at the farm and supply chain levels (Cabell and Oelofse, 2012; Vroegindewey and Hodhod, 2018).

Like farms, dairies showed a rather high level of autonomy, with very few of them reporting ruptures in input supply, such as raw materials for packaging. This autonomy was related to their strategy to source those inputs mainly from mainland French suppliers in a form of local inter-dependency. On production lines, production levels were close to saturation but always remained just in time. Dairies quickly narrowed the range of products manufactured to optimize production efficiency at minimum cost and satisfy consumer demand, reflecting their flexibility and agility (Jain et al. 2006, Erol et al., 2010, Hosseini et al., 2019) to quickly adapt to the unexpected.

4.2. Limits to the present study and future prospects

This study focused on the short-term impacts of the Covid-19 pandemic on French organic dairy cattle farms and supply chains. A first limit is that while we had farmers responding our online surveys from several of the main French dairy regions, we managed to interview a single expert at the supply chain level. Although he is recognized as having in-depth knowledge of the whole sector, he may have missed issues occurring in specific contexts (e.g. very small dairies). Further research will be required to strengthen our findings at the supply chain level.

Immediate ecological impacts were voluntarily neglected and we may have missed some of those immediate impacts. Moreover, longer-term impacts should not be underestimated. When assessing resilience, one key aspect is how slow variables are managed (Walker et al., 2012). Slow variables, such as the level of plant diversity in a pasture, shape how fast variables, such as pasture feed quality, respond to environmental variations, such as changes in rainfall. Although farmers reported zero to limited impacts from the pandemic in most cases, they may have slightly changed some of their practices (e.g., delaying the timing of manure spreading to avoid nuisances for confined neighbors), which may have in turn influenced slow variables we did not consider (e.g., soil organic matter content). At the supply chain level, one expert predicted a shortage of organic milk on the domestic market in autumn 2020 resulting from reduced milk production, product stocks and increased consumption. Such legacy effects on slow variables will need to be captured at farm and supply chain levels in the coming months.

This necessary longer-term perspective was well illustrated by farmers’ perceptions of risks to production after the spring 2020 crisis. Even after such a pandemic, they remained more concerned with the impacts and likelihood of long-term risks on their farms such as climate change or a reduction in public subsidies than by the more immediate issues of the Covid-19 pandemic, as already observed by several authors (Flaten et al., 2005; Belhenniche et al., 2009). The wider economic context may also be at risk. For the year 2020, the pandemic is expected to cause French economic growth to decline by ~7.2% (International Monetary Fund, 2020). The expected recession will likely impact household purchasing power and consumers’ capacity to access organic food. According to experts (Ouivrad et al., 2020), the crisis led people to return to fundamentals such as eating quality food and enjoying a healthy environment, suggesting that consumption of organic products will continue despite price differences. But given the extent and duration of the expected recession (International Monetary Fund, 2020), such changes still deserve to be demonstrated in practice.

Finally, we reported cases where the pandemic acted as a development opportunity to increase farm and supply chain resilience as these actors sought more autonomy and diversified their activities, products and sales channels. These development pathways involve adaptations and transformations that generally do not come without costs (Bowman and Zilberman, 2013). It will be necessary to monitor implementation of those adaptations and transformations and determine whether they compromise the profitability and resilience of farms and supply chains either due to overwhelming complexity of their management or to changes in the surrounding environment such as shifts in consumer demand.

5. Conclusions

We reported clear evidence for the resilience of French organic dairy cattle farms and supply chains to the Covid-19 pandemic. Farms experienced zero to moderate impacts in most cases and supply chains remained capable of satisfying consumer demand. This was possible through the intrinsic buffer and adaptive capacities of these farms and supply chains. Nearly all these organic farms followed agroecological principles. They were family farms relying on internal resources and embedded in local networks. These features promote several resilience factors including autonomy, social self-regulation, connectivity and local interdependency that supported resilience capacities. Supply chains continued functioning just in time and demonstrated agility and flexibility to reorganize quickly and cost-efficiently around a basic mix of products. The pandemic context even created new business opportunities for farms and supply chains, which in the end could sustain the organic sector’s growth. Although legacy effects of the pandemic should be investigated in the future, these findings confirm the relevance of the call from an increasingly large number of academics to move towards agroecological models to achieve resilience in farming and food systems. They provide the evidence needed by farmers, supply chain decision-makers and policymakers to guide the agri食品 sector.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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