Resilience in the Food Industry: Interviews-based evidences

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Abstract

Resilience is a key issue for the food context as never before, given the several challenges that companies are subjected to such as the climate change, geo-political instability or price volatility. Literature returned a gap in terms of tools and metrics for determining and quantifying the resilience level of agri-food systems, and after a preliminary top-down perspective, the bottom-up approach is proposed in this document. Indeed, the aim is to present and discuss results from semi-structured interviews carried out with 7 practitioners of the food industry (based in Parma, in the heart of the Italian *food valley*) aimed at identifying the most important factors to be considered when evaluating resilience, according to their opinion. Results allowed to derive a set of 22 potential indicators, which will be implemented in a following model for quantifying the resilience level of an agri-food supply chain. Indicators are classified according to the supply chain area they belong to, namely: supply, production/transformation and distribution/sales. The cash flow availability and the diversification of both raw material suppliers and produced finished products turned out to be the most important factors to be considered, almost unanimously.

Keywords: food systems resilience; semi-structured interviews; empirical study; resilience factors; resilience key performance indicators.

1. Introduction

The last quinquennium was unfortunately rich of negative and unexpected events: starting from the Covid-19 pandemic with its lockdown to the two recent wars (i.e., the first, still ongoing, between Russia and Ukraine and the second between Israel and the Gaza Strip), to their aftershocks in terms of raw material scarcity and increased prices, as well as the energetic issue. Also, natural events are not missed: for instance, in Italy two recent floods devastated part of the Emilia Romagna region in the North (in 2023) and the previous year the same happened for the Marche region. In the African or Asiatic regions, instead, the opposite problem can be found: droughts due to the lack of water and rain which make it difficult for families to get food (e.g.,

Nahid et al., 2021).

These repeated challenges, that also affect supply chains from different points of view, forced to integrate a new aspect related to an economic system: its resilience.

Resilience is generally defined as the ability of a system (in this specific case a supply chain) to withstand changes of steady-state and converge to the original state or to a new desirable one (Christopher and Peck, 2004). Among the scientific literature, however, several other different definitions are proposed, all with different peculiarities; in this regard, readers can refer to (Ribeiro and Barbosa-Povoa, 2018).

How a system reacts and responds to a disruption

represents its level of resilience, which can be assessed in terms of robustness, adaptability or transformability, as other researchers stated (e.g., Miranda et al., 2019 or Bertolozzi-Caredio et al., 2022). Resilience is also seen as an integral part of a pathway or trajectory to sustainability (Doherty et al., 2019).

There are some fields, however, that despite literature is copious and varied, lack of structured and reliable tools to manage and deal with resilience, and this is the case of food systems and in general of the agri-food supply chain (Béné et al., 2023; Tebaldi and Vignali, 2023; Miranda et al., 2023). Nevertheless, the agri-food supply chain is essential for our lives, as it helps our livelihood in providing essentials, contributes to the Gross Domestic Products (GDP) of countries and offers employment; accordingly, its resilience aspect is fundamental, also considering that this field is the most affected by the climate change (El Bilali et al., 2021).

As stated few lines above, this research originates from a lack in literature specifically in terms of models and indicators for quantifying the resilience level of agri-food systems. In (Tebaldi and Vignali, 2023), a literature analysis was carried out in the agri-food context, so as to determine whether analytical models for quantifying resilience existed or not, and what emerged is a scarce contribution from the scientific literature in this sense. According to that, from a *top-down* perspective depicted in that initial research, the authors here shifted to a *bottom-up* one, aimed at investigating the point of view of practitioners. To this end, semi-structured interviews were carried out with representatives from the food industry of companies based in the province of Parma, in the North of Italy in the renowned *food valley*. Starting from the subdivision of an agri-food supply chain into the phases of supply, production and distribution as proposed in (Tebaldi et al., 2021), here the focus is on the production stage.

The ultimate aim of these interviews, however, is to derive factors and key performance indicators (KPIs) impacting on resilience so as to develop a model for assessing the resilience level of an agri-food system. Recalling the three attributes mentioned before, this corresponds to determine the robustness of a system.

For a complete literature overview on the topic, readers can refer to the abovementioned review (Tebaldi et al., 2023). Moreover, it is worth recalling two interesting and recent studies, which both address that the recent blockchain technology could improve the resilience of this field (Giganti et al., 2024; Jellason et al., 2024).

According to this brief introduction, in this manuscript results from the semi-structured interviews carried out are proposed and detailed, so as to derive interesting insights and the factors that respondents associate to the resilience. Note that for the sake of privacy all the respondents and the companies they belong to are kept anonymous.

The remainder of the paper is structured as follows: section 2 proposes the methodology followed for selecting the surveyed companies and carrying out the interviews; section 3 deals with results, followed by section 4 in which a brief discussion is proposed, including the list of the derived KPIs, classified according to the supply, the production and the distribution steps. Finally, section 5 concludes the manuscript, stressing the future research and the next steps.

2. Methodology

The starting point for carrying out the abovementioned semi-structured interviews was the creation of a list of companies, complete with contact information (i.e., email address or mobile phone, if available). The database Kompass (https://it.kompass.com/) was involved to this end; Kompass is a leading provider of business information that can be used for multiple purposes such as sales, marketing, procurement or research (Tebaldi et al., 2022). Specifically, by selecting as sector of interest "Agriculture and Feeding" and as sub-sector "Food products", an initial sample of 100 companies was selected, covering different types of end products.

These companies were contacted in June 2023 via e-mail for presenting the research topic and probe their availability in participating to a video call (lasting approximately one hour) during which discussing on the factors impacting on the resilience level of their business.

To those companies agreeing, a list of 5 questions was preliminary sent, in order to allow participants to prepare themselves for the discussion.

Interviews were carried out from July to September 2023, through Microsoft Teams™.

Below, the 5 questions that respondents had to elaborate and comment:

1. Have you ever adopted/implemented resilience policies for facing recent negative events?
2. In implementing this policy, which factors have you considered?
3. Among these factors, which where the most crucial for minimizing the negative effects and consequently increasing the reactivity of your system?
4. When considering some potential negative events (e.g., wars, pandemics, climatic disruptions, cyber-attacks, increase in price of raw materials or energy, economic shocks etc.), could you please list at least 5/7 key performance indicators (KPIs) involved for quantifying the resilience?
5. Could you please list the KPIs above in order of decreasing importance?

Note that no systematic scoring approach was

involved at this stage.

Also note that the contents proposed in this manuscript are part of a main project whose expected output, as already anticipated in the introduction section, is an analytic model for assessing the resilience level of an agri-food system. Accordingly, these outcomes (i.e., the factors proposed by practitioners) will be then integrated with those derived from the literature, and will constitute the bases for the abovementioned model.

For the sake of clarity, Figure 1 briefly proposes the main steps of this research.
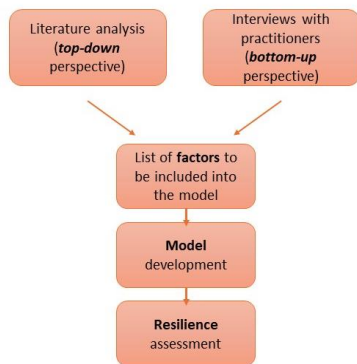
Figure 1. Steps for the development of the model aimed at assessing the resilience of an agri-food system.

3. Results

In this section results from the single interviews are proposed. Overall, 7 companies participated to this survey. Note that two of them only replied via e-mail; however it was decided to include their contribution since they offered interesting insights. Online interviews lasted approximately 45 minutes, and respondents were left free to express their opinions with reference to the 5 questions they had previously received.

In the 7 subsections that follows the contents are deepened, according to the information that respondents provided.

For the sake of clarity, Table 1 below resumes the characteristics of the companies, including their main products and raw materials.

Table 1. Characteristics of the interviewed companies; note that SME stands for Small-Medium Enterprise.

Company	Dimensions	Raw material	End product
A	Small	Seeds for oil	Oil and vegetable fats
B	Large	Tomatoes	Preserves and tomatoes derivative
C	Large	Flavorings, sweetener etc.	Soft drinks
D	SME	Meat	Cured meat (also packaged)
E	SME	Meat	Cured meat
F	Small	Meat	Cured meat
G	Medium	Meat	Cured meat (also packaged)

3.1. Company A – oil and vegetable fats producers

Company A is small (approximately 50 employees and over 100 million revenue) and produces oil and vegetable fats for the food industry; specifically they refer to their products as "specialty goods", meaning that their customers identify the quality of their products and are willing to correspond the adequate monetary value. Their aim is to be the unique supplier for their customers.

They recognize the fundamental support of the Research and Development (R&D) function for proposing eventual alternatives and flexible receipts of their products, and here emerges their primary resilience indicator: the ability of finding alternatives and reinvent themselves in terms of new products or ingredients. This was particularly evident two years ago: in fact, they particularly suffered from the war between Ukraine and Russia since they recorded problems in receiving their raw materials, and immediately had to find alternative solutions: instead of buying crude oil, they started to directly buy seeds (oil raw material), squeezing them on their own and becoming independent and not affected by speculation; thanks to their being "lean", they could implement this solution within a very short time (note that their competitors, instead, normally owns the plantings producing seeds, unlike Company A; surely this novelty closed a little the gap between them and these competitors).

Another fundamental aspect to consider for being resilient, according to their words, is cash availability for being able to face any kind of problem that might arise.

The list of factors to be considered for the resilience assessment that Company A proposed is below listed, in descending importance order:

· Cash availability
· Independent energy production
· To have a cloud system and updated backup of files and documents
· To create synergies with competitors, in case of emergency
· Have backup suppliers

3.2. Company B – Tomato processing company

Company B is one of the leader of the tomato production in the province of Parma and more in general in the whole *food valley*, and have all the characteristics of large companies in numerical terms. It has 3 different active plants where production is carried out, all in the parmesan territory.

To be honest, during the Covid-19 pandemic they were advantaged over other companies, since they were not subjected to a production stop being a food industry (note that this happened for all the companies participating to this survey, although other respondents revealed some pandemic-related

problems anyway); however, the market and consumer habits were changing in that period, and one of their strengths turned out to be the diversification of their sales channels (they sell to the retail for domestic consumption, Ho.Re.Ca field and B2B). In fact, while the Ho.Re.Ca. channel was in down due to restrictions, the retail field on the contrary was increasing its sales volume. They demonstrated to have a flexible production program so as to follow the market demand and properly modify the scheduling.

On the contrary, they significantly suffered the energetic crisis due to the Ukrainian war; they could face this issue thanks to their available liquidity.

Given the fact that their production is based on tomatoes, moreover, they care about the water supply, and are particularly sensitive to weather events, both in terms of water surplus (floods) and in terms of lack (droughts). Having 3 different plants (plants diversification), they confirm that they can overcome this issue. Moreover, they made significant investments in terms of water recover.

Another issue that could help for being resilient is diversifying the geographical areas for cultivating tomatoes, so as to avoid that, if an area is subjected to a disaster, they fully depend on this area. In this regard, company B has a great number of suppliers in the Po Valley region. Also, suppliers should be geographically close, in order to reach the plants in few hours in order to keep the quality of the raw materials and, consequently, of the final product.

The company distributes their products also abroad and Extra EU, adopting a diversification in markets and adapting their products to the different areas in terms of recipes.

Moreover, they recognize as being a crucial issue the employees well-being, and the fact of having a "short supply chain".

As per Company A, Company B as well care about having synergies with competitors, when necessary.

For concluding with Company B, below the list of the factors affecting the resilience of their system:

· Diversification of suppliers, markets, products
· Closeness of suppliers (in geographical terms)
· Cash availability
· Investment in plants for reducing the energy consumption
· Frequent backup of their IT systems

3.3. Company C – beverage company

The third company, named C, is a large company listed on the stock exchange producing soft drinks. Their mission includes resilience not in terms of recover after a disruption, but as an input to improve the AS-IS situation, and consequently prevent losses and problems, meanwhile responding to changes.

They participated to this research by simply listing *via email* the factors that they believe to be relevant for resilience, proposed in descending importance order, as per our initial question:

· To have a team dedicated to the risk management
· To monitor raw material costs
· To study the evolution of the market
· To monitor the geo-political situations of their partners (both suppliers and customers)
· Eco-friendly products
· Collaborations with key stakeholders (including suppliers, for instance)
· Diversification in sales channels (above all having an e-commerce platform)
· Wellbeing of workers
· To have a safety system against cyber-attacks
· To build customer loyalty

3.4. Company D – Charcuterie 1

The fourth company is a charcuterie based in the province of Parma, classified as small-medium enterprise (SME); they specified that most of the workers are in the production area.

Being small, they confirm to not have any specific resilience indicators to consider; they only follow "best practices" of their production field, allowing to be reactive in managing unexpected events. Among these best practices, they diversify suppliers with regard to their principal raw material (i.e., fresh meat), and the selection only falls on Italian meat. This was particularly helpful during the flood in the Emilia Romagna region in 2023, since one of their major suppliers was unable to deliver raw material, but thanks to this diversification the production level did not suffer for this issue.

Another emerged element is, again, the cash availability, which can be supportive in times of inflation or increase in costs (note that they declared that they were not affected by the crisis resulting from the Ukrainian war).

Regardless their company, they believe that a strong IT system and a disaster recovery system is essential to face potential inefficiencies.

Another element that was very important for them, especially during the lockdown period, was the diversification: as per company B, they could increase the volumes that consumers preferred in that period (i.e. packaged ham in their case), instead of the fresh ham directly sliced in the shop; this was a consequence of the perceived reduced sanitary risk of the prosciutto pack. Conversely, after the recent war, consumers' habits shifted again and returned to the fresh, given the increase in cost of the packaging.

However, sincerely, they do not feel these elements as resilience aspects, but as trade policies; accordingly they did not provide a detailed list of indicators.

3.5. Company E – Charcuterie 2

The fifth company as well is a Parmesan SME charcuterie.

Into detail, they had to manage their resilience level in two different and recent unexpected situations: the first was a flood that struck them, destroying their courtyard; their cash availability was crucial in this moment, providing them with robustness. The second, instead, was represented by one of the associates who left the company, demanding his fee. Again in this case, the liquidity rescued them.

During the Covid-19 pandemic the only problem they faced was related to the manpower availability and organization, while as a consequence of the conflict between Ukraine and Russia they only had to face increased costs for energy, but they were able to meet this change.

Overall, in decreasing order of importance, the respondent listed the following elements as being important for the resilience aspect:

- Cash flow
- Diversification of suppliers
- Employees wellbeing
- Define disaster recovery strategies
- Diversification of products (even if in their specific case they recognized that it is difficult, since they deal with a product that cannot be changed)

3.6. Company F – Charcuterie 3

The penultimate respondent is from a family-run charcuterie in Parma. Their customers are only in the Ho.Re.Ca. channel and small shops (no large-scale retail). After this information, immediately readers can imagine that in the pandemic period their sales were subjected to a stop; however, this stop also reflected problems in the furniture, since they had difficulties in receiving their products from their small suppliers located in the North of Italy. Overall, they recorded a great monetary loss under this circumstance.

However, after this bad experience, they expanded the list of suppliers, including backup ones in case of emergencies. They also have a disaster recovery system able to recover documents and material in case of hacker attacks.

Moreover, they believe that their being family-run is a strength, allowing to be more resilient, solid and quick reactive.

Being the owners of their brand is a plus according to their opinion: in case of subcontracting, if the commissioning stops, they should have to re-create a new commercial network, that is not easy.

As other companies before, they also agree on the goal of having good relationship with competitors.

The list of their indicators follows below:

- Diversification of suppliers (and have backup suppliers)
- Possibility to reduce purchase orders (i.e., possibility to change supply contracts)
- To have a disaster recovery system
- Reduced number of workers (i.e., being a small company)

3.7. Company G – Charcuterie 4

The last respondent participated to the present research by replying via e-mail. It is again this time a ham producer, based in the province of Parma. They produce both fresh ham and packaged ham, and their customers are the Ho.Re.Ca. field, the large-scale retail, industry and small local shops.

They only contributed in proposing a list of potential indicators, in decreasing order of importance:

- Cash availability
- Wellbeing attention of the workers
- Diversification of products
- Training of workers
- Investments in technologies
- Disaster recovery procedure
- Diversification of suppliers

4. Discussion

Overall, regardless the modality of participation, i.e., via video-call or by e-mail, it is evident that interesting insights can be derived from these semi-structured interviews, and that almost all the respondents (besides Company D) were prepared about the topic, meaning that they are aware of the importance of considering the resilience aspect into their activities.

First of all, it emerged the warm participation of charcuteries: surely a possible explanation is their wide presence in the Parma territory and the fact that the Parma Ham Consortium cares about liaising with the University of Parma.

Who more or less, all the participants were affected by the recent already mentioned disasters and had to deal with emergency periods or phases; however, according to the opinion of the authors, more structured companies (e.g., companies B or C, the largest of the sample) demonstrated to be solid and well-organized with regard to the resilience aspect.

Since the primary aim of these interviews was that of deriving the factors that affect the resilience level of agri-food companies, the authors re-elaborated the achieved replies and derived a set of 22 factors.

They were divided according to the corporate area they are referred to, i.e., supply, production (transformation) and distribution (sales).

Table 2 below presents these factors; note that also

a column named "General" was added, referring to those elements which could deal with all the three areas. In brackets, it is also possible to appreciate the frequency of mentioning of the element (i.e., the number of companies that perceive that factor as relevant), and factors are listed in decreasing order of mentioning. Note that at the present stage no importance or impact of each factor is defined; this step is planned in the near future.

Table 2. Factors affecting resilience deduced from the interviews.

Supply	Production	Distribution	General
Suppliers diversification (5)	Products diversification/ receipts change (5)	Sales channels diversification (1)	Cash availability (5)
Having backup suppliers (2)	Plants diversification (1)	Geo-political situation of customer (1)	Having a Disaster recovery system/ strategy (4)
Supplier geography (2)	Flexible production scheduling (1)	Customer loyalty (1)	Workers wellbeing and training (4)
Geo-political situation of the supplier (1)	Independent energy production (1)	Evolution of the market monitoring (1)	Strong cloud system and frequent backup (3)
Monitoring Raw Material cost (1)	Eco-friendly products (1)		Investment in technologies (2)
			Synergies/ collaborations with competitors (2)
			Having a Risk Management team (1)
			Being a small-sized company (1)

Overall, it can be stated that the three most important issues that participant perceived as impacting on the way a company reacts to external events are: (i) the cash availability, (ii) the suppliers diversification and the (iii) products diversification. For the first, the explanation is immediate: with money you can buy whatever you need, make proper investments, facing general increases in costs etc.; the second as well is easy to understand, and within it encompasses an important concept: when talking about resilience, 5 out of 7 respondents thought about problems related to source raw materials, meaning that probably they met this issue in their experience and that they associated to resilience the procurement activity. The last aspect, namely the product diversification, surely depends on the product that a company deals with, since not all the products can be diversified; in this concept, it was also included the possibility of changing the receipts, mentioned by Company A; Covid-19 and its lockdown/restrictions surely impacted on that.

Staying on the topic of suppliers, other elements to be considered are: having some backup figures so that when someone cannot provide the material, there is an alternative; having closer suppliers in geographical terms in order to increase the quality of products and get faster deliveries (the closest the most resilient); take care of the geo-political situation of the country in which the supplier is based. With reference to this last aspect, the authors believe that this issue especially emerged after the two recent wars. In economic terms, one company also mentioned to monitor the cost of raw material; note that this last factor was mentioned by the large company which contributed via e-mail, accordingly it was not possible to deepen this aspect, but the authors linked that to the possibility to buy additional stocks in case of favorable prices.

Shifting in production, in addition to the product diversification, 4 more factors can be found: plants diversification, proposed by Company B which has 3 different plants, and they state that in case of difficulties they can count on other production capacity or space for keeping stock; having a flexible production scheduling, in order to follow the market demand and properly adjust volumes and products; another interesting issue, mentioned for economic reasons, is to be as independent as possible with reference to the energy source, for instance with solar panels (several companies are investing in this solutions). Lastly, it is interesting to note that only the large company referred to the issue of sustainability, in terms of eco-friendly product production; this is surely a symptom of foresight, that probably only a company of this caliber may have, since the business, as also demonstrated from these interviews, often relates resilience to an economic issue, but it should not be underestimated the sustainable component.

As far as the last area dedicated to the distribution and sales channels is concerned, only one company explicitly mentioned the sales channels diversification, even if from several interviews it emerged that having multiple channels (e.g., private, HO.Re.Ca., large distribution etc.), is a winning strategy. The same company emphasized the relevance of having an e-commerce system (Company C); the company in question is again the largest listed company, and it should be note that much of the most interesting insights was deduced from their e-mail. As per the suppliers, also for the customers the geo-political situation of their country should be taken into account; again in this case, it is supposed that this element was deduced from the recent wars, which limited exportations and importations of both raw materials and finished products. The last two factors mentioned are the customer loyalty, stressed also from the side of Company A (indeed, having trusted consumers gives a sense of robustness and safety), and to monitor the evolution of the market in order to be ready to react and get ahead of the game.

Lastly, we find all the factors that are not attributable to any specific areas, but are transversal: in addition to the already discussed cash availability, companies care about having a structured Disaster Recovery System (4 companies stressed this point), as well as pay attention to cyber-attacks: have strong IT systems, frequent backup and data protection. Moreover, another positive element this time related not to the environmental but to the social

sustainability, is the fact that several respondents confirmed the importance of the attention to the workers wellbeing: knowing you can count on your employees is a certainty in the middle of the uncertain, and also the teamwork can significantly help. The last two elements worth of attention, in the opinion of the authors, are the emphasis on investments in technologies (sometimes they can allow to be independent from other stakeholders for example, if we refer to Company A and its strategy for squeezing seeds), and to maintain good relations with competitors.

5. Conclusions

This paper has presented results from semi-structured interviews carried out to 7 companies operating in the Italian food context (in the province of Parma, specifically). The ultimate purpose was that of deriving factors to be included in a model that the authors intend to develop for quantifying the resilience level of an agri-food supply chain.

From the interviews, overall, the feeling is that all the companies strongly feel the need for considering resilience in their business, and a list of 22 factors was derived. These factors were classified according to the phase they can be referred to, namely: supply, production or distribution.

As already stated at the beginning of the present manuscript, these contents are the bases and the preliminary inputs of a greater research, whose aim is to develop an analytic model for quantifying the resilience level of an agri-food supply chain; it follows that all these factors and elements emerged will be the starting point for building numerical indicators to be included.

By integrating these factors to those derived from the top-down perspective, i.e., from the literature, the aim is to build a model based on weighted averages for determining the resilience level of an agri-food company, with reference to a specific product. For determining the weight associated with each factor, it is in plan a survey to be sent to practitioners in which they have to express their perceived impact of that factor on the resilience level of their business, according to a specific scale (e.g., from 1 which means no impact to 10 referring to a high impact).

This model will be then validated and tested on real companies and real products.

As a last remark, unfortunately, the authors are aware of the fact that some fields are not represented by any respondent, and surely this constitutes a limit of the present study; probably, also having limited the research to the Parma province was a stringent constraint. Accordingly, the aim for the future is to increase the panel of companies involved, and also to reach farms so as to adapt the future model to this last field as well.

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