

WP2 white paper: *Integrating resilience criteria in the guidelines for CO-SFSC sustainability assessment*

Co-Creation of Sustainable Food Supply Chains (Co-SFSC)

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1. Practical background

This white paper constitutes part of the Belmont-funded project “Co-creating Sustainable Transformations of Food Supply Chains through Cooperative Business Models and Governance” (CO-SFSC), which focusses on the co-creation of collaborative solutions to improve the sustainability of short food supply chains (SFSC). The aim of this white paper is to explore and suggest how resilience criteria may enhance the sustainability assessment carried out in the project in each hub. In line with this aim, a reflection task was completed for each of the CO-SFSC hubs to reflect regarding the concept of resilience in relation to their hub case and intervention(s). The findings of this paper provide resilience insights from each hub, as well as guidance regarding how resilience might be integrated with the guideline for the sustainability assessment in the CO-SFSC project (T2.2).

2. Introduction

When considered in relation to sustainability, resilience in food systems has been broadly described as “the dynamic capacity to continue to achieve goals despite disturbances and shocks” (Tendall et al., 2015, p.18). This application of resilience indicates a concern with the capacity of, for example, a food supply chain or system, to move towards a socially defined desirable state, such as that defined by the Sustainable Development Goals (SDGs). From this perspective, sustainability and resilience are also seen as complementary, with resilience enabling ongoing progress towards sustainability. Tendall et al. (2015) visually represent the nature of this relationship as follows:



Figure 1: Representation of the relationship between sustainability and resilience from Tendall et al. (2015)

For the purposes of this white paper and the CO-SFSC project more broadly, we draw on the concept of social-ecological resilience for guidance, which is a concept that has been explored in relation to agri-food supply chains specifically (Stone and Rahimifard, 2018). Social-ecological resilience concerns the capacity of a complex social-ecological system (**SES**), such as an agri-food supply system, to maintain identity and core functions through responding and adapting to both expected and unexpected change and disturbances (Folke et al., 2016). In contrast to earlier conceptualisations of supply chains as linear and closed systems characterised by stability, SES are characterised by complex multi-actor and multi-scalar interactions involving diverse social, ecological and economic factors (e.g. Vallejo-Rojas et al., 2022).

In relation to SFSC and local and territorial food systems specifically, there is a general tendency for resilience to be framed in terms of shorter-term responses to crisis and “external” shocks, which can largely maintain the status quo (Smith et al., 2015; Nichols et al., 2022). However, resilience also concerns capacities to work with change, through for example learning and experimentation, and in turn making space for potential transformations (Folke et al., 2021). Considering the current socio-ecological challenges and crises facing food systems, there is a clear need for comprehensive change and transformations (Juri et al., 2024). A system’s capacity for transformation, rather than only persistence or adaptation, is therefore central question for long-term sustainability (Folke et al., 2021).

Further, viewing resilience as emerging from and in response to diverse social-ecological interactions, rather than simply as capacity for response and adaptation to crisis and “external” shocks, also provides new openings for achieving long-term sustainability. In this white paper, we therefore employ this more emancipatory framing of social-ecological resilience. For example, and as will be outlined in our findings, working with an understanding of resilience in terms of dynamic resilience ‘capabilities’, or ‘capacities’ provides a way to describe the capacities of food supply systems and the practitioners working in them to work with change and potential transformations in practice in the context of local and territorial food systems (e.g. Andersson et al. 2026).

3. Methods

The research question guiding this white paper is as follows:

- 1. How may theory on resilience inform the guideline for sustainability assessment in the CO-SFSC project?*

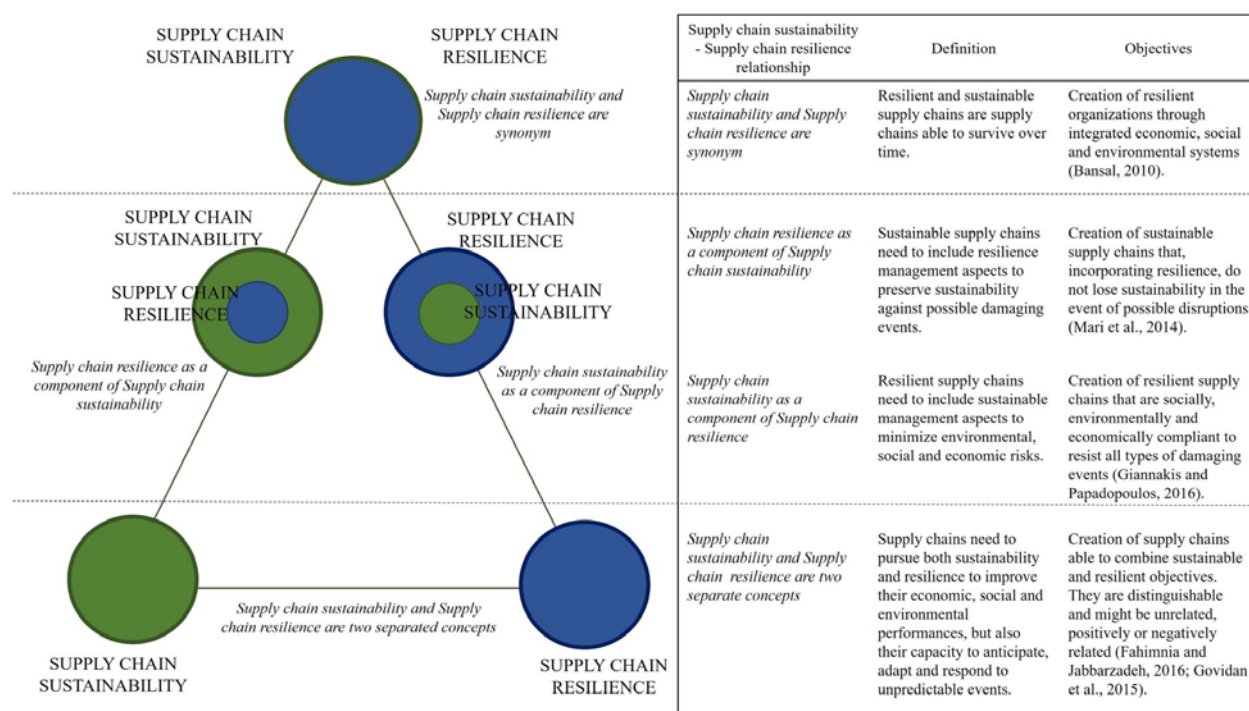
A limited literature review was conducted to develop an understanding of how theory on sustainability and resilience theory has been applied to the study of SFSC. In particular, the aim of the literature review was to understand if and how sustainability and resilience of supply chains have been studied in an integrated way. Selected articles from the review are available in Appendix 1. In addition to the limited literature review, two master’s students at KTH Royal Institute of Technology also completed their thesis research with an empirical case study concerning the integrated study of sustainability and resilience of the SFSC for locally grown apples in the region of Sörmland, Sweden (Olsson and Axelsdóttir, 2024). The master’s students also provided a review of literature regarding sustainability and resilience of SFSC in their thesis. Results from the literature review and thesis indicate that research on supply chain management has begun to call for

new conceptual and empirical research concerning supply chains as open, complex and adaptive socio-ecological systems (e.g. Wieland et al. 2023), as mentioned above. This indicates a shift away from earlier research that has broadly conceptualised supply chains as closed and linear systems. Only a limited amount of research appears to be available concerning the integrated study of sustainability and resilience of SFSC, however, we have found two very useful articles: one literature review (Concetta Carissimi et al., 2023), and one empirical study (Michel-Villarreal, 2023), which have provided valuable guidance on this subject and informed development of the approach to considering resilience in the context of the CO-SFSC project outlined below.

3.1 Reflections on how resilience theory may be integrated with the study of sustainability in the CO-SFSC project

Concetta Carissimi et al. (2023), in their systematic review concerning the joint investigation of sustainability and resilience of supply chains reveal that research investigates sustainability and resilience of supply chains in multidimensional ways. As a result of their review, they provide a conceptual framework to provide guidance on the different ways in which the sustainability and resilience of supply chains have generally been studied to date:

Figure 2: Concetta Carissimi et al.'s (2023) conceptual framework to represent the multidimensional ways sustainability and resilience of supply chains are investigated (Figure 7 in the article).



In the current white paper and for the purposes of the CO-SFSC project, we approach the study of sustainability and resilience in the manner indicated by the bottom points of the triangle in Figure 2 (i.e. 'supply chain sustainability and supply chain resilience are two separate concepts' that need to be studied in a combined way in supply chains). As the text in Figure 2 indicates, sustainability and resilience "are distinguishable and might be unrelated, positively or negatively related". In order to pursue the combined study of sustainability and resilience in supply chains, we therefore apply

the approach taken in the empirical study by Michel-Villareal (2023) and further applied in Olsson and Axelsdóttir (2024). Michel-Villareal (2023) illustrates that the concepts of sustainability and resilience are generally complementary, but that there exist both synergies and trade-offs between the concepts in SFSC in practice. Further, Michel-Villareal (2023) stresses the importance of studying dynamic capacities, strategies and steps related to sustainability and resilience of SFSC in order to account for the open and dynamic nature of these social-ecological systems. Overall, Michel-Villareal (2023) introduces a conceptual framework for the integrated study of resilience capabilities (i.e., flexibility, redundancy, collaboration, visibility and agility) and sustainability practices (social, environmental, and economic) in relation to SFSC. In Figure 3 below we include Michel-Villareal's (2023) overview of the resilience capabilities mentioned above.

Figure 3: Definitions of the resilience capabilities introduced by Michel-Villareal (2023) (Table 2 in the article)

Supply chain resilience capability	Definition	Associated strategies	Resilient sustainable short food supply chain
Flexibility	"The ability to take different positions to better respond to abnormal situations and rapidly adapt to significant changes in the supply chain" (Kamalahmadi and Parast, 2016, p. 122)	Alternate distribution channels, flexible production facilities, multi-sourcing, postponement, mass customisation, standardisation of parts, processes and production systems	1919
Redundancy	It is about developing the capacity to respond to disruptions by investing in resources before they are needed (Kochan and Nowicki, 2018)	Emergency back-up and storage facilities, back-up sites, overcapacity, multiple sourcing, surplus raw materials and finished inventory	
Collaboration	"The ability to work effectively with other entities for mutual benefit" (Pettit <i>et al.</i> , 2010, p. 12)	Risk sharing, collaborative forecasting, communication and information sharing, trust, joint decision-making, supplier certification and development	
Visibility	It is about being able to see structures, processes and products along the whole supply chain (Stone and Rahimifard, 2018)	Business intelligence gathering, information exchange, collaboration with customers and suppliers, information technology (IT), early warning indicators, real-time/financial monitoring and information management	
Agility	"The ability to respond rapidly to unpredictable changes in demand or supply" (Christopher and Peck, 2004, p. 18)	Communication, quick SC re-design, velocity, visibility and flexibility, close collaboration with suppliers, speed and responsiveness	
Source(s): Own elaboration			Table 2. Selected resilience capabilities

We broadly apply the resilience capabilities defined by Michel-Villareal (2023) in order to reflect on the country cases in the CO-SFSC project from a resilience perspective. The main aim is to understand the potential synergies and trade-offs for sustainability and resilience in SFSC in the context of each hub. For this purpose, each hub first reflected on the different resilience capabilities outlined in Figure 3 in relation to their own case and intervention(s). The hub reflections were then compiled and analysed by the Swedish hub, leading to different findings and recommendations regarding the integration of the resilience capabilities with the sustainability assessment criteria in the CO-SFSC project. These findings and recommendations are outlined below.

4. Findings

4.1 Introduction to hub cases and interventions

Sweden: the Swedish research hub primarily focussed on the SFSC for municipal food supply for public meals. This focus involved looking at the practices of individual producers and cooperative producer associations, as well as other intermediary organizations such as wholesalers. In particular, the hub looked at the intervention involving the so-called ‘potato game’ in Södertälje municipality, where a diverse range of practitioners (e.g. farmers, kitchen staff, wholesalers, and other municipal staff) working in the local municipal food supply chain came together to explore the challenges and opportunities for improving the performance of the SFSC for locally grown organic potatoes.

Thailand: the focus of the Thailand research hub concerned sustainable restaurant supply chains in the Bangkok Metropolitan Region (BMR) and Phuket. The main focus was on restaurants as intermediary cooperative food businesses and their supply chains. The specific intervention in the hub involved building partnerships between local organic farmers and restaurants to improve the sustainability of the organic restaurant supply chain. It connected the Bangwan Development Agricultural Women’s Group, which produces high-quality organic Som Kwai (bitter orange) but struggles with local market visibility, with the Hub Poei Café located in the Bangjo Prison (operated to train inmates). The Café introduced new Som Kwai-based drinks and leaflets on the fruit’s origin, health benefits and local importance, leading to customers’ willingness to pay nearly 50% more for these beverages compared to regular ones. The research hub looked at, among other things, understanding consumers’ preferences for organic food beyond health benefits, and exploring interlinkages among farmers, consumers, and restaurants.

Freiburg, Germany: as there was no supply chain-level intervention in the Freiburg research hub, applying the resilience criteria is not possible (resilience in supply chains and food businesses are not synonymous). However, relationships between the focus of the case study, namely the organic food retailer *die Glaskiste*, and their various suppliers were considered in the sustainability assessment conducted in Work Package 2, as well as in the governance assessment conducted in Work Package 3. Furthermore, the completed intervention included the incorporation of end-consumers into the food business through the conversion of the shop to an incorporated food cooperative. Therefore, applying resilience criteria to this case of *die Glaskiste* as a central outlet between food suppliers and its member-customer base in Freiburg was considered to provide perspective into questions of resilience in food supply more generally.

Karlsruhe, Germany: in Karlsruhe, a group of local actors is building FoodCircle, a cooperative hub for sustainable, regional food supply. The initiative aims to create a central node in which organic, largely unpackaged products are procured, processed and distributed, thereby linking regional producers, out-of-home catering facilities and local communities.

While the legal foundation of FoodCircle as a non-profit organisation is still in process, this research project is helping to build up cooperation among local food actors and support the work that brings together producers and consumers to co-develop sustainable regional food chains. Networking and advocacy activities, including organisation of Food Summits, form a core component of the activities in the Karlsruhe Hub, together with the practice partner working on supply chain management (project “KA.Wert”). The activities contribute to the emergence of a supportive local ecosystem through collaborative relations, strategic engagement with public actors and heightened public awareness of food initiatives and cooperative organisational forms. Taken together, these

activities constitute an important groundwork for the gradual development of a new type of local food system oriented towards cooperation, transparency and sustainability.

Taiwan: Taiwan's case investigates the development of the local soybean supply chain for improving food self-sufficiency and sustainability, facilitated by collaborative efforts between government policies and a soybean enterprise (Taiwan Soybean Farmer, **TSF**). TSF addresses different aspects of purchasing practices regarding local soybeans: introducing new materials (e.g. local tofus), enhancing competences of consumers to access more sustainable soybean products (e.g. knowledge provision activities and new sale channels), and creating meanings of sustainable soybean consumption (e.g. organized cultural activities). The Taiwan hub also looked at the sweet potato supply chain. More broadly, the Taiwanese government enacted the Big Granary Programme in 2016, seeking to encourage farmers to transition away from traditional water-intensive crops. Through financial subsidies, assistance in crop diversification and the development of marketing channels, the Big Granary Programme seeks to transition agricultural production towards the national sustainability goals.

4.2 Resilience reflections from the hubs

Flexibility – the ability to take different positions to better respond to abnormal situations and rapidly adapt to significant changes in the supply chain

Sweden: the aim of the potato-game intervention was to increase flexibility in the municipal supply of potatoes by increasing supply from local and regional farmers. This is because the current situation is characterised by supply from one or two major national wholesalers, therefore seen to be lacking flexibility in using more local and regional food supply systems. The intervention worked directly with establishing alternative distribution channels for this purpose. There is, however, an ongoing tension between creating flexibility in the system through alternative distribution channels, while also ensuring that the large quantities of required produce are available to the municipality given their role in providing public meals on a daily basis.

Thailand: the newly formed collaboration between farmers and the café to offer more organic choices (beverages) to consumers enhances the flexibility of the SFSC. This is because the situation of the SFSC (restaurant supply chain) before implementing the intervention showed a limited supply of organic foods and beverages. Thus, inviting an organic farmer group into the SFSC by connecting with the café to provide new alternatives for consumers enhances the flexibility of the supply chain itself. Moreover, this collaboration allows the café to adjust its menu offerings based on seasonal availability and farmer capacity, increasing responsiveness to changing conditions. It also enables diversification of sourcing options, reducing reliance on a single supplier or product category. As a result, the supply chain becomes more adaptable to both market trends and environmental uncertainties.

Freiburg (Flexibility and Redundancy): Die Glaskiste sources its products from more than 50 suppliers, which creates a built-in redundancy lattice: Many suppliers are direct producers of highly specific items, which are the least exchangeable in times of disruption, as the loss of a single producer can create a gap in assortment. On the other hand, die Glaskiste works with a small handful of general-goods wholesalers (food and non-food items), which offer a high degree of exchangeability: these actors can quickly replace a missing line and thereby provide the strongest

redundancy. Between these two supplier types are bundlers and wholesalers that specialise in product groups (i.e. cereal-products): while some alternatives exist within the same product family, switching suppliers in times of disruption would incur additional time and price adjustments.

While this breadth of the supplier base grants the shop high redundancy in its supply chains, it also stretches the shop's coordination capacity. Managing contracts, deliveries and quality checks for dozens of partners limits the depth of relationships that can be built with each supplier. Consequently, the flexibility of the system is partly constrained by limited human resources and the administrative load required to keep the network functional. This results in tensions and trade-offs within and between resilience criteria: More suppliers leads to greater redundancy and contingency options but higher coordination costs and lower intimacy with any single partner. Fewer suppliers, on the other hand, allows for tighter collaboration and potentially lower operating costs but greater exposure to shocks if a key supplier fails.

Converting the shop into a consumer-cooperative could potentially reshape this balance. Regular, predictable purchases from member-customers could stabilize demand, allowing the cooperative to negotiate contracts with a core set of reliable suppliers. At the same time, the existing network of general-goods wholesalers can be retained as a rapid-response reserve, preserving redundancy while reducing the coordination load that comes from managing dozens of relationships.

Karlsruhe: The networking and relationship building activities around FoodCircle increase flexibility in the regional supply of organic vegetables and legumes by connecting multiple producers, a wholesaler, canteens and restaurants, instead of relying on a few large suppliers. CO-SFSC plays an important supporting role here by initiating workshops and exploratory contacts that make it easier to test alternative supply routes and cooperation constellations. Through workshops, fairs and demand–supply matching formats, actors can experiment with product assortments, delivery rhythms and processing options (e.g. pre-processed vegetables) and adjust these arrangements as needs or conditions change. At the same time, the still evolving FoodCircle business model and legal form mean that some of this flexibility remains informal and is not yet fully embedded in long term contracts or institutional routines.

Taiwan: The current grain supply in Taiwan is characterized by a high reliance on imported crops, which lacks flexibility during global logistics disruptions. Our work focuses on the "Big Granary Policy" (a key policy intervention) which encourages establishing alternative distribution channels for local non-GMO soybeans (Taiwan Soybean Farmer) and sweet potatoes (Uncle Sweet). By integrating these local producers into the local supply chain, the system increases its ability to shift sourcing positions when international markets become volatile.

Redundancy – developing capacity to respond to disruptions by investing in resources before they are needed

Sweden: sourcing from a diversity of suppliers with varied sizes, types of production and locations (local and otherwise), is one way to enhance redundancy in a supply system. However, missing factors such as short-term and long-term storage facilities locally, inhibited the establishment of diverse sources of local supply. This is an ongoing issue requiring attention in the region.

Thailand: connecting an organic farmer group with a café to provide local organic beverages is considered a new part of Phuket's SFSC. As a newly established collaboration, redundancy strategies in the supply chain are not yet in place. In the future, developing relationships with additional farmer groups or creating inventory buffers could enhance redundancy and improve resilience.

Freiburg: as above

Karlsruhe, Germany: The intervention's focus on building and strengthening a regional network of organic producers and buyers creates the basis for more diverse sourcing options and thus greater redundancy in local supply chains. In cooperation with the practice partner (supply chain manager) mapping and outreach activities identify additional producers and potential buyers, helping to broaden the portfolio of partners that can step in if individual actors drop out or face shocks. By exploring alternative routes to market and potential shared infrastructures such as pre-processing capacities, the networking activities help to spread risks across multiple actors rather than concentrating them with a few intermediaries. However, many of these redundancies are still emerging and depend on project-based collaboration; developing FoodCircle and/or a producer cooperative as a stable organisational structure is important to secure these multiple options over time.

Taiwan: A major vulnerability in our regional food system is the lack of decentralized processing and storage infrastructure. Our intervention explores the development of localized primary processing facilities within hubs like Taiwan Soybean Farmer. This creates a "back-up" capacity that ensures food supply continuity even if centralized industrial processing plants face operational shocks.

Collaboration – *ability to work effectively with other entities for mutual benefit*

Sweden: the core focus of the potato-game was to increase capacities for collaboration between public and private actors in the local and regional food system. This was achieved through the focus of the intervention on aspects such as information sharing, building trust, communicating in relation to practical challenges and shared and inclusive decision-making. The intervention also focussed on enhancing different actors understanding of each other's everyday practical realities.

Thailand: the key feature of the intervention was forming a collaboration between a local organic farmer group and a café. This collaboration was a success since it provided mutual benefits for both partners (and it aligned with their sustainability goals for doing business). Through this partnership, both actors were able to share knowledge, resources, and market insights, strengthening their operational capacity. The farmer group gained a stable market outlet, while the café enhanced its value proposition by offering locally sourced organic beverages. Additionally, the trust and communication established between the partners serve as a foundation for long-term cooperation and potential future innovations.

Freiburg: collaboration is uneven across supplier relationships at die Glaskiste. As mentioned above, relationship depth varies: a handful of long-term, trust-based ties coexist with more transactional links to larger wholesalers. Negotiations on price are minimal as the shop generally

accepts market-standard terms. Finally, risk-sharing mechanisms (e.g., pre-financing, forward contracts) are largely absent, as purchases are made weekly on a spot-market basis. Where trust has been cultivated (e.g., with regional producers), the shop benefits from reliable deliveries and the ability to co-design product assortments. Conversely, the lack of formal risk-sharing limits the shop's capacity to buffer financial shocks when a supplier experiences a disruption. On the other hand, risk-sharing takes place through the membership model implemented in the cooperative, in which members can pre-finance their purchases or pay monthly contributions to cover the fixed costs of the business. Co-ownership also distributes risk for the overall business across the membership. Members, however, do not participate in co-designing or managing procurement processes with suppliers and therefore cannot influence formal collaboration higher in the supply chain.

Karlsruhe: Collaboration is at the heart of the intervention, which consists largely of convening and facilitating interactions between producers, wholesalers, canteens, restaurants, researchers and municipal representatives. "KA.Wert" (supported by CO-SFSC) functions as a key facilitator in this process, initiating personal contacts, moderating events and creating formats where practical challenges and expectations can be openly discussed. Workshops, regular meetings, fairs and joint events provide spaces for trust building, shared problem solving and inclusive decision making on issues such as pricing, product specifications and logistics. Through these activities, the initiative contributes to the gradual creation of a base of trust and a more supportive local ecosystem for cooperative food initiatives. One concrete outcome of the networking and matchmaking events has been the strengthening of collaboration between a canteen and a processor around the supply of organic carrots, thereby contributing to a gradual reconfiguration of the carrot supply chain towards a higher share of organic products. The envisioned non-profit, cooperative orientation of FoodCircle aims to translate this networked collaboration into more formalised shared governance and responsibility, but this institutionalisation is still a work in progress.

Taiwan: Unlike interventions focused on researcher-led actions, the Taiwan hub emphasizes understanding the effects of policy intervention. We conducted in-depth interviews with Taiwan Soybean Farmer and Uncle Sweet to explore how the "Big Granary Policy" facilitates or hinders collaboration across the supply chain. These interviews reveal how policy guidance helps disparate actors (farmers, processors, and retailers) align their goals, fostering the trust and joint decision-making necessary to handle unpredictable supply chain stresses collectively.

Visibility – being able to see structures, processes and products along the whole supply chain

Sweden: the potato-game intervention worked directly with visibility by uncovering the extensive number of steps requiring coordination along the supply chain for locally grown organic potatoes. It also increased the visibility of power dynamics in current municipal supply chains that are impacting on their resilience. Further work in relation to visibility involves uncovering the different conditions in different parts of the supply system, so that different actors understand the practical challenges and opportunities of local supply (for example, municipal kitchen staff and farmers sharing information on their own practical working conditions and requirements with each other). Increasing visibility also involves articulating the different types of risk different actors must handle in everyday practice.

Thailand: As a part of the intervention, certain areas of visibility were revealed—consumer needs and preferences regarding sustainability criteria and consumers’ willingness to pay. This information is beneficial for the café and the farmer group in planning marketing and pricing strategies. Furthermore, improved visibility enables both actors to better understand demand patterns and adjust their production and supply decisions accordingly. Transparency regarding sourcing and sustainability practices also helps build consumer trust and strengthens brand credibility. In addition, making sustainability information available empowers consumers to make informed purchasing decisions, potentially increasing their engagement and loyalty.

Freiburg: Die Glaskiste excels at consumer-facing visibility: Product origin is generally displayed on labels, in a supplier-map in the shop, and occasionally highlighted through social media. However, visibility for internal supply-chain management remains limited. Product information, including future estimates on availability or pricing may generally be communicated through conversations with suppliers but is not systematically monitored for Glaskiste employees nor made visible for end-consumers. As a result, the resilience benefit of visibility is modest, as Glaskiste employees may lack the data needed to anticipate or respond to disruptions quickly. Conversion to a consumer-cooperative business model therefore likely has little impact on the resilience of supply as a result of increased visibility across supply chain actors.

Karlsruhe: The networking and mapping activities increase visibility along regional vegetable and legume chains by making actors, their roles and their needs more transparent to one another. For example, it improved the transparency about the origin of the carrot supply in the collaboration between the canteen and the processor. “KA.Wert”’s outreach, site visits and events (in cooperation with and accompanied by CO-SFSC) help to reveal who is involved, under which conditions they work and where coordination problems or bottlenecks occur. Events like regional organic fairs and Food Summits, as well as concept work on FoodCircle as a physical hub and information space, highlight where products come from, where bottlenecks occur and which conditions shape everyday practice in kitchens and on farms. At the same time, more systematic tools for sharing quantitative information on volumes, costs and risks across actors are still being developed, so visibility currently relies strongly on personal contacts and dialogues.

Taiwan: In Taiwan, visibility is enhanced through the "Big Granary Policy" framework, which promotes traceability and local brand identity. Our interviews reveal that this policy makes the existence and unique value of domestic crops more visible to the market. For instance, Taiwan Soybean Farmer utilizes food and agriculture education to make the production process of non-GMO soybeans transparent to consumers. Similarly, Uncle Sweet leverages policy-driven certifications (e.g., Traceable Agricultural Product, TAP) to validate product origin and quality. This visibility is essential for differentiating local sustainable products from mass-market imports and building consumer trust.

Agility – ability to respond rapidly to unpredictable changes in demand and supply

Sweden: the intervention did not have a direct focus on agility, however this factor was indirectly supported as a result of the increased collaboration between supply system actors. This provides the potential for developing increased agility to rapidly respond to changes in municipal supply in future. Increased agility is also important for actors to collectively identify and take advantage of

opportunities for more extensive change and transformations in SFSC as they currently operate in the region.

Thailand: due to the recently formed collaboration between the local farmer group, the small size of both the farmer group and the café, and the nature of their business (locally operated and relying on natural conditions for cultivation), agility was still limited. Even with a short supply chain facilitating clear communication, both parties still faced difficulty in predicting demand and supply. Seasonal variability and limited production capacity further constrained their ability to respond quickly to sudden changes in market demand. In addition, the lack of historical data and experience in working together reduced their ability to make accurate forecasts. Over time, as the collaboration matures and data accumulates, their agility is expected to improve through better coordination and planning.

Freiburg: purchasing duties are handled by a small, tightly knit team of 3–6 people in die Glaskiste, giving the shop the theoretical ability to re-allocate orders quickly when a disruption occurs. In practice, identifying suitable substitutes for low-exchangeability items could be time-consuming. With a cooperative business model, regular purchasing patterns could become more stable, reducing the variability that staff must manage daily. This freed capacity may enable the team to focus on contingency planning and to act more swiftly when genuine shortages arise, thereby boosting true agility in the face of shocks.

Karlsruhe: By cultivating direct relationships and communication channels through its networking activities, the intervention builds a foundation for agility, enabling actors to coordinate more quickly when opportunities or disruptions arise. Supported by the practice partner new constellations for the network (e.g. pre-processing projects or new delivery arrangements) were piloted and adjusted based on feedback from farmers and kitchens. Strengthened personal contacts improve mutual trust, which in turn facilitates faster and more adaptive adjustments in the supply chain when conditions change. Pilot projects in demand–supply matching and pre-processing require participants to adapt to new products, logistics solutions and collaboration formats, which fosters learning by doing and a readiness to adjust. The trajectory from the organisation of Food Summits towards the planned establishment of a food council illustrates how event-based networking can evolve into more durable governance structures, thereby prolonging and strengthening a supportive ecosystem for agile regional food supply. Yet, because the organisational and financial consolidation of FoodCircle is ongoing, the network’s capacity to mobilise rapid, larger scale responses (for example to major procurement changes or supply shocks) remains more potential than fully realised in practice.

Taiwan: While not the primary focus, our intervention indirectly supports agility by shortening the physical and relational distance between producers and consumers. The direct communication channels established between TSF and its community allow for rapid re-design of product offerings in response to unexpected harvest fluctuations. This responsiveness is essential for the hub to transform current consumption patterns toward more sustainable, locally sourced alternatives.

4.3 Integrating consideration of resilience capabilities into sustainability assessment

Recommendations regarding the integration of resilience capabilities with the sustainability assessment for the CO-SFSC project are made in the following section based on the case reflections above, and the social, economic and governance criteria and indicators included in the CO-SFSC sustainability assessment below (Table 1).

Social	Human Health	Food safety (safe food)
		Food quality (nutritional/healthy food)
	Culture	Food culture (knowledge, skills, appreciation)
	Work Environment	Working conditions (incl. for vulnerable people)
		Diversity of workforce and leadership
		Quality of internal and external relationships
Economic	Economic Justice	Wages
		Food prices
		Distribution of benefits and burdens
	Economic Efficiency	Economic viability of business
		Economic resilience of business
		Cost-efficiency (Resourcefulness)
	Econ. Impact	Contributions to local economy (value generat.)
Governance	Transparency	Information / Labeling
		Audits and Certifications
	Participation	Workforce participation
		Cooperating in food economy ecosystem

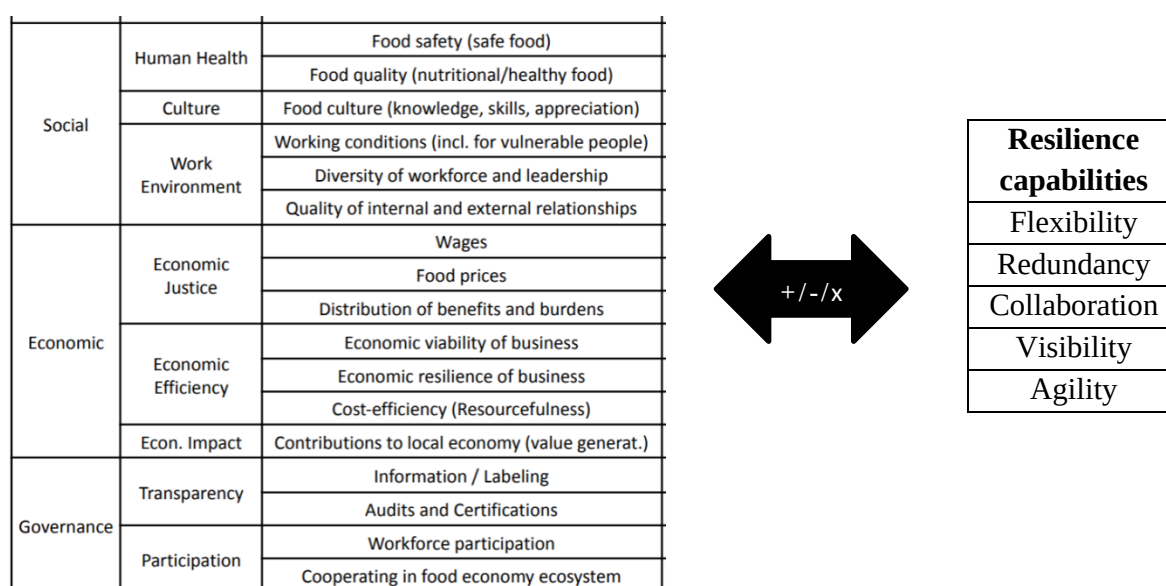
Table 1: social, economic and governance sustainability criteria and indicators applied in the CO-SFSC sustainability assessment in each country hub. The first column to the left indicates the sustainability domain (e.g. social, economic, governance), the middle column indicates sustainability sub-domain, and the right column provides the relevant criteria/indicators for each domain and sub-domain.

The resilience capabilities assessment for the hub cases appears to link naturally with the consideration of social, economic and governance aspects of the sustainability assessment. However, as highlighted in the introduction to this white paper, the assessment of resilience does not simply highlight aspects synonymous with or unquestionably conducive to increased sustainability. The focus on resilience capabilities concerns the capacity of the supply systems in the different hub cases to address and respond to change. While the sustainability assessment highlights aspects that may contribute to or provide a basis for heightened resilience, it is necessary and valuable to apply the resilience capacities independently to each case in order to understand different dynamics influencing the ability of the supply systems to be maintained in both the short and long term. For example, in the Thailand case, while collaborations are present in the system and contribute to improved social and governance sustainability, due to the early development stage of these collaborations, they are not yet considered to contribute with greater redundancy or agility in the system. Further, resilience aspects such as visibility, similar to but not synonymous with transparency, provide unique case insights compared to the sustainability assessment. It is therefore our recommendation that the resilience assessment be integrated primarily as an additional, independent component alongside the social, economic and governance sustainability assessment criteria.

As an additional step, inspired by Michel-Villareal (2023), we also propose that considering findings regarding social, economic and governance sustainability in Table 1 in relation to

independent findings on resilience capacities would be fruitful in transdisciplinary contexts. This would provide for the development of a more detailed understanding about how sustainability characteristics and conditions may contribute (or not) to resilience (i.e., the capacity of a system to deal with and respond to change in both the short and long term) and vice versa. We propose the following simple method for considering the social, economic and governance sustainability criteria and indicators and the resilience capacities/capabilities in relation to each other, which involves considering the nature (positive (+), negative (-) or unrelated (x)) of the relationship between the indicators and capabilities (Figure 4).

Figure 4: a simple model for integrating consideration of social, economic and governance sustainability criteria and indicators with resilience capacities in the CO-SFSC project, involving consideration of the nature (i.e. positive (+), negative (-) or unrelated (x)) of the relationship between the sustainability criteria and resilience capacities.



To provide some case illustrations, the resilience capability of ‘flexibility’ may have different implications for, or be influenced in different ways by, ‘work environment’ sustainability criteria and indicators such as ‘working conditions’, ‘diversity of workforce and leadership’, as well as ‘quality of internal and external relationships’. In the Swedish case, while increasing supply from local farmers may increase flexibility and redundancy in the municipal supply chain, there may be a range of considerations in relation to internal and external relationships and working conditions that require attention to ensure that the desired increase in resilience through flexibility does not have negative social sustainability outcomes due to increased workload without proper operational support.

Similarly, in the case of Freiburg, a broad supplier base for *die Glaskiste* contributing to both increased flexibility and redundancy also has the following implications: “managing contracts, deliveries and quality checks for dozens of partners limits the depth of relationships that can be built with each supplier. Consequently, the flexibility of the system is partly constrained by limited human resources and the administrative load required to keep the network functional. This results in tensions and trade-offs within and between resilience criteria: more suppliers lead to greater redundancy and contingency options but higher coordination costs and lower intimacy with any single partner.” Beyond tensions and trade-offs within and between resilience criteria, these aspects

also influence the performance of the focal supply system in relation to certain social sustainability criteria linked to work environment and relations. The role of consumer-cooperatives appears important, not only for sustainability performance, but also adding to resilience capabilities, in this case. Both the Swedish and Freiburg cases, as well as the Karlsruhe case, point to the importance of formalising flexibility arrangements to ensure that informally maintained forms of flexibility in the system do not negatively impact social sustainability aspects. This finding can in fact be applied to several resilience capabilities in the cases. Many cases highlight that informal forms of resilience are present in the systems, however in the absence of more formalised arrangements to support these capabilities, there are likely a range of negative impacts on social, economic and governance sustainability aspects in the systems.

Conclusions

This white paper, including its background and literature review, the case reflections and final recommendations, collectively provide a way forward in relation to the integration of resilience considerations in relation to the sustainability assessment in the CO-SFSC project. The integration of resilience with sustainability considerations provides a more intricate picture of the conditions that will provide for the function of these systems in both the short and long term. While not covered within the scope of this white paper, an additional stage of integration could involve multiple assessments of resilience across time in each of the SFSC, in order to capture the dynamic nature of resilience capacities in more detail, as well as potential shifts in the interactions between sustainability performance and capabilities for resilience in the different hub cases.

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Appendix 1 – selected literature review articles

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