CO-creating sustainable and competitive FRuits and vEgetableS' value cHains in Europe

Drivers and constraints of sustainability-oriented innovation in agri-food value chains; Key findings from CO-FRESH Task 1.1

Cholez, Célia; Bijman, Jos; Mahdad, Maral; Dentoni, Domenico (Wageningen University, The Netherlands); Giagnocavo, Cynthia; Mehrabi, Sepide; Pérez-Mesa, Juan Carlos (University of Almería, Spain); Borgia, Riccardo; Viaggi, Davide; Zavalloni, Matteo (UNIBO Alma Mater Studiorum, Italy); Turri, Rafaelle (ENCO, Italy)

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Abstract

This document is a public summary based on Deliverable 1.1 in the European innovation action project CO-FRESH. It presents the main drivers and constraints of sustainability-oriented innovation (SOI) in agri-food value chains. The document contains a summary of an extensive literature review of the academic and grey literature on innovative and sustainable agri-food value chains in Fruits & Vegetables and other crops. The review focusses on identifying the drivers and constraints of successful integration of technological innovation with social, organisational, managerial and institutional changes that support and facilitate sustainability outcomes. The review explicitly pays attention to collaboration in agri-food value chains and how different models of collaboration contribute to SOI. Finally, the report presents a list of 16 factors that are known to have a positive influence on the development and implementation of SOI.

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1. Introduction

Grand societal challenges, such as climate change, environmental degradation, food security, immigration, and digital transformation, urge actors in agri-food value chains to embrace sustainability objectives. Value chains actors from farm to fork need to interact and collaborate for environmental, social and economic improvement of the food system. While innovation has long been considered as a factor contributing to growth and competitiveness, with the sustainability objectives becoming more important, innovation is increasingly targeted at making products and processes in agri-food chains more sustainable. The emergence of concepts such as sustainability-oriented innovation and sustainable innovation are undeniable results of this trend. However, our scholarly understanding of these emerging concepts is still limited. Research on drivers and constraints of sustainability-oriented innovation is needed, to provide managers and policy makers the tools and insights to make appropriate decisions. Due to its complexity and multidimensional character, sustainability cannot be achieved individually, and collaboration among value chain partners is crucial. Collaboration is seen as an effective way to turn ambition and commitment into action in the journey toward sustainable food systems.

The CO-FRESH project[1] aims to provide techniques, tools and insights to make agri-food value chains more environmentally sustainable, socio-economically balanced and economically competitive. It does to by promoting collaborative models that support the achievement of sustainability objectives through the smart combination of technological and non-technological innovations, by designing, testing and assessing innovative business models, by improving value chain transparency and by enhancing fair distribution of cost, risk and benefits along the value chain.

Task 1.1. presents a review of the academic and grey literature on innovative and sustainable agri-food value chains in Fruits & Vegetables and other crops. The review focusses on identifying the drivers and constraints of successful integration of technological innovation with social, organisational, managerial and institutional changes that support and facilitate sustainability outcomes. The review explicitly pays attention to collaboration in agri-food value chains and how different models of collaboration contribute to sustainability-oriented innovation.

Figure 1 presents the main research questions that were leading the literature review summarized in this document. Section 2 answers the question “What is sustainability-oriented innovation?”. Section 3 discusses the different modes of collaboration and how these affect sustainability-oriented innovation. Section 4 discusses the public policies that influence the development and implementation of sustainable innovations. Finally, in Section 5 we present a list of recommendations for value chain actors on how they can support the development and implementation of sustainability-oriented innovation in agri-food value chains.

[1] CO-FRESH is a Horizon2020 Innovation Action project with the objective to boost sustainability-oriented innovation and competitiveness in fruit and vegetables value chains in Europe. See https://co-fresh.eu/ for more information on the project.

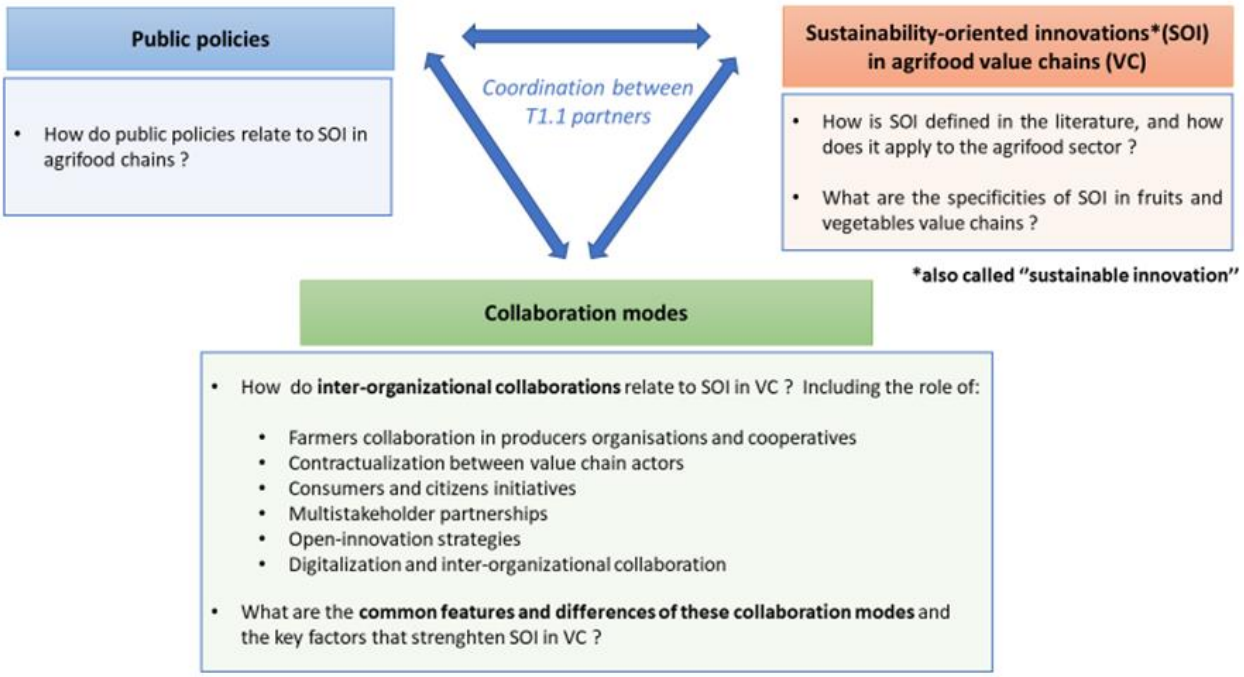

Figure 1. Main research questions in CO-FRESH Task 1.1. Source: Authors

2. What is sustainability-oriented innovation?

In the agri-food sector, sustainability has long been addressed through the environmental lens, first at the farm level and later at the level of the value chain as a whole, for instance when applying a Life Cycles Analysis (LCA). The concept has then evolved to encompass a more holistic view of sustainability taking into account social dimensions of food systems (such as the healthiness of diets, labour conditions and regional socio-economic development) and economic dimensions in value chains (such as a fair distribution of value among value chain actors).

The review of the literature leads to the conclusion that sustainability-oriented innovation (SOI) can be defined according to four dimensions: direction, diversity, degree of openness and distribution. See Figure 2.

1. The direction of SOI refers to the three pillars of sustainability.

While eco-innovation or social innovation put the emphasis on one dimension, SOI takes into account more than one dimension. As a result, SOI involves a higher level of complexity and more uncertainty on the outcomes of the innovation compared to conventional innovation.

2. The diversity of SOI refers to the type of innovation. In the CO-FRESH project we focus on the following types of innovation.

- *Technological innovation*: The implementation of new or significantly improved goods and services, or new or improved methods of producing goods and services.
- *Organizational innovation*: The implementation of a new routines, management structures and methods of coordination within or between organizations.
- *Managerial innovation*: A form of organizational innovation that focuses on the specific roles and functions of the manager, including the interpersonal, informational and decision-making roles.
- *Institutional innovation*: A legitimate change in the cognitive, normative, or regulative rules of a social system.

3. The degree of openness of SOI refers to the participation of different actors in the innovation process.

SOI is a process that can rely on various degrees of value-chain collaboration. It is a process that brings together value chain actors (and sometimes also external actors) toward a common goal and a common understanding of developing and implementing an innovation. While remaining mostly autonomous, value chain actors jointly decide on specific innovation activities.

4. The distribution of SOI refers to the repartition of the benefits.

Many authors argue that SOI should enable a fair benefit-sharing among the value chain actors. In addition to that, the outcomes of SOI could benefit not only the value chain actors but also external stakeholders. For instance, a reduction of the use of chemical inputs on the farm results in cost reduction (an economic benefit) for the farmer, while it also results in a reduction of greenhouse gas emissions, thus an environmental benefit for society as a whole.

The dimensions presented in Figure 2 should be considered as independent. A specific SOI may score high or low on different dimensions, while there is not necessarily a correlation between the scores on the individual dimensions. For example, a technological innovation only (low score on the diversity axis) may still involve collaboration between value chain actors and external stakeholders (high score on the degree of openness axis).

In sum, we provide the following general definition: "Sustainability-oriented innovation (SOI) is a process of collaborative change directed at improving one or more of the three pillars of sustainability (i.e., environmental, economical and social), relying on a diversity of bundled innovations (notably technological, organizational and institutional), and whose benefits are fairly distributed along the value chain actors".

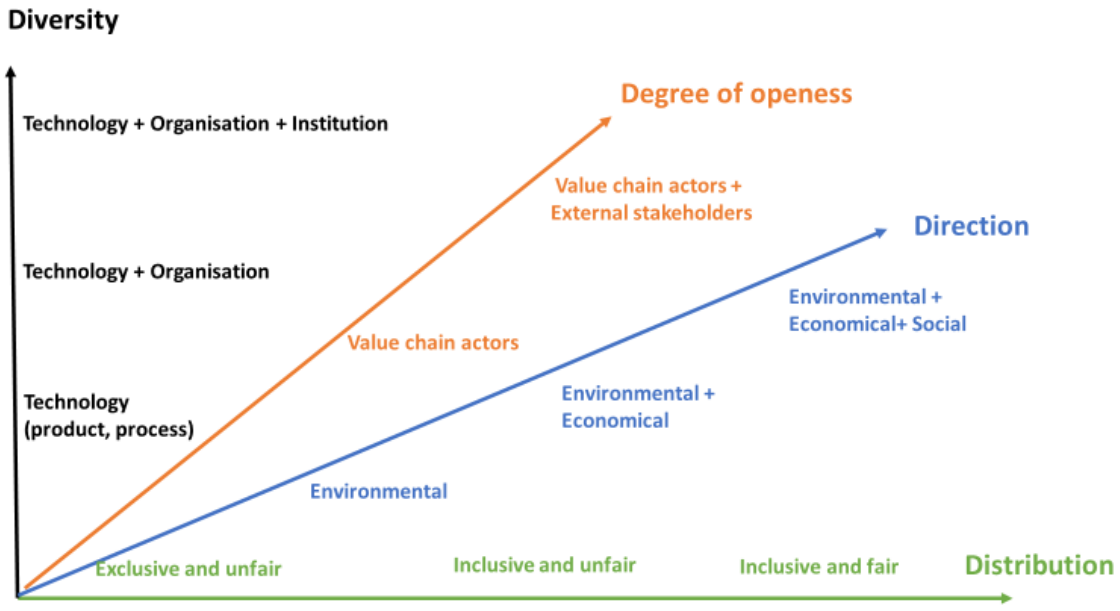

Figure 2. The four dimensions of sustainability-oriented innovation. Source: Authors

3. Collaboration towards sustainability-oriented innovation

Compared to traditional forms of innovation, SOI requires more collaboration both within the value chain and between value chain actors and other stakeholders. First, collaboration can take away some of the inherent uncertainties of SOI and it can reduce the riskiness of SOI, particularly related to acceptance by value chain, market and society actors. Indeed, collaboration between value chain actors and non-conventional actors, including NGOs, consumers and community representatives, can predict otherwise unexpected trade-offs along the value chain and prevent failure in SOI acceptance by consumers and citizens. Second, collaboration enables the adjustments in the configuration of the whole value chain. For SOIs, value chain partners need to make changes in their routines, to invest in new practices and to acquire new knowledge and skills. As such, SOIs are a typical example of co-innovation, because actors at multiple levels are involved and will align their individual activities.

Multiple modes of inter-organizational collaboration can be found in agri-food value chains. The dominant forms of inter-organizational collaboration in the agri-food sector include horizontal, vertical and multi-stakeholder collaboration. We will now discuss how these forms of collaboration contribute to SOI.

Horizontal collaboration is collaboration among similar companies operating in one stage of the value chain. Agricultural cooperatives and producer organisations are classical examples of horizontal collaboration in the agri-food sector. Such cooperatives have been established in order to support the economic and social well-being of the farmer-members, by providing services and goods to the farm and by marketing and processing farm products. Usual motives for farmers to join a cooperative are economic benefits gained from economies of scale, bargaining power, reduced risk, reduced transaction costs, access to inputs and services, and better market information. Also receiving training and technical advice can be an important benefit of membership. Finally, cooperatives may be engaged, on behalf of their members, in lobbying and gaining governmental support.

Cooperatives can support the development and implementation of SOI in several ways. First, they can inform their farmer-members about the economic and technical feasibility of sustainability practices. As part of this information-sharing task, cooperatives can also organize the exchange of experiences among members themselves. Second, they can provide financial support or insurance for their members, thereby reducing the economic risk of new sustainability practices. When farmers experiment with new products and practices, the solidarity principle within cooperatives can be invoked to share risks and costs. Third, cooperatives can build legitimacy and gain public support for the sustainability activities of their members. Fourth, together with their members, cooperatives can develop and market new sustainable products.

Vertical collaboration is collaboration among the sellers and buyers in the value chain. This type of collaboration is oriented at making the value chain more efficient and effective. Common objectives of vertical collaboration are improving product quality, enhancing innovation, and strengthening competitiveness. Vertical collaboration is often organized through bilateral contractual relationships, but also joint venture and strategic alliances can be found in agri-food chains. Production contracts and other forms of vertical collaboration generate shared benefits through mechanisms of risk-sharing, incentive alignment and provision of resources for agricultural production.

Contractualization can support the development and implementation of SOI through the following mechanisms. First, production contracts often provide the farmer with a guaranteed market, thus taking away part of the risk related to applying new sustainable practices. Second, production contracts guarantee a minimum supply of specific products, which allow buyers (for instance processors) to develop sustainability-oriented marketing strategies. Third, production contracts often provide farmers with the inputs and services needed to make the switch towards producing in a more sustainable manner. Providing the necessary

financial services is an important part of the support that buyers can give to their suppliers. Given the innovative and uncertain character of SOI, receiving technical assistance is also of crucial importance for farmers to make the switch. Fourth, production contracts enable frequent interactions between buyer and producers, engaging them in a learning process on new sustainable practices.

Contractual relationship in agri-food value chains are often intermediated by producer organisations. These organisations negotiate on behalf of their members, but also organise the provision of inputs and services on behalf of the buyer company. Thus, it is the combination of horizontal and vertical collaboration that best supports SOI in value chains.

The development of Short food supply chain (SFSC) also rely on both vertical and horizontal collaborations involving consumers and producers. Through direct interaction between groups of producers and groups of consumers, the preferences of the latter for specific sustainability characteristics of food production can be exchanged with producers. Also the absence of intermediary organisations allows farmers to obtain higher prices for their products, which can then be used to cover the additional cost of sustainable practices. SFSCs include community-supported agriculture, consumer buying groups and participatory guarantee systems, which all share a commitment to make food systems more sustainable. SFSCs are important facilitators of SOI.

Multistakeholder collaboration has many different appearances, including public-private partnership, open innovation networks, and ecosystem networks. The main goal of such collaboration is alignment of change. Because solutions for societal challenges require the commitment and investments of multiple actors, the decisions and activities of those actors need to be coordinated. Platforms and networks provide the organisational infrastructure for such coordination. In addition to the basic task of coordination, multistakeholder partnerships can develop and implement transformation projects and can start joint business activities. Often the public partner in such partnership provides (temporary) financial support for the project and business activities.

Multistakeholder partnerships and networks have become more important over the last decades. Acknowledging the complexity of grand societal challenges (or wicked problems), such as the transition towards more sustainable food chains, has led to the realization that solutions will require the coordinated action of multiple actors, including businesses, state agencies and civil society organisations. Multistakeholder partnership can support SOI through their coordination function as well as by being a channel for governmental financial support. Information exchange and building commitment among the partners are important functions of those platforms in support of the transition towards sustainable food systems. Also generating and applying ideas of joint innovation can be a function of multistakeholder platforms. In sum, multistakeholder partnerships are networks of alignment, repositories of shared knowledge, distributors of state (financial) support and initiators of joint innovations.

Digitalization is a transversal trend across all type of collaboration. The literature indicates that digitization will have substantial indirect positive effect on SOI, because it has a large effect on inter-organizational collaboration in agri-food chains.[2] Digitization affects collaboration modes in several ways. First, it will facilitate information exchange and knowledge sharing, particularly for codified knowledge, by overcoming physical constraints such as paper procedures and geographical distance. Second, digitization will improve transparency and reliability, thereby reducing transaction costs derived from the risk of opportunistic behaviour. Techniques like blockchain will reduce the need to take precautionary measures. Third, digitization greatly increases the speed and scope of data collection, data processing and data sharing. All of these effects support different types of collaboration, including collaboration for SOI.

[2] Digitalization also has several downsides such as increasing the risk of monopoly power (due to the 'winner-takes-it-all' effect) and the risk of exclusion of small-scale and computer-illiterate producers.

4. Public policies in support of sustainable innovation

Within Task 1.1., a preliminary review has been carried out on actual and potential impact of public policies on the development and implementation of SOI. Public policies play an important role because they determine the boundaries for current behaviour, but they also enable or constrain future behaviour. As such, policies give direction for actors in the development of SOI. Research on public policy impact may focus on the objectives of the policies, on the instruments of policies (financial, normative and informative), on the geographical scope of the policies, or on the specific dimension of sustainability.

While an abundant literature exists on the impact of public policies on sustainable agriculture as well as on innovation processes and outcomes, literature specifically targeting policy effects on SOI in agri-food chains is scarce. Perhaps the combination of sustainability and innovation is too new to have already attracted a lot of scholarly attention.

One of the main policy fields relevant for SOI in agri-food is the Common Agricultural Policy (CAP) of the European Union. Most of the research on the impact of the CAP has focussed on its financial instruments. By providing financial support to farmers under the condition that they reduce the environmental impact of their farming activities and/or improve the biodiversity on their farms, the CAP has a direct positive impact on SOI in the agri-food sector. Also policies that seek to reduce environmental pollution, for instance by regulating the use of crop protection agents, have a positive impact on the development and implementation of sustainability-enhancing technologies. Such policies force farmers and their suppliers to continuously improve the sustainability of farming practices. Finally, also policies promoting innovation and technical extension in the agri-food sector affect SOI by providing guidance and financial support for the development and implementation of new technologies.

As indicated above, research on the impact of public policies on SOI in agri-food chains is still rare. In general, research has focussed on selected parts of the value chain – mostly primary production – and has focussed on only one of the dimensions of sustainability, usually the environmental dimension. Most of the literature has focussed on crop-specific or geographical case studies. A more comprehensive review of public policies will be carried out in CO-FRESH Task 1.5.

5. Factors that positively affect SOI in agri-food chains.

The literature review identified a number of factors that have a positive influence on the development and implementation of SOI. We present these conclusions in the form of recommendations to actors involved in SOI in agri-food value chains. The recommendations are clustered in three categories: relational, structural and strategic.

Relational factors are about the (social) interactions between actors involved in the value chains and in the innovation processes. Structural factors are about structuring the agri-food chain and structuring of the innovation processes. Strategic factors are about the goals that the actors in the value chain pursue, individually and jointly, as well as the translation of these goals into managerial decisions.

Relationships factors:

1) Activate community-based activities and social exchange

Community-based activities along and across agri-food value chains support interaction among actors, support information exchange and support the building of a common sustainability vision.

2) Facilitate trust by lubricating communications

Successful collaboration among value chain partners include repetitive sequences formal bargaining and informal sense making. These processes shape joint expectations, familiarity and trust, commitment to actions, and an assessment of how the relationship is advancing. For example, direct communication between producers and consumers in SFSCs allows the building of trust as well as the development of joint sustainability goals.

3) Seek alignment of expectations, motivations and goals

Alignment of goals and expectations improves the chances of collaboration in joint projects and joint ventures. Frequent communication strengthens the understanding of preferences and constraints, which allows value chain actors to find common values and joint interests.

4) Enhance relationships between complementary stakeholders

Relationships should be enhanced between stakeholders that have complementary activities and knowledge.

Structural factors:

5) Enable traceability

Digitalization and smart ICT such as blockchain can be used to organize and implement traceability in the value chain and thereby support the development of SOI.

6) Enable inclusive data infrastructure

Develop a collaborative platform for sharing and pooling agricultural data, including both private and public data. This platform could organise the production, processing, storing and use of data on the basis of fairness principles, implement and monitor commonly agreed policies of data use, and reduce the administrative burden for the actors in the value chain.

7) Acknowledge the need for co-creation of different types of innovation

As SOI is a combination of technological and organizational/institutional innovation, acknowledging the interdependence among innovation types supports not only the development SOI, but also its implementation in value chains.

8) Use consistently sustainability indicators across the whole value chain

Consistent and unified use of sustainability standards developed by international organizations facilitates SOI. In addition, participatory approaches could be practiced as a new way of assessing sustainability by empowering farmers and local actors. Sustainability assessments should be undertaken already in the first stages of the new product development process.

Strategic factors

9) Embed sustainability in strategy and culture within the full value chain

Environmental, economic and social sustainability considerations should be evaluated across the entire value chain of a food product. The focus should not only be on agriculture, despite it being the most significant contributor to the negative environmental impact of food production.

10) Align incentives and enable shared benefits

Value chains actors should work out a common plan for sustainability objectives and seek innovations to turn these plans into realities. All actors in the value chains need to think about how their individual strategies are aligned with the (sustainability) strategies of their chain partners, and whether this alignment needs to be enhanced.

11) Reduce unequal power distribution within the value chain

Choose a governance structure (i.e., the rules that frame the transaction between value chain actors) that enables the fair distribution of value among the actors in the agri-food chain. Strengthening bargaining power of those in a disadvantaged position may enhance the fair distribution.

12) Enable win-win contractual agreements that integrate sustainability dimensions

For bilateral agreements, parties have to explore each other's interests in sustainability dimensions, and seek a mutually acceptable outcomes. Contractual arrangements often include a limited set of provisions, including price (or price setting), quality, quantity and delivery conditions. Sustainability indicators could be included in the contracts, in order to facilitate and promote SOI.

13) Create synergy between vertical contractual arrangements and other collaboration modes

When contractual arrangements in the value chain, such as between farmers and processors, are embedded in broader partnership for sustainability, such as multistakeholder platforms, there is a higher chance of including sustainability objectives the contract.

14) Develop competences for all value chain actors to successfully transform their routines, to invest in new practices and to acquire new knowledge and skills

Education and developing employees' competences result in flexibility and competitive advantage. Actors with commitment to implement a competence-oriented strategy will embrace learning, facilitate change acceptance and transform their organizations into learning organizations.

15) Activate farmer entrepreneurship

Facilitate capacity building, structured ways of learning-by-doing, and agricultural extension focused on entrepreneurial knowledge and skills, by means of formal and informal training programs.

16) Integrate and complement financial and normative policy instruments.

For policy makers, our recommendation is to better align normative and informative policy instruments with financial instruments, in order to have a comprehensive set of policy instruments to promote SOI.