Framing the transition towards sustainable agri-food supply chains

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Abstract. The connection of the agri-food sector with the agenda of sustainable development comes naturally, as the chain from production to processing, trading, distribution and consumption is directly connected with significant issues in environmental, economic, and social realms. Today’s challenge for businesses is not whether to embrace sustainability, but rather how to effectively establish sustainable supply chains. Therefore, a solid grasp of the move from “conventional” to “sustainable” supply chains is necessary. In this paper, we focus on the supply chain management of the agri-food sector, seeking to shed light on practices which may contribute to the transition of the sector towards sustainability. In this vein, we extend the conceptual framework which was proposed by Beske and Seuring (2014) so that it accommodates the contemporary particularities of agri-food supply chains.

1. Introduction

Supply chain management (SCM) connects various activities, operations and business partners aiming at the efficient managing of flows of materials and information. The supply chain (SC) is usually understood as a network of actors at various production and service sites [1] and includes all people, organizations, equipment, activities, and technology involved in the development and distribution of a product or service. Transforming SCs towards sustainability is a popular and growing topic in research, policymaking, and management, and great research prospects remain untapped [2].

The planning and decision-making which combines all sustainability pillars is known as sustainable supply chain management (SSCM). To achieve long-term development, it is necessary to address the three dimensions at once and to remove the obstacles in each of them. While the environmental dimension has always gotten the most emphasis, the social and economic dimensions have been overlooked while playing a focal role in sustainability’s success [3]. Modern global rivalry no longer puts individual firms against one another, but rather pits a company’s SCs against those of its competitors. SC organizations must be acutely aware of stakeholders’ expectations, which are increasingly focused on sustainable practices, in order to remain competitive [4–7]. Apart from financial performance, companies are increasingly being held accountable for the environmental and social consequences of not just their own activities, but also their whole SCs, which may include

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second, third, or higher tier suppliers [8]. As a result, an integrated approach to SCM, from raw material extraction to product recycling, demands the creation and nurturing of relational capacities across SC partners [9].

In this paper we study the transition towards sustainable agri-food SCs. In section 2 the main traits of agri-food SCs are discussed. In section 3 we provide a short overview of theoretical frameworks for sustainable SCs, which have been proposed in the literature, with special respect to the approach of Beske and Seuring [10]. In section 4 we present an extended version of the afore-mentioned framework taking into consideration the contemporary particularities of agri-food SCs and we come to an end with some concluding remarks in section 5.

2. The case of agri-food supply chains
Agriculture is one of the most significant industries supporting the livelihoods of a large part of the world’s population. Agricultural output has risen in importance since recent projections predict that the world’s population will exceed 9 billion by 2050. This fact combined with the changing dietary patterns increase the need for sustainable and coordinated agri-food networks [11]. Agri-food SCs are a series of interconnected activities in the agricultural production of food, which include all phases of production, processing, trade, distribution, and consumption, and their capacity to retain agri-food quality, minimize environmental degradation, and satisfy consumer needs is a vital priority. At the same time, agri-food SCs are exposed to a variety of vulnerabilities and hazards due to their complex structure, including breakdowns, operational issues, credit loss, and economic losses [12].

Seasonality in production, long/fixed production lead times, variable quantity/quality requirements of product, trade, buffer stock restriction, and traceability are core characteristics of the agri-food SC. In addition, unpredictable weather, perishable commodities, rigorous food safety regulations, rapidly changing lifestyles, and multi-stakeholder interest are all defining elements for the agri-food sector [13–16]. Moreover, the agri-food SC networks have become increasingly complicated as a result of a significant increase in food standards requirements, growing industrialization, and the creation of customer and governmental food safety concerns [17].

Companies have been working over the last few years to create comprehensive, sustainable methods to managing their agri-food SCs. These approaches examine sustainability concerns not only at the level of the company’s operations, but at all levels of the SC’s activities. Furthermore, conventional local chains have given way to national and, in some cases, multinational chains [18].

3. Sustainable supply chains: mapping the transition

3.1. An overview of theoretical frameworks
Over the years, a growing number of theoretical frameworks have been introduced to study and facilitate the transition of conventional SCs towards sustainability. While the triple bottom line (TBL) has served as a source of inspiration for the corresponding scholars [18], the individual approaches have focused on various traits of SCs, and there is no wide consensus as to which aspects should be included. For instance, Azevedo et al. [19] who provide a methodology for evaluating the long-term sustainability of individual businesses and their upstream SCs, recommend that the linear aggregation approach be used to integrate a collection of indicators from the economic, environmental, and social dimensions of sustainability into a single value, resulting in a composite index for the firm and its SC. In another framework presented by Chen and Kitsis [4] one may find a path for companies which seek to develop and nurture relational capabilities while dealing with increasing stakeholder pressures. Moral reasons enhance and deepen top management commitment, which can aid in the proactive development of relational competencies by channeling stakeholder demands.

In another vein, and based on the Total Interpretive Structural Modeling approach, a theoretical framework was proposed to describe the complex interactions of variables in the dynamic context of SSCM [20]. Through a whole systems perspective, the sustainable SC theoretical framework aids in
describing the dynamic interactions of product design, enabling technology, and environmental conservation strategy to achieve greater brand equity, cost savings, and competitiveness.

A process-oriented approach to SSCM was introduced and 17 sustainable SC processes from the literature were outlined [21]. Furthermore, utilizing the theoretical lenses of stakeholder theory and resource-based view, a framework was proposed to identify the significance of various sustainable SC processes on firm performance.

Svensson et al. [22] explore how organizations across various industries consider external stakeholders in upstream and downstream SCs, the marketplace, and society in their business sustainability initiatives. The stakeholder research approach was put to the test using a typology of 24 different types of stakeholders from industries in Norway and Spain, providing empirical evidence and proof of stakeholder theory in relation to business sustainability across a wide range of companies.

The creation of a robust governance framework to lead the entire SC in working together in a volatile and uncertain environment was analyzed by Wang and Ran [23]. They suggest a sustainable collaborative governance framework with a classification scheme documenting the evolution of a SC in different stages of sustainable development: disorderly development, contractual integration, bilateral integration, and holistic integration. This framework lays out a path for a SC to transition from an unsustainable to a sustainable state that is positively linked to its performance and competitiveness, and it will enable the entire SC to respond proactively and resiliently to uncertainties or perturbations without causing significant disruptions to businesses’ normal operations.

17 constructs for SSCM were derived from the literature and used as components of the framework for SSCM [2]. Further breakthroughs in SSCM theory can be made by analyzing relationships between existing constructs using the abductive reasoning approach. By connecting identified SCM characteristics and SSCM constructs, a more comprehensive SSCM frame of reference may be created. The SC, TBL, SCM decisions, and the associated consequences on sustainability performance and risk are all included in the reference frame.

According to Zimon et al. [7], organizations may take diverse strategic solutions to sustainability depending on their strategic priorities and available resources, resulting in a distinct strategic SSCM model. Based on prior literature on SSCM, they suggested a paradigm for implementation that includes three broad strategic responses (reactive, cooperative, and dynamic), which represent companies’ business priorities and underlying strategic mindsets.

Roy et al. [6] underline that the transition to SSCM is marked by a non-linear path, owing to the never-ending interplay between organizational SSCM initiatives and organizational complexity in facilitating radical changes. Therefore, any SSCM practice cannot be immediately or easily assimilated into organizational SC routines. Furthermore, any deployed SSCM technique faces the risk of rollback, which means that the specific approach will lose its place in organizational SC routines. As a result, the move from traditional to sustainable SCs is an unending journey requiring several initiatives. A new notion for SSCM, namely force-field, was developed to characterize this everlasting journey. Moreover, the innovative idea of differential efforts in SSCM is introduced for defining the central nature of organizational efforts required to guide the progressive SSCM journey.

Santos et al. [24] suggest a theoretical model, which was the result of extensive literature research, that tries to address the shortcomings noted in prior sustainability maturity models. For this, four dimensions (environmental, social, economic, and transversal) and five stages of maturity (nonexistent, conscious, intermediate, advanced, and sustainable) were proposed, seeking to bring the model closer to the TBL concept while also adding one more element. The transversal dimension gives the organization a holistic view that is interwoven with the other dimensions.

Norris et al. [25] noted that despite the fact that sustainability issues are recognized as important in SCs, this relational view of the focal organization and its direct stakeholders has not been extended to value creation for and with indirect stakeholders, such as suppliers’ stakeholders. Then they bridge this gap by incorporating a relational view of SSCM into the management of sustainable business models, which broadens the scope of sustainable business models beyond direct stakeholder ties to include indirect stakeholder interactions with suppliers.
3.2. The framework of Beske and Seuring

Beske and Seuring [10] in an influential and highly cited paper provide a generic approach to instill sustainability considerations into SCM. The contribution of their work is twofold: first, they review the literature, and identify five key categories of SSCM, and consequently, they present specific practices which may help an organization to succeed in each of the following categories (see Table 1).

- the orientation, which focuses on the support of the top-management in the transition of SC towards sustainability.
- the continuity, which concentrates on how the individual members of a SC work together.
- the collaboration, where one may find practices which enhance partnership and teamwork in the vein of a sustainable SC.
- the risk management, as adherents of SSCM are more vulnerable to risks, comparing to participants in conventional SCs.
- the proactivity, considering that individual firms which lead the way towards sustainability are expected to be more proactive.

Table 1. SSCM categories and corresponding practices [10].

| Categories       | Practices                                                                 |
|------------------|---------------------------------------------------------------------------|
| Orientation      | Dedication to the TBL; Dedication to SCM                                  |
| Continuity       | SC partner development; Long-term relationships; SC partner selection     |
| Collaboration    | Enhanced communication; Logistical integration; Technological integration; Joint development |
| Risk Management  | Standards and certification; Selective monitoring; Pressure groups       |
| Pro-Activity     | Learning; Stakeholder management; Innovation; Life-cycle assessment       |

In a recent article, Silva et al. [26] used their empirical research to extend the Beske and Seuring’s [10] framework by altering their categories (including levels and factors) and adding other characteristics of complexity. In addition, they consider orientation elements (strategic level), integration factors (structural level), collaboration, and stakeholder management factors (process level) in addition to contextual factors (institutional and cultural). The incorporation of a multi-level viewpoint (strategic, structural, process, and contextual levels) improves the understanding of the complexity surrounding SC practice and helps to bridge the gap between theory and practice.

4. Extending the framework of Beske and Seuring

4.1. Methodology

Based on a critical analysis of the state-of-the-art in the topic area and on literature-based conceptual reasoning we explored potential extensions of the framework of Beske and Seuring [10] in the case of agri-food SCs. In this vein, the Scopus database was queried to gather research papers in English that deal with agri-food SCs focusing on sustainability. The query led us to 83 papers (final export date: 01 July 2021), based on the following search query: (TITLE ("agri-food" OR "agrifood" OR "agro-food" OR "agrofood") AND TITLE ("supply chain") AND TITLE-ABS-KEY (sustainability) OR TITLE-ABS-KEY (sustainable) AND (EXCLUDE (DOCTYPE,"ed"))). Overall, we draw on these publications, and we provide answers in the following research questions: Can we extend the conceptual framework introduced by Beske and Seuring so that it incorporates the unique characteristics of agri-food SCs?
4.2. Findings

It was not a surprise for us to note that all the constructs of the framework of Beske and Seuring [10] were explicitly or implicitly addressed in the 83 papers, depending on the authors’ primary objectives. Our objectives do not include the extensive recording and documentation of this fact. Our aim is to identify additional constructs which are relevant and useful for the transition of agri-food SCs towards sustainability. These additional constructs are presented in Table 2 and are documented in the sequel.

Table 2. Extension of the framework of Beske and Seuring.

| Categories     | Additional practices                  |
|----------------|---------------------------------------|
| Orientation    | Focal organization leadership; Circularity |
| Continuity     | Re-engineering; Fairness               |
| Collaboration  | Co-operatives                          |
| Risk Management| High-risk events                       |
| Pro-Activity   | Resilience                             |

- **Focal organization leadership** – Because they drive and regulate the SC, the success of focal organizations in supporting sustainable SCs is critical. A comprehensive approach to analyzing focal organizations’ SSCM practices and stakeholders’ expectations will aid in understanding the choice and possible effects of SSCM methods [27,28].

- **Circularity** – Food waste is a major sustainability challenge for food systems and a pressing issue from an economic, environmental, and social standpoint. The food waste hierarchy and food waste valorization which are positioned within the circular economy concept, can open up many activities. In this regard, academics advise focusing on measures that can avoid the production of surplus food while also conserving a greater portion of the sustainable value. Needless to say, technology plays a critical part in the corresponding pre-harvest and post-harvest techniques [29–31].

- **Re-engineering** – Organizational changes, such as restructuring and process improvement, are referred to as re-engineering. It is about the fundamental rethinking and restructuring of business processes in order to produce substantial improvements in operations and performance [32]. Re-engineering in the agri-food sector is driven by various situations and facts such as climate change, organic farming, advances in technology and multi-stakeholder partnerships [33–35].

- **Fairness** – Fair trade is an important part of agri-food sustainability. Fairness in agri-food SCs is critical for reaping the benefits of trade liberalization, particularly in emerging nations’ rural areas. It makes agri-food services such as organic training and premium marketplaces more accessible [36,37].

- **Co-operatives** – A co-operative is a self-governing group of people that band together to obtain economies of scale and compete with major businesses in the marketplace. Farmers that join agricultural cooperatives have access to supplies and markets that would otherwise be unavailable to them [38–40].

- **High-risk events** – Agri-food SCs are extremely sensitive to high-risk events such as pandemics, which have severe economic and social consequences for the most vulnerable [41,42]. Recently, during the early phases of the COVID-19 pandemic, agri-food SCs were shown to be vulnerable.

- **Resilience** – In view of increased volatility generated by issues as diverse as climate change, population expansion, high-risk events, and resource limits, national and global food system resilience is becoming an increasingly relevant topic. Despite a growing interest in the concept of resilience from a variety of research fields, a number of factors, such as the priority placed on food security over economic competitiveness, as well as the unique characteristics of food
as a biological resource, mean that these works are not easily adopted by agri-food SCs [42,43].

In addition, the literature review demonstrated that in the agri-food SC, new information and communication technology (ICT) plays a critical role towards sustainability [29,44–50]. Blockchain, the Internet of Things, wireless sensor networks, cloud computing, and machine learning can all help to improve the agri-food SCs’ sustainability. In particular, blockchain technology can make SCs more transparent and enable the production of high-quality food with minimal social and environmental consequences. Furthermore, it can help customers make better buying judgments. Because it allows for remote management of the location and conditions of shipments and products, the Internet of Things might play a key role in resolving logistical issues. One may argue, that is not easy to accommodate ICT within any of the categories presented in Table 2. Therefore, our suggestion is to regard it as a cross-category construct.

5. Concluding remarks
The transition towards a sustainable paradigm in agri-food SCs is a complex and complicated process. The situation thickens as the pressures form the external environment are intensified: environmental issues call for immediate and effective actions, the regulatory framework becomes more demanding, SC partners raise various claims, and societies demand safe and sufficient agri-food products. Competition takes places at a SC level, and it is crucial to include sustainability considerations in all agri-food SC activities, ‘from farm to fork’. This will allow stakeholders to collaborate to address common issues.

In this paper, an extension of the seminal framework of Beske and Seuring [10] was pursued based on evidence from the literature. The unique characteristics of agri-food SCs provide fertile soil for such an attempt. As for directions for future research, empirical studies are necessary to test the elements of the extended theoretical framework.

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