Sustainability risk management in the agri-food supply chain: literature review

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Abstract. Maintaining an effective risk management procedure can counterbalance a critical effect on supply chains. The Agri-food supply chain has characteristics that are unique and complex if compared with a conventional supply chain. Sustainability risk management in the supply chain is the key to a competitive organisation in the long term. The aim of this paper is to review current research on sustainable risk management in the Agri-food industry chain. These reviews were arranged in steps systematically, ranging from searching related to review of supply chain sustainability risk management (SCSRM), reviewing the general framework of SCSRM and the framework of Agri-food SCSRM. Selection of literature review papers in the period 2010-2019, and obtained 30 papers. Risk aspects were analysed using a multi-dimensional approach (economic, social, environmental, technical, and institutional) that influences the sustainability of the Agri-food industry. The results show that there are few studies focusing on risk management to achieve a sustainable supply chain system. Some studies only focus on Triple Bottom Line elements (economic, social, and environmental). Sometimes, these studies do not consider risks from other elements such as technical and institutional aspects that can be influence the sustainability of the Agri-food industry. Technical aspects such as the reliability of technological systems and institutional aspects as policymakers support sustainability in a business process. The contribution of this paper is to provide an initial theoretical framework to guide researchers in analysing risk through a multi-dimensional approach to sustainability.

1. Introduction

Agri-Food supply chain is characterised with its complexity such as the seasonality in production, long/fixed production lead times, varying quantity and quality standards of product, trade, buffer stock restriction and traceability [1, 2]. A typical of Agri-food supply chain may consist of a number of entities linked from “a farm to fork”, such as farmers, input suppliers, co-operatives, pack houses, transporters, exporters, importers, wholesalers, retailers, and finally consumer [3]. All actors of the supply chain (from supplier to customers, from employees to top management) are involved in risk management activities [4]. In the paper, we focus on the Agri-food industry as among the most challenging and interesting in sustainability terms. The Agri-food industry has a significant economic impact; in the European Union in 2011, it realised a turnover of 956 billion Euro, involving 274,000 firms and creating direct employment for more than four million people [5]. Nowadays, farming approaches have been depleting the Earth's resources and contributing significantly to greenhouse gas emissions, to soil fertility and biodiversity loss, to water scarcity, and to the release of large amounts of nutrients and other pollutants that affect ecosystem quality [6]. If nothing changes in the way we produce and consume food, and in light of the need to increase food production by more than 60% by 2050 [7], the environmental impacts associated with food production systems will become even more severe and will increasingly surpass the planetary boundaries [8].

Sustainable supply chain management (SSCM) has become one of the main means for the company because it is considered capable of managing supply chain risk to fulfil triple bottom line (social,
economic, and environmental). SSCM becoming increasingly relevant for business managers and stakeholders [9]. Unilever implemented one project named “The Unilever Sustainable Living Plan” in 2010 which had improved the health conditions of nearly one billion people. It reduced the impact on environment and achieved purchasing 100% agriculturally sustainable raw materials and packages [10]. Moreover, the “1+3” supply chain responsibility management project of BASF conveys firm social responsibility throughout supply chain, and help its partners with best examples, expertise, and tailored solutions [11]. Based on the research on large number of firms, sustainable supply chain development not only cut the cost and enhance risk management level, but also explore new income source and increase brand value [12].

This paper aimed to review current research on sustainable risk management in the Agri-food industry supply chain. We adopt a risk management perspective to sustainability, by taking into account the risk through a multi-dimensional approach (economic, social, environmental, technical, and institutional). The results of identification are written in a framework model sustainability risk management for Agri-food supply chain. This model is built based on the result of literature review from several studies related to supply chain risk management and sustainable supply chain management.

2. Methods
In this paper, a systematic review is adopted as the main methodology to survey and analyse the recent literature. A systematic review is a structured and comprehensive approach to capture and select relevant theoretical perspectives and practices in the foremost literature in the field [13]. A literature survey has been undertaken of quantitative and qualitative empirical studies published in several leading journal international such as journal of cleaner production, journal of logistic management, journal of logistics management and others journal. Journal publications within the scope of the review have been located and extracted through the utilization of aggregator database including Scopus, and in publisher database including Elsevier, Emerald Insight, Taylor & Francis, Springer. Paper traced by using a few keywords such “agri-food supply chain risk”, “sustainability risk management”, “supply chain management”, “supply chain sustainability”, “sustainable supply chain management”, “SSCM”, “SCRM” and “SCM”. Publication were analysed for the period between 2010 and 2019. However, after screening on the abstracts and reading through the contents of these articles, only 30 articles are admitted as the final samples for the further review and analysis. The distribution of the sample articles by their publication sources is presented in Table 1.

| Journal title                                         | Articles (n=30) | Percentage (%) |
|-------------------------------------------------------|-----------------|----------------|
| Journal of cleaner production                          | 8               | 27             |
| Computers & industrial engineering                     | 1               | 3              |
| Journal production planning & control                 | 1               | 3              |
| Information processing in agriculture                 | 1               | 3              |
| Journal of logistics research                          | 2               | 7              |
| Management decision                                   | 1               | 3              |
| Omega: Journal of management science                   | 1               | 3              |
| Journal production economics                           | 1               | 3              |
| Journal of production research                         | 3               | 10             |
| Journal of purchasing & supply management              | 1               | 3              |
| Journal of engineering and technological sciences      | 1               | 3              |
| Journal of service science and management              | 1               | 3              |
| Journal sustainability                                | 1               | 3              |
| Journal productivity and performance management        | 1               | 3              |
| Management of environmental quality                    | 1               | 3              |
| IOP Conf. Series; Earth and environmental science      | 2               | 7              |
| International journal of technology                    | 1               | 3              |
| Business strategy and the environment                  | 1               | 3              |
| Int. J. of physical distribution & log management      | 1               | 3              |
| **Total**                                             | **30**          | **100**        |
3. Results and Discussion

3.1 Integrated risk management and sustainable supply chain management

Proper and best system recognition, understanding the related risks and do what turns out, can be the best approach to manage these risks [14]. Sustainability risks are risks which threaten the sustainable development of a business by having long-term economic, social, and environmental effect. Risk management is essential to sustainable development and any failure in managing these threats may threaten the sustainable development process [15].

Understanding supply chain sustainability risk can help companies improve the resilience of supply chain [9]. In particular, supply chain sustainability risk management, as a component of sustainable supply chain management, extends the scope of supply chain risk management by incorporating supply chain risk factors related to social and environmental aspects of sustainability.

Transformation of the conventional SCM into SSCM generates tremendous pressure on firms to bring changes to their existing SC in order to meet the current sustainability needs [21]. SSCM is gradually becoming a strategic requirement for companies [16]. Different sources of risk factors may appear in SSCM due to its complex nature. As opposed to the traditional supply chain management, which generally focuses on the economic and financial business performance, SSCM is defined as the explicit integration of the environmental and social objectives into economic development [17]. Supply chain sustainability is increasingly known as an important source for reducing costs and increasing the profitability of the organisation in the long run [18]. Supply chain sustainability risk management is important because the idea of sustainable development and risk management and understanding of the necessity of protecting the supply chain sustainability and treating the threats to the supply chain. The supply chain risk management (SCRM) is not solely aimed at saving costs, because it can increase the sustainability of the supply chain by creating value [19].

3.2 Five dimensional approach to sustainability

In most studies [15, 19], the sustainable development is with respect to the environmental, economic, and social dimensions. However, the sustainable development in the business area includes other dimensions such as technical and institutional dimensions [15]. Supply chain risks are classified into two main categories, namely endogenous risks that are caused by company activities along their supply chain and exogenous risks that are brought about to companies by their interactions with the external environment they operate [19]. Possible risks sustainability associated with these five main Agri-food industry categories are given in Table 2.

Regarding the environmental dimension, the risk guiding principle is to satisfy the requirements towards the quality of a shared ecosystem [19]. Environmental resilience is assessed by evaluating the negative impact of the system on the environment [15]. One of the criteria for evaluating a system is the amount of pollution and its environmental effects [15, 26]. Pollution prevention and product stewardship provide competitive advantage to the firm through reduced emissions and minimizing the life-cycle cost of the product, sustainable development is aimed at a future position of advantage by meeting unmet demand of the needy.

The social dimension refers to the benefits of the system for the community. In fact, measuring social acceptance and public access to the system. The social dimension of sustainability is one of the most important aspects in SSCM as organisations involve multiple stakeholders with varying goals, objectives, and perspectives and managing this variation poses a challenge [21]. The economic dimension considers whether investments are economically feasible to encourage reinvestment because of sustainability. In fact, evaluating that the system is affordable for people to consume it. The technical dimension shows the ability of the system to meet current and future community requirements. This assesses the structure of the system, its infrastructure and inputs and outputs. And the institutional dimension shows the level of local participation in system control and management and describes local skills, local regulations, national development plans, and the level of protection of investors and consumers. This dimension evaluates political decisions about the structure of the future of a system.
| Dimension of sustainability | Risk factor categories Endogenous | Risk factor categories Exogenous |
|-----------------------------|----------------------------------|---------------------------------|
| Economic                    | Bribery; False claims; Price fixing accusations [16, 34]; Antitrust claims; Patent infringements; Tax evasion [19]; Uncertain financial support [1, 20]; Cash flow development; Payment behavior [20]; | Boycotts; Energy prices volatility [33, 34]; Financial crises [21]; Currency fluctuations [16, 22, 34]; Disloyalty of customer, Market share reduction [16, 34]; Reputation loss or brand damage [16]; Natural disasters (e.g. floods, earthquakes) [16, 23, 24, 25]; Water scarcity, Extreme weather (flooding, wind, drought) [1]; Poor workshop production environment [24]; Common work conflicts [25]. |
| Environmental               | Accidents (e.g. fires, explosions), Pollution (water, soil, air) [16, 26, 27]; Non-compliance with sustainability laws, Emission of greenhouse gases, ozone depletion [20, 22, 29]; Unproductive use of energy [29]; Excessive or unnecessary packaging [21]; Product waste [16, 21]; | Social instability; Demographic challenges/ageing population; Urbanization rate; Unemployment rate; Crime index [22]. |
| Social                      | Excessive working time, work-life imbalance; Unfair wages; Child labour/forced labour [16, 29]; Discrimination (race, sex, religion, disability, age, political views); Exploitative hiring policies (lack of contract, insurance), Unsafe behaviour [2, 27]; Failure to fulfil social commitment; Violation of business ethics (e.g. corruption) [16]. | |
| Institutional               | Anti-privatization approach and regulation [34]; Difficulty accessing the market, Lack of relationships between actors in the supply chain [36]. | Government regulation [16,21], [22,33]; Political changes [2,20,22]; Policy changes [2]. |
| Technical                   | **Operational:** Delivery delay [33]; Poor management decisions in asset allocation; Poor quality control; Forecast and planning errors [1]; Process risk; Corporate level risk [9]; Raw material risk [24]; Low ability to launch product [34]. **Staff risk factor:** Inefficient management [15]; Lack of strategic management system [1, 2]; Lack of sustainable knowledge [2, 16]; Error in operation; Physical and mental deficiency; Violation of discipline [24, 28]; Omission of checking or testing [35]. **Equipment:** Low quality of infrastructures [2, 17]; Equipment failure [33, 35]; Improper equipment selection; Improper equipment management [21]. | **Operational:** Demand uncertainty [2,16,20,24,30]; Supply uncertainty [2,16]; Lower responsiveness performance; Coordination complexity/effort [16]; Poor interrelationships between supply chain parters [25]; Scarcity [33,34]. **Staff risk factor:** Low level of information availability [24]. |
3.3 Framework model supply chain sustainability risk management for Agri-food industries

Sustainability related risks may be relatively easy to identify, but the assessment of their impact on company performance is a more complex process, because it is not easy to assign monetary values to human resources, with long-term effects on the environment and for the company's reputation [29]. A typical supply chain risk response strategy aims to reduce supply chain complexity and grace time, minimise costs, increase responsiveness, and optimise operational efficiency. The risk response strategy that can be done on each actor can be done through a supply chain redesign. The redesign of the supply chain the author illustrates in Figure 1.

![Supply chain redesign](image)

**Figure 1.** Framework supply chain sustainability risk management (designed by author)

SSCM is defined as the management of material, information and capital flows and cooperation among companies in the supply chain while taking the objectives of the three dimensions of sustainable development (environmental, social and economic) into accounts that comes from the requirements of customers and stakeholders [17]. Several studies show that the sustainability of the Agri-food industry supply chain is influenced by five dimensions [30, 31, 32]. Therefore, it is necessary to carry out sustainable risk management by implementing sustainable supply chain management practices.

4. Conclusions

Supply chain sustainability risk management extends the scope of supply chain risk management by incorporating supply chain risk factors related to social and environmental aspects of sustainability. Potential risks caused in the Agri-food industry are classified into two categories, namely endogenous and exogenous. Based on the identification of sustainable risks, it turns out that supply chain risks faced come from five dimensions, namely economic, social, environmental, technical, and institutional. Supply chain sustainability risk management is important because the idea of sustainable development and risk management and understanding of the necessity of protecting the supply chain sustainability and treating the threats to the supply chain. Suggestions for further research are the sustainability of Agri-food supply chains need to consider five aspects of sustainability in risk assessment so that risks can be assessed most influential for dimensions of sustainability.

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