Identifying research advancements in supply chain risk management for Agri-food Industries: Literature review

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Abstract. Agri-food supply chain has different characteristics related to the raw materials it uses. Food supply chain has a high risk of damage, thus drawing a lot of attention from researchers in supply chain management. This research aimed to investigate the development of supply chain risk management research on agri-food industries. These reviews were arranged in steps systematically, ranging from searching related to the review of SCRM paper, reviewing the general framework of SCRM and the framework of agri-food SCRM. Selection of literature review papers in the period 2005-2017, and obtained 45 papers. The results of the identification research were illustrated in a supply chain risk management framework model. This provided insight toward future research directions and needs.

Keywords: supply chain risk management, literature review, framework model, agri-food

1. Introduction

Logistic and supply chain management play a crucial role in food industries. Supply chain in food industries related with safety, healthy and nutritious begin from primary production to final preparation and consumption [1]. Refer to [2], the assessment of food supply chain was integrated between quality, safety, sustainability and logistic efficiency. In the context of work carried out by United Nations agencies and international organizations, “food safety is the assurance that food will not cause harm to the customer when it is prepared and/or eaten according to its intended use [3].

Supply chain risk management refers to risk management with a focus on the supply chain and its risk, which have an impact on the company [4]. 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 costumer [5]. All actors of the supply chain (from supplier to customers, from employees to top management) are involved in risk management activities [4]. Supply chain activities include procurement, inventory management, product design and new product development, manufacturing (planning), order processing, transport (distribution), sales, demand management, customer service [5].

According to [6] defined risk management as an effort to reduce the risk and minimize the loss due to risk uncertainty. [7] in his research states that the implementation of supply chain risk management can increase the amount and quality of knowledge and can reduce the chances of risk and risk impact. According to [8] there is a strong influence of the implementation of supply chain risk management on the improvement of sustainable process in supply chain. While [4] in their research explain that it requires a thorough and comprehensive analysis to explore supply chain risk management.
This research aimed to identify advancements in supply chain risk management for agri-food industries. The results of identification are written in a framework model supply chain risk management for agrifood industries. This model is built based on the results of literature review from several studies related to supply chain management, supply chain risk management, food supply chain assessment, food safety, food quality and agri-food industries. The scope of agri-food in this research referred to the agri-food product grouping by [9], horticultural product (e.g. fruit general, pineapple, tomato, fresh cut salads, flowers general, grapewine), meat product (e.g. meat general, beef), dairy product (e.g. milk, cheese), fishery product (e.g. seafood general, fish, lobster, smoked seafood), bakery product (e.g. bakery general, bread), beverage (e.g. beverage general, beer, wine) and other food product (e.g. egg, sushi, pasta, cofee, olive oil).

2. Methods
A literature survey has been undertaken of quantitative and qualitative empirical studies published in several leading journal international : supply chain management journals, risk management journals, production economic journals, journal of food composition and analysis, journal of food engineering, food bioprocess technology journal, journal of food microbiology and others journal. Paper traced using the publisher websites: Springerlink, Willey interscience, Elsevier ScienceDirect, Emerald Insight. Publication were analyzed for the period between 2005 and 2017. Paper traced by using a few keywords such “supply chain”, “risk management”, “risk assessment”, “food industry”, “food supply chain” and “agri-food industries”.

The overall sample contain forty-two papers in totals (status papers published up to the end of 2017). Out of this sample only 45 papers specially discuss about food supply chain. The number of used publication papers for each step can be seen in table 1.

| Table 1. Distribution of Journals of reviewed, 2005-2017 |
|---------------------------------------------------------|
| Distribution of journal review                          |
| Count                                                   |
| Journal Review                                          |
| Supply Chain Risk Management : Review                    | 3  |
| Agri-food Supply Chain : Review                          | 5  |
| Supply Chain Management (SCM) : Review                  | 3  |
| Supply Chain Management integrated with Knowledge Management : Review | 1  |
| Sustainable Supply Chain Management (SSCM) : Review     | 3  |
| Framework SCRM Food Industry                            | 7  |
| Framework SCRM                                          | 3  |
| Journal Agri-food Supply Chain Risk Management           | 20 |

The number of publications on each years is indicated in Figure 1.

3. Result and discussion

3.1 Supply chain risk management
Consequently, we follow the SCRM definition [10] ”the management supply chain risks through coordination or collaboration among the supply chain partners so as the ensure profitability and continuity”. [6] defines global SCRM as “the identification and evaluation of risks and consequent losses in the global supply chain, and implementation of appropriate strategies through a coordinated approach among supply chain members”. Furthermore [6] defines risk management as an effort to reduce the risks and minimize losses due to the uncertainty of risk.

Risk cannot be eliminated completely but the influence and impact on the company can be reduced, with proper risk management. SCRM aims to identify potential sources of risk in the supply chain, through the coordination of all supply chain members, to reduce the overall supply chain vulnerability. Supply chain activities include : procurement, inventory management, product design and new product
development, manufacturing (planning), order processing, transportation/distribution, sales, demand management and customer service [5].

[11] states that sources of uncertainty in the supply chain is divided into two internal source and external source. Internal source uncertainty include available capacity, custom regulation, information delays, internal organization. Whereas external source uncertainty meliputi competitor action, manufacturing yield, political environment, price fluctuations, stochastic cost, supplier quality.

[10] four main approaches in the management of SCR is supply management, product management, demand management, information management. [12] explain drivers of supply chain consists of risk globalization, product variants, outsourcing, reduction of suppliers, focus on efficiency, central distribution, centralized production.

According [13], states there are three main elements of SCRM definition, they are risk identification and evaluation/assessment, global supply chain and coordinated risk management strategies. [14] defines risk into three dimensions, (1) Likelihood of occurrence of a particular event or outcome, (2) Consequences of the particular event or outcome occurring; and (3) Causal pathway leading to the event. [15] apply matrix loss exposure for assessment of risk factors. Risk factors are categorized as operational risk, financial risk and physical risk. [6], presents the supply chain risk categorize consists of supply risk, operational risk, demand risk, security risk, macroeconomic risk, competitive risk and resource risk. [16] suggest the supply chain risk categorize includes the supply chain risk demand, the damage risk, inventory risk, the risk of breakdown process, the risk of physical capacity of the plant, supply risk, system risk, the risk of power/authority and transportation risk. While [4], suggests the supply chain risk categorize in the three groups, the risk in the company, the risks outside the company and in the supply chain and risks beyond the supply chain, but it has an influence on the supply chain. [6] propose a framework for the integrated global supply chain risk management by using the relation of table risks. [16] develop a Supply Chain Risk Management Process (SCRMP) as the development of Risk Management Process (RMP) to identify, assess and manage risks of supply chain. Risk evaluation is based on the total value of the index Hazard Totem Pole (HTP) of the integration of the three dimensions, namely the risk of severity, probability and cost. [8], develops models of supply chain risks that connecting the process from upstream risk identification, risk assessment, risk mitigation and performance risk to the continuous improvement process. [13] SCRM framework was developed based on taxonomy defined for risk events and risk management approach.

3.2 Paper Review Related Supply Chain Risk Management for Agri-food

[17] identified risks in supply chain. The supply chain management discussed includes material flow risk, financial flow risk, and information flow risk. [10] represents four main approaches in supply chain risk management: supply management, product management, demand management, and information management. [6] created an integration framework for global supply chain risk management with the help of risk table linkage. [14] risk and performance risk [4] developed a framework for future analysis and exploration of supply chain risk management. The supply chain environment factors considered include external threats and resource requirements to improve the economy. [18], developed an integration framework of marketing strategy and supply chain.

| Article | Subject area            | Main objective of the paper                                                                 |
|---------|-------------------------|---------------------------------------------------------------------------------------------|
| [19]    | Supply chain risk       | SCRM literature review combined Systematic Literature Review (SLR) with Citation Network Analysis (CNA) through dynamics perspective approach |
|         | management              |                                                                                             |
| [17]    | Supply chain risk       | Described about the supply chain operation management includes material flow risk, financial flow risk, information flow risk |
|         | management              |                                                                                             |
Table 2. List of paper review related with SCRM for Agri-food

| Article | Subject area | Main objective of the paper |
|---------|--------------|-----------------------------|
| [4]     | Supply chain risk management | Built Risk-related terminology, drivers of supply chain risk, Deriving 17 principles of supply chain risk management |
| [9]     | Agri-food supply chain | Analyzed the development of RFID technology in the agri-food sector |
| [20]    | Agri-food Supply Chain | Conducted an assessment of the state of the art food supply chain planning models from the different components |
| [21]    | Agri-food supply chain | Developed hierarchical decision-making framework and critical taxonomy from agrifood supply chain |
| [22]    | Risk assessment Agri-food | Analyzing the risk assessment of Campylobacter result in broiler meat |
| [23]    | Agri-food supply chain | The design of food transportation system model with notices the temperature parameter, bacterial growth and others in the food transport |
| [24]    | Supply network design | Review about: (1) decisions addressed in the model, (2) performance metrics, (3) the degree to which the model supports integrated decision processes, and (4) globalization considerations. |
| [25]    | Supply chain management | Described about SCM from knowledge philosophy perspective and future SCM research |
| [26]    | Supply chain management : RFID Technology | Developed a state-of-the-art on RFID technology deployments in supply chains |
| [27]    | Supply chain knowledge management | Evaluated the relationship between knowledge management and SCM with analysis of the existing theoretical and empirical works |
| [28]    | Sustainable Supply Chain | Evaluated quantitative model sustainable supply chain |
| [29]    | Sustainable Supply Chain | Explained about design and management sustainable supply chain and future research opportunity |
| [30]    | Sustainable Supply Chain | Literatur review sustainable Supply chain. |

3.3 Framework Model Supply Chain Risk Management for Agri-food Industries

[16] developed Supply Chain Risk Management Process (SCRMP) as the development of Risk Management Process (RMP) to identify, assess, and manage supply chain risk. The risk evaluation was performed based on the total value of a Hazard Totem Pole (HTP) index of the integration of three dimensions, namely, severity, probability, and cost. However, this research has not been equipped with data management system to store risk relationship information and risk update as. [8] developed an upstream supply chain risk model that links the processes of risk identification, risk assessment, risk mitigation, and risk performance to continuous process improvement. [13] conceptualization and planning of supply chain risk management process.

[31] conducted a study on risk assessment in agricultural supply chain in developing countries. The major risks assessed include weather-related risks, natural disaster, biological, and environmental risks, market-related risks, logistical and infrastructure risks, management and operating risks, public and institutional policy risks, and other risk magnitudes. While [32], arranged risk management in New Zealand. [5] drew up a conceptual framework of a food supply chain development collaboration. [2] developed a food supply and logistics supply chain assessment framework by integrating four elements, namely, quality, security, sustainability, and logistics efficiency. In addition, transportation
problems in the supply chain were also considered. [33] developed a knowledge-based supply chain risk framework model for dairy agroindustry. The risks were identified from the breeders, the cooperatives, to the dairy processing industries.

Table 3. List of paper review related with framework model of SCRM for Agri-food

| Articles | The approach used | Main objective of the paper |
|----------|-------------------|-----------------------------|
| [34]     | Mathematical model, numerical experiment | Decision of pricing strategy, shelf space allocation, and replenishment policy in a single-item food supply chain setting. |
| [35]     | Qualitative analysis, expert judgment | Identified the major risks that Japanese food companies: Production risk, price purchase risk, demand risk and procurement risk. |
| [36]     | Extensive literature review | Developed an integrated framework for food supply chain resilience. A conceptual framework that highlights the importance of logistics, collaboration, sourcing, and knowledge management in achieving supply chain resilience. |
| [37]     | Theory of fuzzy sets | Identified RFs in PSCs, based on the distance between fuzzy numbers. The development of some mathematical areas, such as probability theory, theory of fuzzy sets, and rough theory, enables that uncertainty and imprecision of any kind be sufficiently well described quantitatively. |
| [33]     | Expert system and fuzzy logic | Framework model of sustainable supply chain risk management for dairy agroindustry based on knowledge Base. |
| [2]      | Integration of multiple decisions affecting the performing of the system | Conceptual framework for the assessment of food supply chain (FSC) and logistics of food products in agreement with a multidisciplinary and integrated view. |
| [8]      | Empirical analysis | Empirical testing to see the relationship between risk identification, risk assessment, risk mitigation and risk performance with continuous improvement processes |
| [16]     | The total value of the index Hazard Totem Pole (HTP) | Develop a systematic structure and approach to incorporate supply chain risk and assess severity and likelihood so that risk mitigation plans can be developed. |
| [31]     | Supply chain situation analysis | Framework for undertaking assessments of risk and risk management capability within agricultural supply chains in developing countries |
| [5]      | In depth interviews in the two companies | A conceptual framework of collaboration development in the agri food supply chain |

[38] describes a conceptual ABM that is based on a regional food system in western Iowa and eastern Nebraska. Agents in the model include: Food Hub Manager Agent, Producer agent and Customer Agents. [39] the study showed that external drivers of the organizations affect internal drivers, and compared to external drivers, internal drivers have a more important role in creating sustainable orientation within an organization. [40] the aim of this paper is to highlight the determinants of competitiveness and complementarity of different organizational models of SFSCs, led by actors who play different roles along the supply chain, in urban and peri-urban areas across Europe. [41] the overall aim of the current research is contribute to a better scoping practice of Life Cycle Assessment (LCAs) and Life Cycle Coasting (LCCs) of side flows in a food waste context. [42] proposed a method based on data from the testing of food-waste feed with comprehensive evaluation of its product safety by integrating fuzzy mathematics effectively and the model of AHP. [43], the model suggest that the institutional factors are the most influential factors to food supply chain risk management, followed by the basic characteristic of enterprise and finally the characteristic of employees. The summary from the identification research supply chain risk management for agri-food industries displayed in figure 1.
4. Conclusion

- Research on supply chain risk management for agri-food industries highly developed in accordance with needs for food products. Risk that occurs on supply chain food had the chance larger than a manufactured product. The unique features of the food industry such as the perishable nature of food products differentiate it from other sectors of the economy, and have intensified the need for an efficient supply chain.

- risk assessment that occurs in supply chain agri-food in general have to take attention into aspects of quality, safety, sustainability and logistic efficiency

- Research has been widely implemented in supply chain risk measurement, but few was discussed about risk mitigation plans in the agri-food supply chain so that it gives a great opportunity to do such research.

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