KnE Life Sciences

ICoA Conference Proceedings
The 3rd International Conference on Agro-Industry 2016
"Competitive & Sustainable Agro-Industry: Value Creation in Agribusiness"
Volume 2017

Knowledge E
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Conference Paper

An Application of RapAgRisk (Rapid Agricultural Supply Chain Risk Assessment) Method on Fresh Vegetables for Identifying and Reducing Damage during Delivery to Consumers

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Abstract

Vegetables have distinctive properties that are easily damaged, so handling and delivery time will be the important factors in the whole supply chain. Identification and mitigation of the damage is very important to prevent damage to vegetables and maintain resale value. This study uses the Rapid Agricultural Supply Chain Risk Assessment (RapAgRisk) based on the risk management standard ISO 31000:2009 to conduct a risk analysis. The field research uses sample of the actors in the supply chain from the farm producer to the point of sale. The research was done by taking convenience sampling through in-depth interviews with the actors of the supply chain. The research location in fresh vegetable production centers in Magelang (Central Java Province), and Sleman (Yogyakarta Province). Research result showed risk factor of the weather, natural condition, biological and environmental, related markets, logistics (infrastructure), and operational management in the supply chain of fresh vegetables. At the level of farmers and collectors, each have four risks while at the merchant level, there are five important risks getting attention for follow up. Mitigation each of these factors lead to the reducing damage and it can be applied to maintain the quality of the vegetables and increase the selling price.

Keywords: Fresh vegetables; RapAgRisk; Risk management; Risk mitigation; Supply chain

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Received: 25 December 2017
Accepted: 5 February 2018
Published: 1 March 2018

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICoA Conference Committee.

INTRODUCTION

Vegetables are one of the valuable horticultural commodities in Indonesia. According to General Directorate of Horticulture [1], the vegetable production in Indonesia reached 11,005,954 tons per year for the last 5 years. The National vegetable production also

increases every year, but these increasing of production should be followed by good quality of vegetable. As its perishable characteristics, vegetables need special handling throughout the supply chain because vegetables are easily wither, easily damage and seasonal. The main problems in the supply chain of vegetables are planning, distribution and delivery activity.

Each tier along the supply chain may handle different kind of risk in which the activities to prevent the risk in each tier might be different as well [2]. Therefore, risk management throughout the supply chain should be conducted to ensure the quality of the vegetables from the first to the last tier and the risk that may cause losses in quality and quantity can be properly resolved. Rapid Agricultural Supply Chain Risk Assessment (RapAgRisk) was used to identify, analyze and evaluate both internal and external risk in the fresh vegetable supply chain [8]. This study is aimed to identify existing risks in the supply chain, mitigate risks, and suggest the appropriate supply chain strategy.

MATERIAL AND METHODS

This research was conducted in the center of vegetable in the highland area which are Magelang, Central Java and Sleman, Yogyakarta. This research used convenience sampling method, while data collection was conducted through in-depth interview to the respondents throughout the supply chain. In-depth interviews were conducted to identify the risk and related information from the risk owner. Moreover, risk analysis method used the Rapid Agricultural Supply Chain Risk Assessment (RapAgRisk) based on the ISO 31000: 2009 risk management standards [7]. Risk mapping is also used to analyze probability and severity of the risk. The combination of probability and severity results the Expected Loss Ranking Matrix, then it can be used to develop Risk Management and Vulnerability Assessment by combining with the assessment of capacity to manage the risk in each tier. Based on the risk analysis, the risk treatment and risk mitigation thus can be properly proposed for each risk in each tier.

RESULTS AND DISCUSSION

The Supply Chain of Fresh Vegetable

This study analyzes the supply chain of fresh vegetable for both organic and non-organic to the modern trade, hotel and restaurant. Based on the field survey conducted

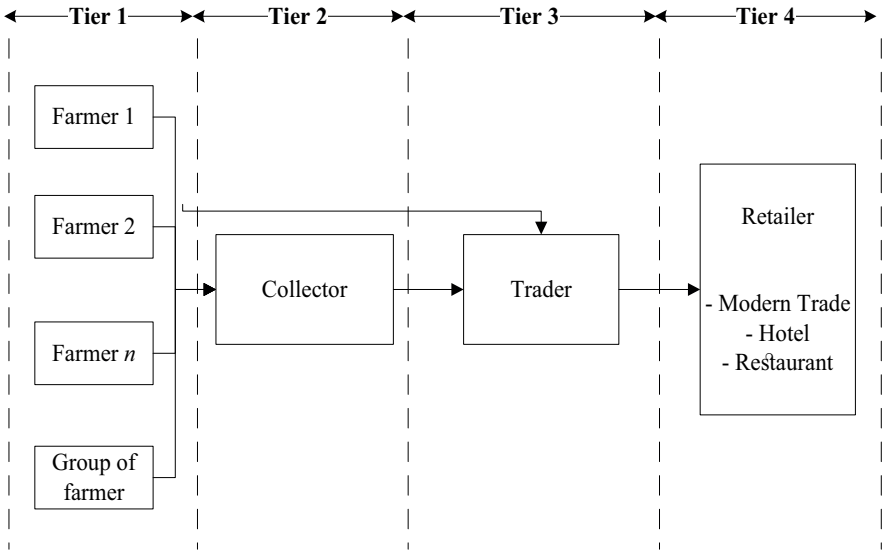

Figure 1: Supply chain of fresh vegetable.

in the two regions, the supply chain of fresh vegetable consists of 4 tiers including farmer, collector, trader and retailer as shown in Fig. 1. In-depth interviews were conducted to 12 farmers, 2 collectors and 5 traders. Farmers for organic product do not use pesticides and chemical fertilizers to produce organic vegetables. Most of farmers who produce organic product will join with a group of farmer in their area. Several groups of farmer use setting system where the farmer plants the vegetables based on the demand from the group who has received the order from traders. Some of farmers and groups of farmer sell the vegetable to the collector nearby their area, while some others sell it directly to the traders. However, most farmers who sell the vegetable to the trader follow the demand and requirement from the trader and also send the vegetable regularly to the trader, while most farmers who sell it to the collector can decide type and quantity of vegetable by themselves. Based on the in-depth interview, a group of farmer who also acts as collector helps the farmer to do marketing activity and manages activity in the home packing. The activity in the home packing include sorting, washing, weighting, packaging, and delivery to traders. In addition, traders who receive vegetable from collectors or directly from farmers carry out some activities including sorting, washing, weighing, packing, and delivery of vegetable to the supermarket, hotel, and restaurant before being consumed by the end consumer. Both collector and trader do not carry inventory activity because fresh vegetables have short shelf life.

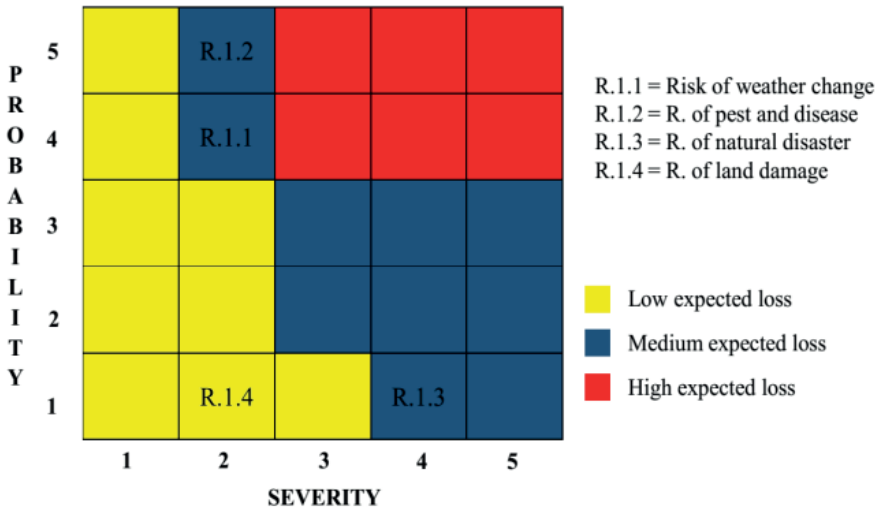

Figure 2: Expected loss ranking matrix in farmer level.

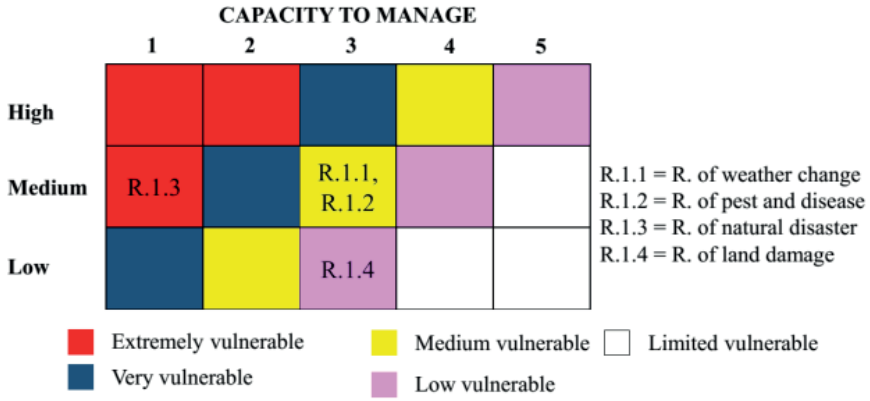

Figure 3: Vulnerability assessment in farmer level.

Supply Chain Risk Assessment

Jaffe [4] stated that RapAgRisk aims to help all tiers along the supply chain figuring out their risk through risk identification, analysis of the probability and severity, analysis of expected loss, and assessment of capacity to manage. According to 8 type of risks in the RapAgRisk method, there are 6 type of risks that are identified from the fresh vegetable supply chain: weather risk (R.1.1), natural disaster risk (R.1.3), biological and environment risk (R.1.2), market risk (R.2.1, R.2.3, R.2.4, R.3.2, R.3.4), logistics and infrastructure risk (R.2.2, R.3.1), and management and operational risk (R.1.4, R.3.3, R.3.5) as shown in the Fig. 2 to Fig. 7.

Figures above show that as long as the vegetable moving towards the consumer level, the risk tend to decrease but the capacity to manage tend to increase. This is indicated by the absence of extremely vulnerable or very vulnerable at the trader level. In the supply chain of fresh vegetables, only both farmers and collectors who own

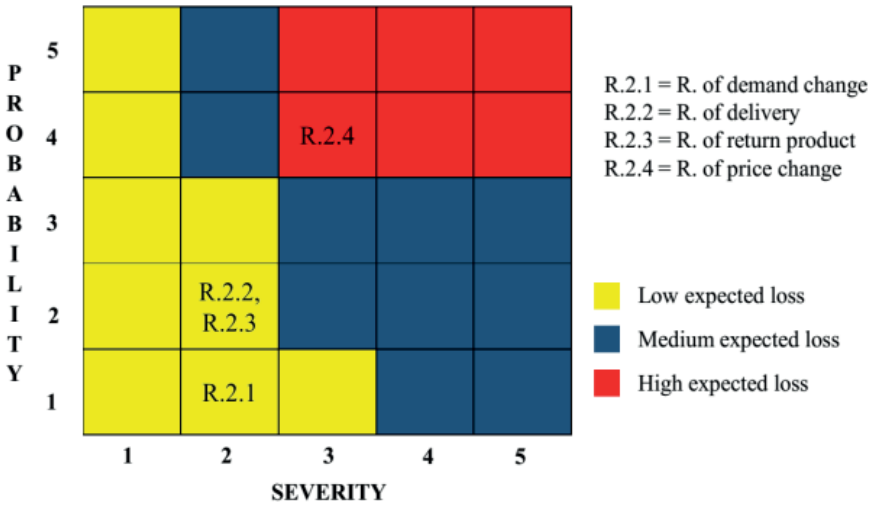

Figure 4: Expected loss ranking matrix in collector level.

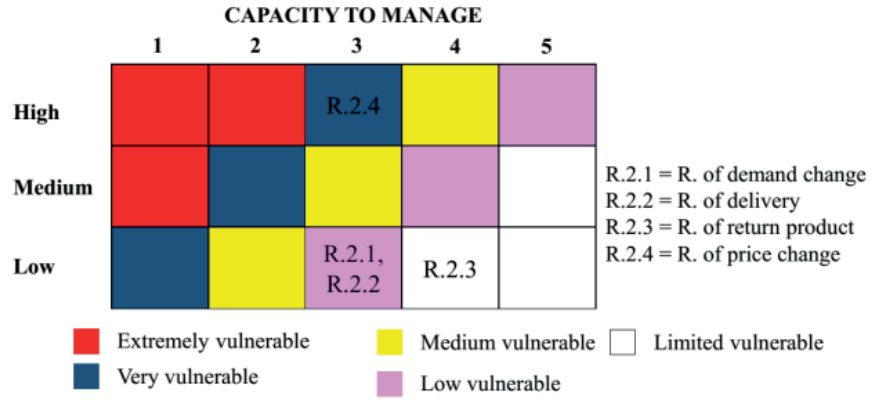

Figure 5: Vulnerability assessment in collector level.

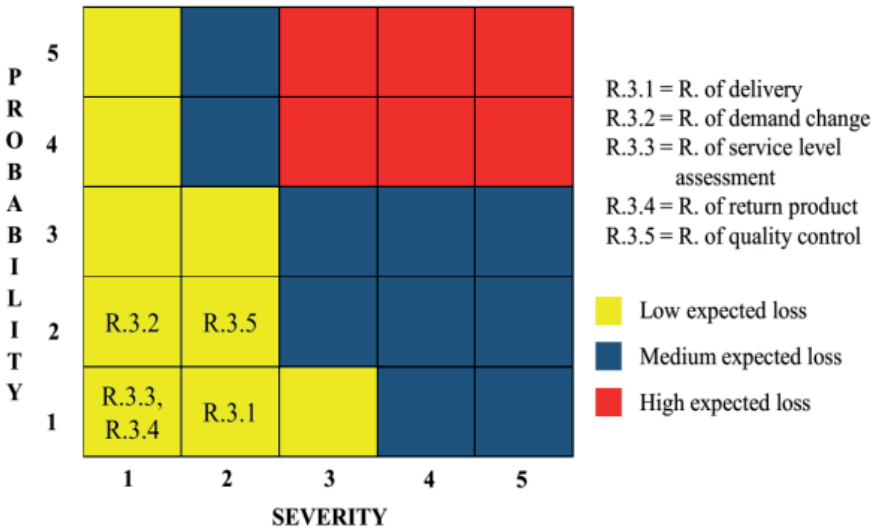

Figure 6: Expected loss ranking matrix in trader level.

the risk in the category of low vulnerable, medium vulnerable, very vulnerable, and extremely vulnerable. The risk in the trader level are classified as limited vulnerable

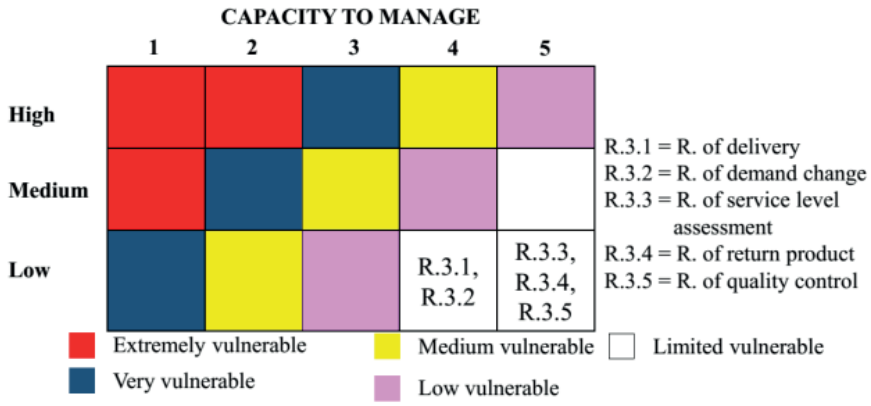

Figure 7: Vulnerability assessment in trader level.

risk. For the risk in the category of limited vulnerable, there are no treatments and mitigations needed because they are in the acceptable level of risk and the risk owner in the supply chain have been able to handle those risks. In the case of natural disaster such as Mt. Merapi eruption which is classified as extremely vulnerable, the farmer should use roof or cover the plant with plastic to mitigate the risk. Based on historical data analysis from Ministry of Energy and Mineral Resource [5], the average of Mt. Merapi eruption was once in 4 years. Moreover, farmer should improve the quality of pre-harvesting activities including planting pattern, fertilizer application, irrigation, regular control, and harvesting technique to prevent the risk. For the risk treatment, immediately spray the water to remove volcanic ash and separate the plant that have been infected by pest may help to reduce the impact of the risk. In the collector level, collector should strengthen the coordination with the farmer and trader, make an agreement and conduct forecasting related to the price and order quantity. Good coordination with farmer and trader may help the collector negotiate when the price and demand are fluctuating.

Strategy for Supply Chain of Fresh Vegetable

The difference in the demand pattern either order before planting or order before harvesting, sales of vegetables, and characteristics of each vegetable cause the different in the strategy. For farmers with order before planting pattern, they should use efficient strategy to minimize the cost because they can easily predict the demand quantity of each vegetable since the order has been received before planting activity. Thus, the risk of demand change is low. On the other hands, responsive strategy is suitable to be applied in the order harvesting pattern by improving the ability to quickly and accurately respond the change of demand. According to Guritno [3] and

Pishvae et al. [6], lead time can be used as a basis in determining the appropriate strategy in the supply chain of vegetables. Types of vegetables such as cabbage, spinach, beans, tomatoes and celery should apply an efficient strategy because they have short lead time and their demand is predictable. For vegetables such as broccoli, Choy sum, Chinese cabbage, red lettuce, rosemary, parsley, chayote, leek, and Gai lan, a responsive strategy is the appropriate strategy. The responsive strategies thus is suitable to be applied on vegetables which have a long lead time while efficient strategy is appropriate for vegetables with short lead time.

CONCLUSSIONS

The fresh vegetable supply chain is divided into 4 tiers including farmers, collector, traders, and retailers. Some of the farmers join with the group of farmers to increase their bargaining power with the collector, while some others decide to do it as individual. Group of farmers who also act as collector will help the farmer to sell the vegetables to the trader. Based on the supply chain risk assessment, this research concludes that the expected loss of the risk is reduced in accordance with the movement of vegetables to the consumers, while the capacity to manage is increasing.

Furthermore, the risk mitigation in farmer's stage focuses on the use of roof in case of preventing natural disaster and pre- harvesting quality improvement. Expanding and strengthening the coordination with farmers and traders may help the collectors to coordinate about price and flexibility demand. Different type of vegetable may require different strategy where vegetable with short lead time and low risk of demand change should use efficient strategy. Otherwise, they should use responsive strategy in order to easily response to the changing situation.

ACKNOWLEDGEMENT

Many thanks addressed to Ms. Nur Rahma Laila and Ms. Megita Ryanjani Tanuputri which have helped in the collection of field data, conduct processing, and a lot of effort and discussion in the preparation of this paper.

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