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## Supply Chain Risk Management: A Case Study in Thailand

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# Supply Chain Risk Management: A Case Study in Thailand

*Chatchai Raka and Jirapan Liangrokapart*

While the increasing of globalization trades, the supply chain has been confronted with complexity and insecurity. Supply chain risk management has become an important tool for managing the risks in the supply chain. Thus the objective of this paper is to study the supply chain risk management by using a fresh produce supply chain in Thailand as a case. Targeted supply chain's stakeholders were interviewed including growers, collectors, wholesalers, processors, retail stores and consumers. The risk events were identified and evaluate into 9 categories. They are Climate risk, Demand risk, Financial risk, Information risk, Operational risk, Policy risk, Price risk, Regulatory risk, and Supply risk. The details of these risks have been clarified and some of risk management guidelines are introduced in order to mitigate them. As a result, the current fresh produce supply chain structure in Thailand has been draw up additionally.

**Keywords:** Supply Chain Risk Management, Risk Identification, Risk Assessment, Risk Control

## 1 Introduction

Thailand is an agricultural country. The Office of Agricultural Economic, Ministry of Agricultural stated that in 2011, Thailand total export amounts are 6,882,642 million Baht (or USD 229,421 millions) with 1,447,716 million Baht (or USD 48,257 millions) for agricultural products. Because of a globalization trade of agricultural products is increasing, its supply chain is more complicated accordingly. Ineffective supply chain management will make its chain risky and vulnerability. These will lead decreasing of supply chain's performance. To mitigate the risks which might be occurred in the chain, risk management strategies play an important role for risk reduction. To integrate risk management concept into supply chain activities, supply chain risk management (SCRM) can be defined as "the management of supply chain risks through coordination or collaboration among the supply chain partners so as to ensure profitability and continuity" (Christopher 2006, p.453). The typical risk management steps start from risk identification, risk assessment, risk management, risk control and monitoring. The aim of this paper is to study supply chain risk management by using a fresh produce supply chain in Thailand as a case. A fresh produce supply chain is a dynamic operation, their products are easily to perish and there are many factors influencing while moving along the chain. Hence, this research will study the obstacles or risk factors in a fresh produce supply chain and to acquire the guidance for risk mitigation based on risk management process as mentioned above.

## 2 Literature Review

### 2.1 Definitions of Risk

There are a number of research papers defining the concept of risk and uncertainty. The study of risk started in seventeenth century and the probability theory which is the important method to study risk management nowadays was developed. The definitions of risk were addressed by many studies. Manuj and Mentzer (2008) defined uncertainty as the event which is difficult to predict the possible outcome, whereas risk is consisted of three components; they are the possibility of losses, the probability of those losses which might be happened and the importance of the losses' result. Khan and Burnes (2007) have compared the definition of risk and uncertainty that risk can be measured and estimated the probability of the outcome while uncertainty cannot be quantified and estimated. Norrman and Jansson (2004) stated that risk can be quantified the probability of the occurrence of the primary event and measured the consequence of that event. Then Tang and Musa (2010) believed that risk's impact outcome and risk's sources expectation are among the important topics to be studied and discussed. Merna and Al-Thani (2008) explained the risk and uncertainty as the decision about risk will be made if the outcome can be estimated for both possibility and probability, while uncertainty is defined if there are a number of possible outcome but the probability of individual outcome cannot be estimated. Manuj and Mentzer (2008) refined the concept of risk from their research about "Global supply chain risk manage-

ment strategies" as the potential losses are the significant losses if risk happened and the likelihood is the probability of the emergent event that leads to those risks become realization.

Therefore, the definition of risk for this research is defined as risk is the potential of losses which can be estimated their likelihood and the significant of the outcome should be evaluated for risk mitigation further.

## 2.2 Supply Chain Risk Management

Risk management can be defined as any actions taken by organizations in order to mitigate the risk arising within their businesses. The risk management involves risk identification, estimation of the probability and the severity of that occurrence, decision to mitigate the risks and implementation of the decided actions. Tang (2006) portrayed four basic approaches which organizations could implement during coordination in their supply chains. The four basic approaches are supply management, demand management, product management and information management. Considering the whole supply chain originating from supply until products' delivering to meet end customers' demand, there are a number of risks along the chains. The major risk factors occurred in both internal and external supply chain are supply risk, operational risk, financial risk, demand risk, information risk, economic crises, change of government rules and regulations, labor issue, natural and man-made disasters and any others.

Many studies involve the risk evaluation and the impact of the risks in difference supply chains. Liangrokapart (2012) studied the case of hospital supply chain disruptions in Thailand. Raka and Liangrokapart (2013) described the risks in pharmaceutical supply chain. While Blos et al. (2009)

who studied SCRM on the automotive and electronic industries in Brazil stated four vulnerabilities in the supply chains; they are financial vulnerability, strategic vulnerability, hazard vulnerability and operations vulnerability.

Vilko and Hallikas (2012) grouped risks into six categories: supply risks, operational risks, security risks, macro risks, policy risks and environmental risks. Manuj and Mentzer (2008) defined risks into eight groups: supply risks, operational risks, demand risks, security risks, macro risks, policy risks, competitive risks and resource risks but the first four are exactly assort with supply chains. Olson and Wu (2010) categorized risk from the literatures into 2 groups, internal and external. Internal risks consist of nature, political system, competitor and market, whereas external risks include available capacity, internal operations and information system. Ritchie and Brindley (2007) described supply chain risk management framework. Risks in the supply chain are originated from particular variables – environmental, industrial, organizational, problem specific and decision-maker related variables. These variables are not only affect risk in terms of systematic and unsystematic, but also affect potential performance.

### **2.3 A Fresh Produce Supply Chain**

The fresh produce industry in Thailand flows from farmers or growers who plant the varieties of products, then harvest and pack in many types of packaging and sell to the district or regional wholesale markets. Most of products are sold through middlemen or collectors and transported to

wholesale markets and processing plant. Then processed products are delivered to local retail stores and oversea. Lertrat et al. (2008) has studied the supply chain management for fresh vegetable in Nakornprathom province, Thailand and stated that the stakeholders in this chain from upstream through downstream consisted of farmers or growers (upstream), collectors (middle stream), processors and exporters (downstream) and final delivered to consumers for both domestic and oversea markets. Moreover, Bourlakis and Weightman (2004) said that the food supply is very important for all countries. The general food chain in UK consists of farmers, food manufacturing, wholesaler, retailer, catering or food service, and then delivered to the consumer.

From the literatures and preliminary study, the fresh produce supply chain in Thailand is not much different from vegetable supply chain and food supply chain mentioned above. Fresh produce are perishable products include fruits, vegetables, foods, flowers, meats and etc. Hence, the fresh produce supply chain can be drawn as shown in Figure 1 below;

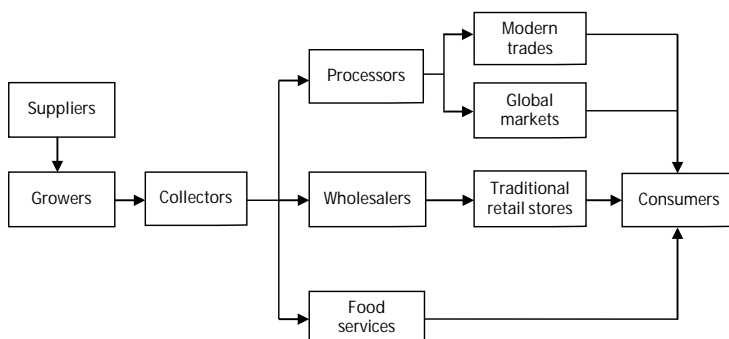


Figure 1 Thailand fresh produce supply chain (Authors)

There are a number of stakeholders in a fresh produce supply chain in Thailand as shown in Figure 3. This research focused on the major stakeholders including growers, collectors, wholesalers, processors, traditional retail stores and domestic consumers for data collection.

### 3 Research Methodology

After studied a fresh produce supply chain context, then risk assessment in supply chain risk management (SCRM) process has been proceeded. The risks were identified, analyzed and evaluated respectively. A qualitative technique has been applied to this study. An in-depth interview was used to identify the risks in a fresh produce supply chain in Thailand. The samples consist of growers, collectors, wholesalers, processors, traditional retail stores and domestic consumers were selected based on the purposive sampling theory. The risk events in the supply chain have been identified and categorized. Then risk ranking and filtering technique has been applied for risk evaluation. Some of risk control strategies have been suggested consequently in order to minimize the significant risks. The research framework has shown in Figure 2.



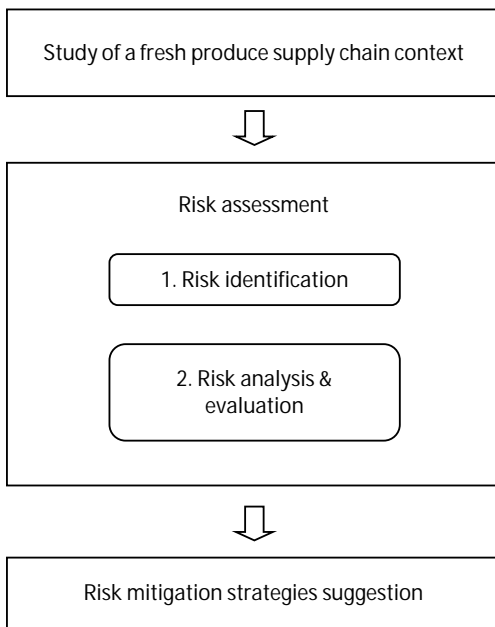


Figure 2 Research framework

## 4 Findings

After interview, a total of 33 risk events in the fresh produce supply chain were identified. The risk events have been grouped based on its individual relevant to each stakeholder and categorized into climate risk, demand risk, financial risk, information risk, operational risk, policy risk, price risk, regulatory risk, and supply risk. The source of these risk events are classified into two major categories: internal and external. Numerous obstacles

during supply chain activities, both internal and external. From farm to fork, the stages of fresh produce; harvesting, collecting, processing, delivering and consumption, encounter many difficulties e.g. price fluctuation, environmental disaster, lack of knowledge, insufficient resources, demand fluctuation, regulatory problems, short shelf-life and etc. These risks are shown in Table 1.

Table 1 The risk events in the fresh produce supply chain

Risk events	Code	Risk sources	Category
Growers			
1. The products' price are lower than cost.	E1	External	Price risk
2. Climate change.	E2	External	Climate risk
3. Lack of knowledge in agricultural technology.	E3	Internal	Information risk
4. Agricultural pest problem.	E4	Internal	Operation risk
5. Lack of labor.	E5	Internal	Operational risk
6. Seeds, fertilizers and pesticides shortage.	E6	External	Supply risk

Risk events	Code	Risk sources	Category
7. Uncertainty government policies.	E7	External	Policy risk
8. Cash flow problem.	E8	Internal	Financial risk
Collectors			
9. Trust between growers and collectors, not strict to the commitment (if benefit involved).	E9	External	Price risk
10. Cash flow problem.	E10	Internal	Financial risk
11. Uncertainty purchase order from buyers.	E11	External	Demand risk
12. Responsible for perished products.	E12	Internal	Operational risk
Wholesalers			
13. Cash flow problem.	E13	Internal	Financial risk

Risk events	Code	Risk sources	Category
14. Responsible for perished products.	E14	Internal	Operational risk
15. Short shelf-life products.	E15	Internal	Operational risk
Processors			
16. Raw materials' price fluctuation.	E16	External	Price risk
17. Short shelf-life products.	E17	Internal	Operational risk
18. Production planning difficulty.	E18	Internal	Operational risk
19. Strictly regulations from regulators, both domestic and overseas.	E19	External	Regulatory risk
20. Highly cost for quality systems.	E20	Internal	Financial risk
21. Labor cost problem.	E21	Internal	Financial risk

Risk events	Code	Risk sources	Category
22. Lack of labor skills.	E22	Internal	Information risk
23. Lack of workforces.	E23	Internal	Operational risk
24. Selling price problem, especially for modern trades.	E24	External	Price risk
25. New competitors can enter easily.	E25	External	Demand risk
Retail stores			
26. Short shelf-life products.	E26	Internal	Operational risk
27. Products shortage due to farming problems.	E27	External	Supply risk
28. Strictly regulations from regulators, such as pesticide residue test, will make unsatisfactory from consumers.	E28	External	Regulatory risk
29. Increasing of new competitors.	E29	External	Policy risk

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Risk events	Code	Risk sources	Category
30. High cost.	E30	Internal	Financial risk
Consumers			
31. Products quality problem.	E31	External	Supply risk
32. Higher price if buy from modern trades but the quality might be equal to other fresh food markets.	E32	External	Price risk
33. Consumer confidence in terms of products traceability.	E33	External	Supply risk

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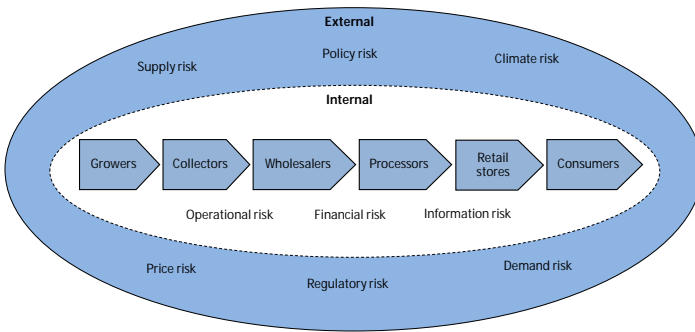


Figure 3 External and internal risks in the fresh produce supply chain

The risk events which happened in each major stakeholder in the fresh produce supply chain have been categorized into 9 categories as explained above then merged into the supply chain as shown in Figure 3. The internal risk sources which occurred within their organizations are including financial risk, information risk and operational risk, respectively. And the remaining; climate risk, demand risk, policy risk, price risk, regulatory risk and supply risk are under the external risk sources as they are the circumstances outside which effect to the chain.

These risks have been evaluated by risk ranking method to quantify the probability and consequence with a two-dimensional diagram, a basic evaluation model. The scores are assigned as high (3), medium (2) and low (1) for both probability of occurrence and severity of consequences. The risk score ( $R_n$ , a risk event  $n$ ) is given by the multiple of probability ( $P_n$ , a probability of occurrence  $n$ ) and severity ( $S_n$ , a severity of consequence  $n$ ) as shown in formula (1).

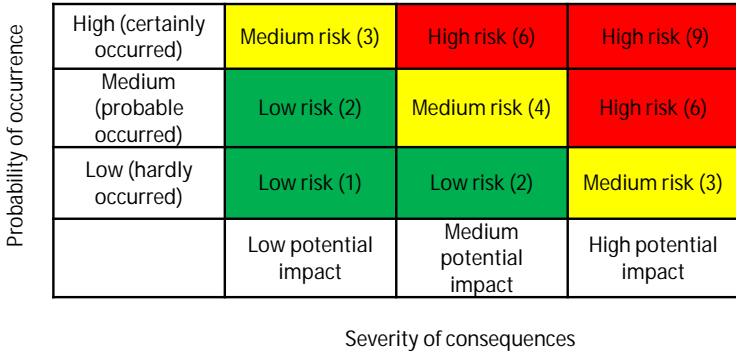


Figure 4 Two-dimensional diagram risk ranking matrix (adapted from The Chartered Quality Institute, UK, 2010)

The risk ranking and evaluation has been presented in Table 2, these results were evaluated by 3 experts who are senior managers in a fresh produce supply chain. Two-dimensional diagram risk ranking matrix has been illustrated in Figure 4 below;

$$R_n = P_n \times S_n \tag{1}$$

Table 2 The risk ranking and evaluation

Risk events	Category	$P_n$	$S_n$	$R_n$
E1	Price risk	3	3	9
E2	Climate risk	2	3	6
E3	Information risk	3	1	3



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Risk events	Category	$P_n$	$S_n$	$R_n$
E4	Operation risk	2	2	4
E5	Operational risk	2	2	4
E6	Supply risk	2	3	6
E7	Policy risk	2	1	2
E8	Financial risk	3	3	9
E9	Price risk	2	3	6
E10	Financial risk	3	3	9
E11	Demand risk	2	2	4
E12	Operational risk	2	2	4
E13	Financial risk	3	3	9
E14	Operational risk	2	2	4
E15	Operational risk	2	2	4
E16	Price risk	3	3	9
E17	Operational risk	2	2	4

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Risk events	Category	$P_n$	$S_n$	$R_n$
E18	Operational risk	2	2	4
E19	Regulatory risk	2	1	2
E20	Financial risk	2	3	6
E21	Financial risk	3	3	9
E22	Information risk	2	2	4
E23	Operational risk	2	2	4
E24	Price risk	3	3	9
E25	Demand risk	2	2	4
E26	Operational risk	2	2	4
E27	Supply risk	2	3	6
E28	Regulatory risk	2	1	2
E29	Policy risk	2	1	2
E30	Financial risk	2	3	6
E31	Supply risk	2	3	6

Risk events	Category	$P_n$	$S_n$	$R_n$
E32	Price risk	2	3	6
E33	Supply risk	2	3	6

The risk events which revealed 6, 9 points are high risks. The scores of 3, 4 are medium risks. Then the scores of 1, 2 are low risks. Therefore, the risk score can be summarized into 3 levels; high, medium and low. From the result in Table 2 above, climate risk, financial risk, price risk and supply risk resulted in 6 and 9 scores which located in the high risk area. These risks are the most priority for growers and most significant for collectors, processors and consumers as well. The cash flow problem, raw materials' price, raw materials supply, climate change, operational cost, labor cost and selling price are the most critical for them. While, demand risk, information risk and operational risk resulted in 3 and 4 scores, moderate risk level. Lack of information, operational difficulty, labor shortage and demand uncertainty are medium potential impact to the chain. At last, policy risk and regulatory risk are lowest priority for risk mitigation as resulted in 1 and 2 scores.

The experts also recommended some suggestions which are useful to reduce risk impact. These suggestions were merged into 4Ts strategy by the authors. The Chartered Quality Institute, UK (2010) explained risk mitigation strategy based on 4Ts (treat, transfer, terminate and tolerate), a beneficial method for risk control. The risks will be treated to reduce their sever-

ity of consequences and prevent their probability of occurrence, transferred to the third party such as consider to buy the insurance, terminated by stop implementing the risks' activities and tolerated them by accept the insignificant risks or do not perform any actions. The risk control guidelines are concluded in Table 3.

Table 3 The level of risk and risk control guidelines

Risk categories	The level of risk	Risk control guidelines	4Ts Strategy
Climate risk	High	- Crop insurance.	Transfer
		- Avoid planting if climate forecast detected any problems.	Terminate
Financial risk	High	- Low interest loan from agricultural bank or the government financial institute.	Transfer
		- Cost control.	Treat
		- Attend some financial or accounting courses.	Treat
		- Avoid investment without appropriate plan.	Terminate
Price risk	High	- Price guarantee from the government.	Transfer

Risk categories	The level of risk	Risk control guidelines	4Ts Strategy
		- Avoid unreliable partners.	Terminate
		- Multiple sources.	Treat
Supply risk	High	- Multiple sources. Treat	Treat
		- Implement contract farming.	Treat
Demand risk	Medium	- Implement customer relationship management.	Treat
		- Using information technology e.g. forecasting model.	Treat
Information risk	Medium	- Attend training courses concerning agricultural technology.	Treat
		- Using information technology e.g. internet.	Treat
Operational risk	Medium	- Provide in-house or outside training courses concerning operation / quality control.	Treat

Risk categories	The level of risk	Risk control guidelines	4Ts Strategy
		- Implement human resource management program in order to maximize employees' performance.	Treat
Policy risk	Low	- Accept the policies as launched by the government.	Tolerate
Regulatory risk	Low	- Accept the regulations to comply with the government's orders.	Tolerate

## 5 Conclusion

In this study, risk events in the fresh produce supply chain in Thailand have been identified and evaluated. These risk events have been classified into 9 categories. They are climate risk, demand risk, financial risk, information risk, operational risk, policy risk, price risk, regulatory risk and supply risk. Climate risk, financial risk, price risk and supply risk have the strongest impact to the fresh produce supply chain whereas demand risk, information risk and operational risk are in average effect. Policy risk and regulatory risk are insignificant to the chain as per the experts' perspectives. Furthermore, the risk mitigation strategies for risk control have been suggested regarding 4Ts strategies (treat, transfer, terminate and tolerate) in order to reduce

the probability and severity of these risks, especially the most impact categories. In addition, the current fresh produce supply chain structure in conjunction with internal and external risks has been drawn as well.

Finally, other stakeholders in a whole chain would be considered for further study in order to ensure the risk categories. Other research methodologies e.g. Analytical Hierarchy Process (AHP) might be applied to select the most appropriate risk mitigation strategies.

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