Conference Paper

Risk Mitigation Strategy for Mangosteen Business Using House of Risk (HOR) Methods: (A Case Study in "Wijaya Buah", Blitar District, Indonesia)

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Abstract

The study aimed to determine the order of priority risk agents and risk mitigation strategies that should be implemented by "Wijaya Buah" as a fruit wholesaler. This research used 2 phases of House of Risk (HOR) methods. HOR I was used to identify risk events and risk agents in mangosteen business based on the mapping of business activities using the Supply Chain Operations Reference (SCOR) version 9 level 2. HOR II then was used to determine the risk mitigation strategy based the relation between the risk mitigations and the risk agents. The results of the study showed that 19 risk events were identified with 27 risk agents. Based on the calculation of Aggregate Risk Potential (ARP), 1 risk agents became priority to be designed for mitigation strategies. In order to reduce the incidence of risk agent, 3 mitigation strategies should be applied in "Wijaya Buah".

Keywords: HOR; Mangosteen; Mitigation; Risk; SCOR

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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

Mangosteen is a favored tropical fruit commodity of Indonesian exports. Export of mangosteen contributed in average 25.5% of exported fruit from Indonesia [1]. One of the mangosteen centres in Indonesia is Blitar District in East Java in which Sub-District of Nglegok as the center.

Mangosteen business in Sub-District of Nglegok is dominated by "Wijaya Buah" as a wholesaler of fruits. The main activity of "Wijaya Buah" is selling fruits bought from collectors. "Wijaya Buah" business has not been organized yet. It does not have a long term partnership with some certain collectors. It gives impact of availability and quality risks as well as the fluctuation of mangosteen prices. In order to fulfill the

demand of mangosteen. "Wijaya Buah" must improve it business with considering some risks. This study aimed to determine the order of priority risk agents and risk mitigation strategies that should be implemented by Wijaya Buah as a wholesaler of fruits, especially mangosteen.

MATERIAL AND METHODS

The activities of mangosteen were analyzed only on farmers as the owner of mangosteen orchard, the collectors as suppliers of mangosteen to "Wijaya Buah", and "Wijaya Buah" as a wholesaler who distribute mangosteen to exporters or retailers. A purposive sample was used to ensure the representation of experts within each member of the supply chain. Respondents were 6 experts who have expertise in mangosteen business. They were selected from which 2 as farmers' representative, 2 as collectors' representative, and 2 as representative of "Wijaya Buah".

Supply Chain Operations Reference (SCOR)

In order to identify the risks easily in mangosteen business, the activities of the business were mapped using SCOR version 9 level 2. The SCOR-model provides a unique framework for supporting communication among the members of the chain. It also improves the effectiveness of supply chain management and related activities of supply chain improvement. SCOR is composed of three process levels. Level-1 processes are SCOR processes which are defined for each member in the supply chain. Level-2 and 3 metrics are generally associated with a narrower subset of processes. A set of standard notation is used throughout the model. i.e. P, S, M, D, and R depicts Plan, Source, Make, Deliver, and Return elements respectively. Return element has 2 type of return, i.e. SR (Source Return) and DR (Deliver Return).

House of Risk (HOR) Model

According to Pujawan and Geraldin [6], House of Quality (HOQ) model was adapted as HOR model which determines the priority of risk agents for preventive actions. The priority are given to risk agent based on the magnitude of the aggregate risk potential of each risk because one risk agent could induce a number of risk events. A few of those considered having large potentials to induce risk events can be selected if there are many risk agents.

In this study, two phases models of HOR were used, i.e. HOR I and HOR II. HOR I was used to identify risk events and risk agents in mangosteen business based on the mapping of business activities using SCOR level 2. HOR II then was used to determine the risk mitigation strategies based the relation between the risk mitigations and the risk agents.

RESULTS

Activities Mapping of Mangosteen Business

The member of mangosteen business which is run by "Wijaya Buah" in Sub-District of Nglegok, District of Blitar, East Java, Indonesia are farmers, collectors, "Wijaya Buah", and retailer. Farmers as the owner of mangosteen orchard do not maintain the orchard regularly. They only maintain it in the period of mangosteen peak season. In the mangosteen season, collectors will come to the farmers for buying mangosteen. When the fruits already appear but not ready to be harvested, collectors buy the mangosteen on tree without counting the fruits. If farmers agree with the price, then collectors will pay the farmers.in cash. When the mangosteens are ready to be harvested then collectors will harvest them. The mangosteens then are packed in baskets or sacks annd delivered to "Wijaya Buah". All mangosteens are bought by "Wijaya Buah". The price of the mangosteen depends on the quality of mangosteen which are checked manually. "Wijaya Buah" then grades and sorts the mangosteen to be sold to the exporter and retailers which already ordered the mangosteen. The activities mapping of mangosteen business of "Wijaya Buah" is shown in Figure 1 and the detail activities is shown in Table 1.

HOR I

The identification of risk events and risk agents is shown in Table 2. The assessment of the impact (severity) of such risk event (if happened) and its occurrence used a scale of 1-10. The description about the scale is shown in Table 3

The result of HOR I is shown in Table 4 which contains the assessment of the impact (severity) of such risk event (S_i), the likelihood of occurrence of each risk agent (O_j), the matrix relationship between each risk agent and each risk event (R_{ij}), and the aggregate risk potential of the risk agent (ARP_j).

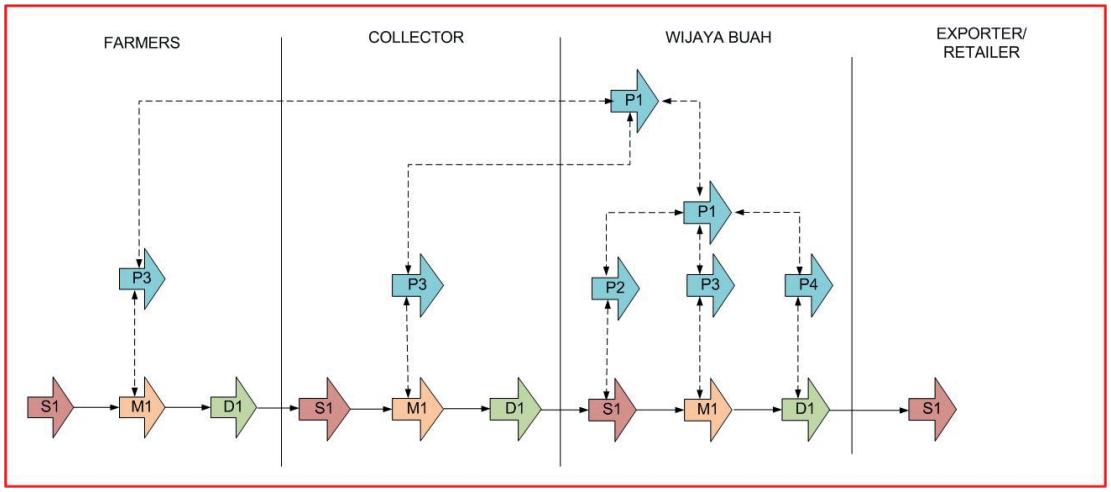

Figure 1: The activities mapping of mangosteen business.

HOR II

In this study, the aggregate risk potential which contribute the highest ARP was unmaintained orchard (A_{14}). The actions considered relevant to prevent the risk agents (PA_k) were organizing the farmers by building farmers association, providing counseling, training, and coaching in management and maintenance of mangosteen orchard, and providing information about obtaining working capital loans.

The result of HOR II is shown in Table 5 which contains the relationship between each preventive action and each risk agent (L_{jk}), the total effectiveness of each action (TE_k), the assessment result of the degree of difficulties for conducting each action (D_k), and the ratio of total effectiveness to difficulty (ETD_k)

DISCUSSION

The result of HOR I showed that unmaintained orchard (A_{14}) were a risk agent with the highest aggregate risk potential. It stimulated some risk events, such as inappropriate fertilization (E_8), inappropriate pruning (E_{10}), and unclean weed (E_{11}). All those risk events happened on the production process (M1) at farmers which will give impact on the growth retardation of mangosteen tree and the decreasing of mangosteen quality and quantity.

The farmers have been having mangosteen orchard of heritage. They inherited 10-20 mangosteen trees with the age of the tree were more than 10 years in average. Due to the lack of knowledge in mangosteen tree cultivation, the farmers think that the mangosteen productivity will not be decreasing. They also do not have enough budget

Table 1: Detail Activities of Mangosteen Business.

Members	SCOR Level 2	Activities
Farmers	P3	Planning of harvesting schedule
		Planning of fertilization schedule
		Planning of insecticide spraying schedule
		Planning of pruning schedule
		Planning of weed cleaning schedule
	S1	Fertilizer purchasing
		Insecticide purchasing
	M1	Fertilization
		Insecticide spraying
		Pruning
		Weed cleaning
	D1	Deliver information of harvesting time to the collector
		Receiving payment from collector
Collector	P3	Planning of harvesting technique
		Planning of harvesting fee
	S1	Ordering unripe (still on tree) mangosteen to the farmers
	M1	Mangosteen harvesting
	D1	Deliver mangosteen to "Wijaya Buah"
		Receiving payment from "Wijaya Buah"
		Pay to the farmers
"Wijaya Buah"	P1	Planning of mangosteen business
	P2	Planning of plastic baskets procurement for storing mangosteen
	P3	Forecasting of mangosteen peak season
		Planning of mangosteen selling price for retailer / exporter
	P4	Planning of deliver schedule to retail
		Planning of picking mangosteen up by retailer / exporter
		Planning of the way of payment
	S1	Getting order information from retailer / exporter
		Pay to the collector
	M1	Mangosteen sortation
		Mangosteen grading
		Storing mangosteen using plastic basket
	D1	Deliver mangosteen to retailer / exporter
		Receiving payment from retailer / exporter

to spend money for maintaining the mangosteen orchard, meanwhile mangosteen orchard need to be fertilized and pruned as well as the orchard clean from the weeds so the trees grow optimally in producing mangosteen fruits.

Improper time and technique in fertilization of mangosteen orchard will make the lack of soil nutrient to the mangosteen trees [8]. The availability of soil nutrient in appropriate time will support mangosteen trees grow optimally [3].

Improper time and technique in pruning of mangosteen orchard will retard the growth of mangosteen trees. A routine pruning will support the blooming of flowers of mangosteen trees so that the mangosteen trees will produce more mangosteen fruits. The pruning of mangosteen trees should be done twice a year simultaneously with fertilization and soil tilling. [7].

Unclean weed will also retard the growth of mangosteen trees. The weed will take the soill nutrient so that decrease the productivity of mangosteen trees and poison the trees. It will make yellow or black spots which will decrease the quantity and the quality of the mangosteen [5]. In order to have clean mangosteen orchard from weed growth, the orchard must be cleaned from orchard growth routinely at least once a week.

All of risks of inappropriate fertilization, inappropriate pruning, and unclean weed can be mitigated by providing counseling, training, and coaching in management and maintenance of mangosteen orchard to the farmers (PA_2). This risk mitigation was the most difficult to be applied among others risk mitigations because the farmers think that they do not need counseling, training, and coaching in doing their business. Although this risk mitigation was the most difficult to be applied, a lot of risks potential can also be mitigated by providing counseling, training, and coaching in management and maintenance of mangosteen orchard to the farmers. The subject of the counseling, training, and coaching in more detail can be how to maintain the mangosteen orchard appropriately, how to manage the diseases on mangosteen orchard, how to manage mangosteen defects, how to estimate the harvesting schedule accurately, how to have a high bargaining position in negotiating with collector, as well as how to monitor the availability and inventory of fertilizer and pesticide. The counseling, training, and coaching in management and maintenance of mangosteen orchard to the farmers should be carried out subject by subject in a long term by Agricultural Office in Blitar District and it should also involve other stakeholders, like "Wijaya Buah" and the collectors.

Table 2: Risk Events and Risk Agents.

Risks Code	Risk Events	Risk Agent Code	Risk Agents
E_1	Error in estimating of harvesting schedule	A_1	Farmers inaccuracy in estimating the time of harvesting
		A_7	Plant diseases

Risks Code	Risk Events	Risk Agent Code	Risk Agents
E_2	Financial loss	A_3	Pricing system without considering mangosteen quantity (the buyer buys all mangosteen in one tree without counting the mangosteen quantity)
E_3	Mangosteen defects	A_4	Defect due to harvesting technique of collector
		A_6	Untrained human resource
		A_7	Plant diseases
E_4	Unfulfilled demand	A_{12}	No fixed agreement between "Wijaya Buah" and retailer / exporter
		A_8	Lack of supplier
		A_9	Not having fixed consumers
E_5	Lack of fertilizer	A_{10}	Unavailability of fertilizer
E_6	Lack of insecticide	A_{11}	Unavailability of insecticide
E_7	Inappropriate quantity and quality of mangosteen	A_4	Defect due to harvesting technique of collector
		A_7	Plant diseases
		A_{13}	Out of season
E_8	Inappropriate fertilization	A_6	Untrained human resource
		A_{10}	Unavailability of fertilizer
		A_{14}	Unmaintained orchard
E_9	Inappropriate pesticide spraying	A_6	Untrained human resource
		A_{11}	Unavailability of insecticide
		A_{15}	Lack of human resources
E_{10}	Inappropriate pruning	A_6	Untrained human resource
		A_{14}	Unmaintained orchard
		A_{15}	Lack of human resource
		A_{16}	Lack of budget for maintaining the orchard
E_{11}	Unclean weed	A_2	Unmonitored weed cleaning
		A_6	Untrained human resource
		A_{14}	Unmaintained orchard
		A_{17}	Weed growth
E_{12}	Mangosteen defects in harvesting	A_5	Unskilled collector in harvesting

Risks Code	Risk Events	Risk Agent Code	Risk Agents
		A_{18}	Too high mangosteen tree
E_{13}	Fluctuation demand	A_9	Not having fixed consumers
		A_{19}	Uncertain market
E_{14}	Inappropriate grading	A_{20}	Inaccuracy employee of "Wijaya Buah" in grading
E_{15}	Misinformation about harvesting time from farmers to the collector	A_1	Farmers inaccuracy in estimating the time of harvesting
		A_{21}	Miscommunication between farmers and the collector
E_{16}	Mangosteen defect in delivery process from collector to "Wijaya Buah"	A_{22}	Unstable condition in delivering mangosteen
		A_{23}	Overload in delivery
E_{17}	Shortage of mangosteen inventory	A_8	Lack of supplier
		A_{27}	Uncertain demand
		A_{13}	Out of season
E_{18}	Mangosteen defect in delivery process from "Wijaya Buah" to retailer / exporter	A_{22}	Unstable condition in delivering mangosteen
		A_{24}	Inappropriate mangosteen handling
		A_{25}	Unstandardized storage
E_{19}	Delayed payment from retailer	A_{12}	No fixed agreement between "Wijaya Buah" and retailer / exporter
		A_{26}	Miscommunication between "Wijaya Buah" and the collector
	: Farmers	: Collector	: "Wijaya Buah"

Organizing the farmers by building association of farmers (PA_1) will support the activities of providing counseling, training, and coaching in management and maintenance of mangosteen orchard to the farmers. The farmers will be easier in getting information about their business and solving problem in their business if they have association. According to General Directorate of Horticulture [2], the productivity of the mangosteen orchard can be increased by 2% if the orchard is rearranged and managed together in groups which then join the association of farmers to discuss all the problem and exchange all information about mangosteen business.

Table 3: HOR I.

		A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}	A_{13}	A_{14}	A_{15}	A_{16}	A_{17}	A_{18}	A_{19}	A_{20}	A_{21}	A_{22}	A_{23}	A_{24}	A_{25}	A_{26}	A_{27}	S_i
Plan	E_1	3						3																					8
	E_2			9										9															7
	E_3				9	3																							8
	E_4								3	3			1																4
Source	E_5										3																		6
	E_6											3																	7
	E_7				3			3						3															6
	E_8						3			3					9														7
Make	E_9						3			3						1													7
	E_{10}						3								9	1	3		3										5
	E_{11}		3				3								9			9											4
	E_{12}					3													3										7
	E_{13}									3										1									5
	E_{14}																				3								5
	E_{15}	3																				3							3
Deliver	E_{16}																						3	3					6
	E_{17}								3					9														3	8
	E_{18}																						3		3	3			7
	E_{19}												3														3		5
O_j		2	6	7	6	4	4	5	4	2	2	2	3	5	7	1	2	4	2	5	2	1	2	2	5	2	4	4	
$ARP_j = O_j \sum_i S_i R_{ij}$		66	72	441	540	180	276	210	144	54	120	42	57	765	1008	12	30	144	72	25	30	9	78	36	105	42	60	96	
Rank		16	15	4	3	7	5	6	9	19	10	21	18	2	1	26	24	8	14	25	23	27	13	22	11	20	17	12	

Table 4: Scale of Severity and Occurrence.

Level	Severity	Occurrence
1	No	Almost Never
2	Very Slight	Remote
3	Slight	Very Slight
4	Minor	Slight
5	Moderate	Low
6	Significant	Medium
7	Major	Moderately High
8	Extreme	High
9	Serious	Very High
10	Hazardous	Almost Certain

The availability of capital in sufficient amounts and on time was very important for implementing risks mitigations of mangosteen business. Financial institutions were the sources of the capital [4]. Most of the farmers have not known about the capital loans given to farmers so that information about obtaining working capital loans should be provided to farmers.

Table 5: HOR II.

Risk Agent Code	Description of Risk Agent (A_j)	Organizing the Farmers by Building Association of Farmers (PA_1)	Providing Counseling, Training, and Coaching in Management and Maintenance of Mangosteen Orchard (PA_2)	Providing Information about Obtaining Working Capital Loans (PA_3)	ARP_j
A_{14}	Unmaintained orchard	9	9	3	1080
Total Effectiveness of Proactive Action k ($TE_k = \sum_j ARP_j L_{jk} \forall k$)		9720	9720	3240	
Difficulty of Conductiong Action k (D_k)		5	4	3	
Ratio of Total Effectiveness to Difficulty k ($ETD_k = TE_k / D_k$)		1944	2430	1080	
Priority of Proactive Action k		2	1	3	

CONCLUSSIONS

A lot of risks potential in running mangosteen busines in Blitar District. Unmaintained orchard were a risk agent with the highest aggregate risk potential in that business. Providing counseling, training, and coaching in management and maintenance of mangosteen orchard to the farmers was the most priority of actions for preventing the risk agent. This action should be done by collaboration of all stakeholders of mangosteen business in Blitar District.

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