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Risk analysis of Jernang plant (*Daemonorops draco*) in Aceh Province

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Abstract. Jernang is a non-timber forest product (NTFP) which has started to be traded and become a high-value commodity. Jernang is a type of rattan that produces a resin known as “dragon's blood” which has many benefits such as dye raw materials in the ceramics, marble, wood, paper and pharmaceutical industries. Aceh province is one potential area for Jernang development. Supply chain is a complex system that has elements that are orderly, interrelated, dynamic, have specific goals and are probabilistic. In the Jernang supply chain there are risks that can cause losses and failures in production. Failure in production does not only occur at the end process but can also occur at the beginning or when the production process is being carried out. Through the Failure Modes and Effect Analysis (FMEA) method, it is expected that each form of failure can be identified in the production process. The results identified indicate that nineteen risk factors at the producer level. Based on the calculation of Risk Priority Number (RPN), the risk of decreasing production results is the most important risk. As such, this risk is the first priority that must be addressed.

1. Introduction

Jernang is a non-timber forest product (NTFP) which has started to be traded and become a high-value commodity. Jernang is a type of rattan that produces a resin known as “dragon's blood”. The resin is processed as powders, granules, or lumps, which has many benefits such as dye raw materials in the ceramics, marble, wood, paper and pharmaceutical industries. [1] The potential for growing Jernang in Indonesia is in the islands of Kalimantan, Java and Sumatra. In Sumatra, Jernang is found in many areas of Jambi, South Sumatra, Riau and Aceh Province. Villagers collect Jernang fruits in forest, and fruits are processed through dry or wet method before they are traded. The rise of illegal logging and forest clearing activities into agricultural and plantation land has made the availability of Jernang in the forest increasingly scarce. Also, intensive collecting of Jernang fruits caused declining Jernang stock in the wild [2]

Jernang market chains included activities from harvesting of the wild or cultivated resource, various degrees of processing and storage of the product at different points in the chain, and transport. Usually, the collection of Jernang fruits from the forest is carried out in groups. These groups usually receive advance loans from the agents at the village level and they are obliged to sell the proceeds from the collection of Jernang fruits to the wholesaler. Furthermore, agents will sell to exporters at a good price. Sometimes these activities don't always happen in that order [3] Supply chain is a complex system that has elements that are orderly, interrelated, dynamic, have specific goals and are probabilistic [4]. In the Jernang supply chain there are risks that can cause losses and failures in production. Failure in production does not only occur at the end process but can also occur at the beginning or when the production process is being carried out.



CV Draco Industrial Agribusiness (CV DIA Group) is a Jernang product export company located in Banda Aceh since 2014. CV DIA Group is often faced with various risks in the flow of the Jernang supply chain. With the very high selling price of Jernang, the demand for Jernang is also increasing. Meanwhile, in fulfilling consumer demand, CV DIA Group often has difficulty fulfilling it both in quantity and quality so that it can threaten the continuation of production. Risk as the probability that an event will result in a loss when that event occurs during a certain period. Handling risks in the supply chain is very necessary in order to minimize costs, time and performance incurred in the supply chain activities. Therefore, through the Failure Modes and Effect Analysis (FMEA) method, it is expected that each form of failure can be identified in the production process and can be determine the risk rating based on the Risk Priority Number (RPN) [4].

2. Materials and methods

2.1. Data collection

The study was conducted from October to November 2017. This research method uses the expert judgment method, namely interviews / filling questionnaires which are conducted directly to those who are experts in their fields. This study used experts selected from the farmer collectors, agents and CV DIA Group. The selection of experts in this research is based on the length of time they have been involved in the Jernang commodity sector, whether in the fields of cultivation, collection, development, trade or utilization of Jernang. The farmers in this study were in Jaya District, Sabet Village, Aceh Jaya Regency, while the agents were in Lhoknga District, Kueh Village, Aceh Besar Regency and CV DIA Group in Banda Aceh. Furthermore, from the results of the interview, the risk rating is determined based on a scale of 1- 10 shows in table 1

Table 1 The ranking is sorted from a scale of 1-10

Category	Rank		
	Severity	Occurrence	Detection
No Risk	1, 2, 3	1, 2, 3	1, 2, 3
Quite risky	4, 5, 6	4, 5, 6	4, 5, 6
It's risky	7, 8	7, 8	7, 8
Very risky	9, 10	9, 10	9, 10

2.2. Data Analysis

Data analysis is performed using the Failure Mode and Effect Analysis (FMEA) method, by determining the Risk Priority Number (RPN) of severity, occurrence, and detection contained in the Jernang supply chain. The Risk Priority Number (RPN) methodology is a technique for analyzing risks associated with potential problems that have been identified during the FMEA creation. RPN is used in FMEA to identify risks based on three criteria, namely: (a) Severity (S), the severity that may occur. (b) Occurrence (O), the level of possibility of risk and (c) Detection (D), the level of ability to detect risks. RPN is a multiplication between severity (S), Occurrence (O) and Detection (D) [5]

3. Results and discussion

3.1. Risk identification. Supply chain risk identification aims to determine the risk factors that have a strong influence on supply chain actors. The results (Table 2) identified indicate that are nineteen (19) risk factors at Jernang production. The risk of the quality of goods that do not comply with standards and the risk of goods received not meeting the quantity can be caused by a lack of knowledge about Jernang so that farmers cannot distinguish between Jernang and non-Jernang seeds and do not know which species of Jernang are of good quality. There are 12 species of *Daemonorops* that produce Jernang sap and among these 12 species are the *Daemonorops draco* willd species which produce the best quality Jernang sap [6]. The very high selling price makes farmers very hasty in harvesting

Jernang fruit. The potential for Jernang sap production is decreasing and even tends to be increasingly scarce due to unsustainable harvest patterns by cutting the trees, so that the natural regeneration system is hampered. This is also exacerbated by the expansion of plantation crops [7]. Product counterfeiting can also occur due to the difficulty of finding Jernang in the forest. Farmers or agents mix the Jernang with the seeds and skin of the rattan Jernang fruit, or even the powdered bricks to increase the weight and physically the mixture looks authentic [7]

Table 2 Identification of risks in CV DIA Group

No	Element	Risk Identification	
1	<i>Plan</i>	p1	Risk of schedule errors in the delivery of goods by suppliers.
		p2	The risk that the goods received are not as desired
		s1	Risk of late receipt of goods from suppliers
		s2	The risk of the quality of goods that do not comply with standards
2	<i>Source</i>	s3	Risk of goods received not meeting the quantity
		s4	The risk of goods being damaged during the delivery process
		s5	Risk of suppliers not making sales
		s6	Risk of limited ability of workers
		s7	There is a risk of excess goods in the warehouse
		m1	The risk of materials in the warehouse can no longer be used (damaged due to too long storage)
		m2	Risk of delays and delays in processing
		m3	Risk of damage during the production process
3	<i>Make</i>	m4	Risk of decline in production yields
		m5	Risk of contamination during processing
		m6	Risk of equipment damage during processing
4	<i>Deliver</i>	d1	Risk of sudden demand from consumers
		d2	Risk of running out of stock
5	<i>Return</i>	r1	The risk of product return
		r2	Risk of price fluctuation of goods

3.2. Supply chain risk evaluation.

The risk evaluation in the supply chain aims to measure the level of risk in each supply chain. This risk evaluation is necessary in order to select priority-based management actions in accordance with the risk factors that have been identified. Table 3 shows that the critical risks that must be handled at the CV DIA Group are the risk of suppliers not making sales, the risk of running out of inventory, the risk of decreasing production results, the risk of quality of goods that are not in accordance with standards, the risk of damage during the production process, the risk of goods received not as desired and the risks product returns. To anticipate the occurrence of risks in a supply chain, cooperation contracts between parties that have an interest in risk sharing can be carried out and thus increase profits among supply chain actors. And also risk handling can be done by making risk mitigation [8] Risk mitigation that can be done by CV DIA Group is (a) Determine the quantity of Jernang supply, (b) Determine the Jernang production schedule, (c) Perform maintenance of production equipment, (d) Determine the supply schedule for Jernang, and (e) Determine the distribution of quality in processing Jernang

Table 3 Score Severity, Occurrence and Detection at CV DIA Group

No	<i>Failure mode</i>	S	O	D	RPN
p1	Risk of schedule errors in the delivery of goods by suppliers	3	4	6	72
P2	The risk that the goods received are not as desired	6	7	6	252
s1	Risk of late receipt of goods from suppliers	5	6	8	240
s2	The risk of the quality of goods that do not comply with standards	5	8	6	240
s3	Risk of goods received not meeting the quantity	4	5	7	140
s4	The risk of goods being damaged during the delivery process	2	4	6	48
s5	Risk of suppliers not making sales	8	7	6	336
s6	Risk of limited ability of workers	5	4	6	120
s7	There is a risk of excess goods in the warehouse	2	3	6	36
m1	The risk of materials in the warehouse can no longer be used (damaged due to too long storage)	6	6	5	180
m2	Risk of delays and delays in processing	3	2	6	36
m3	Risk of damage during the production process	7	6	6	252
m4	Risk of decline in production yields	9	8	5	360
m5	Risk of contamination during processing	7	7	5	245
m6	Risk of equipment damage during processing	4	5	7	210
d1	Risk of sudden demand from consumers	5	7	7	175
d2	Risk of running out of stock	9	8	4	288
r1	The risk of product return	4	6	7	168
r2	Risk of price fluctuation of goods	5	4	8	160

4. Conclusions

In the analysis that has been carried out, the Jernang supply chain has a very high level of risk. Risk cannot be avoided but can be minimized or reduced by carrying out appropriate risk management so as to minimize costs, time and supply chain activities. From determining the risk rating with the RPN, it can be determined the distribution of risk based on high risk, medium risk and low risk.

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