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Supply Chain Risk Analysis on Koi Fish Cultivation Business in Sumberdodol Village, Panekan District, Magetan Regency

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A B S T R A C T

Indonesia has various sectors that make an important contribution to its development, one of which is the fishing industry. Koi fish is a type of fish that is cultivated in Indonesia. Risk management is important for controlling risks that may occur by identifying risks and risk causes, risk categories and possible risk responses. Risk management is carried out to reduce the possibility of risk impact on this project. The House of Risk (HOR) method is used to identify risk events and risk agents and design mitigation to address the causes of these risks. This study identified 10 risk events and 16 risk drivers through the project. The priority risks addressed are A1 (ineffective financial management) and A7 (long-term material shortage) with 4 recommended mitigation actions.

INTRODUCTION

Sector development in Indonesia can be applied to the fisheries sector. Classification of types of cultivation includes cages, paddy fields, marine cultivation, ponds and floating nets (Rufaidah, 2020). Koi fish is a type of fish that can be cultivated in Indonesia. The koi fish hatchery process needs to be done properly to minimize the risks that can occur in koi fish farming. Risk is an unpleasant or detrimental consequence of an action or of an action that will arise. While production risk is a bad condition that occurs as a result of the treatment or action taken in the ongoing production process. Vulnerable production risks arise in hatcheries because the condition of fish that are still small and weak will easily die for certain reasons. Supply chain risk management is the implementation of strategies to manage both daily and extraordinary supply chains based on continuous risk assessment (Nguyen, 2017).

Supply chain risks are classified into operational and disruption risks. Operational risk is related to uncertainty in the supply chain which includes uncertainty in demand, supply and costs. Disturbance risk is the risk that occurs as a result of natural or man-made disasters such as earthquakes, floods, tsunamis, and major economic crises. Both operating risks and disruptions can seriously disrupt and can delay the availability of materials, information and materials, thereby impairing sales performance and increasing costs. Supply chain risk management has the objective of reducing the likelihood of risk events occurring and increasing the ability to recover from disruptions (Pujawan, 2009). Risk management is an important concept in project management, which all project managers should not ignore. Therefore, in project planning, project managers and teams must ensure that more attention is paid to the identification and causes of risk, risk categories, and possible risk responses (George, 2018). This study aims to identify risk agents or risk causes and provide risk mitigation with the House of Risk (HOR) approach.

House of Risk is developed on the foundation of the well-known House of Quality (HOQ) model but in the sense of determining which risk actions should be addressed first and choosing a series of proactive actions deemed cost-effective to prioritize. It is divided into two phases, namely House of risk 1 (HOR-1) and House of risk 2 (HOR-2), in which stage HOR-1 generates priority risk agents used for preventive action. Whereas at the HOR-2 stage, effective actions with a fair value are prioritized (Nguyen, 2018).

LITERATUR REVIEW

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METHODOLOGY

The research method was carried out starting with observations made in Sumberdodol Village, Panekan District, Magetan Regency, especially on koi fish cultivators. This activity was carried out to find out the current situation regarding ongoing cultivation activities. There are 3 stages in this research, namely:

1. Data Collection and Processing Stage Data collection is carried out to identify risk events (risk events) and risk causes (risk agents). Furthermore, the risk event value and risk agent value are linked to determine the priority risk agent. Then carry out the HOR-2 stage related to risk agents and preventive actions to produce appropriate preventive actions.
2. Analysis and Discussion Stage Analysis was carried out on the results of HOR stage 1 and HOR stage 2 to see what factors had an influence and how to analyze the preventive measures.
3. Conclusion Stage This stage is based on the formulation of the problem and objectives set in the investigation (Putri, 2021).

RESEARCH RESULT AND DISCUSSION

Risk identification activities are carried out by means of interviews with cultivators. Interviews were conducted to identify risk events and what risk agents might occur in these activities. Identification of risk events or risk events from interviews and the risk severity value (Si) can be seen in Table 1.

Table 1. Identification of Risk Events

No.	Risk Event (Ei)	Si
E1	The consumer cancels the contract.	5
E2	The pool frame is not strong enough to support the weight.	2
E3	Lack of capital.	3
E4	The quality of the materials is not up to standard.	3
E5	Prices of materials fluctuate.	4
E6	Material shortage	4
E7	Errors in delivery (quantity, product type, date, address).	1
E8	Delayed project	3

E9	Dead fish in transit.	2
E10	Dead fish in quarantine.	1

Source: Primary Data, 2023

Then the identified risk agent or risk agent (Aj) and the value of the occurrence rate (Oj) based on interviews with cultivators are listed in Table 2.

Table 2. Identification of Risk Agents (Risk Causes)

No.	Risk Agent (Aj)	Oj
A1	Manage finances ineffectively.	2
A2	Weaknesses in supplier selection.	3
A3	Weaknesses in the control system (quality of materials, products).	3
A4	Incorrect purchase information.	2
A5	The size of the pool does not match the water discharge.	1
A6	Economy Crysis.	2
A7	Long-term stock shortage of materials.	3
A8	Limits on the quantity of materials from suppliers.	3
A9	Supplier went bankrupt.	2
A10	Strict requirements for products.	4
A11	Transportation disruption.	2
A12	Supplier delivery times change many times.	3
A13	Low salary workers.	4
A14	The distance for sending fish to the location is too far.	3
A15	Unhealthy condition of fish.	2
A16	Lack of oxygen due to long shipping.	2

Source: Primary Data, 2023

Data processing begins with measuring the correlation value (Rij) and calculating the risk priority index (ARP) value. This value is used to determine risk management priorities and then becomes input for HOR Stage 2 (Magdalena, 2019). The results of measuring correlation values and ARP calculations can be seen in Table 3.

Table 3. Calculation of Stage 1 HOR

Ei	Risk Agent (Aj)																Si
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	
E1	9	3							1								5
E2			9	1	9												2
E3	9					9											3
E4			3	9				1									3
E5						3			1	3							4
E6							9	9	1	3							4
E7				3							9	9					1
E8	1						3		3		3		9				3
E9											1			9	1	9	2
E10														1	9	3	1
Occ (Oj)	2	3	3	2	1	2	3	3	2	4	2	3	4	3	2	2	
ARP	150	45	81	64	18	78	135	117	26	96	40	27	108	54	22	42	
Priorit as	1	11	6	8	16	7	2	3	14	5	12	13	4	9	15	10	

Source: Primary Data, 2023

The cumulative results of the ARP values calculated using the HOR stage 1 are followed by making a Pareto diagram as shown in Figure 1.

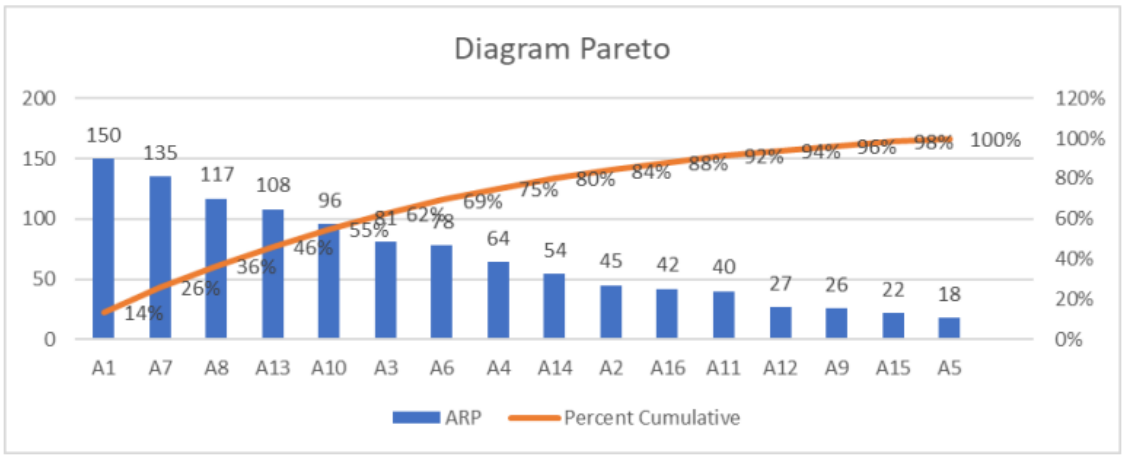

Figure 1. Pareto Chart

This stage is the risk evaluation stage which determines the cause of the risk to be prioritized. Table 4 shows rating 1 risk agent (causes of risk), namely ineffective financial management (A1), ARP value 150 to rating 16 risk agent code A5, namely the size of the pool does not match the water discharge with an ARP value of 18.

Table 4. Pareto Calculations

Risk Agent	Rating	ARP	ARP Cum.	ARP %	Persen Cum.	Category
A1	1	150	150	14	14	Priority
A7	2	135	282	12	26	
A8	3	117	401	11	36	Not Priority
A13	4	108	510	10	46	
A10	5	96	606	9	55	
A3	6	81	687	7	62	
A6	7	78	765	7	69	
A4	8	64	829	6	75	
A14	9	54	883	5	80	
A2	10	45	970	4	84	
A16	11	42	925	4	88	
A11	12	40	965	4	92	
A12	13	27	992	2	94	
A9	14	26	1018	2	96	
A15	15	22	1040	2	98	
A5	16	18	1058	2	100	

Source: Primary Data, 2023

Then the calculation of HOR stage 2 is carried out in several stages. First, design risk mitigation measures, then determine the correlation between risk mitigation and agent risk and calculate the ratio of effectiveness to difficulty. Identification for risk mitigation can be seen in Table 5.

Table 5. Identification of Mitigation Measures

Risk Agent	Mitigation Actions	Mitigation Code (PA)
Manage finances ineffectively (A1)	Evaluate the effectiveness of financial flows	PA1
	Improve the flow of the financial system	PA2
Short term material stock shortage (A7)	Have a backup supplier	PA3
	Looking for substitute materials	PA4

Source: Primary Data, 2023

The results of the assessment of risk mitigation measures with risk agents with a recapitulation of the calculation of the ratio of effectiveness to difficulty as the output of HOR phase 2 can be seen in Table 6.

Table 6. Calculation of Stage 2 HOR

Risk Agent	Mitigation Actions (PAk)				
	PA1	PA2	PA3	PA4	ARP
A1	9	3			150
A3			9	9	135
Total effectiveness of action (TEk)	1350	450	1215	1215	
Degree of difficulty performing action (Dk)	3	3	3	4	
Effectiveness to difficulty ratio (ETD)	450	150	405	304	
Rating	1	4	2	3	

Source: Primary Data, 2023

The total effectiveness of action (TEk) is obtained by adding up the results of the correlation values that match the ARP on each priority risk agent. Degree of difficulty performing action (Dk) is a degree of difficulty that describes the level of difficulty of mitigation actions.

The value scale used is based on a score scale of 3 for mitigation actions that are easy to implement, 4 for mitigation actions that are rather difficult to implement and 5 for mitigation actions that are difficult to implement. Effectiveness to difficulty ratio (ETD) is a benchmark or parameter of mitigation measures based on the order of ease of implementation. The higher the ETD value, the more ideal mitigation actions are considered to be implemented. Based on table 6, it can be concluded that the most ideal mitigation to do is to evaluate the effectiveness of financial flows (PA1). Mitigation actions are sorted from the highest ETD value to the lowest value. Mitigation action recommendations based on research results are:

1. Evaluating the effectiveness of the financial flow (PA1) Risk mitigation measures have the highest rating with a TEk score of 1350, a Dk value of 3 and an ETD value of 450. The factors in the financial flow need to be maximized to increase their effectiveness.
2. Having a backup supplier (PA3) The second rank risk mitigation measure with a TEk value of 1215, a Dk value of 3 and an ETD value of 405. A reserve supplier can be one way to minimize the impact of the risk of material shortages.

3. Looking for material replacement materials (PA4) Mitigation measures ranked third with a TEk value of 1215, a Dk value of 4 and an ETD value of 304. Substitute materials can be an option when the material used is out of stock, but material replacement materials also need to be reviewed according to the standards used.
4. Improving financial system flows (PA2) Mitigation measures in the last rank with a TEk value of 450, a Dk value of 3 and an ETD value of 150. Financial system flows need to be improved to support the smooth running of koi fish cultivation.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the House of Risk measurements in this study, it can be concluded that there are 10 risk events with 16 risk agents. The results of calculating the ARP priority index in the House of Risk model stage 1, the highest score was obtained by A1, namely ineffective financial management with an ARP value of 150. Meanwhile, the lowest value was A5, namely the size of the pool did not match the water discharge with an ARP value of 18. Based on the results mapping with a pareto diagram, the first rank risk agent is ineffective financial management (A1) and the second rank is a long-term shortage of material stocks (A7). These two risk agents indicate that ineffective financial management and long-term stock availability are causes that will be prioritized as preventive measures in koi fish farming. Risk mitigation carried out at House of Risk stage 2 is to minimize or avoid risks in koi fish farming. Based on the results of the analysis, there are 4 recommendations for priority mitigation actions. The mitigation action with the highest ranking is evaluating the effectiveness of financial flows (PA1) with a total effectiveness of action (TEk) value of 1350, an effectiveness to difficulty ratio (ETD) of 450 and a degree of difficulty performing action (Dk) of 3. This mitigation action is expected can minimize the risks that occur in koi fish farming.

ADVANCED RESEARCH

Still conducting further research to find out more about Supply Chain Risk Analysis in Koi Fish Cultivation Businesses in Sumberdodol Village, Panekan District, Magetan Regency.

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