Risk Analysis of Supply Chain Cultivation of JOPER

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Abstract. Joper (Jowo Super) is one kind of high-quality chicken. The demand of this type of chicken is an increasingly popular type of livestock to be developed and is expected to meet market demand for native chicken meat. On the other hand, there are some obstacles experienced by farmers, such as the risk in cultivation. This study aims to identify and analyse the risk event and risk agent that may occur using the House of Risk method. From the research results, 12 risk events and 14 risk agents were found. The result of House of Risk phase 1, it is found that 5 of the 14 risk agents includes in the area of dominant risk agents. Then, the process to identify the priority of mitigation strategies of the risk is performed in the House of Risk phase 2. In this phase, there are 7 risk management mitigation been proposed and prioritised to be applied.

1. Introduction

One principle of a supply chain management to effectively and efficiently perform is to produce and deliver the goods and services in the right quantities, to the right places at the right time in a cost effective manner [1]. A research by [2] reveal that risk is a detrimental event where the chance of occurrence can be measured by decision makers. According to [3] and [4], risk is the possibility of an occurring event and related to uncertainty which can cause losses and cannot be known definitely by the decision makers. Risk may occur in many stages or phase in the production stream from upstream to downstream. The stream develops a chain that is familiarly known as supply chain. In [5], the definition of supply chain management is the integration of all activities starting from procurement to distribution to customers. The risk in a supply chain should be manage in a discipline of management known as risk management. Risk management is various effort made by management so that the company gets variety of benefits ranging from achievement, minimizing losses, increasing profits, and providing job security. According to [6], the factors causing the risk of supply chain activity is a very complex supply chain network, high dependence on suppliers, the existence of organizational interactions within the supply chain, the short life cycle of a product. Performance of a supply chain process becomes a focus to design systems that can minimize time and cost [7]. Risk in supply chain can be a series of negative outcomes in various areas of the supply chain, including supply, operations, marketing, sales, and customer service [8].

The production (farming) of Joper has high economic value, and tends to be continuously increasing, the main reason is in the native chicken is drug and antibiotic residues free. At present, the supply of native chicken is still low, it only able to supply 30% of the total demand of this variety of chicken. Traditional native chicken farmers in Indonesia tend to raise the chicken in small quantities and without the support of good treatment techniques. In regard with this issue, there is a crossing
variety of chicken between the type of native chicken which has the characteristics of rapid growth and high posture with chicken with high egg productivity which is called as Joper (Jowo Super). Joper is a faster growth chicken compared to native chicken. This makes Joper become increasingly popular and favored by farmers and very suitable for intensive cultivation. Joper is also expected to meet market demand for native chicken meat. CV Rafli and Danu’s Farm is a company focusing in the Joper farming and has produced Joper since 2009. However, there are several obstacles in the area such as risks in cultivation. Also, the length of the supply chain in CV Rafli and Danu’s Farm results in risks that might occur. Therefore, a study is required to identify and analyze the risks that may occur in the cultivation process and there is lack of research has been done in the area of Joper cultivation. So far, research about chicken only discusses about the quality of frozen chicken meat [9], the supply chain of poultry in facing the sanitation crisis [10], and the management of poultry supply chains [11]. The result of this study is a set of risk mitigation proposed to reduce risk in the supply chain of this livestock, which is the best step in reducing the impact of risk and can minimize losses that will be obtained by the farmers.

2. Research Methods
To deal with the problem, some data will be collected and analyzed. The data analysis method use is the House of Risk (HOR) model which is the development of the FMEA and QFD models useful for developing the framework for managing supply chains [12]. House of Risk phase 1 (HOR 1) is used as a process of identifying, analyzing, and evaluating risk. HOR 1 produces the aggregate of risk potential (ARP), which easily lead to proposed and planned mitigation strategy [13].

House of Risk phase 2 (HOR 2) is used to determine the risk management from the sources of risk that have been identified at the highest level based on the highest ARP value in the House of Risk phase 1 process (HOR 1). House of Risk phase 1 will be used as input to the House of Risk phase 2. In HOR 2, the priority of risk management strategies is determined to identify at risk agents at high risk level. After conducted design priority to mitigate the risk agent, it’s expected no longer risk existed in the red area of the risk map [14].

3. Result
3.1. Risk Identification
The supply chain activities at CV Rafli and Danu’s Farm is shown in Figure 1. It is started with receiving supply of three different “raw materials”: Eggs; drugs, vaccines, and vitamins; and foods.

![Figure 1. Supply Chain of CV Rafli and Danu’s Farm](image-url)
Mapping the activities in the supply chain of CV Rafli and Danu’s Farm uses a SCOR model consisting of plan, source, make, deliver, and return which are the major processes of the business process in the supply chain. The mapping process will facilitate the identification of risk agents and risk events that occur in CV Rafli and Danu's Farm’s business activities in interviews and observations with an expert. The result of this process is presented in table 1 and table 2. Table 1 shown the identification of risk event and table 2 presents risk agent. Risk event is possible occurrence of risk and risk agent is the cause of the risk event.

Table 1. Risk Event

| Process       | Activity                        | Risk Event                                           | Code |
|---------------|---------------------------------|------------------------------------------------------|------|
| Plan          | Planning needs                  | Planning needs are not as planned                    | E1   |
|               | Production planning             | Sudden changes in the production schedule            | E2   |
|               | Scheduling raw material arrivals| Delays in the arrival of raw materials                | E3   |
| Source        | Receiving and checking raw materials | The quality of raw materials is not good and defective | E4   |
|               | Egg production process          | Eggs are damaged when chickens lay eggs              | E5   |
|               |                                 | Eggs break during cleaning                            | E6   |
|               |                                 | The egg hatching process is not vertile at 7 days    | E7   |
|               |                                 | The eggs do not hatch on the incubator process at 18 days old | E8   |
|               |                                 | Overdrawn leg defects in the 21 days age selection process | E9   |
| Make          | Hatching process                | DOC dies during the process in the heating box       | E10  |
|               | The chicken production process which is ready to harvest | The chicken dies during the process in the growing cage | E11  |
| Deliver       | Chicken delivery                | The delivery of chicken is interrupted               | E12  |

Table 2. Risk Agent

| Risk Agent                                           | Code |
|------------------------------------------------------|------|
| A significant increase in demand                     | A1   |
| Lack of communication                                | A2   |
| Lack of human resource                               | A3   |
| Transportation disruption                             | A4   |
| The egg falls too high                               | A5   |
| Washing too fast                                     | A6   |
| The imperfect fertilization                           | A7   |
| External factors from suppliers                       | A8   |
| Egg shells are too hard                              | A9   |
| DOC dies before hatching                              | A10  |
| DOC feet pinched                                     | A11  |
| Poor DOC quality                                     | A12  |
| The amount of feed is not balance with the number of chickens | A13  |
| Limited transportation                               | A14  |
3.2. *House of Risk Phase 1*

After the risk event and risk agent are identified, the result will be mapped in to the HOR phase 1 as shown in table 3. The top row in the table is the risk agent while the first column is the risk event. The value of severity and occurrence is obtained from the scale of the company’s losses which are configured in terms of costs and how often the events occur within a certain time period.

| Business Processes | Risk Event | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9 | A10 | A11 | A12 | A13 | A14 | Severity |
|-------------------|------------|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|---------|
| Plan              | E1         | 1  |    |    |    |    |    |    |    |    |     |     |     |     |     | 5       |
|                   | E2         |    |    |    |    |    |    |    |    |    |     |     |     |     |     | 6       |
|                   | E3         |    | 1  |    |    |    |    |    |    |    |     |     |     |     |     | 4       |
|                   | E4         | 1  |    |    |    |    |    |    |    |    |     |     |     |     |     | 3       |
|                   | E5         |    |    | 9  |    |    |    |    |    |    |     |     |     |     |     | 8       |
|                   | E6         |    |    |    | 9  |    |    |    |    |    |     |     |     |     |     | 7       |
|                   | E7         |    |    |    |    | 9  |    |    |    |    |     |     |     |     |     | 9       |
| Source            | E8         |    |    |    |    |    | 8  | 9  |    |    |     |     |     |     |     | 9       |
|                   | E9         |    |    |    |    |    |    |    |    |    | 9  |     |     |     |     | 8       |
|                   | E10        |    |    |    |    |    |    |    |    |    |     | 3  |     |     |     | 8       |
|                   | E11        |    |    |    |    |    |    |    |    |    |     | 9  | 5   |     |     | 5       |
|                   | E12        |    |    |    |    |    |    |    |    |    |     |    |    | 3  | 6     | 6       |
| Make              | E13        |    |    |    |    |    |    |    |    |    |     |    |    |    |    | 5       |
|                   | E14        |    |    |    |    |    |    |    |    |    |     |    |    | 5  | 5     | 5       |
| Deliver           | E15        |    |    |    |    |    |    |    |    |    |     |    |    |    | 5     | 5       |

Based on the ARP calculation in the table 3, then the dominant risk agent is determined using the Pareto diagram. The pareto diagram of the risk agent is presented in figure 2.

![Pareto Chart](image)

**Figure 2.** Pareto chart of the risk agent

Based on the Pareto principle, 78.14% risk agent is selected in order to design mitigation strategy that is expected to affect the improvement of 21.86% other risk agents. There are 6 dominant risk agents out of the total of 14 risk agents in the supply chain activities of CV Rafli and Danu’s Farm. The position of the risk agent in the risk map based on ISO 31000 shown in figure 3. It is shown in figure 3 that all the determined and prioritized risk are in the red area in the risk map. Mitigation
strategy to reduce the impact of the risk is required. The process to develop the strategy to mitigate the risk will be done in HOR phase 2.

Figure 3. The risk map before the planning handling strategy

3.3. House of Risk Phase 2

Based on interviews with experts after the calculation of house of risk phase 1, it is found 7 preventive actions (PA); evaluate the mechanism of artificial insemination (PA1); give direction to employees (PA2); Regular handling of dirt (PA3); agreement with suppliers (PA4); do the egg binoculars early (PA5); strict engine control is related to temperature, humidity and egg reversal (PA6); give base to the egg basket (PA7); for the mitigation strategies for the dominant 6 risk agents and presented in HOR phase 2 as presented in Table 6. The value of correlation between risk and preventive action is presented by scale 9 (strong correlation), 3 (medium correlation), and 1 (weak correlation), 0 (no correlation).

Table 4. HOR Phase 2

| To be treated risk agent          | Preventive Action (PAk) | Aggregate Risk Potentials (ARP) |
|-----------------------------------|-------------------------|---------------------------------|
| Imperfect fertilization           | 9                       | 3                               | 9                               | 810                             |
| External factors from suppliers   | 3                       | 9                               | 9                               | 720                             |
| Egg shells are too hard           | 3                       | 9                               | 9                               | 648                             |
| DOC dies before hatching          | 3                       | 9                               | 9                               | 567                             |
| DOC feet pinched                  | 9                       | 9                               | 9                               | 360                             |
| Washing too fast                  | 9                       | 9                               | 9                               | 315                             |
| Total effectiveness of action     | 7.290                   | 2.835                           | 4.374                           | 6.480                           | 13.770                          | 5.103                           | 3.240                           |
| Degree of difficulty performing action | 3                  | 4                               | 5                               | 4                               | 5                               | 3                               | 4                               |
| Effectiveness to difficulty       | 2.430                   | 708.75                          | 874.80                          | 1.620                           | 2.754                           | 1.701                           | 810                             |
| Rank of priority                  | 2                       | 7                               | 5                               | 4                               | 3                               | 1                               | 6                               |

The mitigation strategy is then discussed with the management to predict the impact to the risk agent. The result of the discussion is the presented in risk map as shown in figure 4. It is shown that based on the expert, the mitigation strategy is predicted to be able to reduce the level of the risk in the risk map. Before the risk mitigation, all the risk agents are in the red area but after the mitigation, the status is reduced to yellow and green area.
Figure 4. The map of risk after planning a handling strategy

4. Conclusion
Based on the results of research conducted on CV Rafli and Danu’s Farm, it is found that there are 12 risk events and 14 risk agents in the supply chain activities of CV Rafli and Danu’s Farm. In HOR phase 1 and there are 6 risk agents that is selected as the priority of treatment. Based on the results of HOR phase 2, the priority results of the handling strategy are obtained and can be a consideration for companies to make decisions in the context of handling risks. However, the study has not concerned with the financial aspect of the mitigation. For the further study, it has been prepared to do research about the financial aspect of the strategy so that the management may choose between apply the strategy to reduce the risk or leave the risk without any mitigation based on the most cost-effective alternative.

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