Risk Mitigation for Agricultural Products Distribution in Agro-business Terminal Mantung, Kabupaten Malang

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Abstract. Distribution process of the horticultural products in Kabupaten Malang is affected by many factors. The distribution factors need to be identified to find the potential risks arise from every problem, in order to anticipate the barriers and losses. This research is conducted using the Supply Chain Operation Reference (SCOR) method in identifying risks and their risk agents, and using the House of Risks (HOR) method in analysing every risk to determine the mitigation strategies. The results for STA Mantung discovered 15 risks with 23 risk agents. From these 23 risk agents, 12 major risk agents were selected and analysed to determine risk mitigation strategies. There are 14 horticultural mitigation strategies. With these risk management and mitigation strategy the STA Mantung shall be better prepared to face them.

Keywords: SCOR, HOR, Agricultural

1. Introduction
Agricultural products distributions always affected by many factors. [1] found twelve variables affected on distribution of food grain in Punjab, India. [1] Their research found that for six month distributions of food grain, storage anf time of distributions dominates the factors in the distributions. Factors affected in agricultural product distribution have to measure to know the performance of the distribution activity. Ther are five categories for performance measurement which devided into 17 criteria for these five categories [2]. The categories and criteria is aimed to measure the performance of distribution channels in distributing commodities from farmers to end customers. Because agricultural products are perishable, they have risk in distributing from farmers to end customers. Yeboah, et al, found that there are eight risk factors affected in agricultural distributions [3]. Market effects, logistic, weather, biological related and government policy is the most affected in distributions of agricultural products. A solution to overcome risks is contract between distributions channels in agricultural products marketing. [4] Contracts will hel each distribution channels to minimize risk of deteriorating the products. HOR and SCOR is the effective method to find out the risk agents and mitigations. [5]

Kabupaten Malang is one of the districts that are producers of agricultural products to various regions. Agricultural products from Malang Regency are rice, vegetables, tubers, and fruits. Some sub-districts which are the main producers in Kabupaten Malang are Dau, Poncokusumo, Ngantang and Pagelaran. As one of the producers, farmers, traders and suppliers must carry out a good distribution process evenly. The agricultural products of Kabupaten Malang are distributed to various regions in Indonesia, both in Kabupaten Malang itself, to outside the province of East Java. However, in the...
process of distributing agricultural products, there are still some problems. One of them is that some regions in Kabupaten Malang have difficulties in making maximum sales for their agricultural products. Therefore, the process of distributing agricultural products is considered to be less than optimal considering that this is still the case in the distribution process. As one of the producers, farmers, traders and suppliers must carry out a good distribution process evenly. The agricultural products of Kabupaten Malang are distributed to various regions in Indonesia, both in Kabupaten Malang itself, to outside the province of East Java. However, in the process of distributing agricultural products, there are still some problems. One of them is that some regions in Kabupaten Malang have difficulties in making maximum sales for their agricultural products. Therefore, the process of distributing agricultural products is considered to be less than optimal considering that this is still the case in the distribution process.

Because problems are still often found in the supply chain of agricultural products in Malang Regency, it is necessary to identify and analyze risk to find the risks arising from any existing problems in order to anticipate the losses and obstacles that can be caused. Risk management and supply chain risk analysis is defined as supply chain management. This supply chain management is able to find the cause of the problems caused through the process of identification and analysis of the distribution process. After an analysis, an appropriate strategy will be found to maximize the distribution supply chain, in this case the distribution of agricultural products from vegetable products in Malang Regency.

The research aimed to examine the risks involved in every decision taken in the supply chain of agricultural product distribution in Kabupaten Malang in order to minimize problems that would arise to the cause of each problem. This research was conducted at the Technical Unit (UPT) of the Sub-Department of Agribusiness (STA) Mantung, Pujon, Kabupaten Malang. This is because the process of entering and selling, until distribution is carried out by the perpetrators of the horticulture type vegetable supply chain at the UPT STA Mantung using SCOR (Supply Chain Operations Reference) and HOR (House of Risk).

2. Methods
Preliminary observations were made by visiting markets in Kabupaten Malang. Discussions were held with a trader, supplier and retailer from problems that often arise during the process of distributing vegetables. The results of the discussion found several problems that occurred, such as the distribution of products to the market as a final place of sale for agricultural products still not maximally accommodating all agricultural products, causing a lot of agricultural products that could not be sold. Not only the two problems that arise but there are still many other problems that occur in the process of distributing vegetables in Kabupaten Malang.

The next step is to observe UPT STA Mantung, Pujon, Kabupaten Malang, to confirm the problems that occur in the distribution chain of vegetable products in Kabupaten Malang. The Supply Chain Operation Reference (SCOR) method is used to measure the activities of horticulture product distribution. The SCOR method used is level 1, which defines the scope and content of the supply chain. At this level the performance of the supply chain will be seen. Supply chain management using the SCOR method is divided into several parts of the supply chain, namely planning (plan), procurement (source), making (make), delivery (deliver), and return [6]. The following are the functions of each supply chain division:
1. Planning (Plan)
   This section describes activities related to developing plans to operate supply chains.
2. Procurement (Source)
   This section describes ordering, scheduling, shipping and receiving of goods until the service is received.
3. Making (Make)
   This section describes activities related to material conversion or the creation of product.
4. Delivery (Deliver)
This section describes the process of meeting the demand for goods of the supply chain.

5. Returns

This section describes activities related to the return of goods or products for various reasons.

Data obtained from interview and field study, the activities of the supply chain of the vegetable distribution process at UPT STA Mantung Kabupaten Malang. This supply chain mapping uses the SCOR method which has 5 elements of supply chain division namely, plan, source, make, deliver, and return. The mapping or distribution of supply chain activities is used to make it easier to see the relationship between each chain of functions and see potential risks.

The House of Risk is used to measure the risk in distribution of horticulture product in STA Mantung. The results of the development and modification of the HOQ model that serves to determine risk agents and determine priorities in prevention [5]. Table 1 shows HOR phase 1:

| Business Process | Risk (Ei) | Risk Agent | Severity |
|------------------|-----------|------------|----------|
| Plan             | E1        | R11        | R12      | R13      | S1       |
| Source           | E2        | R21        |          |          | S2       |
| Make             | E3        |            |          |          | S3       |
| Deliver          | E4        |            |          |          | S4       |
| Return           | E5        |            |          |          | S5       |
| Occurrence (Oi)  | O1        | O2         | O3       |
| ARP              | ARP1      | ARP2       | ARP3     |

After performing the first phase of the HOR model for seven steps, the next step is to create a second phase HOR model. Table 2 shows HOR phase 2:

| Risk Agent | ARP | Mitigation Strategy |
|------------|-----|---------------------|
| A1         | ARP1| SM1                 |
| A2         | ARP2| SM2                 |
| A3         | ARP3| SM3                 |
| A4         | ARP4|                     |
| Total Effectively Strategy | TE1 | TE2 | TE3 |
| Strategies difficulty level | D1  | D2  | D2  |
| Total Effectiveness of Difficulty Ratios | ETD1 | ETD2 | ETD3 |
| Priority Rating of Mitigation Strategies | ETD1 | ETD2 | ETD3 |

By choosing the risk agent with the highest rating or rating using the Pareto diagram the potential risk priority is defined. A priority rating from the risk agent is doing to identify the appropriate mitigation strategy using the Ishikaw dia}
3. Result and Discussion

The research is focused on the distribution supply chain for traders or village collectors in STA Mantung Kabupaten Malang and on some vegetables like mustard greens, cabbage, carrots, leeks, and celery. Because the five vegetables are the most common vegetables found in STA Mantung Kabupaten Malang, the identification process of SCOR method is needed to classify supply chain elements. These elements are plan, source, make, deliver, and return. The following are the criteria or activities in the STA Mantung distribution supply chain in Kabupaten Malang which are included in the SCOR elements:

| SCOR Elements | Activities |
|---------------|------------|
| Plan          | Plan of delivery schedules, Plan of vegetables, Plan of the amount of vegetables, Plan of fees or payments, Vegetable quality requirements |
| Source        | Checking of the supply of vegetables, Checking of the supply of vegetables, Check of the quality of vegetables, Schedule for checking, Check of costs or payments |
| Make          | The process of weighing vegetables, Packaging process, Buying and selling process |
| Deliver       | Process of sending vegetables, Vehicle selection, Selection of travel routes |
| Return        | Return qualification, Return process |

Interviews were conducted with authorized three office staff in the STA Mantung and two collectors. The following are identified risks:

| SCOR Elements | Risks |
|---------------|-------|
| Plan          | E1 Increase in the price of vegetables from the main producers, E2 Collector / trader profits are reduced, E3 Incompatibility of the types of vegetables ordered |
| Source        | E4 Incompatibility of the quality of vegetables ordered, E5 Too many vegetables |
| Make          | E6 There are broken vegetables, E7 Depreciation of the quantity and quality of vegetables, E8 Decreasing the quality of vegetables due to packaging, E9 Order cancellation, E10 The number of collectors or traders, E11 The amount of vegetables wasted |
| Deliver       | E12 Decrease in quality due to the shipping process, E13 Errors in the type or amount of vegetables sent, E14 Damaged vehicles, E15 Delays in delivery |
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fter getting a correlation assessment, the next step is the calculation of aggregate risk potential (ARP). The ARP calculation could be shown as table below

| Risk Agent | ARP Value | Ranks | Risk Agent | ARP Value | Ranks |
|------------|-----------|-------|------------|-----------|-------|
| ARP15      | 2156      | 1     | ARP11      | 910       | 11    |
| ARP2       | 1908      | 2     | ARP7       | 692       | 12    |
| ARP6       | 1820      | 3     | ARP19      | 594       | 13    |
| ARP9       | 1536      | 4     | ARP17      | 568       | 14    |
| ARP1       | 1421      | 5     | ARP3       | 468       | 15    |
| ARP10      | 1404      | 6     | ARP16      | 378       | 16    |
| ARP23      | 1280      | 7     | ARP21      | 356       | 17    |
| ARP20      | 1172      | 8     | ARP5       | 351       | 18    |
| ARP8       | 1056      | 9     | ARP13      | 344       | 19    |
| ARP22      | 1024      | 10    |            |           |       |

Analysis using fishbone diagrams or causal diagrams, a number of mitigation strategies or actions are obtained for each risk agent. The following are mitigation strategies for each risk agent that have been analyzed:

| Codes | Types | Strategy | Explanation |
|-------|-------|----------|-------------|
| SM1   | Reactive | Sort the main producers | Sort the main producers (farmers) by looking at the best quality vegetables. |
|       | Reactive | Make basic specifications of vegetable quality | Make patented basic specifications for the quality of vegetables that will be accepted or rejected, so that every trader has good vegetable quality. |
| SM2   | Proactive | Making a cooling storage | Make cooling storage to maintain the quality of vegetables to avoid shrinkage. Cooling storage usually can maintain the quality of vegetables for ± 2 weeks. |
| SM3   | Proactive | Training on the treatment of horticultural products | Conduct training for HR at STA Mantung Malang Regency in the treatment or handling of horticultural products, especially vegetables. |
| SM4   | Avoid | Fast sales | A sure and fast sale could be done by recording all requests or sales that have been previously done in order to estimate sales that must be done in the future. This is done so that not much vegetables should be wasted. |
| SM5   | Avoid | Avoiding congested routes | Avoiding solid delivery routes by studying other alternative routes. |
| SM6   | Reactive | Choose the right time to send Training on the treatment of horticultural products | Choose the right time to make deliveries by avoiding heavy hours of vehicles. Conduct training for HR at STA Mantung Malang Regency in the treatment or handling of horticultural products, especially vegetables. |
| SM7   | Proactive | Make inventory plans and seasonal calendars | Make inventory planning from previous requests or sales so as not to harm traders or collectors at STA Mantung. In addition, create a seasonal calendar for some vegetables that often experience scarcity or up and down commodity prices. |
| SM8   | Proactive | Make inventory plans and seasonal calendars | Make inventory planning from previous requests or sales so as not to harm traders or collectors at STA Mantung. In addition, create a seasonal calendar for some vegetables that often experience scarcity or up and down commodity prices. |
Table 6 Mitigation Strategy (cont.)

| Codes | Types   | Strategy                       | Explanation                                                                                                                                 |
|-------|---------|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| SM9   | Proactive | Conduct training on human error | Conduct training to avoid and reduce human error of human resources in STA Mantung.                                                      |
|       |         | Choose and make design facilities that are environmentally friendly | Choosing facilities that are environmentally friendly, easy and safe to be used by HR at STA Mantung. In addition, it adds a place to sell for auction traders. |
| SM10  | Avoid   | Selection of the right type of vehicle | Choosing the right vehicle so as not to damage the vegetables in the course of shipping. It is better to use a vehicle that does not require too many vegetables to be stacked. |
| SM11  | Avoid   | Complete recording of consumer information | Carrying out complete and clear information and administration regarding consumer order information so that errors do not occur in meeting consumer demand. The main information needed is the name, address, number and type of vegetables, and delivery schedule. |
| SM12  | Proactive | Confirm the main producer     | Confirm in advance to the main producer (farmer) regarding the availability of types and quantities of vegetables to the quality in accordance with the request. |
| SM13  | Avoid   | Make inventory plans and seasonal calendars | Conduct routine inspections for the feasibility of vehicles in shipping vegetables so as not to harm various parties. This inspection can be done for 6 months or once a year. Make inventory planning from previous requests or sales so as not to harm traders or collectors at STA Mantung. In addition, create a seasonal calendar for some vegetables that often experience scarcity or up and down commodity prices. |
| SM14  | Proactive | Make basic specifications of vegetable quality | Carry out inspection for the feasibility of vehicles in shipping vegetables so as not to harm various parties. This inspection can be done for 6 months or once a year. Make inventory planning from previous requests or sales so as not to harm traders or collectors at STA Mantung. In addition, create a seasonal calendar for some vegetables that often experience scarcity or up and down commodity prices. |

The final step in processing the second phase of HOR data is to provide an action rating or risk mitigation strategy. This rating is obtained from the total ratio of the effectiveness of the difficulty. The highest total difficulty effectiveness ratio becomes the highest ranking of risk mitigation actions. Following is the ranking of risk mitigation actions that have been identified:

Table 7 Risk Mitigation Action Rating

| Mitigation Strategy | Ranks |
|---------------------|-------|
| SM11                | 1     |
| SM1                 | 2     |
| SM4                 | 3     |
| SM3                 | 4     |
| SM7                 | 5     |
| SM5                 | 6     |
| SM6                 | 7     |
| SM12                | 8     |
| SM2                 | 9     |
| SM13                | 10    |
| SM9                 | 11    |
| SM10                | 12    |
| SM8                 | 13    |
| SM14                | 14    |
4. Conclusion
Based on the risk identification using the SCOR method, 15 risks were found in the distribution of vegetables in STA Mantung, with details, three risks to planning, two risks to procurement, six risks to manufacture, and four risks to shipping. Identification of risk agents was found as many as 23 risk agents causing the risk that had been identified previously. Furthermore, after processing the data using HOR, the selected risk agent ranks to carry out risk mitigation strategies to reduce, avoid, move, and eliminate risks. Based on the selection of risk agents, twelve risk agents were found that needed mitigation strategies.

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