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Designing Efficient Logistic System of Fresh Agricultural Products for Small Farms

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Abstract: This research paper presents a framework of an efficient logistics system of fresh agricultural products for small farms. This paper illustrates efficient logistic system with a case study of apple products in East Java – Indonesia, in order to increase competitiveness against imported apples. The research focuses are small farms, farmer groups, middlemen, and distributors. Data are obtained from observations and interviews with the farmer's groups which are representing small farms and distributors which are treated using process activity mapping (PAM), value stream mapping (VSM), and activity-based costing (ABC). Data analysis has identified value added and non-value added activities. Based on the analysis, this paper proposes an alternative efficient logistics system. However, this research has not been fully integrated due to insufficient data for designing holistic efficient logistics system for apples product by taking into account country and regional conditions.

Keywords: Logistic System, Small Farms, Value Added and Non-value Added Activities

1. Introduction

Logistics is part of a supply chain associated with the movement and storage of goods and at the same time with regard to the flow of money and information. Based on this understanding, it is known that the logistics is related to the ease of supply of goods in the region. It also indicates that, logistics plays a key role in the growth of the industry and the economy of a region. Logistic is becoming a key role because logistics activity is a major cost component for businesses and intertwined with many other economic activities.

The success of a holistic logistics management becomes an important requirement which directly or indirectly have an impact on the economic growth of the region. Indicators of success in logistics management can be viewed from the aspect of availability, flexibility and cost efficiency. The indicators related to the availability of goods and services at the right time and place while having the flexibility of the amount and delivery time in an area with a logical price.

But these three indicators of the success of the logistics often becomes irrelevant for fresh agricultural products due to the following factors: a). Availability of fresh agricultural products are influenced by the short time-gap between the time the of supply to the time of consumption; b). Total supply is inconsistent due to the influence of the season; c). Prices fluctuate according to season and d). The local government policy towards supply of fresh agricultural products varies among country and region.

Fresh agricultural products are products that should be consumed immediately to prevent damage without further preservation process. Therefore, the products must be delivered as soon as possible at a reasonable cost using the right logistics system. But before designing efficient logistics system; the farming activities, distribution, and transportation should be taken into account.

East Java province is one of the largest fresh agricultural producers in the country. The fruit products come from different plantation locations, such as Batu, Pasuruan, Probolinggo, and Blitar; while vegetables come from plantation locations in Batu, Lumajang, and Bondowoso.

Most of the consumers of agricultural products that were produced in East Java are living in the entire province of East Java, Jakarta and even reach out to almost all provinces in Kalimantan and Sulawesi. However, this fact remains controversial for producers. On the one hand, agricultural products from East Java province reach the wider consumer, but on the other hand, the initial benefits received by producers, especially yeoman and group of farmers not significantly increased. If conditions are unfavorably untreated, it can decrease the number of producers. A decrease in the number of producers will have an impact on the availability of products that are not continuous; the price is not stable so it will give a negative effect on efforts to improve the region's economy. That means handling of fresh agricultural products need special attention.

2. Literature Review

The main issue addressed in this study is designing a framework of the efficient logistics system of fresh agricultural product that is able to improve the welfare of society and the economy of the region.

2.1. The Concept of Logistics and Logistics Management System

According to Hutchinson [1], logistics is a process of getting things right (the right item), in the right amount (in the right quantity), at the right time, at the right place for the right price. Logistics management terminology according to the Council of Supply Chain Management Professionals (CSCMP), is part of supply chain management which is to plan, implement and control the level of efficiency and effectiveness of the flow and storage of goods/services, money and information from upstream to downstream and vice versa from the point the origin of the goods up to the point where the goods are used or consumed in order to meet customer demand [2] [3].

2.2. Logistics Cost

A key component of a logistics system is a logistics cost. Logistics costs are a logical consequence of the use of resources (resources) on each of logistics activity [4]. These logistics costs occur in each chain logistics system, thus forming a total logistics cost charged to the product being sold. Logistics costs have become one of the important components in the cost of the product and the selling price of products. Should logistics cost is naturally high, then the price of agricultural products is high [5]. One way to control logistics cost is to keep supply chain activities controllable. Logistics costs are important to note because, according to the World Bank survey, the logistics cost in Indonesia is one of the highest in the world. According to the survey by the World Bank, Logistics Performance Index (LPI) of Indonesia is less competitive among neighbors. As an example; logistics costs along the 55 kilometer (km) in Indonesia is about US $ 550, while in Malaysia is only US $ 300 [6]. There are six indicators measured in the Logistics Performance Index (LPI). The six indicators are:

a. The efficiency of the process of clearance customs and excise office services.
b. The quality of transport infrastructure and trade.
c. Ease in setting the price shipment
d. Competence and quality of logistics services by logistics service providers (3PL)
e. The ability to perform track and trace shipments.
f. Timeliness of distribution.

2.3. Fresh Agricultural Products

The price of fresh agricultural products is depending on logistics cost and their freshness upon arriving at the point of sales location. According to Pingxia et al [5], most of the research on logistics cost of fresh agricultural products, concentrated in the simple economical analysis. Therefore, research on how to maintain freshness of the product is becoming an important area in an agricultural supply chain network. Supply Chain of fresh agricultural products is different from other product supply chains. The important difference between agricultural supply chains and other supply chains is the significant change in the value of products throughout the entire supply chain until the points of final consumption [7]. Longer channel of supply chain would increase transportation distance of product due to the geographic separation of each channel, starting from a farm to the point of consumptions.

According to statistic analysis conducted by Roeger and Liebtag [8], transportation costs are a significant component of the final prices for fresh products. Therefore, one of the problems to be solved in an agricultural product is how should members of agricultural supply chain take into account the transportation cost and time, to appropriately make the most decisions. Study of Ferro et al [9] found that 3 features that characterize the fresh fruit supply chain are long supply lead times, uncertainty of supply and demand, and small margins. These features cause a need for efficiency in logistics management.

3. Data Collection and Methodology

This research is using constructive research paradigm. To construct a framework of an efficient logistics system, this research uses holistic approach by combining quantitative and qualitative strategy. This research mainly focused on quantitative approaches to streamline logistics costs. However, a qualitative approach is also used to increase costing comprehension.

For a case study of fresh apples, data collection is conducted through questionnaires, direct observation and interviews with the origin farmers, group of farmers, middlemen and distributors. Data of demand and logistics cost is obtained from the origin of apple farmers, middlemen and retailers. Data of transportation cost is obtained from 3PL, middlemen and distributor. Data related to the logistic activities including: operation process charts with time consumed of each process, human resources activities, and number of demand are collected from direct observation combined with interviews to the relevant functional person. The data then processed using the method of process activity mapping, value stream mapping, and activity based costing.

4. Designing Framework of Efficient Fresh Agricultural Products

A framework of efficient logistics system for fresh agricultural product starting from identification supply chain network, until making out logistics activities of each stage of supply chain. After identifying process, the next step is collecting relevant data.

A related data are human resources activities, driver cost, and processing time of each manual activity. Data then processed using process activity mapping (PAM), value stream mapping (VSM), and activity based costing (ABC) methods. Process activity mapping is used to determine the allocation of resources and time required of each activity. Value stream mapping is used for mapping processing time and lead time of activities based on visual observation related to the current conditions. Value stream mapping is also used to distinguish value added and non value added activity. Non-value added activities consist of necessary and unnecessary activities. Unnecessary activities are categorized as wastes for the logistics activities.

In order to prioritize types of waste to be handled, Pareto chart will be used. Activity-based costing is used to identify cost drivers of each activity and categorized them into SC drivers. Unnecessary non value added is using time as a unit then convert into financial unit (cost). Ishikawa diagram is used as a method for finding cause and effect relationships of each significant and important waste. While processing time is determined by people who work on, then it is possible to merge some activities with the aim of reduce processing time. A proposed framework of efficient logistics system is shown in Figure 1.

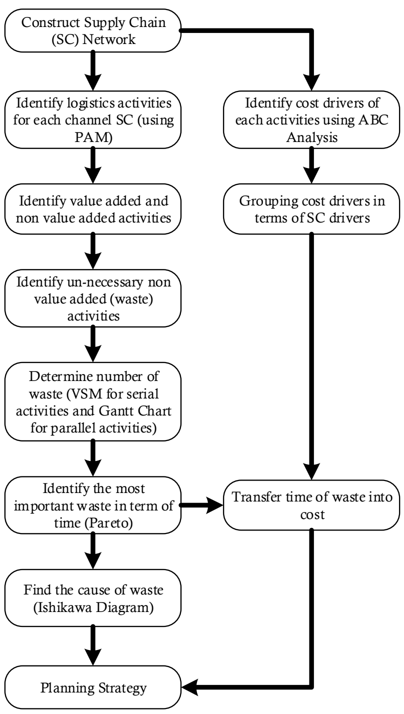

Figure 1. *Framework of efficient logistic system of fresh agricultural products.*

5. Case Study

5.1. Apple's Supply Chain in East Java-Indonesia

Supply Chain of fresh apples produce by small farm (yeoman) and group of farmer in East Java-Indonesia is shown in Figure 2.

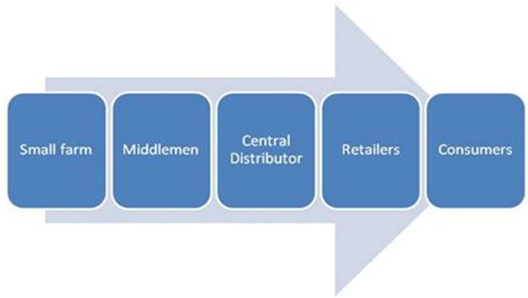

Figure 2. *Apple Supply Chain in east Java-Indonesia.*

For a case study of fresh apples, data collection is conducted through direct observation and interviews with the group of farmers and distributors. Data related to the activities undertaken are human resources activities, costs, and processing time. Data then processed using the method of process activity mapping (PAM) [8], value stream mapping (VSM) [9], and activity based costing (ABC) [10]. At the last activity-based costing is used to calculate the total cost per kg of apples for each different grade. Data processing results are then analyzed to do improvement of non-value added activity

5.2. Discussion

Supply chain in distributing apples consists of 5 entities, namely farmers, middlemen, the central distributor, retailer, and consumer. Farmers plant and nurture the apples to be harvested. Harvested apples will be sold to middlemen. Central distributor collects and stores apples from middlemen then distributing apples to various retailers who will sell directly to consumers.

Data which are collected from farmers and middlemen is processed using process mapping activity in order to know the percentage of time for value added activity and non-value added activity. The following Table. 1 and Table. 2 presenting the allocation of time for value added activity (VAA) and non-value added activity (NVAA) based on logistics processes in the group of farmers namely KTMA and central distributor namely UD. Buah Segar.

Table 1. *Allocation of process activity mapping at KTMA.*

Process	**No. Activities**	**Time (mins)**	**%**	**VAA (mins)**	**% VAA**	**NVAA (mins)**	**%**
Operation	9	13,655	91.0%	13,655	91%	0	0.0%
Transportation	1	30	0.2%	0	0%	30	0.2%
Inspection	0	-	0.0%	0	0%	0	0.0%
Storage	1	1,320	8.8%	0	0%	1.320	8.8%
TOTAL	11	15,005	100.0%	13,655	91%	1.350	9.0%

Table 2. *Allocation of process activity mapping at UD. Buah Segar.*

Process	No. Activities	Time (mins)	%	VAA (mins)	% VAA	NVAA (mins)	%
Operation	3	615	23.56%	615	23.56%	-	0.00%
Transportation	1	75	2.87%	0	0.00%	75	2.87%
Inspection	1	180	6.90%	0	0.00%	180	6.90%
Storage	1	1,740	66.67%	0	0.00%	1,740	66.67%
TOTAL	6	2,610	100%	615	23.56%	1,995	76.44%

Outputs of process activity mapping were processed using value stream mapping to obtain lead time, value added and non-value added activity. Through process activity mapping it is known that required lead time for KTMA is 250 hours with a value added activity = 225 hours. Hence, the required lead time for UD. Buah Segar = 43.5 hours with value added activity 10.25 hours with remains time are non-value added activities.

The total cost per kg of apples at KTMA was calculated using conventional methods; this is due to the same activities performed for each grade apples. Here is the calculation of the total cost per kg of apples at KTMA: The total cost per kg of apples in KTMA = total cost of the activity KTMA/output = IDR 62,373,650/8,000 kg = IDR 7,797 / kg

Based on direct observation, the selling price of apples in the supermarket is IDR 35,990 / kg, thus the total cost per kg of apples from KTMA constitute 21.66% of the total selling price in the supermarket. The total cost per kg of apples at UD. Buah segar for grade AA and AB grade is calculated using the conventional method for the same activity and activity based costing methods for different activities.

Through observation using value stream mapping, the biggest cost to the farmer or middleman is transportation costs. Another problem at the farmer level is long picking time and high cost for picking apples. Other issue at the middlemen is a long time to collect apples.

Identification of in-efficiencies at the level KTMA find in-efficiencies in the activity of cleaning, planting, harvesting, sorting, and storing apples. While the in-efficiency at the distributor level, mostly in apple storage. Furthermore, to improve efficiency of KTMA, some of the activities should be merged; namely merging cleaning activity with planting, harvesting with sorting, and eliminating the storage of apples. This proposal will generate lead time = 225 hours with value added activity = 225 hours. Besides a shorter time, these improvements will lower the total cost per kg of apples at KTMA. At the distributor level; is proposed to immediately send apples that had finished packaged on the same day. With this improvement proposal, the storage time decreases from the original 1,740 minutes to 840 minutes.

6. Conclusion

Efficient logistics systems for fresh agricultural product is important for supply chain involving small farms in its supply chain channel, because of the use of labor instead of mechanization. Consequently, logistics process time for small farm is influenced by weather conditions and facilities out of reach of small farms.

Integration of logistic activities among different channel of a supply chain for a fresh agricultural product has become a critical problem in increasing competitiveness due to the deterioration, freshness, and availability constraints. Efficiency discussed in this case is the efficiency in terms of time and cost simultaneously.

Application of the framework has merged some manual activities and decrease lead-time that can be converted into cost.

In order to increase competitiveness of local apples compared to the import products, the efficiency and at the same time margin of small farmers should be increased by government support. Types of support possibly by increasing the road construction investment for reducing the transportation time, Secondly, increasing the freshness of apples by supporting farmers with specific warehouse, and transportation vehicles and sharing results of agricultural research.

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