The Implementation of Activity-Based Costing on Black Rice Supply Chain in Sleman District, Yogyakarta

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Abstract

As the primary rice consumers, Indonesians, especially people in Yogyakarta, particular consumers progressively changed their carbohydrate intake from white rice to black rice because of human health benefits. Consequently, from 2015 to 2018, Yogyakarta black rice farm extended its arable land, production, and productivity to fulfill the demand. The research aims to help the actor of business to supervise the activities, wasting higher costs and reducing the profit by analyzing the logistics cost structure along the black rice supply chain with Activity-Based Costing (ABC). The results found that the highest cost proportion of farmers (63.57%), farmer groups (69.97%), and distributors (50.47%) take place in the material handling activity. In comparison, retailers spend most of the cost on inventory activity (64.29%).

Keywords: *activity-based costing, black rice, logistics activities, logistics cost, supply chain*

1. INTRODUCTION

Most Indonesian consume rice every day. This habit makes food diversification a challenge. From 2012 to 2015, Indonesia was in the 3rd position, and total rice consumption per year reached 38.24 million tons (Suwandi, 2016). According to FAO, in 2014, Indonesia was in the 3rd world rank after China and India in rice production (Anonim, 2014).

Many people want to live healthier by consuming healthy food, including pigmented rice. One of the most popular pigmented rice is black rice. Black rice is widely consumed as a functional food because it contains anthocyanins that function as an antioxidant. Functional food is a natural food containing one or more compounds that benefit human health. Black rice is considered capable of reducing cholesterol levels that trigger the appearance of liquid coronary heart disease and clogged arteries (Kristamtini, et al., 2012).

In Yogyakarta, the demand for black rice increased from 900 tons in 2013 to 1,200 tons in 2015. Meanwhile, in 2016 pigmented rice per capita consumption in Yogyakarta was 1.2 kg/capita/month, with the purchase average being 3.5 kg/month (Wuryadani, et al., 2016). Thus, between 2015 to 2018, Sleman black rice farming has extended its arable land, production, and productivity.

Each tier of the black rice supply chain (farmers, farmer groups, distributors, and retailers) yields logistics costs. They source from its production activities and possibly affect the generated profit. In a supply chain system, the fluctuating cost in a tier certainly involves the other tier.

For example, the black rice prices at the farmer's tier are Rp 18,000 per kg while the retailer's price is Rp 30,000 per kg. When farmers experience increased costs, they possibly raise their product prices. Consequently, retailers would undoubtedly set a higher price to keep the profit. To observe the gap in prices between tiers, this study attempt to analyze the logistics cost structure of the black rice supply chain. Observing the logistics cost structure is essential to identify the structure, explore the most influenced costs component on their respective logistics activities, and determine activities that should be controlled and improved. Therefore, the analysis suggests that the black rice business actor should supervise the activities, wasting higher costs and reducing the profit.

2. MATERIAL AND METHODS

This research focuses on the black rice supply chain in Sleman District. The black rice variety is restricted only to Semabada Hitam, which has the national certification of local black rice. The respondents who participated in the research are the black rice business actors.

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The sampling methods used to find the right respondents are purposive sampling for determining the research location and the respondents' criteria and snowball sampling for identifying the supply chain flow. The respondents consist of 18 farmers, 3 farmer groups (Poktan), 5 distributors (including farmer group association), and 4 retailers. The in-depth interview is the technique to draw the data from respondents. It needs an interview guideline script to ensure the respondents' responses according to the research goals. Hence, it contains several questions concerning logistics flows, activities, and costs. The logistics flows draw the supply chain of black rice. Table 1 presents the details of the logistics activities observed.

Table 1. Activity in Each Type of Logistics Costs

Logistics cost	Description
Procurement	Transportation costs of purchasing supplies such as seed, fertilizer, pesticides; depreciation and maintenance of procurement vehicles; and communication costs between suppliers and farmers, farmers and farmer groups, farmer groups and distributors, distributors and retailers.
Material handling	Harvesting cost, handling cost, depreciation cost of materials and handling equipment, loss of production, and labor wages.
Transportation	Driver wages, fuel cost, depreciation and maintenance of the delivery vehicle, and losses during delivery.
Inventory	The opportunity cost of inventory of supplies, losses during inventory, include warehouse and electricity costs.
Communication	Communication cost between farmer and farmer groups, farmer groups and distributors, distributors and retailers.

The method to analyze the logistics cost structure is Activity-Based Costing (ABC) with the key elements being logistics activities. Activity-based costing (ABC) systems have been developed to improve the costing system, and claim to be more accurate than traditional costing methods (Ongkunaruk, et al., 2011). This system assumes activities consume resources to make products or services (Almeida & Cunha, 2017). Besides, the unit cost would be considered as an output of Activity-Based Costing (ABC) for measurement (Zheng, et al., 2019). The steps of the research are shown in Figure 1.

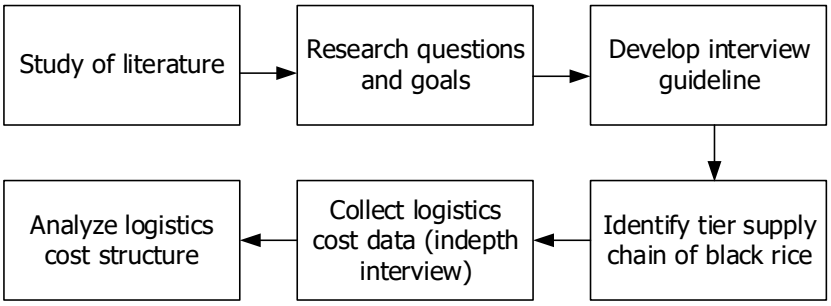

Figure 1. Research Flowchart

3. RESULTS AND DISCUSSION

3.1 Black Rice Supply Chain

Figure 2 presents the black rice supply chain in Sleman District. The profile of tiers on the black rice supply chain is:

1) **Farmers**: Farmers acquire seeds, fertilizers, and other production equipment from suppliers. They often hire local laborers to help with the production activities. The harvesting period takes 140-150 days. Only half of the farmer respondents use organic fertilizers, while others use a combination of organic and chemical fertilizers. Most farmers market the dry whole-grain of black rice to farmer groups.

2) **Farmer groups**: The groups consist of small-scale farmers. They supply help their members by providing production instruments, processing the dry whole-grain into rice, and finding the right market.
3) **Distributors:** Distributors are intermediaries between farmer groups and retailers. Their activities are buying the rice from farmer groups, sorting the rice and the waste, packing it into bags, and distributing it to retailers.
4) **Retailers:** Retailers sell the rice to end consumers, usually in small quantities.

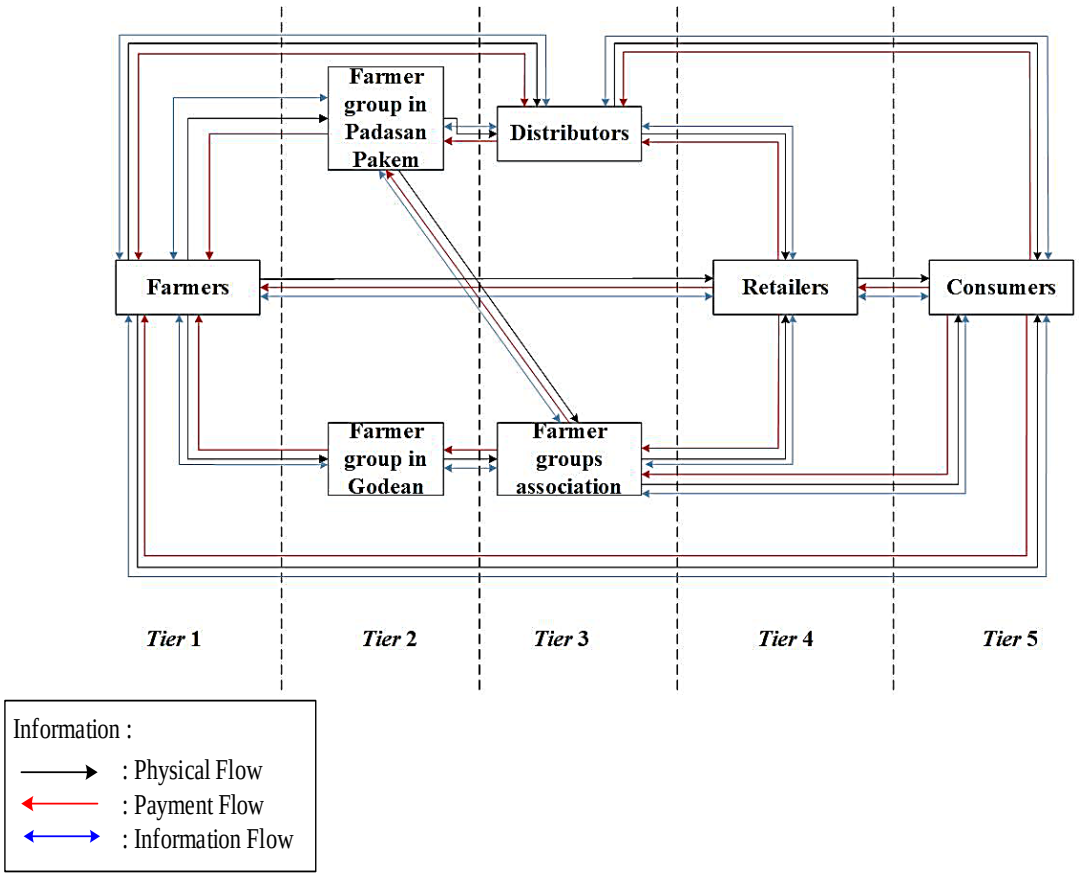

Figure 2. Supply Chain of Black Rice (Ismoyowati, et al., 2018)

3.2 Logistics Cost Structure Analysis

The ABC method calculates the logistics cost in two stages. The first stage consists of five steps: determining (1) the activities, (2) the cost pool, (3) the cost driver, (4) the homogeneous cost pool, and (5) the pool rate. The logistics activities in each supply chain tier are classified according to the hierarchy. Determining the cost pool means costs are grouped based on their main activities: procurement, material handling, transportation, storage, and consumer communication generating the proportion of costs in each logistics activity. If the same cost driver causes a cost pool, the cost pool is grouped into a homogeneous cost pool. For example, the transportation of seeds, fertilizers, and pesticides has the same group, transportation of material procurement, because it has the same cost driver: distance and frequency of purchase. Determining the pool rate is dividing the total cost of a cost pool by the unit cost driver used. The second stage consists of tracking and loading each cost pool into the black rice products by using the pool rate for each product and calculating the cost-based activity and cost per unit.

Figure 3 shows the logistics cost of black rice in farmers tier. Farmers spend more than half of their production cost on material handling costs (63.57%). It consists of crop handling cost, depreciation cost of materials and handling equipment, loss of production, and labor wages. The depreciation cost of materials and handling equipment takes the highest part of the cost because of the high-frequency usage. Compared to other stakeholders, farmers, the main actors in the supply

chain, spend on procurement costs (24.23%) to grow black rice. It includes the transportation cost of purchasing seed, fertilizer, and pesticides. The transportation cost to deliver the product to consumers amounts to 8.31%. Some farmers market their rice themselves. As a result, it could spend more cost on transportation. After harvesting, most farmers hand over their crops to the farmers' group. Thus, the inventory cost accounts for 3.68%. The lowest logistics cost for farmers is customer communication (0.21%).

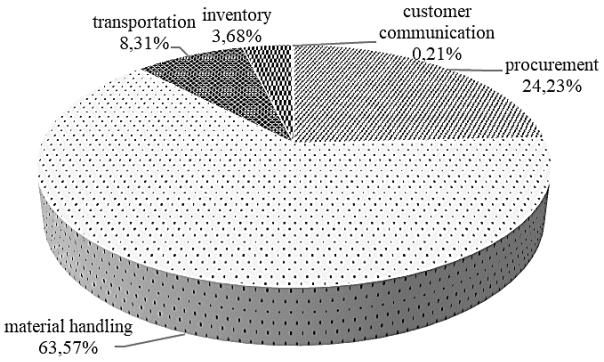

Figure 3. The Structure of Logistics Cost in Farmers

Figure 4 shows the logistics cost of black rice at farmer groups tier. Farmer groups have a similar logistics cost structure as farmers. They spend 69.97% of their cost on material handling. They need more to handle sortation, depreciation of materials and handling equipment, loss of production, and labor wages. Loss of production is one of the main problems of material handling. It is because the milling process turns the dry dry whole-grain into rice. Some milling processes could not be efficient because of the machine or the dry whole-grain condition. In addition, some rice millers use own techniques and design own machines, which may not be compatible with the rice conditions and milling process. These activities may also cause the loss of rice (Wiratchai, et al., 2017). Thus, it could produce more residuals than rice. The other problem in material handling is the high sorting labor cost. The procurement process spends up to 14.99% of its production cost. They frequently purchase the dry dry whole-grain in cash in large proportion from farmers. The large stock could save them from the shortage of black rice. Thus, they spend more cost on inventory activity compared to farmers (9.29%). The transportation activity only consumes 3.42% of their production cost. The rest, 2.33%, spend on customer communication activity.

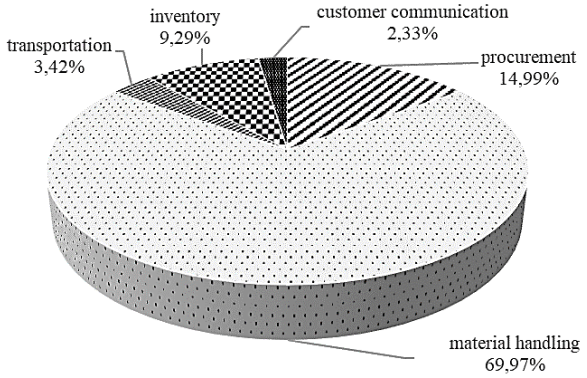

Figure 4. The Structure of Logistics Cost in Farmer Groups

Figure 5 shows the logistics cost of black rice at distributors tier. For distributors, material-handling activity consumes the highest production cost (50.47%). The production cost consists of sortation cost, packaging cost, depreciation cost of material and handling equipment, loss of production, and labor wages. Distributors purchase the black rice from the suppliers in bulk sizes and pack them in smaller. Packaging materials cost the highest for material handling activity. To show the content of the product, maintain the quality of the product, and reduce the risk in the distribution process, the

packaging materials must be well prepared. The other high proportion of production cost is transportation activity. It takes 28.56% of the production cost to market it to the consumers. The procurement activity spends 9.42% of the production cost purchasing and picking up the black rice from suppliers. Because they take up the black rice on a large scale, they do inventory activity consuming 9.05% of the cost to bear with the depreciation of the warehouse building. The lowest proportion of the production cost is customer communication activity, which accounts for only 2.49%.

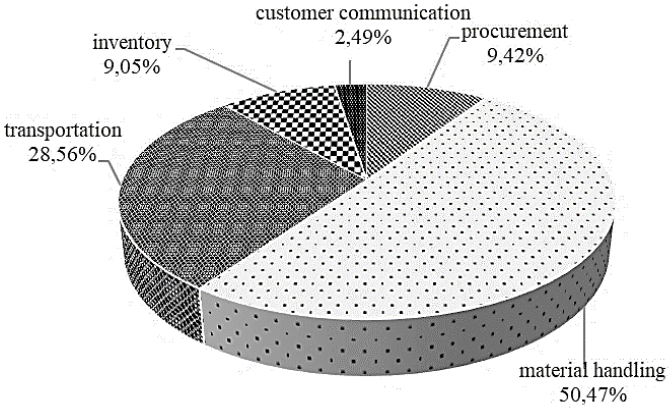

Figure 5. The Structure of Logistics Cost in Distributors

Figure 6 shows the logistics cost of black rice at retailers tier. Different from other tiers, retailers spend more cost on their inventory activity (64.29%). They have to rent the store and pay the electricity bills regularly. They also consume more production costs in material handing activity (26.03%), especially packaging materials. Some of them pack their product based on consumers' daily needs sizes. Procurement activity costs 9.41% of the production cost for taking up the black rice from suppliers. Because they already had the store, they have no spending on transportation and consumer communication activities.

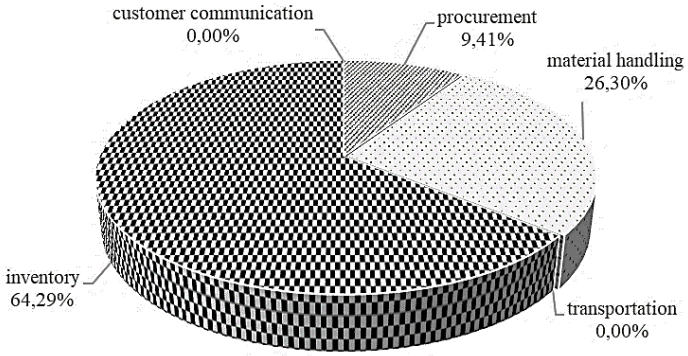

Figure 6. The Structure of Logistics Cost in Retailers

Table 2. Logistics Costs of Activities for Tiers in Black Rice Supply Chain

Tier	Procurement (%)	Material handling (%)	Transportation (%)	Inventory (%)	Customer communication (%)
Farmers	24.30	63.57	8.31	3.68	0.21
Farmer groups	14.99	69.97	3.42	9.29	2.33
Distributors	9.42	50.47	28.56	9.05	2.49
Retailers	9.41	26.30	0	64.29	0

Table 2 shows that comparing all tiers, the highest logistics costs of the procurement structure is at the farmer's tier. The most significant high cost is from purchasing farming materials (seeds, fertilizers, and pesticides), hiring local laborers, and borrowing farming equipment. In comparison, farmer groups, distributors, and retailers in procurement activities only waste a few amounts of cost in purchasing a dry whole-grain or black rice. The highest proportion of logistics costs for material handling activities is for farmer groups because only the actors who process the dry whole-grain into the rice. The distributors' tier has the highest logistics cost for transportation activities because they deliver black rice to the following tiers (the retailers) themselves. The solution to the transportation problem lies in the transportation system's efficiency and the number of intermediaries (Sharma, et al., 2013). The retailers' tier has the highest logistics cost for inventory activities because they would spend more on storage costs than other tiers. The most increased logistics cost for customer communication is at tier distributors because they have to keep the product stock information updated once a week. Agreement with the consumers regarding the order quantity possibly could reduce communication (Sylvia, et al., 2018).

4. CONCLUSIONS

The black rice supply chain consists of farmers, farmer groups, distributors, and retailers. There is a flow of products (black rice), information, and funds in the supply chain flowing from upstream to downstream and vice versa. Logistics activities occur in each tier along the chain. Each tier does different logistics activities in delivering the products to end consumers and keeping the quality of the product. Those activities generate costs affecting the product price.

The finding shows that farmers (63.57%), farmer groups (69.97%), and distributors (50.47%) spend the highest costs on material handling activity. The depreciation cost of materials and handling equipment takes the highest proportion of farmer production cost. They can reduce the depreciation cost by renting the equipment besides buying it. For farmer groups, transforming the products from whole grain into rice (milling process) costs the most because of the inefficiency of the milling machine, reducing the net weight. To decrease spending, farmer groups should use high-efficiency devices for the milling process. Packaging materials cost the highest for distributors because consumers desire proper bags showing the content of the product and keeping the quality of the product. The distributor can have key partners and build a relationship with the packaging suppliers to reduce expenses on packaging material. The retailers spend the highest proportion of the cost on inventory activity (64.29%). Retailers should control the inventory by managing the procurement and storage process.

The government of the Sleman district should contribute to the black rice agroindustry, especially the black rice is a local variety of the Sleman district, and the business potentially increases the regional income and the people's prosperity. It can help the actors with the farming equipment, high-efficiency milling machine, other production suppliers, information about handling products, and accessibility to the market.

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