Conference Paper

Analysis of Logistics Costs for Rice Mills in Improving the Aroma of Jasmine Rice

Aueamorn Wiratchai, Apichaya Lilavanichakul, and Parthana Parthanadee

Department of Agro-Industrial Technology, Faculty of Agro-Industry, Kasetsart University 50 Ngamwongwan Rd., Lad Yao, Chatuchak, Bangkok 10900, Thailand

Abstract

One of unique characteristics of Thai jasmine rice is its aroma, which can easily reduce in various conditions during post-harvesting activities, especially in rice milling stage. This study aims to investigate logistics cost analysis of the rice mill of Kasetwisai Agricultural Cooperative, Ltd. by using activity based costing (ABC) method and to define key activities for the improvement of the rice aroma loss reduction. The results show that the activity that has the highest logistics cost is warehousing at 26.52%, followed by material handling at 24.27%, transportation at 12.33% and packaging at 10.84% of the total logistics cost, respectively. The total logistics cost per unit of the rice mill is about 4.52 baht/kg. Findings from an in-depth interview revealed that warehousing and transportation can be major activities influencing aroma loss in jasmine rice. To reduce the aroma loss in a cost effective way, the Kasetwisai Agricultural Cooperative, Ltd. should focus on storage time and temperature in warehousing and transportation systems. In addition, the collaboration of the rice miller with supply chain partners should be encouraged to cut the logistics cost and to improve the quality of rice.

Keywords: Activity Based Costing; Aromatic Rice; Jasmine Rice; Logistics Cost; Value Chain

Corresponding Author
Apichaya Lilavanichakul
apichaya.l@ku.ac.th

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INTRODUCTION

Thai jasmine rice is the most popular aromatic rice in Thailand. The major compound contributed to its aroma is 2-acetyl-1-pyrroline (2AP), which is a volatile substance that can be easily lost during the post-harvest stage. Loss of jasmine aroma and aroma quality changes may result from various logistics activities and production management. Using high temperature in drying process for a longer time or sun drying [3, 11] and longer storage time can reduce the 2AP concentrations in rice [11]. Moreover, 2AP may reduce along rice supply chain, especially the stages that relate to humidity,

temperature and time [6]. Therefore, the production and technology management should be investigated in order to improve the operation efficiency and maintain the quality of rice.

Thailand is the second largest rice exporter after India in 2015. In general, the total production of jasmine rice is about 4 million tons per year, which about 50% of the total production is consumed domestically. In 2015, the export volume of jasmine rice was 1.99 million tons, which rose 6.4% from 2014 [9].

Even though Thailand is known as one of the top rice producing and exporting countries in the world, it still faces several quality control and manufacturing problems including high production costs, lack of proper standard control during rice milling process, and low milling yields. One prominent problem is the cost effectiveness of milling process since most rice mills in Thailand are still based on labor force for various activities such as piling, loading, and bagging. 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 aroma.

The major participants of Thai rice supply chain consist of farmers, collectors, rice millers, manufacturers, distributors and exporters. A rice miller is in the midstream of the chain and plays three important roles: buying paddy from farmers or collectors, converting paddy into milled rice, and distributing milled rice to consumers. Many rice millers vary in types of business, scales, and technologies. Some agricultural cooperatives may buy the paddy from farmer members and run a rice mill as well. Under the supply chain management perspective, most agricultural cooperatives face a few common problems: ineffective logistics management, no access to markets, and lack of collaboration along the supply chain, which lead to high logistics costs and lower-quality rice. In addition, rice mills are highly competitive business, so each rice miller attempts to reduce operation costs or improve the quality of rice for gaining competitive advantages. To improve the aroma loss reduction in a cost-effective way, the selected logistics activities are based on the cost of logistics activities and in-depth interview with experts. Activity-Based Costing (ABC) method is one of the common costing tools. It assigns costs to the activities, which can help the manager make a better decision in identifying the cost of logistics activities and non-value-added activities.

The objective of this paper is to analyze logistic costs of the rice mill of the Kasetwisai Agricultural Cooperative, Ltd. by using the ABC method and identify activities which have high logistics costs. Then, the recommendations on improving the aroma of Jasmine rice based on each activity are provided.

LITERATURE REVIEW

Logistic management plays an important part in the supply chain related to several activities (i.e. plans, implements, handles and controls) from farms to forks in order to reach consumer needs [2]. Logistic activities take place in every supply channel including customer services, transportation, inventory management, information flow and order processing. These main activities play prominent roles to the total logistics cost and to the effectiveness of logistic management. The support activities vary from one company to another company such as warehousing, material handling, purchasing and so on. These logistics activities link to many operations along the supply chain and affect the operation costs. As a result, every company should focus on the balance between the financial operation and utilization of resources.

For the rice supply chain, there are many different logistics costs and functions in each stage of supply chain. Literatures on the analysis of logistics cost for various chain participants (i.e. farmers, collectors, and rice millers) have been investigated. Imsil et al. [7] studied on the comparison of logistics costs between two rice mills. Similarly, Thoucharee and Pitakaso [10] analyzed logistics costs of rice supply chain in Northeastern area of Thailand. They found that material movement and transportation activities contributed most to logistics costs for all participants in the supply chain, except the middlemen who had procurement cost as the key cost. Therefore, all chain participants should mainly focus on material handling and transportation management to reduce non-value added activities and the total logistics cost.

Nowadays, all companies are seeking for various techniques to create better supply chain managements for their competitive advantages. Activity-based costing (ABC) is one of the method that is usually used to improve business performances, identify high cost based activities, and measuring logistic management performances[1, 4, 8]. The ABC approach is more accurate than traditional costing approach. It can determine precise process costs which lead to constant process improvement [8].

METHODOLOGY

The data were collected from the in-depth interview on the manager, officers and staffs that relate to post-harvest logistics activities and from secondary data sources. The secondary data were collected from an annual accounting report and rice aroma laboratory reports from previous research [5]. For the primary data, the questionnaire was developed to gather the costs of all logistics and activities at the rice mill of the

Table 1: Logistic cost structure identified by activities.

	Logistic activities	Sub-activities
A	Receiving raw material	Receiving rice paddy and sampling; inspection; weighing; unload paddy from farmer trucks; piling up paddy in warehouse; filling paddy in big bag and moving to warehouse.
B	Material handling	Loading and unloading paddy rice; checking and recording data of paddy rice; handling rice paddy, polished rice and milled rice.
C	Warehousing	Managing inventory level and checking quality of rice paddy and milled rice.
D	Packaging	Preparing machines; packing and sealing; quality control checking.
E	Transportation	Preparing trucks; managing the truck routes and delivery; organizing the truck loads.
F	Order processing	Receiving orders; processing invoices, quotations, and taxes; invoicing, selecting shipping routes.
G	Customer service	Contracting and communicating with customers.
H	Management and communication	Recording and managing data; controlling process; communicating within organizations.
I	Purchasing and maintenance	Purchasing support parts and equipment; maintaining building, equipment and machines; purchasing office supplies.

Kasetwisai Agricultural Co-operative, Ltd. in Roi Et province. The data were computed and the logistics costs were allocated to 9 logistic activities with 41 sub-activities as shown in Table 1. Then, using the ABC method, the cost drivers and the structure of logistics costs were analyzed to identify which activity has the highest contribution to the costs. Finally, the suggestions on loss reduction of rice aroma related to logistic activities were presented.

RESULTS AND DISCUSSION

Rice milling process of the Kasetwisai Agricultural Cooperative, Ltd. has a production capacity of 60 tons/day. This cooperative plays roles as collector, facilitator and processor in the supply chain. The operation starts at purchasing paddy from farmer members followed by moving paddy to warehouse, preparing for fulfilling the production process, milling, packaging and transporting the packed milled rice to customer. The logistic activity flow also includes coordinating and controlling logistic activities: customer services, order processing, management, planning, maintenance, and communication.

Under the ABC method, cost data was divided into five categories including labor cost, usage area cost, machine and equipment cost, material cost, and transportation cost. These cost data were allocated to each activity through the cost driver. The cost based activity and cost per unit (baht/kg) were calculated. Cost structure of the rice mill categorized by activity is presented in Table 2.

From Table 2, warehousing is the highest logistics cost at 26.52% of the total, which carries the highest cost of usage area. The second-highest cost is material handling (24.27%), followed by transportation (12.33%), packaging (10.84%), and raw material receiving (10.14%). For material handling activity, labor cost and usage area cost are about the same at 34.69% and 35.05%, respectively. The logistics costs of other activities are lower than 10%, including purchasing and maintenance (7.16%), management and communication (4.07%), customer service (2.45%), and order processing (2.22%). The total logistics cost per unit of milled rice is 4.52 baht/kg. If the selling price is 30-35 baht/kg, the total logistics cost accounts for 12.9-15% of the selling price. The costs per unit of warehousing and material handling are 1.20 baht/kg and 1.10 baht/kg, respectively. In this study, the improvement on rice aroma loss reduction is recommended on the top three highest logistic costs. These suggestions are based on the in-depth interview with experts and the secondary data. The aroma loss during storage is about 35.68% after 6 months at the storage temperature of 28°C, and the aroma loss during transportation is about 5-20% of the total 2AP concentration of finished products at the rice mill. In addition, time and handling activities in drying process can cause the loss of aroma [5].

For warehousing cost, carrying paddy rice for a long time results in a high inventory holding cost, as well as losses of rice aroma and weight. In fact, the inventory cost of the agricultural cooperative is significantly high because of lack of proper inventory management. As the rice aroma (or 2AP) decreased with storage time, it is necessary to consider the balance among levels of stock for production, holding cost, and the quality of rice. The types of package and storage condition (i.e. cooling storage) may help to decrease damage cost and loss of rice aroma.

Material handling cost in rice mill comes from many activities: truck unloading and loading, moving the work-in-process (WIP) by forklift trucks, checking and recording data of paddy and handling paddy, polished rice and milled rice. The impact of handling activities on loss of rice aroma is difficult to specify because of the variety of material handling equipment and vehicles. In sun drying process, using human labor force has a lower impact on the loss of aroma than using trucks [5]. However, the labor cost and

Table 2: Cost structure of rice mill categorized by activity.

	Main logistics activity	Labor cost (%)	Usage area cost (%)	Machine and equipment cost (%)	Material cost (%)	Transportation cost (%)	Activity cost (%)	Logistics cost (baht/kg)
A	Receiving raw material	30.22	10.21	8.62	50.95	0.00	**10.14**	**0.46**
B	Material handling	34.69	35.05	5.33	24.93	0.00	**24.27**	**1.10**
C	Warehousing	4.85	84.27	0.30	10.58	0.00	**26.52**	**1.20**
D	Packaging	7.66	52.44	4.89	35.00	0.00	**10.84**	**0.49**
E	Transportation	22.60	11.45	10.44	0.00	55.51	**12.33**	**0.56**
F	Order processing	59.94	20.14	14.99	0.00	4.93	**2.22**	**0.10**
G	Customer service	23.40	25.75	1.37	38.72	10.75	**2.45**	**0.11**
H	Management and communication	41.16	32.09	19.95	0.00	6.80	**4.07**	**0.18**
I	Purchasing and maintenance	27.06	51.28	19.12	2.55	0.00	**7.16**	**0.32**
	Total						**100.00**	**4.52**

usage area cost contribute the most of handling cost. The adjustment of load utilization to reduce cost of material handling should be considered.

Transportation cost is mostly related to vehicle usage including fuel, driver salaries and hiring rates of outsourced transport providers. The cost per unit is about 0.56 baht/kg, which accounts for 12.33% of total logistics cost per unit. The cooperative have two types of transportation: outsourced and own trucks. The selection of transportations depends on various factors including load utilization, hiring rates of outsourcing, delivery time, and transportation scheduling. Thus, the cooperative should manage the maximum load, scheduling and consolidating orders to reduce line hauls. For the rice aroma, if temperature during transportation is quite high (above 30°C), it can cause the aroma loss about 5-20% of the total 2AP concentration of finished products at the rice mill, depending on the transportation system (i.e. open or close system) [5]. Thus, if the cooperative can use temperature controlled vehicles, the quality of rice could be improved. However, an economic cost/benefit analysis has to be further conducted to support this.

CONCLUSIONS

This paper presents the cost structure of rice mill categorized by the activity and calculated per-unit cost (baht/kg) of each logistic activity, which is useful for managers to define which activities possess high logistics costs, consider a trade-off between responsiveness, utilizations of resources and levels of investment, and make decisions on the improvement of aroma loss reduction based on cost/benefit consideration. The study result shows that the total logistics cost per unit of the milled rice of the Kasetwisai Agricultural Co-operative, Ltd. is 4.52 baht/kg. The major logistics cost is warehousing, followed by material handling, transportation, packaging and receiving raw material activities. The agricultural cooperative can reduce its logistics cost by increasing collaboration in supply chain among stakeholders. Some logistics activities are related directly to the rice aroma loss such as warehousing, packaging, transportation, and material handling, whereas order processing, communication, and maintenance have an indirect impact on the quality of rice. The controls on conditions in warehousing and transportation activities, including humidity, temperature, and storage time, can maintain rice aroma and improve quality of products. Thus, the rice mill should focus its quality controls on those activities.

For the future research, the effect of logistic costs should be evaluated when the logistic activity has been improved in order to maintain the rice aroma, as well as value-added activities and non-value-added activities can be investigated to propose which activities should be eliminated or improved. Moreover, the comparison of activity-based costing between different cooperative rice mills in terms of production capacity and the quality of rice aroma could be addressed.

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