



AN ANALYSIS OF SUGARCANE AND SUGAR SUPPLY CHAIN IN UTTARADIT PROVINCE A CASE STUDY: THAI IDENTITY SUGAR FACTORY CO., LTD

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Abstract

This research aimed to analyze sugar cane and sugar supply chains in Uttaradit Province, a case study of Thai Identity Sugar Co., Ltd. It started with farmers processing sugarcane into various products and studied problems and obstacles in the supply chain system. It also presented a solution and development of sugarcane and sugar supply chains in Uttaradit Province. The study was divided using the value chain into primary and support activities. Besides, the analysis tools for quality management were the cause-and-effect diagram and SWOT analysis that helped to assess the potential of sugar cane and sugar supply chains in Uttaradit Province.

The above research results were known to the sugar production process from the beginning to the end products. It would help increase efficiency. Moreover, it was finding ways to improve the sugarcane and sugar supply chains of Uttaradit Province. It was helpful for sugarcane farmers to know the basics to improve and continuously increase efficiency within the cane and sugar supply chain in the future. It also increased the ability to compete in the market as well.

Keywords: Sugarcane and sugar supply chain, Value chain, Quality management



1. Introduction

The supply chain concept is a competitive advantage strategy, especially in business operations, such as increasing trade competitiveness. Because of the trade competition, entrepreneurs have to adjust their strategies to be superior to their competitors and meet the increasing customer demands. The effects that will follow after adjusting strategies and responding to customer needs are management, logistics, and transportation costs. Inventory Management and increasing costs of various management are not only the cost impact, but many other factors affect entrepreneurs, such as internal quality management and corporate credibility. Therefore, in the current competitive situation, operators need to increase their work efficiency, equivalent to the same industry or different industries domestically and internationally.

The attributes of the cane and sugar industry in Thailand are primarily medium and large industries. Likewise, the cane and sugar industry in Uttaradit province studied in this research is considered significant. The study found that the sugar cane and sugar industry in Uttaradit province tended to expand continuously. Because small farmers prefer to grow more sugarcane throughout the year and have serious support from the government, this research has foreseen the importance of studying ways to improve the sugarcane and sugar supply chains in Uttaradit Province to increase operational efficiency, reduce costs, and reduce losses within the supply chain, and lastly, to lead to sustainable development in the future.

2. Research Objectives

To study the supply chain of sugarcane and sugar industry with a case study in Uttaradit Province.

3. Research Methodology

In this research, a case study of sugar cane and sugar cane supply chains in Uttaradit Province was studied to identify supply chain problems and find solutions by using analytical principles and tools. The details are as follows:



3.1 Study basic information and structure of sugar cane and sugar supply chain in Uttaradit Province

To conduct a study on the sources and importance of data collection related to research in order to obtain information and structure of the supply chain with the following sub-steps:

3.1.1 Conduct liaison with relevant parties and make a detailed presentation of the research objectives, scope, and expected benefits.

3.1.2 Conduct preliminary interviews with people involved in the supply chain, studying additional document information and summarizing the supply chain structure as a diagram for further study.

3.1.3 Study information, concepts, principles, and related theories domestically and internationally.

3.2 Study and research the current situation of sugarcane and sugar supply chains

After studying the preliminary information on cane and sugar supply chains, the next step was to study the activities of each unit in the supply chain, from breeding preparation, preparation of the planting area, maintenance, harvesting, and collecting data on various activities of the agency from interviews and questionnaires. However, gathering information from collected documents can be done from both memos and work documents collected by the following:

3.2.1 Surveying the actual processes of each activity in the work units, from sugarcane breeding, planting area preparation, and harvesting including trading sugarcane.

3.2.2 Interviewing the concerned people in each activity about activities or procedures, such as planting area preparation, maintenance, harvesting, etc.

3.3 Make the application of relevant principles and theories

3.3.1 Record all activities to analyze the activity types by applying the Value Chain Analysis (VCA) principle. This principle identifies the primary activities and support activities necessary to operate towards the industry's ultimate benefit: the expected profit.

3.3.2 Assess the activities by using the SWOT analysis. It is the analysis of the strengths and weaknesses of the organization to evaluate the main problems that threaten the operation of the sugarcane and sugar business. The main problems will come from weaknesses and obstacles within the supply chain.

3.3.3 Use cause and effect diagrams. This chart is one of the industry's most widely used quality management tools. The objective is to find the causes that make problems that can be modified to make work more productive and also solve problems on the spot, including knowing the root cause from the hidden actual situation.

3.4 Analyze the problems of the cane and sugar supply chain for the solutions

From the collection of case studies and survey data, the research team used for the analysis. The processes started with finding sugarcane needs, procuring varieties, planting, harvesting, trading, transportation, processing into sugar products, quality inspection, and sugar distribution. The information mentioned above was analyzed into various issues and found ways to solve problems within the sugar cane and sugar supply chains in Uttaradit Province.

3.5 Summary and presentation of recommendations

3.5.1 Summarize the results of the study of the supply chain system, identify problems, find ways to solve the problems of the supply chain, and consider improving activities in the supply chain.

3.5.2 Propose guidelines for improving the supply chain system and further research in the future.

4. Results

This section presents details of the study of the current situation of sugar cane and sugar supply chains in Uttaradit Province, including a case study of Thai Identity Sugar Co., Ltd. In order to understand the sugarcane and sugar supply chain system, value chain analysis, SWOT analysis, and cause-and-effect tree analysis were used, and the details were shown as follows:

4.1 Cane and Sugar Supply Chain: A Case Study

It was found from the study that the upstream to the downstream of the supply chain were sugar cane farmers in Uttaradit Province. Before farmers plant sugar cane, they contact the factory's promotion unit to enter a contract to deliver the products obtained to the plant. In the work of the plant's promotion unit, it could have the consult for plantation to the harvest, including the sugar product sent to the factory. In addition, the promotion unit would be responsible for recruiting new sugarcane farmers to persuade them to enter into contracts with the factory to deliver their products to the factory. From the above steps, when planting until harvesting, produce would be transported using ten-wheel trucks or trailers depending on the amount of product. All processes are done under the contract. The sugar products of these processes would be sent and exported to the food and beverage industry abroad. Transportation of sugar to various food and beverage factories would be transported by ten-wheel trucks or trailers. Vehicle usage depends on the amount of sugar in each round. For the transportation of sugar to foreign countries, the factory would transport sugar to the port. The cane and sugar supply chain is shown in Figure 1.

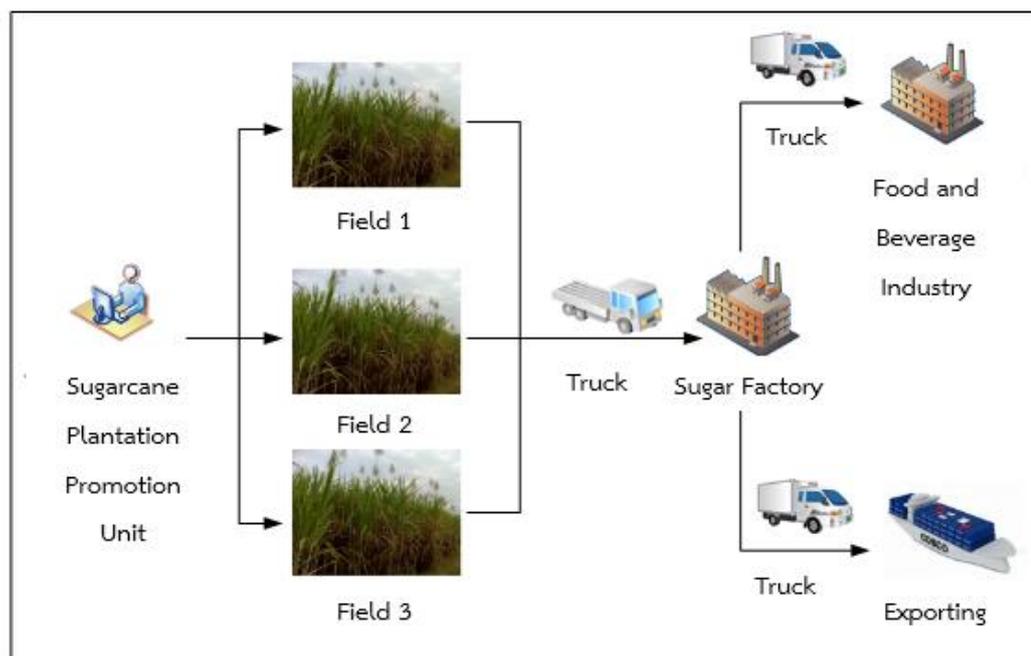


Figure 1 The cane and sugar supply chain

4.2 Value Chain Analysis

Accordingly, the value chain focused on activities within the supply chain that consisted of procuring varieties, planting, harvesting, processing, and distributing sugar to end customers, both domestic distribution and exporting. It aimed to build the ability to compete in business. Therefore, a value chain links activity inside and outside the organization that affect competition. In the end, it is the success that the Lord will receive as a return, which is the profit itself (Porter, 1980). The research team collected information from farmers, academicians, the Office of the Cane and Sugar Board, and units of the Thai Identity Sugar Factory, and it was found that there were forms and procedures as shown in Figure 2.

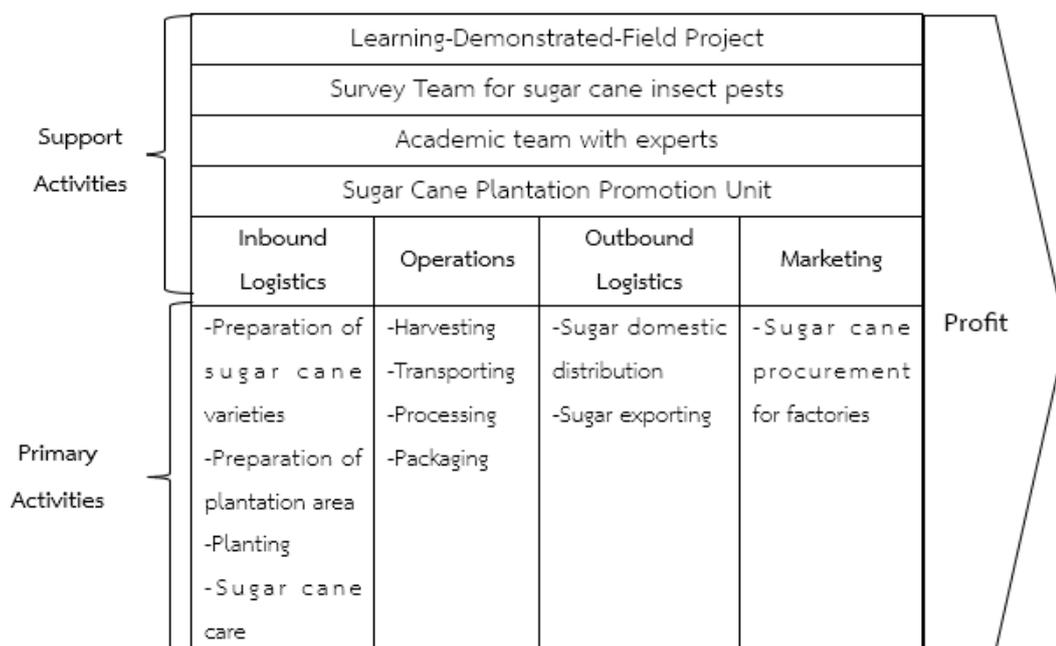


Figure 2 Value Chain

The resulting value chain can explain the connection of operations from Figure 2 as follows.

4.2.1 The main activities include

(1) Inbound Logistics: There were 4 steps in the inbound logistics. The details are shown as follows:

Step 1 Preparation of sugar cane varieties: Most of the sugarcane varieties planted are planted by the farmers. Some of them are taken from farmers who sell sugar cane varieties. Sugarcane varieties that farmers prefer to grow are Khon Kaen 3 and U-Thong varieties. The species that will be planted must be complete, considering that the cane eyes must be complete and covered with leaf sheath to prevent eye damage. The size of the cultivars used for planting should have 2-3 eyes. Sugarcane cultivars must be about 8-10 months old.

Step 2 Preparation of plantation areas: The environment and soil characteristics suitable for sugarcane cultivation must not be dense, friable, and have good water and air circulation. The pH is in the range of 5.5-7.0, the salinity is not more than 4.0 decimal per meter, the temperature is 30-35 degrees Celsius, and the rainfall is 1,000-1,500 mm. per year. The nutrient requirement was 14 kg of nitrogen per rai, 10 kg of phosphorus per rai, and 30 kg of potassium per rai. The soil preparation process was initially considered as weeding that will allow rainwater to seep through into the soil well. So, it makes sugarcane roots grow easier. In preparing the soil, it will plow, plow, and then raise the trench. General soil preparation involves plowing 2-3 times, about 30-50 cm deep, as shown in Figure 3.



Figure 3 Plowing the soil for planting

Step 3 Sugarcane planting: Sugarcane planting is suitable to be planted after the rainy season, which starts planting around October-November. By the time of the sugarcane planting, it must be at least 12 months.



Figure 4 Sugarcane planting using machinery to assist in planting



Figure 5 Sugar cane plantation



Figure 5 shows a replanting of sugarcane in case the sugarcane planting machine does not reach the planting area. Another case is the sugarcane that has already been cultivated without growing. Therefore, it must be planted and repaired to yield as the farmers want.

Step 4 Sugarcane Care: this step includes fertilizer care. It will be divided into 2 stages as follows.

Stage 1 Planting sugarcane: Fertilization will be divided into 2 phases. The first phase is when the cane is 1.5 months old, apply chemical fertilizer formula 16-20-0, rate 100 kg./rai. The second phase is when the sugar cane is 3-4 months old, apply chemical fertilizer formula 20-5-28, rate 100 kg./rai.

Stage 2 Sugarcane stumps: Fertilization will be divided into 2 phases, the same as the first stage. In the first phase, fertilizer will be applied immediately after harvest. In the second phase, when the sugarcane is 3-4 months old, chemical fertilizer formula 20-5-28 is applied at 150 kg/rai, and will use manual labor to mow grass or tractors. In the period from the beginning of planting to 4 months, if the herbicide is used, atrazine is used at the rate of 500-625 g/rai. After spraying in the first phase for 2-3 months, chemical spraying will be used again. Supplemental water supply will be provided on average 3 weeks/time. As shown in Figure 6, fertilizer is applied to take care of sugarcane during the rainy season. This is a step used to adjust the physical condition of the soil to be suitable for cultivation. The amount of fertilizer to be added should be based on the soil's fertility, and the sugar cane's growth.

Figure 7 shows pouring water in the plantation area, which is a cost-saving and convenient water supply. This type of watering is limited in that the planting area must be level to flow easily and continuously.



Figure 6 Fertilizing for Sugarcane Care



Figure 7 pouring water

(2) Operations: The first step in the operation is sugar cane harvesting. The extension unit will plan the harvest from the start, whether to use manual labor or cutting machines. It was considered whether the planted area could be cut into or not. Sugar cane suitable for harvesting must be about 13 - 14 months old, and the

sweetness of sugarcane at this stage will reach the standard. Sugarcane harvesting can be done by methods, as shown in Figure 8, which is sugarcane harvesting by using a sugarcane harvester. Sugar cane harvesting using harvesters is the most popular harvest and is mostly used by farmers today, which is fast and convenient with less cost.



Figure 8 Harvesting sugarcane using cane harvesters

Another way to harvest sugarcane is by using manual labor, and the harvest is rarely used today due to high labor costs. Harvest labor is few. It's hard to find laborers, and they need to work faster. So, the harvest is delayed to meet the demand of factories, as shown in Figure 9.



Figure 9 sugar cane harvest using manual labor

Step 2 Transporting sugarcane to the factories: Sugarcane is transported to the processing plant by ten-wheel trucks or tow trucks, which depends on the amount of sugarcane transported in each trip. Primarily, ten-wheel trucks are used to transport sugarcane to factories. The vehicles to be transported will come from farmers, factories, and truck operators. Farmers hire most vehicles used for transportation to transport sugarcane directly, as shown in Figure 10.



Figure 10 sugar cane truck

In this step, the factory will have the truck driver come in and grab a queue card to wait for sugarcane to be poured into the sugar processing process in the industrial factory.

Step 3 Processing: sugar processing is divided into two main processes as follows:

The first process is the production of raw sugar, which brings sugarcane into the sugar production process through sugarcane juice extraction, cleaning, boiling, chewing, and centrifugation to seal the sugar.

The second process is producing white sugar production. The process is the same as the production of raw sugar. It was by bringing raw sugar into the production line to produce sugar again through the melt spinning, cleaning, bleaching, and chewing processes, then separating sugar crystals and dehumidifying.



Step 4 Packaging: White sugar or raw sugar produced will be packed into sacks for storage and on the line for sale. Each sack will weigh 50 kilograms.

(3) Outbound logistics is divided into 2 steps:

Step 1 Sugar domestic distribution: 80% of Thai Identity Co., Ltd.'s sugar would be sold to Thailand's food and beverage industry. The beverage and food industry had made a contract and paid in advance. So that the factory could plan the production and allocated the amount of sugar correctly. The sugar quota sold to this group of customers is Quota A.

Step 2 Exporting sugar to foreign countries: Sugar exports will be sugar type Quota B, which is raw sugar. The export operation will be exported by Thai Cane and Sugar Co., Ltd. Export operations must comply with government regulations, which way to export Thai sugar is not sold directly to consumers in the country. However, it will be sold to a brokerage firm and well-known legal sugar traders in the international trade.

(4) Marketing: Procurement of sugarcane to the factory is in this process. The factory will have a sugarcane plantation promotion agency to recruit farmers to join the contract with the factory. The supporting agencies will provide advice on planting, maintenance, and even providing services for harvesting sugar cane trucks.

4.2.2 Support activities include

(1) There is a demonstration plot project for farmers to learn about sugarcane cultivation properly.

(2) There is a team of academics to help survey insects and pests of sugar cane in all areas promoted.

(3) There is a team of academics from the sugar factory to advise on planting and harvesting sugarcane to send to the factory.

(4) The Sugarcane Plantation Promotion Unit will supply sugarcane to the factory. The agency will recruit farmers who want to grow sugarcane or who already cultivate sugarcane to join the sugar factory. The agency will have academics to advise on cultivation, care for farmers' cultivation capital, and check the soil conditions of the participating areas to determine if it is suitable for planting sugarcane. Sugar cane harvesters are also available to provide services to farmers who join the factory.



4.3 Evaluation of Potential Using SWOT Analysis

They use SWOT analysis to assess the potential of cane and sugar in Uttaradit Province by analyzing internal factors, strengths, weaknesses, external factors, opportunities, and threats. In order to assess and find ways to increase the efficiency of the sugarcane and sugar supply chains of Uttaradit Province and increase competitiveness with neighboring regions and neighboring countries, SWOT analysis is a qualitative method for this case. The analysis details are shown in Table 1.

Table 1 SWOT Analysis

	Positive Procedures	Negative Procedures
Internal Factors	<p>Strengths</p> <ol style="list-style-type: none"> 1. There are plenty of plantation areas. 2. There are sugar factories in the province. 3. There are both domestic and foreign academic team and experts who give advice and consult for all processes. 4. There are high efficiency of plantation. 	<p>Weaknesses</p> <ol style="list-style-type: none"> 1. There is not enough labors, including skilled labors. 2. The fields and the factory are far away from each other. 3. It is bad weather in the areas. 4. Farmers are lack of plantation knowledge.
External Factors	<p>Opportunities</p> <ol style="list-style-type: none"> 1. The Office of the Cane and Sugar Board supports water sources and water pumps. 2. The Uttaradit Provincial Agricultural Office has a policy to promote sugarcane cultivation. 	<p>Threats</p> <ol style="list-style-type: none"> 1. World sugar price has been decreasing continuously since the sugar production is in surplus. 2. There is lack of irrigation system. 3. Competitors have high-efficiency production technology that make a production advantage.

4.4 Cause and Effect Diagram

The researchers have used the information from the above SWOT analysis, weaknesses, and threats to conduct questioning of all involved parties. The problems of sugarcane were the lack of quality and others. It can be expressed as a cause-and-effect diagram analysis, as shown in Figure 11.

The resulting diagram can analyze the factors affecting the quality of sugar cane as follows:

4.4.1 Workers, employees, or personnel lacked care, so it was caused by insufficient farm labor, resulting in lower-quality sugarcane.

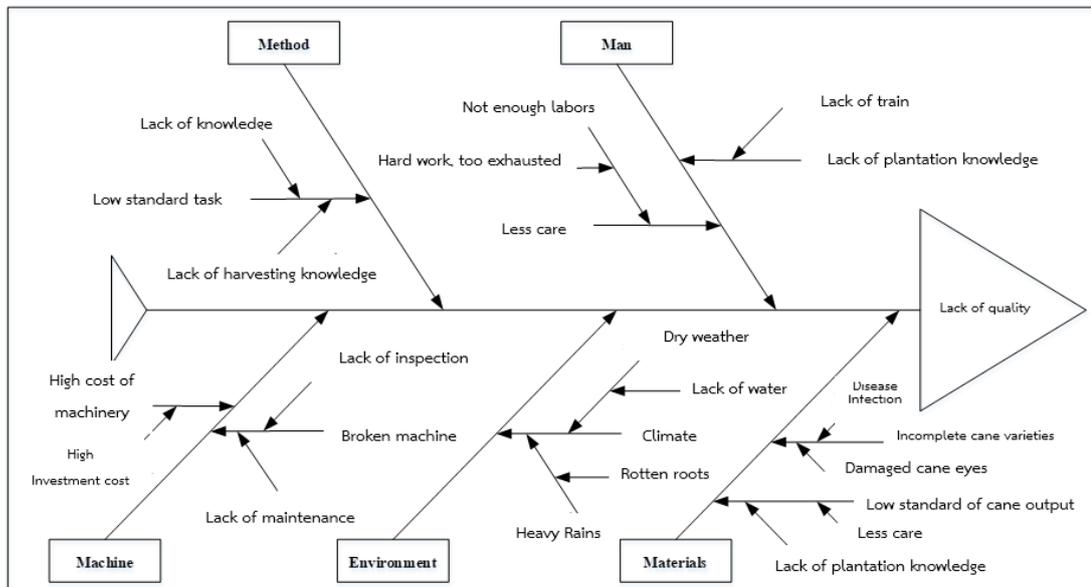


Figure 11 An analysis of Cause-and-Effect diagram

4.4.2 Non-standard work was the need for more knowledge about the planting process. Improper care, improper cultivation, and less care resulted in better-quality sugar cane.

Lack of harvest knowledge was a factor that affected sugar cane quality. Most farm owners set fire to sugar cane before harvesting because of the convenience of harvesting. Sugarcane burning is very detrimental to sugarcane quality. Burning the cane before harvesting will reduce the weight of the cane and lower its sweetness.

4.4.3 Machines and accessories

Planting machinery is expensive, making farmers unable to buy machinery for their own. As a result, farmers need to gain knowledge of modern cultivation technology and care. Besides, the lack of machinery may result in higher costs for cultivation, increasing the rental of machinery and equipment. However, when the machine is damaged, maintenance costs will also have a high price.



4.4.4 Materials, spare parts and other equipment

The imperfections of the varieties are caused of low-quality sugar cane due to diseased sugarcane or damaged sugarcane eyes. Cultivation of diseased sugarcane varieties or damaged sugarcane eyes will cause the sugarcane not to grow, and the sugarcane sweetness level will not meet the standards. As a result, the sugarcane planted has less yield and poor quality.

4.4.5 Environment, weather, and places

Dry weather causes the sugar cane to lack water, resulting in the sugarcane's sweetness not being up to the standard or dying. In the case of heavy rain, there is water in the area, which may cause the cane roots to rot and eventually die. Hence, it causes less productivity and poor quality.

5. Conclusion and Discussion

The results of the study of cane and sugar supply chains of Uttaradit Province, a case study with value chain management, were analyzed by using a fishbone diagram or a cause-and-effect diagram. It analyzed the potential by SWOT analysis to know the problems that arose and made the guidelines for increasing efficiency as follows:

5.1 Summary of the study of sugarcane and sugar supply chains

5.1.1 It found that the sugarcane farmers needed knowledge, making it impossible to plant and take care of sugarcane properly. Mostly, the cultivation of sugar cane was a plantation that required high costs and were causing some farmers to lose money in planting investments. It was impossible to cultivate fully, resulting in a small amount of sugar cane production and lower quality than the standard.

5.1.2 Problems of Sugarcane Processing Entrepreneurs

The researchers directly asked the operators in the factory, and It was found that the problems encountered were problems in the quality of raw materials that needed to meet the specified standards. However, they need help promoting prices because sugar prices tend to fall continuously.

5.1.3 Problem of transportation



Farmers are likely transported by trucks or tow trucks. The studies showed that transportation cost to factories is costly because the factory area is located far from the farmer's area.

5.2 Improvement and Development Guidelines Cane and Sugar Supply Chain

5.2.1 There should be more training for farmers in various points, including preparation for planting sugarcane, taking care of harvesting the right produce according to appropriate agricultural principles, training to educate about technology to increase productivity, using machinery in the production process appropriately, and controlling of production costs and product transportation costs. It should continue to provide knowledge to farmers continuously and thoroughly. Besides, the government should consider providing financial assistance to farmers for investment in agricultural machinery and equipment. It is to help them increase the efficiency of sugarcane cultivation, which tends to increase.

5.2.2 The transport sector should study and formulate measures to reduce transport costs. The related transport unit has to show the know-how for using fuel efficiently, including choosing the truck's appropriate size, increasing maintenance standards, and training truck drivers for efficient and safe driving.

6. Recommendations

This research has been suggested in terms of education about sugarcane cultivation, operation, and further research as follows:

6.1 Knowledge for farmers

Most farmers still need to gain knowledge about cultivation and care. Therefore, academics and experts should provide knowledge to farmers directly and thoroughly with continuous training on sugarcane cultivation and knowledge of agriculture about proper cultivation. This may result in better-quality of produce sugar cane.

6.2 Planning

Sugarcane farmers should plan to be more productive by focusing on production costs, quantity, and output quality.



6.3 Government support

The government sector should get involved in educating farmers about sugarcane cultivation, setting prices, and finding ways to reduce production costs. It should set up funds for them to invest in sugar cane, fertilizer, herbicides, etc., including reducing the interest on loans for machinery and technology.

6.4 Research Extension

This research studies the upstream-to-downstream supply chains of the sugarcane and sugar industry in the overview. Further studies can be extended in other areas, for example, production efficiency, reduction of production costs, transportation costs, cost reduction in logistics activities, warehouse and inventory management, and sales and exports.

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