TECHNICAL EFFICIENCY AND MOTIVATION OF CONTRACT AND NON-CONTRACT FARMERS PARTICIPATION IN THAILAND'S SUGARCANE LOADING STATION

By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

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July 2023

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In the sugarcane industry in Thailand, the sugarcane loading stations emerge as pivotal entities that significantly contribute to the reduction of transportation costs for sugarcane farmers. These loading stations serve as the hub for sugarcane farmers, playing a vital role in the search of sustainable agriculture practices. The decision-making process of farmers in selecting sugarcane contracts with specific loading stations is a complex process, influenced by numerous factors encompassing interpersonal relationships, financial considerations, and social standing. Understanding the influential factors associated with the management system of loading stations is imperative for enhancing the productivity of sugarcane farmers. The main objective of this study was to examine the impacts of loading stations on sugarcane farmers and the factors that farmers to participate as contract farmers. The methodology of this involved surveying 500 sugarcane small farmers in north-eastern Thailand using a questionnaire. Data analysis techniques such as statistics (frequency, percentage), factor analysis, multiple regression analysis, and Stochastic Frontier method were employed. The research identified two types of farmers: contract farmers (coded as 1) and non-contract farmers (coded as 0). The study found that contract farmers exhibited higher motivation and tended to stay longer at sugarcane loading stations compared to non-contract farmers. The positive and significant effect of the dummy variable coefficient on motivation suggested that contract farmers were more inclined to continue their relationships with the loading stations. The technical efficiency of sugarcane production was analysed using the Cobb-Douglas Frontier 4.1 method. The total average efficiency of sugarcane farmers at transfer stations was 78.06 %. Contract farmers had the potential to improve efficiency by 0.22, while farmers without contracts had an average efficiency of 81.06 and could increase the efficiency by 0.19. Promoting sugarcane farming to meet production targets requires creating common goal awareness and fostering development. Sugar mill staff have been involved in sharing knowledge with sugarcane farmers, focusing on cultivation practices and benefits. The decision of farmers to stay in the sugarcane and sugar industry is influenced by factors such as financial considerations, loans, and

support. Government agencies are urged to fulfil their duties by promoting cooperation and completing missions through a network. The proposal includes creating a system to track production and provide support, advocating for policies following regulations, and preventing disputes to assist sugarcane farmers effectively.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KECEKAPAN TEKNIKAL DAN MOTIVASI PETANI KONTRAK DAN BUKAN KONTRAK UNTUK MENGAMBIL BAHAGIAN DALAM STESEN PEMUATAN TEBU THAILAND

Oleh

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Dalam industri tebu di Thailand, stesen pemuatan tebu muncul sebagai entiti penting yang menyumbang dengan ketara kepada pengurangan kos pengangkutan untuk petani tebu. Stesen pemuatan ini berfungsi sebagai hab petani tebu, memainkan peranan penting dalam mencari amalan pertanian mampan. Proses membuat keputusan petani dalam memilih kontrak tebu dengan stesen pemuatan tertentu adalah proses yang kompleks, dipengaruhi oleh pelbagai faktor merangkumi hubungan interpersonal, pertimbangan kewangan dan kedudukan sosial. Memahami faktor pengaruh yang berkaitan dengan sistem pengurusan stesen pemuatan adalah penting untuk meningkatkan produktiviti petani tebu. Objektif utama kajian ini adalah untuk mengkaji kesan stesen pemuatan terhadap petani tebu dan faktor-faktor yang melibatkan petani sebagai petani kontrak. Metodologi bagi kajian itu melibatkan tinjauan 500 petani kecil tebu di timur laut Thailand menggunakan soal selidik. Teknik analisis data seperti statistik (kekerapan, peratusan), analisis faktor, analisis regresi berganda, dan kaedah Stochastic Frontier telah digunakan. Kajian ini mengenal pasti dua jenis petani: petani kontrak (dikodkan sebagai 1) dan petani bukan kontrak (dikodkan sebagai 0). Kajian mendapati petani kontrak menunjukkan motivasi yang lebih tinggi dan cenderung untuk tinggal lebih lama di stesen pemuatan tebu berbanding petani bukan kontrak. Kesan positif dan signifikan pekali pembolehubah dummy terhadap motivasi menunjukkan bahawa petani kontrak lebih cenderung untuk meneruskan hubungan mereka dengan stesen pemuatan. Kecekapan teknikal pengeluaran tebu dianalisis menggunakan kaedah Cobb-Douglas Frontier 4.1. Jumlah purata kecekapan petani tebu di stesen pemindahan ialah 78.06%. Petani kontrak berpotensi meningkatkan kecekapan sebanyak 0.22, manakala petani kecil tanpa kontrak mempunyai kecekapan purata 81.06 dan boleh meningkatkan kecekapan sebanyak 0.19. Mempromosikan pertanian tebu untuk memenuhi sasaran pengeluaran memerlukan kewujudan kesedaran matlamat bersama dan memupuk pembangunan. Kakitangan kilang gula telah terlibat dalam berkongsi pengetahuan dengan petani tebu, memberi tumpuan kepada amalan penanaman dan faedah. Keputusan petani untuk kekal dalam industri tebu dan gula dipengaruhi oleh faktor-

faktor seperti pertimbangan kewangan, pinjaman, dan sokongan. Agensi kerajaan digesa melaksanakan tugas mereka dengan menggalakkan kerjasama dan menyelesaikan misi melalui rangkaian. Cadangan itu termasuk mewujudkan sistem untuk menjejaki pengeluaran dan menyediakan sokongan, menyokong dasar mengikut peraturan, dan mencegah pertikaian untuk membantu petani tebu dengan berkesan.

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CHAPTER 1

INTRODUCTION

This chapter presents the research background and current situation of the cane and sugar business in Thailand, including its role as a leading world sugar exporter, its area planted to sugarcane, sugarcane production and job contribution, sugarcane pricing and the supply chain. Additionally, discussions are presented related to the background of sugarcane transportation, sugarcane loading technology, the establishment of sugarcane loading stations, the evolution of sugarcane loading stations, agricultural contract farming and sugarcane contract farming in Thailand. In the following sections, this chapter presents the problem statement, research questions, research objectives and significance of the study.

1.1 Background of the Study

Thailand's policies in dealing with the spread of COVID-19 are to support economic activity and support the livelihoods of the most vulnerable centred on an off-budget budget of 1.5 trillion baht, about 9% of GDP, for money transfers. Medical economic and social rehabilitation massive remittance programs have been established to support vulnerable groups who are not protected by existing social assistance mechanisms (World Bank, 2021). Agriculture, hunting and forestry contributed to Thailand's gross domestic product (GDP) in 2020 of about 1.36 million baht. Others, such as forestry and fisheries, contributed less to the country's livestock-related GDP rising to 2.7 per cent (World Bank, 2021).

The emergence of a vaccine-resistant coronavirus could affect domestic activities, trade in goods and the expected recovery in tourist numbers. The economic impact of Russia's invasion of Ukraine may last longer than expected. A prolonged impact on prices is likely to put further downward pressure on consumer demand. To maintain recovery, it is important to rebuild the fiscal buffer. Examine the vulnerability of the financial sector. And exploring more sustainable and efficient economic production methods for the environment. To bring back momentum in poverty reduction policy priorities must focus on expanding social assistance benefits for vulnerable populations. It is estimated that without the government's recommended compensation measures, Poverty will increase to 7.4% in 2020 instead of the actual 6.2%. The effect of COVID-19 in 2021 has slowed the recovery with a disproportionate burden on vulnerable groups (World Bank, 2021). In the world export rankings, Brazil is the first largest sugar exporter followed by Thailand as the second largest, with Thailand exporting about 11 million metric tons in 2022 (Table 1.1). Additionally, Thailand's share of the global centrifugal sugar market from 2019 to 2022 was about 13-16%. This indicates that the Thai sugar industry has a significant influence on the global supply of sugar.

Table 1.1 : Top Five Export Countries in the World of Centrifugal Sugar

Country	2019	2020	2021	2022	2019	2020	2021	2022
	Thousand Metric Tons				Percentage Share			
Brazil	19,280	32,150	25,950	28,200	36%	51%	38%	41%
Thailand	6,695	3,739	10,000	11,000	13%	6%	15%	16%
India	5,800	8,406	11,730	9,390	11%	13%	17%	14%
Australia	3,600	3,400	3,120	3,570	7%	5%	5%	5%
Guatemala	1,858	1,395	1,740	1,750	3%	2%	3%	3%
Other	16,191	14,419	15,302	15,342	30%	23%	23%	22%
Total	53,424	63,509	67,842	69,252	100%	100%	100%	100%

(Sources: United States Department of Agriculture, November 2022[1])

For many centuries, sugarcane was planted as an economic crop in Thailand (Arjchariyaartong, 2007). Its successful use as raw material for refining sugar began in 1937 (Office of the Cane and Sugar Board, 2013). However, the challenges of limited land for sugarcane cultivation and the low sugar content of local sugarcane species restricted the growth of the industry in Thailand before the 1950s (Chanprame & Teinseree,2008). In 1959, a new sugarcane species with a higher sugar content was sought and the Thai government promoted this new species to the sugar industry (F140, Saengwong, 2004). Then, more sugar mills were built in Thailand and the country was transformed from a net importer to a net exporter of sugar by 1970 (Kuldilok, 2019). Over the years, the number of sugar mills in Thailand continuously grew from 32 sugar mills in 1987 to 56 sugar mills in 2018 (Office of the Cane and Sugar Board, 2019).

1.2 An overview of the Sugar and Cane Industries in Thailand

Sugarcane is one of the important economic crops for Thai industries and farmers. Sugarcane is considered an important raw material for the sugar production industry in Thailand. Thai sugarcane farmers earn about USD 937.5 million of income annually. Sugarcane can be planted in any region of Thailand and there is a dependable market for the products. Sugarcane is a plant from the grass family that can grow well in many types of soil (Office of the Cane and Sugar Board, 2016). Except for the southern region, Thailand's sugarcane-producing area is spread throughout the whole country. The northeastern area accounts for about 43 per cent of overall sugarcane farming, the highest percentage compared to other regions (Office of the Cane and Sugar Board, 2017). The centre and northern areas, where the first sugar mill was built 80 years ago, are the second and third most prolific regions (Office of the Cane and Sugar Board, 2018).

Furthermore, over 80% of all sugarcane growers are small-scale farmers, with just 15% having medium-sized fields and 5% having extensive plantations (Sriroth, 2016). A small is defined as 0.16-9.44 ha, a medium-sized farm as 9.6-31.84 ha, and a big farm is defined as more than 31.84 ha. The percentage of small-scale farms in Thailand's northeastern area is more significant than in the rest of the country. Almost all medium

[1] Retrieved from: https://apps.fas.usda.gov/psdonline/circulars/sugar.pdf

and large farms are located in the northern and central areas, where sugar mills have been in operation for over eight decades (Kuldilok, 2021).

Thailand's sugarcane output grew dramatically during the past decades, from 1,076.35 ha to 1,957.77 ha (Office of the Cane and Sugar Board, 2018). However, owing to drought and the COVID-19 scenario, Thailand produced less sugarcane in the crop years 2015-2016 and 2020-2021, respectively (S&P Global, 2021). The growth of Thai sugarcane output is attributable to the extension of the producing area rather than an increase in yield. Given that the worldwide trend of sugar prices has dropped, sugarcane prices in Thailand are decreasing (intercontinental Exchange, 2020). Farmers may suffer due to poor income, especially when the average cost of sugarcane production rises. Material and labour expenses account for a larger percentage of typical manufacturing costs. According to Athipanyakul et al. (2019), this amounts to more than half of overall labour expenses. In Thailand, the price of sugarcane output is the price at the mill destination, and thus farmers must bear the transportation expenses. The cost of transporting sugarcane from farm to mill has risen by an average of ten dollars per ton in recent years. This issue was exacerbated mainly by the absence of queuing mechanisms in virtually all mills in Thailand, where the average loading time is 48 hours (Athipanyakul et al., 2019).

1.3 Sugarcane Planted area in Thailand

In the production year 2021/22, there are sugarcane plantations nationwide in 47 provinces totalling 1,806,942.30 hectares. From the total sugarcane plantations in the country, it was found that the northeastern region had the largest planting area, followed by the central, northern and eastern regions. The sugar cane production of farmers in each region is spread through many provinces. (Office of the Cane and Sugar Board, 2022).

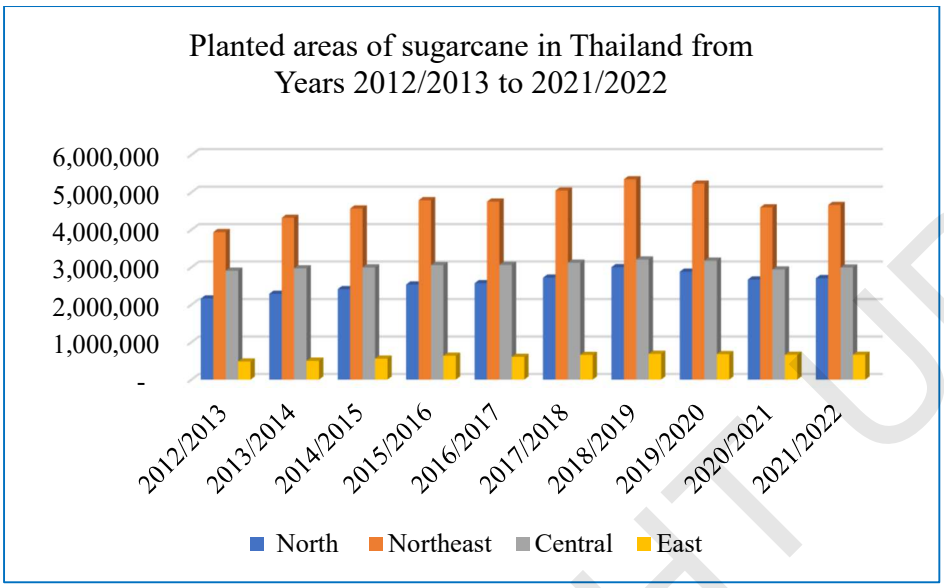

Figure 1.1 : Planted areas of sugarcane in Thailand from Years 2012/2013-2021/2022
(Source: Office of the Cane and Sugar Board, Thailand 2022)

In Thailand, there are four regions of sugarcane cultivation based on productivity. These are the north, central, northeast, and eastern regions. In the north of Thailand, sugarcane cultivation is done in nine (9) provinces. These are Phrae, Uttaradit, Sukhothai, Tak, Phitsanulok, Kamphaengphet, Phichit, Nakhon Sawan and Phetchabun, comprising about 395,605 hectares (Figure 1.2) by the provinces with the most planted areas this in the first 3 provinces to Nakhon Sawan Province, Kamphaeng Phet and Phetchabun respectively. Sugar mills in the north there are 10 factories located in Kamphaeng Phet Province 3 factories, in Nakhon Sawan, 2 factories in Phetchabun, 2 factories in Sukhothai, 1 factory in Uttaradit, and 1 factory in Phitsanulok.

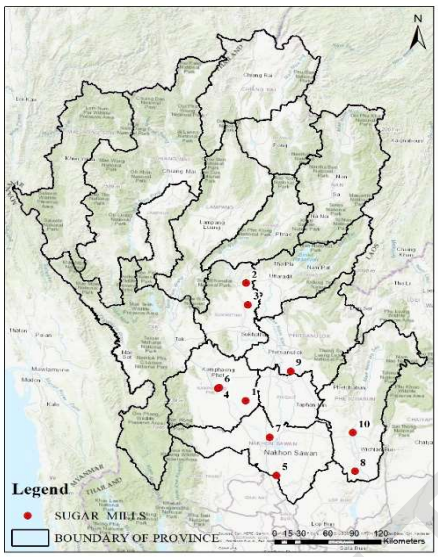

Figure 1.2 : Thailand sugarcane production and factories in north region
(Source: Office of the Cane and Sugar Board 2022)

The northern region has a sugarcane plantation area of 443,597 hectares an increase of 6,197.87 hectares or 1.42% from the 2020/21 production year (Figure 1.3) The first 3 provinces with the most sugarcane planting areas are Nakhon Sawan, Kamphaeng Phet and Phetchabun respectively.

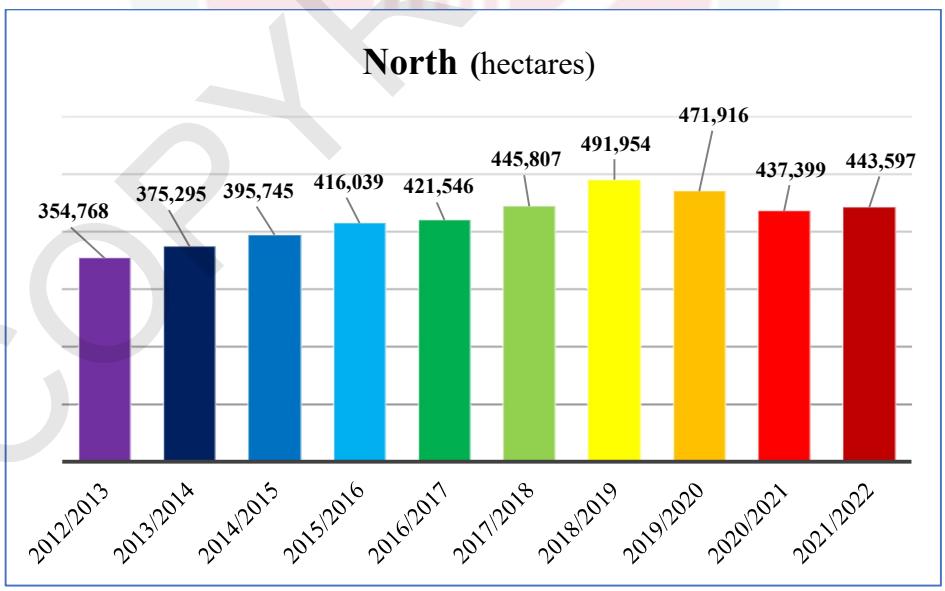

Figure 1.3 : Thailand sugarcane production in north region 2012/2013 – 2021/2022
(Source: Office of the Cane and Sugar Board 2022)

In the central region of Thailand, sugarcane cultivation is done in twelve (12) provinces, which include Uthai Thani, Chainat, Singburi, Lopburi, Saraburi, Ang Thong, Suphan Buri, Kanchanaburi, Nakhon Pathom, Ratchaburi, Phetchaburi and Prachuab Kirikhan (Figure 1.4) by the provinces with the most planted areas this in the first 3 provinces to Kanchanaburi Province Lopburi and Suphan Buri respectively. Sugar mills in the central region, there are 20 factories located in Kanchanaburi 8 factories, Suphan Buri 3 factories, 2 factories in each province Uthai Thani, Lopburi, and Ratchaburi successive and 1 factory located in each province including Saraburi, Singburi, Prachuap Khirikhan respectively.

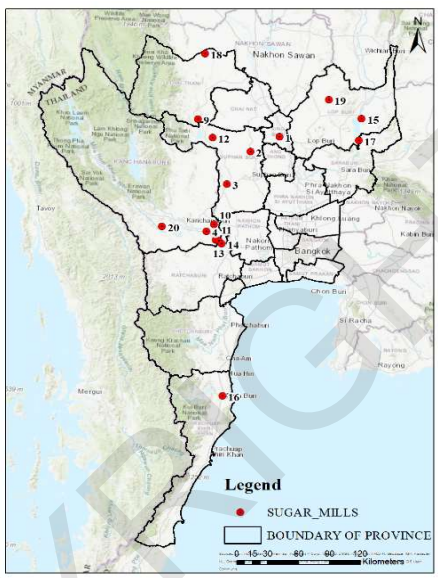

Figure 1.4 : Thailand sugarcane production and factories in central region
(Source: Office of the Cane and Sugar Board 2022)

The central region has a sugarcane plantation area of 490,389 hectares an increase of 8,826.72 hectares or 1.77% from the 2020/21 production year (Figure 1.5) The first 3 provinces with the most sugarcane planting areas are Kanchanaburi, Lopburi and Suphanburi respectively.

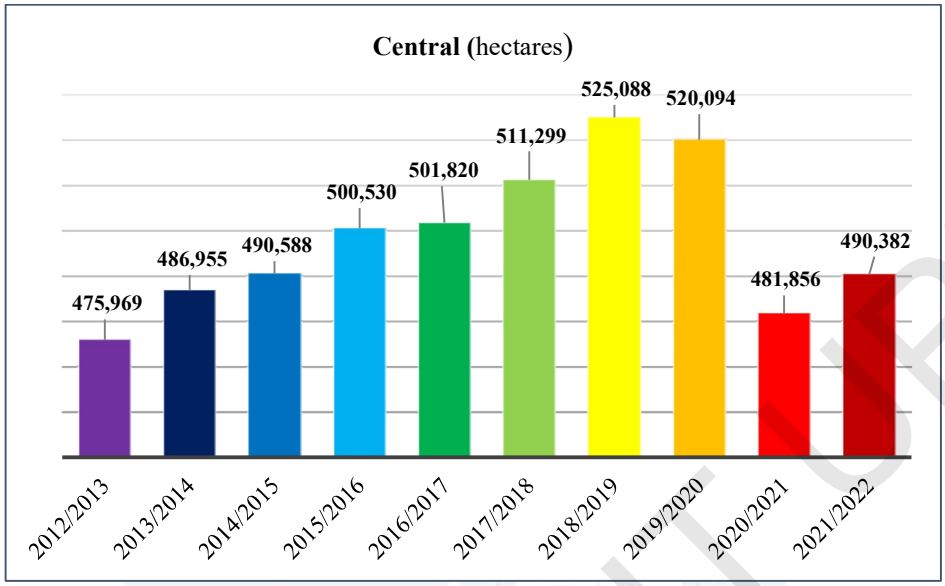

Figure 1.5 : Thailand sugarcane production in central region 2012/2013 – 2021/2022
(Source: Office of the Cane and Sugar Board 2022)

The bulk of sugarcane production is done in the northeast with the 20 provinces of Udon Thani, Loei, Nong Khai, Nong Bua Lamphu, Bungkhan, Sakon Nakhon, Nakhon Phanom, Chaiyaphum, Khon Kaen, Mahasarakham, Roi Et, Kalasin, Mukdahan, Amnat Charoen, Nakhon Ratchasima, Buriram, Surin, Sisaket, Yasothon and Ubon Ratchathani (Figure 1.6) by the provinces with the most planted areas this in the first 3 provinces to Udon Thani Province Khon Kaen and Nakhon Ratchasima respectively. Sugar mills in the northeast region, there are 22 factories located in Udon Thani 4 factories, Nakhon Ratchasima 3 factories, 2 factories in each province including Loei, Chaiyaphum, Khon Kaen and Kalasin successive and 1 factory located in each province including Nong Bua Lamphu, Sakon Nakhon, Mahasarakham, Mukdahan, Amnat Charoen, Buriram and Surin respectively.

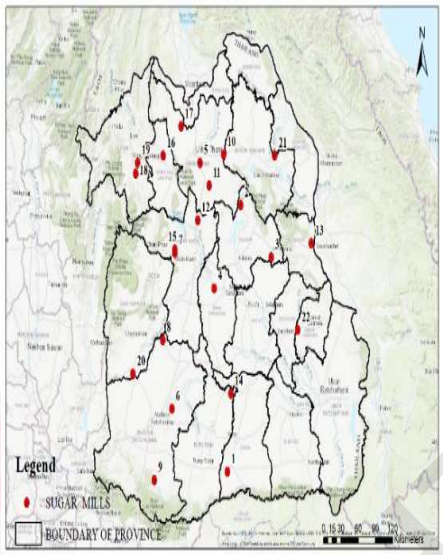

Figure 1.6 : Thailand sugarcane production and factories in northeast region.
(Source: Office of the Cane and Sugar Board 2022)

Northeast here are sugarcane planting areas of 764,229 hectares, an increase of 11,041.14 hectares from the 2020/21 production year or 1.77% (Figure 1.7). The first 3 provinces with the most sugarcane planting areas are Udon Thani, Khon Kaen and Nakhon Ratchasima respectively.

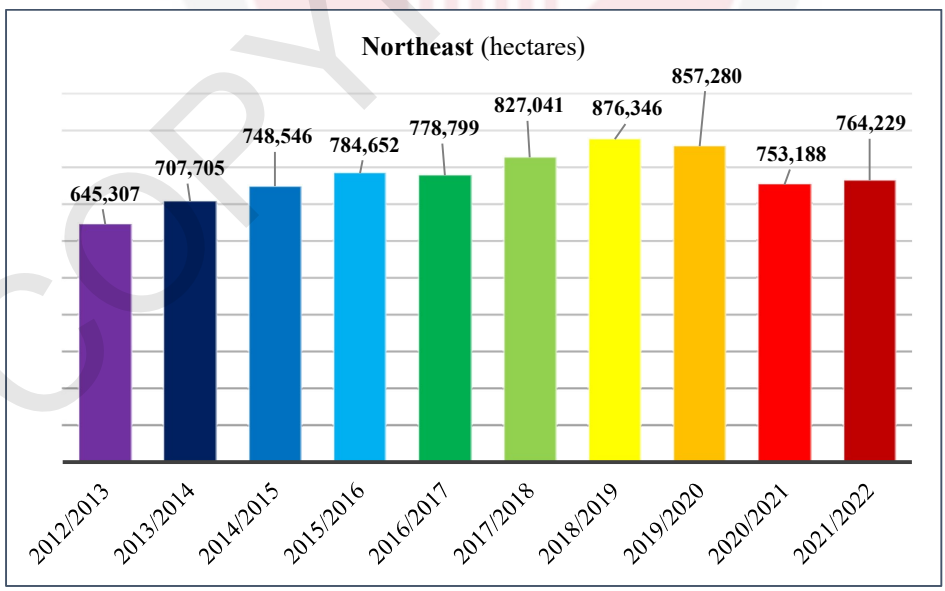

Figure 1.7 : Thailand sugarcane production in central region 2012/2013 – 2021/2022
(Source: Office of the Cane and Sugar Board 2022)

Compared to the east region, there are only 6 provinces including Chonburi, Rayong, Chanthaburi, Sa Kaeo, Chachoengsao and Prachin Buri planted sugarcane in 2016 the planted area for sugarcane was estimated at 4,632 hectares (Figure 1.8) by the provinces with the most planted areas this in the first 3 provinces to Sa Kaeo Province, Chonburi and Prachin Buri respectively. In sugar mills in the east region, there are 4 factories located in Chonburi and 2 factories located in Sa Kaeo Province.

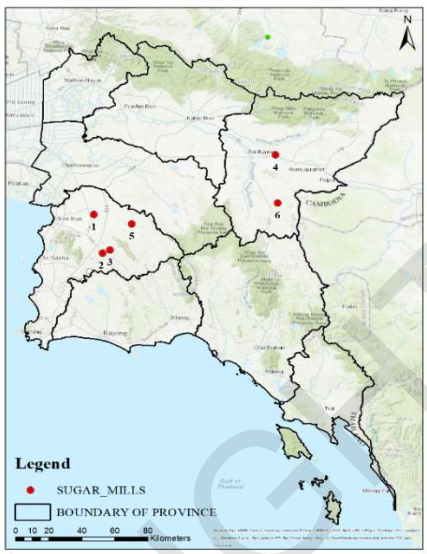

Figure 1.8 : Thailand sugarcane production and factories in east region
(Source: Office of the Cane and Sugar Board 2022)

The eastern region has 108,734 hectares of sugarcane plantations, an increase of 420.8 hectares from the 2020/21 production year, or 0.39% (Figure 1.9) The first three provinces with the most sugarcane plantations are Sa Kaeo, Chonburi and Prachinburi respectively.

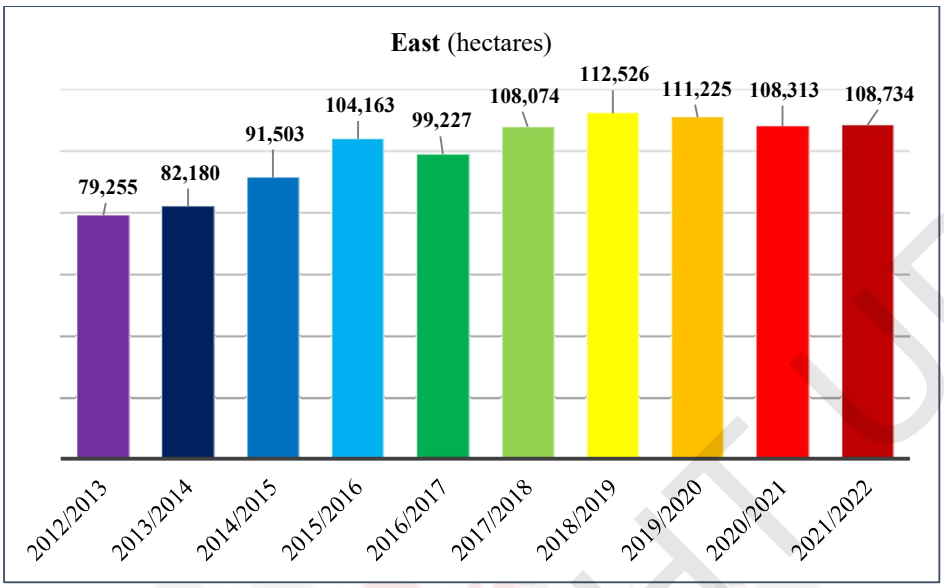

Figure 1.9 : Thailand sugarcane production in central region 2012/2013 – 2021/2022
(Source: Office of the Cane and Sugar Board 2022)

At present, the sugar and cane industry in Thailand sugarcane is likely to expand further. Due to a large number of requests for setting up and expanding sugar mills. The government pushed for a policy to manage agricultural areas of crops (Zoning). Changing rice plantations that are in inappropriate areas to plant sugar cane, cassava, oil palm, and maize for animal feed, resulted in an increase in sugarcane plantations in Thailand. As a result, sugarcane and sugar production in Thailand continue to increase. As a consequence, the world sugar price has a good trend, resulting in the price of sugarcane rising, which is an incentive for Some of the sugarcane farmers to turn back to growing sugarcane. In addition, this year, Thailand has had monsoon since the beginning of the year, resulting in the amount of rainwater sufficient for sugarcane growth, resulting in increased production per ton. However, even though the price of Sugarcane will increase, the overall cost will also increase, such as the cost of fuel, labour and fertilizer.

1.4 Thailand's Sugarcane Production and Employment Contribution

Many countries where sugarcane is planted areas employ different techniques and technologies for sugarcane transport. In Thailand, the sugarcane and sugar industries are an important agricultural industry that supply raw materials used in the sugar and several allied industries. These associated industries are ethanol, pulp, bio-fertilizer and electricity production. Sugarcane is also a very important crop for economic and social development. It is also a source of job creation that supports 427,395 farmers and their families (United Nations, Thailand, 2018).

As of 2021, Thailand has a total of 58 sugar mills as presented in Table 1.2 below (57 mills operated, 1 mill temporarily closed). The majority of sugar mills are situated in sugarcane growing regions mentioned above for three main reasons:

1. It is similar to acquiring input according to production plans.
2. It lowers transportation expenses.
3. It is easier to communicate with sugarcane farmers or provide help.

Furthermore, mill sites are often influenced by logistical considerations, and thus they are typically near metropolitan areas, ports and important trade hubs. As a result, Kanchanaburi has the highest concentration of sugar mills, with quantities of eight (8) mills, followed by Udon Thani and Chonburi, each with a quantity of four (4) mills.

Table 1.2 : Sugar mills in Thailand

Thai Sugar Mills	Sugarcane Crushed (Mn Tones) 2020/2021
Thai Roong Ruang Group (TRR) (10 mills)	12.23
Mitr Phol Group (7 mills)	12.00
Tamaka Group (KSL) (5 mills)	6.05
Thai Ekalak Group (KTIS) (3 mills)	5.50
Chonburi Grup (Cristalla) (3 mills)	3.70
Korach Group (2 mills)	3.50
Eastern Sugar & Cane Group (ES) (2 mills)	2.94
Banpong Group (2 mills)	2.60
Wang Kanai Group (4 mills)	2.56
Thai Kanchanaburi Group (TSM) (2 mills)	2.25
Kumpawapi Group (KP) (2 mills)	2.00
Rajburi (2 mills)	1.78
Mitr Kasetr Group (MK) (2 mills)	1.60
Rayong Group (2 mills)	1.15
Independent (9 mills)	9.57
Total	**69.43**

(Source: Office of the Cane and Sugar Board 2022)

This industry generates more than 1 million jobs and has helped to propel the country's economy (Office of the Cane and Sugar Board, 2021). The sugarcane and sugar industry in Thailand further grew due to the establishment and expansion of sugar mills in Thailand based on governmental support policies introduced in 2017. During this time the number of Thai mills in Thailand increased while others expanded their production capacity. However, Thai sugarcane production fell by 8.2 million tons to 66.7 million tons in the 2020-2021 crop year, from 74.9 million tons in 2019-22, down from a record 14.7 million tons in 2017-2018, according to the Thai Sugar Millers Corporations Limited (2021). Due to the production year 2020/21, there are sugarcane plantations nationwide in the total area of 47 provinces in the amount of 1,780,755.74 hectares, which has decreased from the production year 2019/20 in the amount of 159,759.02 hectares or 9.17%, divided into sugarcane planting areas and the highest decrease in 5 provinces was Buriram, Chaiyaphum, Kanchanaburi, Surin and Nakhon Ratchasima.

Due to the continually decreasing price of sugarcane, farmers have to plant other crops instead. The important issues that both the government, sugar mills and sugarcane farmers must work together to solve the problem. In addition to the change in sweetness, this will also result in a decrease in the sugar extraction efficiency of the factory. however, according to the measure to reduce sugar cane burning within 3 years, the cost of cutting sugar cane in sugar cane farms is still high. labour shortage and buying a high-value sugarcane harvester is not worth the investment. The Cane and Sugar Board has set the initial sugarcane price and the initial yield of sugar production and distribution in the production season 2021/22 at the rate of 1,070 baht per ton at the sweetness level of 10 C.C.S. The determined up and down rate of sugarcane price is equal to 64.20 baht per 1 C.C.S. unit and the initial yield of sugar production and distribution in the production season 2021/22 is equal to 458.57 baht per ton of sugarcane (Figure 1.10).

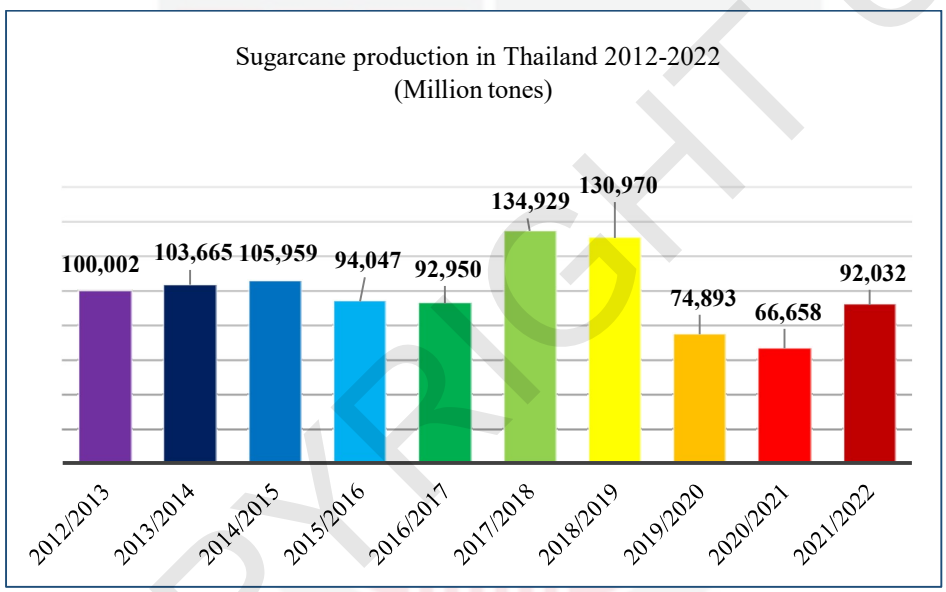

Figure 1.10 : Sugarcane production in Thailand from 2012/2013 – 2021/2022
(Source: Office of the Cane and Sugar Board 2022)

1.5 Sugarcane Prices in Thailand

Thai sugarcane production in each area involves centralized sugar mills. Trading is characterized by monopoly markets both from the buyers' (sugar mills) and vendors' (farmers) sides. Although there are many entities involved, they are integrated into one organization (a Bilateral Monopoly). This is a market that, if left uncontrolled, produces unpredictable results. It depends on the bargaining power of both parties. Each side has high power in negotiations. Sometimes negotiations cannot be concluded or both parties may have very high negotiating costs. Generally, this is a state-owned industry with the potential to create a more efficient system to reduce the problems and costs of negotiating among stakeholders (Office of the Cane and Sugar Board, 2018).

The sugarcane and sugar industries in Thailand use a 70:30 control system (Sriroth, 2016) with benefit sharing between the farmers and sugar mills (70% for farmers and 30% for sugar mills). The Office of the Cane and Sugar Board, Ministry of Industry of Thailand sets the initial cane prices and returns for the production and distribution of primary sugar for the sugar mills to announce the purchase price of sugarcane at the specified price (Office of the Cane and Sugar Board, 2021). These are different each year. Zoning in the calculation of the purchase price of cane greatly varies according to the district and sugar sweetness levels or C.C.S (Commercial Cane Sugar). C.C.S means the amount of sugar present in sugarcane (Office of the Cane and Sugar Board, 2019). It is the material that can be extracted into pure white sugar, according to the Commercial Cane Sugar during the process. If there is an impure substance dissolved in sugarcane it will lose 50% of its sugar content. Ten (10) is the threshold for Commercial Cane Sugar) when it is passed through the production process. Sugarcane is 10% pure. So, 1 tonne or 1,000 kilograms of sugarcane will yield 100 kg of pure white sugar. This means that sugarcane varies in quality and sweetness. Very sweet sugarcane will command high prices. C.C.S. varies by region as shown in (Table 1.3).

Table 1.3 : C.C.S. Nationwide Average Production for 2021/2022 Classified by Area Used for Calculate Sugarcane Prices

Zone	Average of CCS
1.Northern	12.24
2.Central	11.60
3.Eastern	12.45
4.Northeast	13.45
Total	**12.71**

(Source: Office of the Cane and Sugar Board, Thailand 2022), (www.ocsb.go.th)

The amount of sugarcane sent to the factories throughout the country is 92 million tons. Compared to the production year 2020/21, it was found that the amount of sugar cane sent to the factory increased. 25.37 million tons, representing 38.06 per cent. The sweetness quality of sugar cane was 12.71 C.C.S. compared to the production year 2020/21, it was found that the sweetness quality of sugarcane decreased by 0.20 C.C.S. was 1.55 per cent. The efficiency of sugar production per ton of cane, in the whole country was at 110.07 kg per ton of cane compared to production year 2020/21 it was found that the efficiency of sugar production per ton of cane decreased by 3.74 kg/ton of cane or 3.29 per cent. (Table 1.4) In Thailand, higher sugarcane production was obtained in the northeast due to increased planted areas in recent years (Office of the Cane and Sugar Board, 2022). Comparing the four zones, Eastern Thailand only contributed about 5.35% of the 2016/2017 total sugarcane production. However, the sugar yield in the central part was lower compared to other zones, even though the planted area for the central part was the second highest in Thailand.

Table 1.4 : Production of Sugarcane, Sugar and Sugar yield in Thailand, 2021/2022

Zone	Sugar cane supply (tones)			C.C.S	Sugar (tonnes)	Sugar yield (kg)
	Fresh cane	Burned cane	Total			
Northern	16,609,712.560	3,186,183.390	19,777,895.950	12.24	2,070,620.60	104.69
Central	17,658,173.040	3,951,152.520	21,611,535.310	11.60	2,092,870.58	96.84
Northeast	30,064,536.455	16,120,898.310	46,185,434.765	13.45	5,484,077.29	118.74
Eastern	2,598,387.200	1,858,889.370	4,457,276.570	12.45	482,476.35	108.24
Total	**66,933,019.005**	**25,099,123.590**	**92,032,142.595**	**12.71**	**10,130,050.82**	**110.07**

(Sources: Office of the Cane and Sugar Board, Thailand 2022)

1.6 Sugarcane Supply Chain in Thailand

The traditional supply chain of Thailand's sugarcane showed that farmers transport their harvested sugarcane and sell it to middlemen, who then sell it to the mills. This is due to their limited trucking capacity. In this traditional system, middlemen played a significant role in collecting sugarcane from farmers and reselling it to the mills. Usually, this system will result in a lack of bargaining power for smallholders. Farm prices are lower and the mills have to pay more to the middlemen. To improve upon the traditional supply chain, the government implemented a loading station strategy to reduce the cost of transportation from the fields to the mill in 2003 (Buppapun & Thunyapornsakol, 2011). In this new supply chain, the loading station is owned by the sugar mills. They launched 167 stations in Thailand (Office of the Cane and Sugar Board, 2017). The loading stations are set up in areas near sugarcane-planted areas to reduce the smallholders' transportation costs. According to Chetthamrongchai et al. (2001), loading stations are estimated to save 27.8 - 40.9% on transportation costs compared to the traditional supply chain system. Even loading stations are implemented to reduce farmers production costs but not all farmers sell their production in this manner (Department of Agricultural Economics, 2019). The following chart will represent the relationship between the agent and the flow of income (Figure 1.11). According to the Department of Agricultural Economics, Thailand, currently only 67% of sugarcane farmers are contracted with loading stations. The remaining 33% is still in the traditional supply chain, which employs middlemen (Athipanyakul et al., 2019).

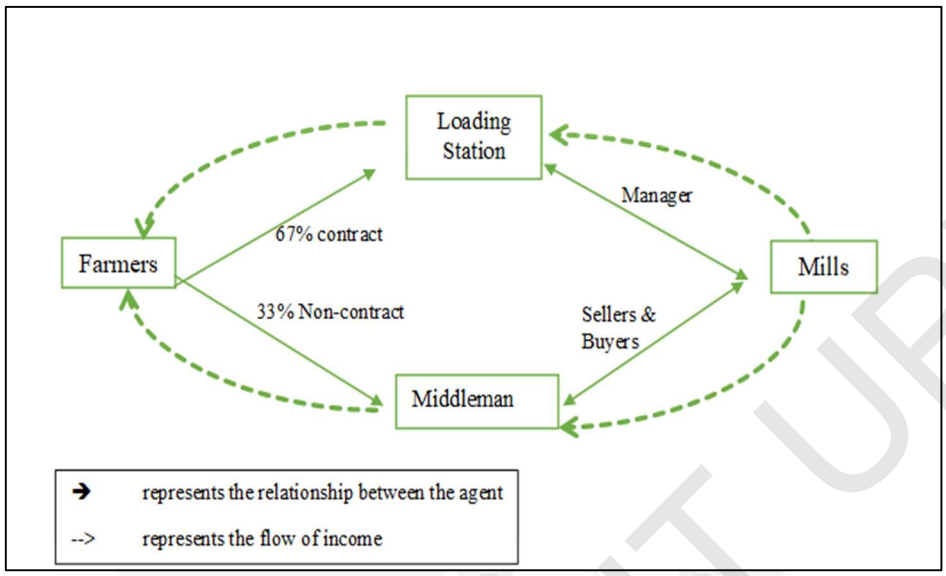

Figure 1.11 : The flow of farmers' production to the mills in Thailand
(Source: Office of the Cane and Sugar Board, Thailand, 2018)

In the new supply chain system, middlemen are still contracted with sugar mills to collect sugarcane from 33% of the smallholders (Athipanyakul et al., 2019). Middlemen will search for smallholders to supervise about 20-30 persons, depending on the amount of sugarcane contractually needed in the current year (Office of the Cane and Sugar Board, 2017). After the middlemen collect the targeted production. Then, they transport the sugarcane to a sugar mill using their trucks. Some of the farmers are forced to rely on middlemen due to shorter payment periods for their crops and the urgency of their financial needs. When the farmers trade with middlemen, they receive cash immediately. However, farmers who trade with loading stations need to wait for about 15 days to receive payment for their crops. This is a burden for those farmers who are very poor and have labour, harvest and other operation costs (Department of Agricultural Economics, 2019).

Loading stations help to manage sugarcane production from nearby areas. In Thailand, loading stations are owned by the sugar mills which contract with sugarcane farmers during a special meeting with the farmers. Before the harvest period (Office of the Cane and Sugar Board, 2017), a loading station representative will offer contracts to the smallholder farmers and ensure that the farmers can contribute the minimum quota of sugarcane during the harvest period. In the contract, the loading station will guarantee to provide the farmers with financial support in the form of loans with lower interest rates, fertilizer, pesticides, and some simple tools (Pongwanich-anan, 2009). This will benefit the farmers and encourage them to expand their sugarcane cultivation area. Additionally, a loading station will offer higher prices compared to middlemen, but they will take 15 days to pay after they receive a farmer's crop. In 2021, around 200,448 farmers signed contracts with loading stations in Thailand's sugarcane supply chain (Office of the Cane and Sugar Board, 2021).

1.7 Evolution of Sugarcane Transportation in Thailand

According to the Office of Cane and Sugar Board, Ministry of Industry (Office of the Cane and Sugar Board, 1982). The channels to transport sugarcane of small farmers are related to the marketing system of sugarcane. They pass through a middleman or "Head of Quota" who has a contract with sugar mills and rights to deliver sugarcane to a mill. Small farmers who do have not enough planted areas to sign a contract with sugar mills can sell to a middleman (Head of Quota) directly (Office of the Cane and Sugar Board, 2017). Moreover, small farmers have to pay contract fees to the Head of Quota to allow them to deliver their production. They also must pay transport costs (Office of the Cane and Sugar Board, 2009). As a result, using trucks and trailer trucks is suitable, but there are still problems with transport queuing. Trucks are idled much of the time during the harvest season. Transport costs are quite high compared to those of other products. These costs are a major income source for middlemen and the Heads of Quota, allowing them abnormally high profits (Office of the Cane and Sugar Board, 2017). It is thought that the sugarcane transport system should change some of its methods such as reducing the minimum quota to allow smaller farmers to contract directly with sugar mills, bypassing the middlemen and Heads of Quota (Office of the Cane and Sugar Board, 2017). Queuing at the sugar mills can be decreased if the factory arranges to transfer sugarcane from trucks as they arrive at the factory. This would allow for a reduction in the number of trucks used in transport (Office of the Cane and Sugar Board, 2009). More efficient utilization of trucks will reduce the cost of sugar processing (Piewthongngam et al., 2009).

1.8 Sugarcane Loading Stations in Thailand

Over the past decade, several sugar mills in Thailand have devised and implemented a sugarcane loading station approach to decrease the cost of carrying sugar cane from distant small farms to the mill. Following the loading station method, local farmers carry cane from the fields to a nearby loading station using their available vehicles, often tiny vehicles (e.g., 5-ton capacity), rather than bringing the cane straight to the mill. The mill then organizes complete trailer truck transportation from the station to the facility (e.g., 39-ton capacity). Chetthamrongchai et al. (2001) found that this method has been found to save between 27.8 and 40.9 per cent on transportation expenses compared to the conventional approach. The loading station approach also aids in the management of the mill's daily truck arrivals. The number of trucks coming to the mill may be decreased and more effectively planned. While the loading station approach is advantageous for the sugar cane procurement system, it also has two significant drawbacks. For starters, the sugar cane quality may suffer due to multiple handling caused by emptying the cane from the small vehicles and reloading the cane into the trailer truck (Khamjan et al., 2013). Second, establishing a loading station requires a significant investment in land and material handling equipment such as loading and unloading cranes. Most sugar mill managers are concerned about the investment expense. The construction of a loading station is a costly endeavour, and a loading station may need to be operational for many crop years to be effective (Wongkusolkit, 2018). In Thailand, the logistics of sugarcane from the farm to the mill vary in every area. Loading stations or sugarcane collection facilities are mainly found throughout the Northeast regions of the country (Office of the Cane and Sugar Board, 2017). Sugarcane, on the other hand, is supplied directly by

farmers in the Central regions. The majority of sugarcane farms use the queue method to arrange sugarcane supply to the mill. In 2020, the cost of transportation per ton varied between Baht 180 and 220 (Office of the Cane and Sugar Board, 2021).

1.9 Agricultural Contract Farming in Thailand

Contract farming is an agricultural system with livestock or cropping, that involves a forward sales business contract between a producer or farmer and contract parties or receivers who agree on production and purchase (Farlangthong, 2011). The contract parties or receivers are private companies that promise to buy products from the producer at an agreed-upon price known as a "price guarantee or price insurance" which can be changed after the contract becomes due. Agricultural contract farming in Thailand has been done informally for a long time. Personal and social relationships were used to promise benefits. This developed into formal contracts between farmers and capital groups that allow farmers to have access to capital sources and production factors. Farmers obtain marketing solutions, but they enter a cycle of capital dependency and a need for production factors from capitalists. Then, capitalists have the power to determine prices. For higher benefits, farmers surrender bargaining power and enter the poverty cycle (Office of the National Economic and Social Development Council, 2015). In 2017, the Agricultural Extension and Development System Act of the Ministry of Agriculture and Cooperatives was enacted to better regulate the contract farming system. A system of promotion and development promising fair agriculture under international standards will help to build trust, and cooperation, that encourages the development of production potential for sustainable agricultural produce or services. Farmers can then receive stable income and the necessary transfer of knowledge as well as standardized production technology enabling cost control in agricultural products and services.

There is protection from external factors and business while obtaining quality products that meet standards within a specified period. This builds confidence and the business strength of the country so that it can compete in free trade. However, contracting in the agricultural system consists of a combination of labour and purchase agreements that are complex in terms of value and cost. There is a necessity in the contract farming system to ensure fairness for all parties (Council of State, 2016). The promotion and development of the Agricultural Bonding System Act defines "agricultural contract farming" as a system for producing agricultural products or services arising out of contracts for the production of agricultural products or services. It is a system of contracts between a business entrepreneur on one side and other entities. These entities may be ten or more persons engaged in agriculture, agricultural cooperatives, farmers' groups under the Law on Cooperatives, community enterprises, and networks of community enterprises under the law promoting community enterprises that are engaged in agriculture (Killian, 2012). The latter party is subject to conditions for production, distribution, or outsourcing to produce agricultural products or services. In these agreements, farmers agree to produce, distribute or engage in the production of agricultural produce meeting conditions specifying the quantity, quality, price or duration of production. The agricultural entrepreneur agrees to purchase the said produce or pay compensation as stipulated in the contract by the agricultural entrepreneur involved in the production process. Responsibilities may include determining the

production methods, procuring seeds, seeds, agricultural products or production factors used by farmers (Phoethisai, 2009).

1.10 Contract Farming in the Thai Sugarcane Business

The agriculture system has developed covenants and applied them to system development. These are integrated agriculture systems that are widely used in various areas of the country. Contracts became very prevalent during the 6th National Economic and Social Development Plan (1987-1991) (Office of the National Economic and Social Development Council, 1986). Sugarcane is a crop that entered the agricultural contract farming system in its early stages. It has been more successful than other crops. The pineapple and pulp industry business operations also rely on agricultural contract farming systems. Entrepreneurs do not need to own vast plant areas. Operations entail contracts between the farmers and owners of processing plants. This approach has been very successful in agriculture. The contract is a negotiation in advance between the operator and individual farmers. It is a beneficial agreement that satisfies both parties. With some crops, legal developments protect the advantages of such partnerships so that they are fairer, as is the case with sugarcane and sugar. When planting sugarcane under contract, farmers can be grouped as "quota" or "open quota alone" by contacting sugar factories. The farmers must have collateral to make a disbursement contract through a quota leader or agent. The purchase price depends mainly on world sugar market prices (Elbert et al., 2009; Pongwanich-anan, 2009). Sugar mills in Thailand play a significant role in the local sugar supply chain (Khamjan et al., 2013). In Thailand, sugarcane farmers face higher costs of transportation to deliver their crops from the field to the mill in the traditional supply chain. According to Pongwanich-Anan (2009), most of the small independent growers face higher costs of transportation, accounting for about 21.91% of their total operation costs annually. Often, there are mills set up at places far from the sugarcane growers' planted areas. However, the loading station system is not perfect. It still faces three main challenges in sugarcane procurement Piewthongngam et al., 2009 & Khamjan et al., 2013).

1.11 Problem Statement

Small farmers face higher delivery costs. Some small farmers face further inefficiencies since the volume of their daily production is insufficient for a full truckload. This results in higher transport costs per ton of cane (Chetthamrongchai et al., 2001). In 2001, the Thai government received complaints from small farmers representatives about unfair delivered charges. Then in 2003, the strategy of establishing loading stations was proposed by the Thailand Department of Agricultural Economics in close cooperation with the sugar mills owners. The main objective was to launch a loading station strategy to reduce operating costs in sugarcane cultivation, especially transport costs. Through loading stations, farmers receive more benefits than trading with middlemen. These benefits include financial aid in the form of lower interest rates and fertilizer aid, among other considerations. Consequently, loading stations became the backbone of the sugarcane farmers in their goal of sustainable agriculture. First, the quality of sugarcane may be degraded because of double handling. This is due to unloading the cane from the small vehicles and re-loading it onto trailer trucks. Second, the establishment of a loading

station requires a large investment in land and material handling equipment. Third, poorly integrated cane supply planning between mills and cane growers generates an excess of cane that exceeds the mills' capacity during the peak of the harvest season. According to Vongkusolkit (2018) found that commented that setting up a "sugarcane loading station" to facilitate small farmers who do not have to run long distances for sugarcane helps to save transportation costs for farmers by more than 30 per cent ever. As a byproduct of having a sugarcane transfer station, it also helps small farmers who have sugarcane planted areas during 5 – 10 hectares around them to grow sugarcane as a career in the household, using labor in their own families without having to rely on migrant workers. Moreover, help farm to reduce cost in this section in another way. The equipment used does not have to be large. Small farmers can exist small trucks can be used to transport sugarcane to the nearby sugarcane loading station. More importantly, it also helps reduce accidents that may occur from long-distance sugar cane delivery, something that many people do not expect when it comes to the safety and property of farmers. This is another advantage of having their sugarcane. A study by Brohmsarn (2008) identified factors affecting the decision of sugarcane farmers in selecting transport channels through sugar mills and sugarcane loading stations. Three main factors were presented including 1. Contracted cane quota factor, 2. Distance to loading stations factor, and 3. Vehicle type factor). Consistent with the study by Buppapun and Thunyapornsakol (2011) studied the factors influencing the farmers decision to sell sugarcane to the sugar mills with the main factors being 1. The selling price received. and the factor that most affected the satisfaction of smallholder farmers was distance from the sugarcane field to the sugarcane transfer station of the factory. Hence, loading station efficiency can be affected operations sub-optimal capacity and poor management of sugarcane quality. Determination of the influential factors related to loading station management system is crucial to increase their productivity. Concurrently, the impacts of loading stations on the contract small farmers still need further investigation. Moreover, there is lack of research to examine the impact of loading stations on the direct and indirect benefits to farmers.

1.12 Research Questions

- What factors motivate small farmers to have a business contract with the loading station and why are the remaining small farmers still selling their products to the others channel?
- What are the factors that affect sugarcane small farmers' production? Do the small farmers still continue their production and still long-term in the cane and sugar industry?
- What are the factors influencing the efficiency of the sugarcane small farmers?

1.13 Objectives of the Study

The main objective of the study is to examine the impacts of loading stations on sugarcane farmers and the factors that farmers to participate as contract farmers. The specific objectives of the study are:

i. To determine the factors that influence farmer's motivation to participate and still non participate with sugarcane loading stations,

ii. To investigate the impact factors that affected the sugarcane farmers production,

iii. To determine the impacts of loading stations on farmers' technical efficiency.

1.14 Significance of the Study

This study would like to improve the behavioural responses of small sugarcane farmers in Thailand There needs to be an oversight on sugarcane management and the benefits farmers will receive from the transfer station project. The aim is to make farmers interested in understanding the advantages of using transport stations and give them a good understanding of the benefits and impact on the overall cost of production. Small farmers in Thailand's sugar cane industry are subjected to the now-familiar cycle of changing prices, growing costs, and increasing debt and crop losses due to unpredictable weather. Moreover, the Thai government should constantly stimulate the sugarcane farmers to contract the nearby loading stations to minimize the supply-chain cost pressure. Loading stations can benefit all parties involved, e.g., farmers, truck drivers and mills. Small farmers dependent on their family labour would be anticipated to reap the most significant benefits from adopting these technologies.

1.15 Operational Definition of Key Terms

Loading station: Loading stations refers to places where sugarcane is placed on trucks for transport to mills. They are established by sugar mills in communities near the planted areas of farmers (Bijman, 2008; Piewthongngam et al., 2009).

Contract Farming: A system of business contracts with sugarcane loading stations into which small scale sugarcane farmers enter to gain the support of sugar mills (Khamjan et al., 2013).

Small Farmers: Sugarcane farmers who have sugarcane planted areas not exceeding 15 hectares (ha). This includes small scale farmers who have and do not have contracts with sugarcane loading stations (Cai et al., 2008).

Motivation: The inspiration or the reasons small scale sugarcane farmers decide to enter business contracts with sugarcane loading stations (Piewthongngam et al., 2009; Khamjan et al., 2013).

Participate: The actions of small-scale sugarcane farmers who have decided to enter business contracts with sugarcane loading stations (Pongwanich-anan, 2009; Athipanyakul et al., 2019).

1.16 Organization of the Thesis

This thesis is divided into five chapters. Chapter One, discusses the background of the study, its objectives to assess the impact of loading stations on sugarcane farmers and factors that motivate Thai farmers to participate as contract farmers. A problem statement is presented in detail. Chapter Two discusses sugar and cane production globally and in Thailand, the current situation, evaluation of loading technology and establishment of loading station, information about contract farming methods and analyses used in previous studies. Then, Chapter Three explains the conceptual framework and data collection procedures of the current study, as well as the analytical and estimation tools used. Chapter Four, discusses the findings of descriptive analysis, factor analysis, regression analysis of the study and technical efficiency. Finally, Chapter Five, presents the major findings, implications and recommendations of the study and conclusions.

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