Role of Supply Chain Management in Supporting Agroindustry: A Study Case from Thailand

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Abstract

Thailand's economy has relied on agriculture sector and agroindustry for a long time. Yet with changing and fluctuation of world trade situation, plus with the climate change, the impact on agriculture sector and agroindustry is inevitable. If there is no adaptation, Thailand may lose competitiveness. Consequently, under Thailand's Agricultural Development Plan Year 2012-2036, it aims to strengthen the agriculture sector and agroindustry. This article will illustrate the role of supply chain management in strategic planning and operational planning to support Thailand's Agricultural Development Plan Year 2012-2036.

Keywords: Supply Chain Management; Agricultural Zoning; Supply Chain Collaboration; Information Sharing

1. Introduction

Value of agroindustry to Thailand's growth can be evidently disclosed by the following Gross Domestic Product (GDP) data from agricultural sector, which has been primary indicator for country development since 1957. Based on National Statistical Office (NSO), GDP during the past ten years of agricultural sector can be illustrated in Figure 1.

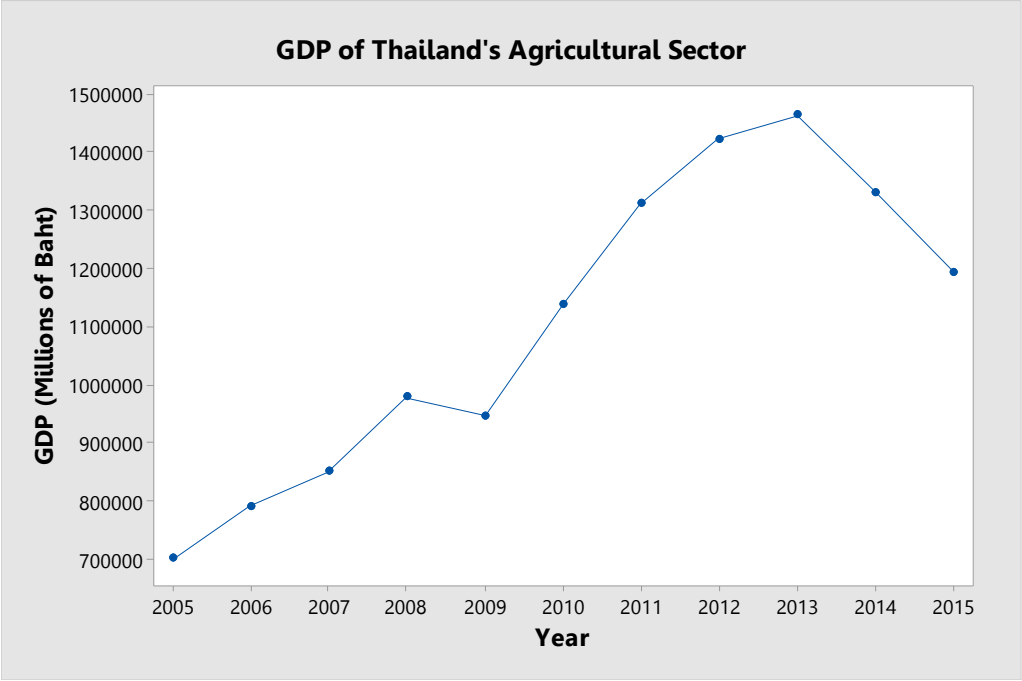

Fig. 1. GDP of agricultural sector

It can be grasped from Figure 1 that GDP gradually increased in first four years and slightly dropped in year 2009. After that it abruptly escalated during year 2010-2013 and later it has drastically decreased. However, agricultural exports still play a major role to the total value of Thailand's export such illustrating in Figure 2. It can be determined that value of agricultural products export was accounted for 31.20 percent in average of all products export during the past ten years. In addition, it may contribute to the fall of GDP in year 2014 and 2015 as it can be perceived from Figure 1 and Figure 2.

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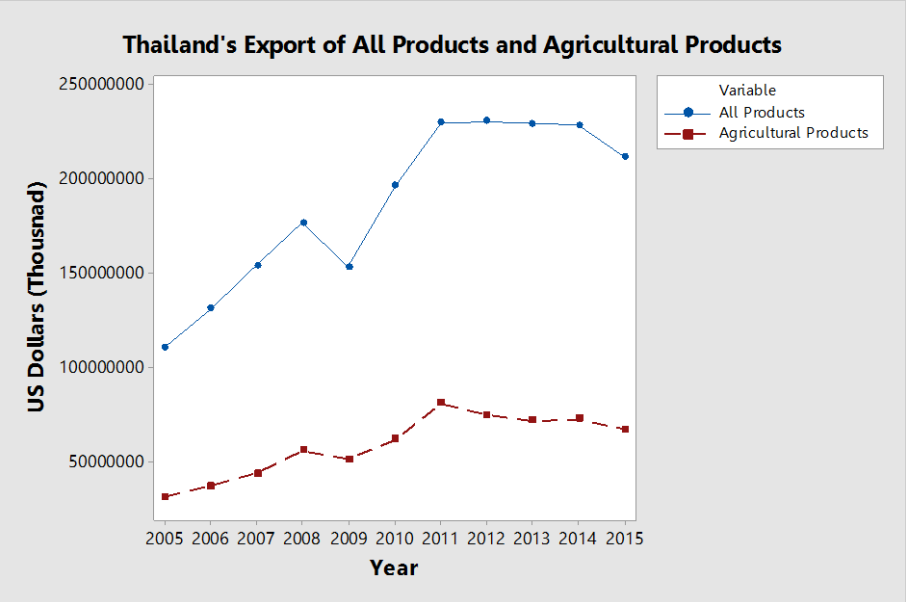


Fig. 2. Thailand's Export [1]

NSO's census reported that Thailand's population is about 65.5 million persons in year 2017. Also the latest Agricultural Census in 2013, it revealed that Thailand had totally 5.9 million of agricultural holdings with family members about 19.7 million persons, which was accounted for 25.2 percent of total households of the country. And the total land area of the kingdom is around 51.4 million hectares while the total area of agricultural holdings was 18.64 million hectares or averagely 3.16 hectares per holding. However, with detailed consideration, it can be seen the distribution of size of total area in Figure 3 following, which is illustrated that there were only ten percentages of holders who had an area greater than 6.40 hectares, while the rest are small holders through last twenty years.

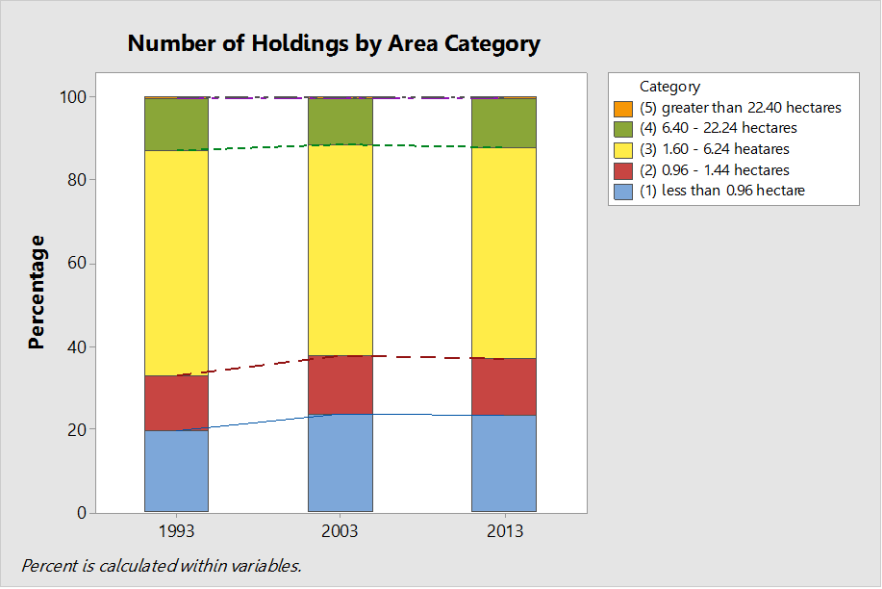


Fig. 3. Number of agricultural holders by area

By area of holding, types of agricultural production in Thailand can be respectively classified into rice, field crops, rubber, and permanent crops, which crop production was accounted for more than 60 percent in year 2013. The main commodities are rice, rubber, fishery, and animal products.

For characteristics of Thailand's agriculture, problems, which have been perpetually existed, can be considered from each input factors which are land, labor, capital, and technology. First, normally area of farm is small size, which can be obviously seen in Figure 3 that about 90 percent of holders have land area lower than 6.24 hectares. Next, percentages of farmers who have their own farms are declined. And most of the farms are dependent to the weather and other environments. Nutrients in soil are exhausted and the damage areas are increasing, as a result production efficiency is plunged. Regarding on labor, there are decrease in agricultural labor and increase in average age of labor. For capital, logistics costs such transportation cost are still high and incompetent. Last but not least, the applications of modern technology are still low [2].

In order to settle agricultural problems, Thailand's Agricultural Development Plan Year 2017-2036, which is a 20-year program to modernize the country's agricultural sector, has just released under vision of secure farmers, prosperous agricultural sectors, and sustainable agricultural resources, which can be formulated in five strategies, which are (1) strengthening farmers and farmers institutions, (2) escalating production efficiency and upgrading product standards, (3) enhancing competitiveness in agricultural sectors with technology and innovation, (4) managing agricultural resources and environments with equity and sustainability, and (5) developing governmental administration and management system. And policies, which were afterward deployed from strategies, can be illustrated in the following Figure 4.

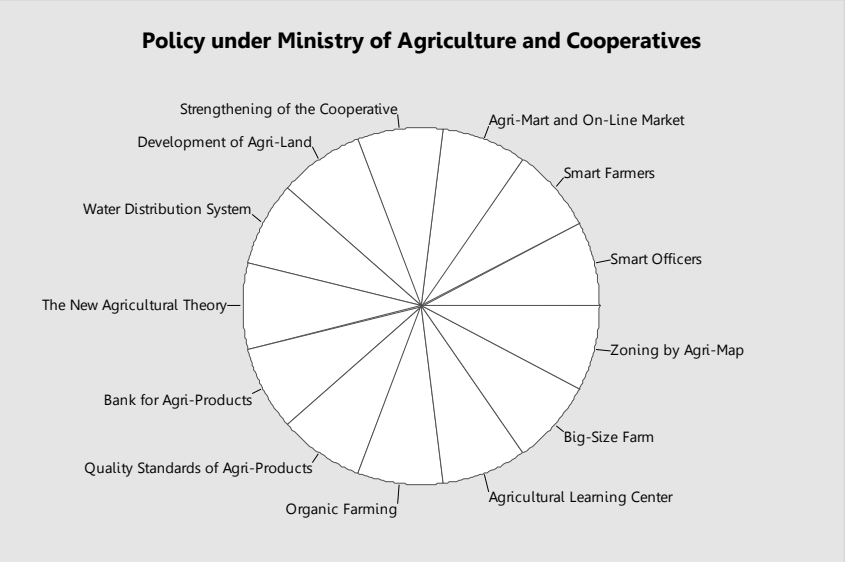


Fig. 4. Policy of agricultural development plan year 2017-2036

From Figure 4, it can be seen the key policies which were set for the next twenty years from now. The review period will be scheduled every 5 year. And these policies will be driven by three mechanisms, which are (1) sufficiency economy philosophy, (2) integration to agenda based and area based, and (3) technology, innovation, and knowledge. Final goal at the end will be aimed at better quality of farmers' life.

2. Agroindustry in South of Thailand

Southern Thailand, located on the Malay Peninsula, comprises of 14 provinces with a total area of 7.07 million hectares, accounting for 13.8 percent of the whole country. The region stretches from north to south, which is about 750 kilometers in distance. And it is approximate 220 kilometers in width from east to west. The southern coast has a total of 1,643 kilometers. The climate is tropical monsoons, which has rainy season alternating with short drought due to its location close to the equator. In 2014, the South had a population of 9.21 million persons, or 14.1 percent of the country's population. The Gross Regional Product (GRP) was valued at 1.13 trillion Baht, accounting for 8.6 percent of gross domestic product. The leading economic structure of the South is agricultural sector, which accounts for 27 percent of GRP. Following by industry sector, trade sector, transport and tourism sectors are accounted for 12, 10, 9 and 8 percent of GRP, respectively [3].

Agriculture is always important manufacturing sector of the South because most of the populations are dependent on agriculture. It can create employment to 43 percent of total employment, which were classified into (1) cultivation accounted for 83 percent, and (2) fishery accounted for 17 percent [3]. Some of agricultural products are consumed in southern region and other regions in country. The remaining products are used as raw materials for agroindustry, which can add value and create labor employment. Besides, they can be exported in forms of such smoke sheet rubber, concentrated latex, rubber glove, rubber wood, crude palm oil, frozen and chilled shrimp, and canned seafood, which can increase revenue and reduce the loss in international trade balance for Thailand. The following subsection will provide the synopsis of vital agricultural products from Southern Thailand.

2.1. Rubber

Rubber is a major economic crop of the South and the nation, which Thailand is the foremost rubber producer in the world among the top five producers, which the rest are Indonesia, Vietnam, China, and Malaysia, respectively. In year 2016, Thailand has total area of 3.14 million hectares of rubber plantations, which increase 122,808 hectares or accounted for 3.9 percent from the previous year. The most plantations are located in the south approximately 2.05 million hectares, accounted for 67% of the total cultivated area, which 0.28, 0.21, 0.20, and 0.19 million hectares are in Surat Thani, Songkhla, Nakhon Si Thammarat, and Trang, respectively. Rubber production is mainly for export 86 percent in forms of block rubber, smoked sheet rubber, concentrated latex, and rubber glove; while the rest is 14 percent for domestic consumption. In year 2015, the total rubber export volume was 3.75 million tons, which is 170, 418.73 million Baht.

2.2. Oil palm and palm oil

Oil palm is also a key economic crop of the South and the nation, which its role is gradually rising in aspects of economic, food security, and alternative energy for country. Thailand is the third largest for palm oil production in the world. In year 2017/2018, the total world's palm oil production was 66.85 million tons, which Indonesia and Malaysia were the first and second largest producers with 36 million tons and 21 million tons of production volume, respectively. Then Thailand was the third largest producer with 2.2 million tons of production [4]. It can be seen from statistics that total production volume from three countries were accounted for 88 percent of the world's production. In year 2016, Thailand has total area of 730,223 hectares of oil palm plantations, which increase 42,642 hectares or accounted for 6.2 percent from the previous year. Not unlike rubber, the most plantations are located in the south approximately 622,828 hectares, accounted for 85.29% of the total plantation area.

Although Thailand is currently the third largest palm oil producer in the world, however it has very small share of the world's export market. Most of products are domestically consumed, which can generate domestic economic value throughout the supply chain of industry more than 92,000 million Baht in year 2010 and more than 100,000 million Baht in year 2012. In addition, it can produce income from annual export averagely 23,000 million Baht with the small number of export. In year 2015, about 50 percent of crude palm oil was used for domestic consumption and industry, and about 40 percent were used for biodiesel production. The rest were exported and kept for stock in country.

2.3. Chilled and frozen shrimp

White leg shrimp, or Litopenaeus Vannamei is another main economic product of the South and the nation, as a result the chilled and frozen shrimp industry is one of the vital Thailand's industry. In year 2011, Thailand was accounted for 24.29 percent of the world's shrimp production, or second largest producer whereas China was number one. For ASEAN's shrimp production, it was nearly 1.14 million tons, accounted for 55 percent of the world's production; which Thailand could produce 502,000 tons or 47.40 percent of ASEAN's production. The major shrimp farming areas in Thailand are located in the South about 60 percent and in the east 30 percent. Most of finished products around 90 percent are exported.

Unfortunately, the disease so called Early Mortality Syndrome (EMS) had pervasively infected in the farms since the end of year 2012, the shrimp production in Thailand plunged sharply. So Thailand lost world's champion in shrimp exporter, which Thailand had possessed for a long time. Thus Thailand regressed to the fourth place in year 2013 and to the fifth place during year 2014-2015. And India became the leading exporter of the world, followed by China, Vietnam, and Indonesia in year 2015. However, a better trend could be observed in year 2016 as Thailand's shrimp export was amounted at 1,735.15 million US dollars. In addition, exports of chilled, frozen, and value-added shrimp during January – February 2017 were 205.56 million US dollars, which are increased 7.17 percent over the same period of the previous year. Major markets are the United States, Japan, Vietnam, South Korea, and Australia, accounting for 83.89 percent of total.

3. Role of Supply Chain in Supporting Agroindustry

As discussed in previous section, Thailand growth has been fundamentally founded on agricultural and agroindustry. Nevertheless, Thailand's agriculture is subjected to fluctuate because of depending on external factors such climate and internal factors such higher production cost, lack of farm management, irrigation system, etc., as a result productivity and yield have scarcely improved. When agricultural sector, which is upstream, has fluctuation so agroindustry, which is downstream, cannot inevitably run into problems. Downstream agroindustry such rubber industry, palm oil mill, frozen food factory, may be unable to compete in globalized industry. Thus, supply chain management has an essential role to agroindustry because any broken link in the chain may affect to chain performance. The key reason is that supply chain management fundamentally relates to total business process excellence and represents a new way of managing business within each link and the relationship with other members of the supply chain [5].

By typical definition of supply chain, it is the tasks, activities, events, processes, and interactions undertaken by all suppliers and all end users in the development of procurement, production, delivery, and consumption of a specific goods or service. Once agricultural sectors and agroindustry adopt the supply chain concept, it can be represented its network as shown in the following figure.

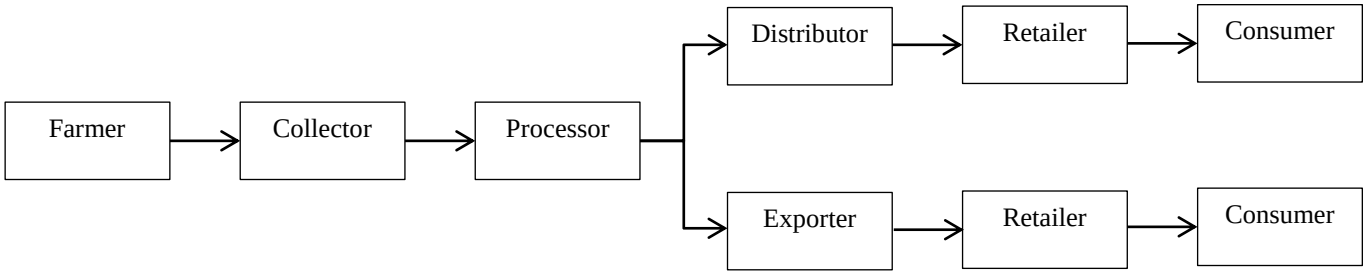


Fig. 5. Supply chain network of agroindustry

In next section, role of supply chain management in supporting agriculture and agroindustry will be demonstrated by research study relating to policies issued by Ministry of Agriculture and Cooperatives.

4. Case Study

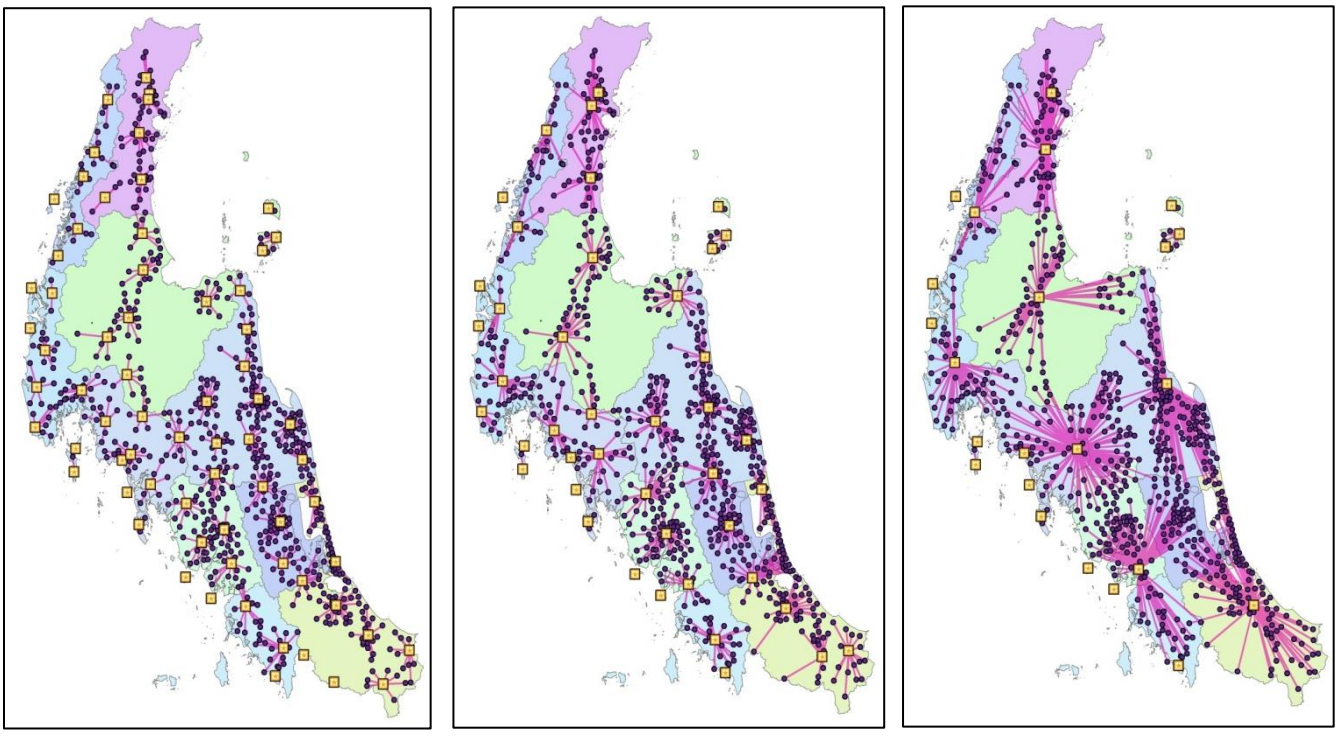
Some case studies will be demonstrated in this section along with the Agricultural Development Plan Year 2017-2036 under different policies, which can be exemplified such (1) agricultural zoning plan, (2) big size farm, (3) smart farmer. These case studies will adopt and integrate the supply chain management principles, which can deploy the policies into action.

4.1. Zoning by agri-map

With the goal to enhance farm productivity and farmers' incomes, the policy of zoning area has been emerged. Under this policy; the six economic crops, which are rice, maize, sugar cane, cassava, oil palm, and rubber, are designated the zoning area. It is estimated about 1.95 million hectares which is proper for growing these crops. However, the comment from agricultural experts cited that the idea of zoning for economic crops is not novel. It has been implemented in the past for the sugar cane crop but the problems were such no seamless policy or management system for managing the products in case of the high quantity or lower price. So the drawback in the past can be resolved and fulfilled under supply chain management, which can facilitate in planning form upstream to downstream.

A study on the directions for the establishing of crude palm oil (CPO) factories in oil palm supply chain has been studied to support this policy into action. The objectives were to study the current inbound transportation system of fresh fruit bunch (FFB) to CPO factories and to recommend the directions for establishing the CPO factories in order to balance between plantation area and production capacity CPO factories with mathematical formulas and multiple decision making criteria. This study was initiated from benchmarking of CPO factories utilization between Thailand, Malaysia, and Indonesia. It was uncovered that Thailand's average factory utilization was about 58 percent, while Malaysia and Indonesia were at 95 percent and 82 percent, respectively in year 2013. Key reason for least factory utilization is because the growth of CPO factories is unlimited and unbalanced to the growth of plantation. It can be disclosed that in year 1987 one CPO factory had plantation area around 6,700 hectares to feed FFB to factory production, but in year 2015 plantation area per one CPO factory decreased to 4,440 hectares.

To prevent the recurrence of the utilization problem, planning to establish the number of CPO factories matched with the plantation area under the zoning area of Ministry of Agriculture and Cooperatives is required. New plantation in the zoning area for oil palm is around 1,048,670 hectares; not only number and location of CPO factories, but also allocation of FFB from plantations, via collectors, to CPO factories are the solution for better planning in the future. Illustration of the research output can be shown in the following figure.



(A) 30 kilometers (B) 50 kilometers (C) 100 kilometers

Fig. 6. Location and allocation of oil palm supply chain network

Figure 6 provides the idea of how to locate and allocate from plantation areas to collectors and from collectors to CPO factories. Solution provided from this research can be presented three different alternatives in the following table.

Table 1. Result of location and allocation

Alternatives	Initial number of CPO factories	Adjusted number of CPO factories	Total transported FFB (million tons/year)	Total transportation cost (million IDR/year)	Utilization of CPO factories
Within 30 kilometers	52	36	11.21	67,389	96.25
Within 50 kilometers	28	21	13.36	131,004	97.44
Within 100 kilometers	8	7	13.85	306,107	95.02

Note: exchange rate is 400 IDR equal 1 Baht

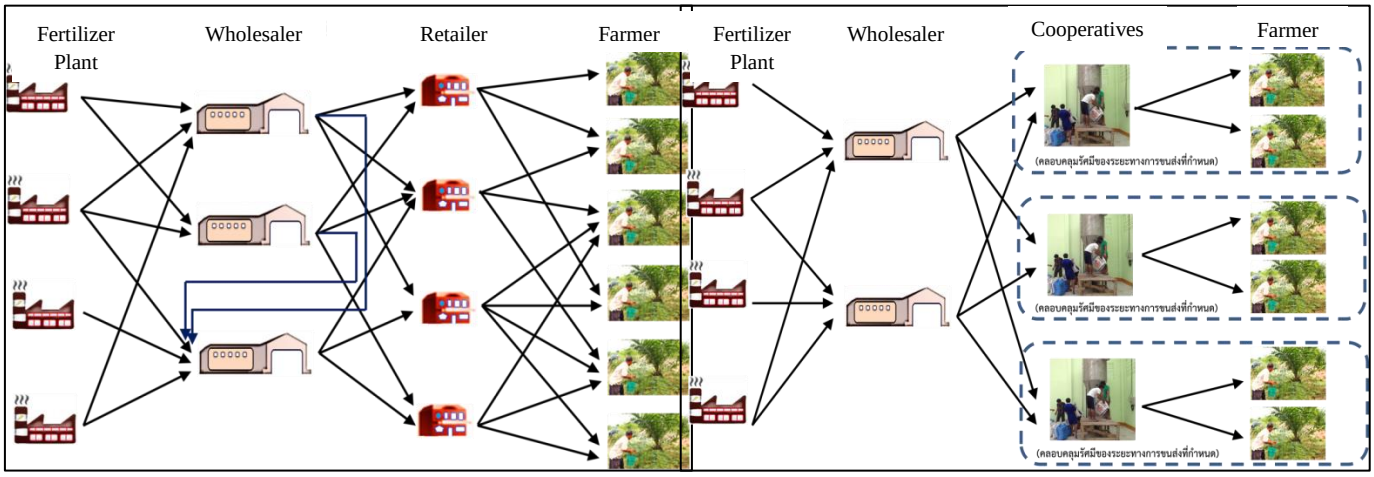
In Table 1, solution offered is categorized into three alternatives based on the distance from collectors to factory. Under each alternative, number of CPO factories will be decreased as the distance of raw material procurement is increased. Nevertheless; the preliminary solution must be adjusted because of overlapping with the existing CPO factories and nonconforming to factors or criteria in facility location selection. Then total FFB transported and total transportation cost can be evaluated as shown. Research outcome can be measured in terms of both balance between plantation areas and number of CPO factories, and increment of utilization.

4.2. Big size farm

With the goal of gaining advantage from economies of scale and higher bargaining power, the policy of promoting big size farm also has been issued to help small holders, who are the major portion of the agricultural sector. In order to support this policy, 800 cooperatives across the country will have significant role. Idea behind this policy is specifically associated to supply chain collaboration. However, relationship within supply chain can be classified into various classes depending on the degree of relations, which are cooperation, coordination, integration, and collaboration [6].

A study on the collaboration in fertilizer management to reduce supply chain cost for the oil palm industry was initiated from the fact that more than 1.3 hundred thousand holders in oil palm industry were small holders and oil palm plantation cost was somewhat high because there was much less collaboration. In addition, fertilizer cost was accounted to almost 50 percent of production cost in the first three years and about 60 percent during the fourth and fifth year of plantation. So objective of this study was to develop collaboration model in fertilizer management, focusing on procurement and distribution activities, within upstream of oil palm supply chain.

To develop collaboration model based on mathematical model, the "AS-IS" situation was studied and the "TO-BE" model was proposed. Contrast between "AS-IS" and "TO-BE" models can be illustrated in the following figure.



(A) "AS-IS" Model (B) "TO-BE" Model

Fig. 7. "AS-IS" model versus "TO-BE" model

From Figure 7; it can be seen that if farmers can collaborate, they will have larger volume of fertilizer usage so they will have more bargaining power to wholesaler. And under setting up new cooperative groups or existing groups, they need to manage their groups and act as retailers. By running mathematical model, transportation cost of "TO-BE" model compared to "AS-IS" model can be reported in the following table.

Table 2. Cost comparison between "AS-IS" and "TO-BE"

Distance (kilometers)	Number of cooperatives	Percent of transportation cost decreased (-) / increased (+)			Percent of total transportation cost decreased (-) / increased (+)
		Fertilizer plant to wholesaler	Wholesaler to cooperative	Cooperative to farmer	
10	50	-50.33	-12.08	-62.53	-42.34
15	29	-49.59	+2.57	-45.56	-38.17
20	19	-38.27	+3.24	-10.50	-27.56
25	14	-39.59	-0.28	+14.57	-27.38
30	11	-37.59	-9.71	+31.47	-26.38

In Table 2, solution can be shown by different scenarios based on the distance of covering each farmer and unifying them to one cooperative. Under each scenario, total transportation cost can be fragmented into tier by tier, which cost in distinct tier may decrease or increase under various scenarios. But overall transportation cost always decreases. However, inventory cost has not been considered in this study. Research outcome can be stated in term of collaboration will provide the approach for cost reduction to small holders, which are major sector in the agriculture of the country.

4.3. Smart farmers

Thailand 4.0 is a current economic model, which focuses on a value-based economy. It aims to change in Thailand's economy and production thru three mechanisms. First mechanism is developing a knowledge-based economy by research and development, science and technology, creative thinking and innovation. Second is providing equitable access to the success of prosperity and development for all levels and everyone in society. And third is depending on sustainable growth and development. Incidentally, Thailand's Agricultural Development Plan Year 2017-2036 deployed from Thailand 4.0 economic model, which is a 20-year program to modernize the country's agricultural sector, has an aim to change the traditional farming to smart farming.

As explained in section 2.3 about the rise and fall of chilled and frozen shrimp industry, industry's strengthening is truly compulsory for the sake of the industry's competitiveness. However, the competitiveness in the globalization will be measured by the chain competitiveness; hence supply chain management which is strategic management is absolutely right for now. The following research aims to modernize the chilled and frozen shrimp industry by integrating all members in the chain through information technology, which can be illustrated in the following figure.

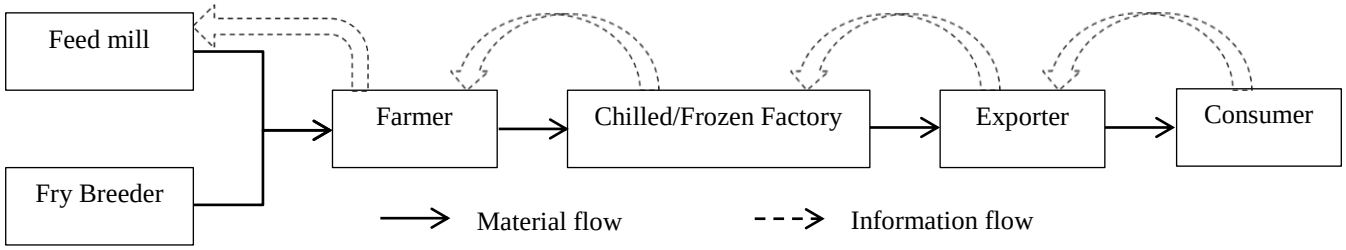


Fig. 8. Industry supply chain

Starting at the consumers or demand side, ideally data such order requirements can trigger the process in supply chain network, so called pull system. Yet the practice in reality is quite far from ideal since the farmers or supply side hardly know the true demand such size, quantity, and quality of shrimp; consequently, the farmers just anticipate what the demand side needs and raise shrimp as they expect, so called push system. Sometimes there is mismatch between supply and demand, it causes total loss to supply chain network. Thus the best practice that has been widely famous in supply chain management is information sharing.

In order to develop the information system, business processes along the industry chain were analyzed both intra-firm and inter-firm. Subsequently, database system was developed in order to obtain key information from both supply side and demand side such amount and size of shrimps or order requirements and delivery date. Finally, information can be shared along the supply chain via the technology such internet. Conceptual system design can be represented in the following figure.

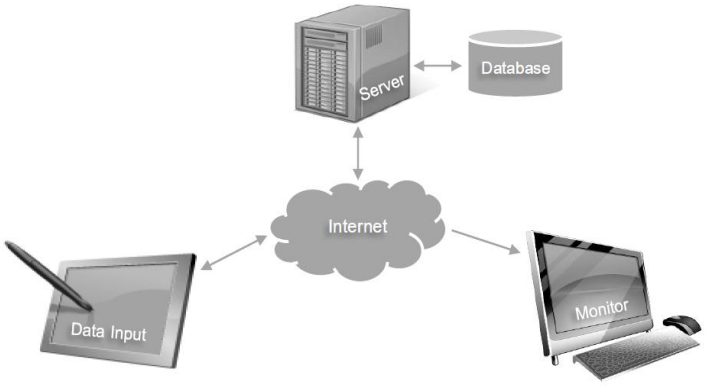


Fig. 9. Conceptual design

With the development of information technology system for supply chain integration, it will be benefit for industry competitiveness in the globalization era and it will transform the traditional farmers to smart farmers in accordance with the business situation.

5. Conclusion

This article presents the role of supply chain management to the development of agricultural sector and agroindustry which are the backbone of the country. It can be evidenced from various case studies that adopted the principle of supply chain management to provide in level of both strategic and operational planning in accordance with the policy of Ministry of Agricultural and Cooperatives. Contribution of supply chain management to several areas ranging from manufacturing, agriculture, construction, tourism to healthcare has already been proved for more than two decades. Nevertheless; there are numerous problems still waiting for researchers and practitioners to desirably explore with the supply chain theory as long as the business world is constant change, undeniably.

Acknowledgements

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