The Potential of Rubber Supply Chain Along the Economic Corridors Indonesia-Malaysia-Thailand Growth Triangle (IMT-GT): Case study in Thailand

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Abstract

This study aims to demonstrate the potential of the rubber supply chain along the IMT-GT Economic Corridor in the 14 southern provinces by analyzing qualitative data from upstream, midstream and downstream which can be used as a guideline to support the strategy for developing the rubber industry in the South along the IMT-GT economic corridor and use data to increase spatial potential.

Production (Upstream), the south has the most rubber plantation areas or 60.40% of the total rubber plantation areas in the country. The rubber plantation areas of the provinces along the economic corridors constitute 53.72% of the rubber plantation areas nationwide. The area with the largest rubber plantations is Surat Thani or 407,113 hectares (11.29%), followed by Songkhla or 316,599 hectares (8.47%), and Nakhon Si Thammarat or 240,052 hectares (8.03%). They are situated in EC1 with the total area of 30.11%. Moreover, the rubber plantation areas in EC6 constitute 11.22% of the output. Therefore, the appropriate areas for the development of rubber value chain will be the areas in EC1 and EC6 that collect, process, and distribute rubber products for domestic consumption and export.

Processing (Intermediate), the primary product is tapped rubber (100%) which will be processed into three products namely: 1) Latex (59%) farmers in the south of Thailand tend to sell latex more for convenience and ability to reduce the risk of price fluctuation. 2) Raw rubber sheet (8%). 3) Cup lump or rubber crumb (33%)

Distribution (Downstream), the products from the intermediate industry include 1) Concentrated latex with 78% for export and 22% for domestic consumption. They consist of rubber gloves (47%), condoms (7%), and others (46%) 2) Ribbed Smoked sheet with 88% for export and 12% for domestic consumption 3) Technically specified rubber with 90% for export and 10% for domestic consumption such as rubber tires (91%) and others (9%). The downstream industry is the industry to process raw materials from the intermediate industry into final products for consumers. The products include pillows, latex mattresses, rubber gloves, condoms, rubber roads, auto tires, motorcycle tires, aircraft tires, rubber bands, conveyor belts, athletic shoes, waterproof strips.

Keywords: Supply Chain, Rubber Products, Economic Corridors, Potential Industries

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Introduction

Thailand is the world's leading producer and exporter of intermediate rubber, which is used as a raw material for a variety of products and is a commodity with a futures market, especially in the South, which is connected along the economic corridor Indonesia-Malaysia-Thailand Growth Triangle(IMT-GT). The most prominent and important potential areas are Chumphon-Surat Thani-Nakhon Si Thammarat-Songkhla-Penang-Medan(EC1), because it has the largest planting area and production of 1,469,974 tons, accounting for 30.11 percent and Songkhla-Pattani-Yala-Narathiwat-Perak-Kelantan-East Sumatra (EC6) have the following planting area and production at 543,218 tons, accounting for 11.22 percent of Thailand, which is connected to Malaysia and Indonesia, which is another important mechanism that will help drive the economy at the sub-regional level o support the rubber supply chain to elevate itself to create more innovations in rubber production, as well as create cooperation in the form of a rubber economic corridor and increase rubber consumption in the region. **(Figure 1)**

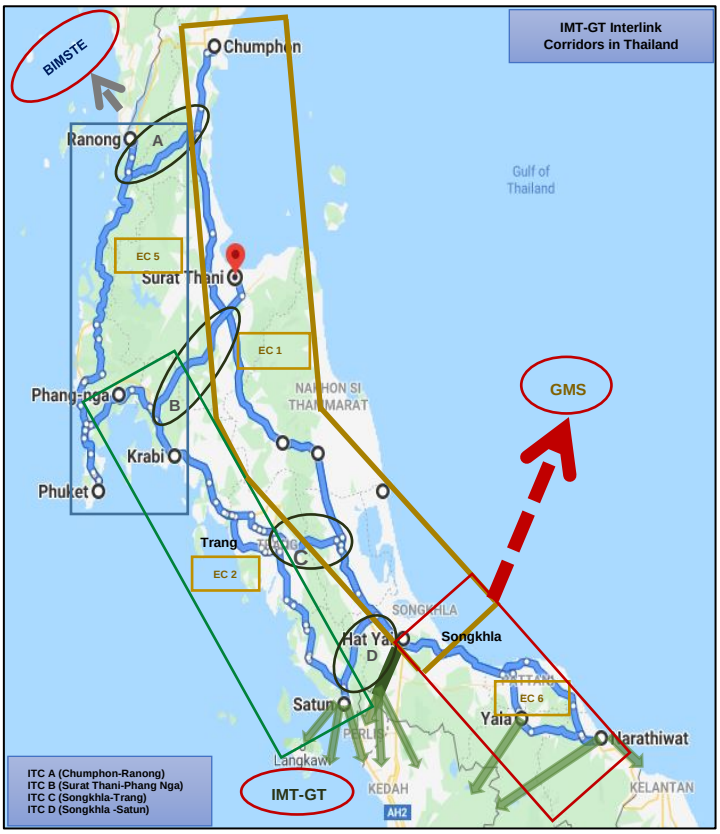

Figure 1: IMT-GT Economic Corridors in Thailand

Source : Google map modified by the Author

The rubber industry is expanding in terms of both production and consumer demand. Factors that support increased production include expansion of planting areas and farmers' maintenance to accelerate harvesting of products at attractive prices. Domestic and export sales volumes tend to increase due to supporting factors of demand for rubber in downstream industries, including 1)the automotive industry, automotive parts, and rubber wheels, in line with the recovery of the economy, investment, and domestic and international tourism 2)Construction sector from investment in infrastructure which tends to accelerate and 3)Medical rubber products, especially rubber gloves, following the increase in the elderly population and the risk of new emerging diseases which are likely to occur again from time to time.

By rubber plantation area in 14 southern provinces of Thailand, namely Songkhla, Pattani, Narathiwat, Yala, Satun, Trang, Phatthalung, Nakhon Si Thammarat, Phuket, Phang Nga, Krabi, Ranong, Chumphon and Surat Thani, the connectivity of the economic corridor according to IMT-GT.

The Extended Chumphon-Suratthani-Nakhon Si Thammarat-SongKhla-Penang Medan Economic Corridor (EC1) in Thailand starts in Chumphon and ends at the Thai-Malaysian border checkpoint. It is divided into 11 sections namely Chumphon Mueang District-Surat Thani Mueang District, Surat Thani Mueang District-Nakhon Si Thammarat Mueang District, Nakhon Si Thammarat Mueang District-Phatthalung Mueang District, Phatthalung Mueang District-Hat Yai District, Songkhla Mueang District-Hat Yai District, Songkhla-Padang Besar Border Checkpoint, Songkhla-Sadao Border Checkpoint, Songkhla-Ban Prakob Border Checkpoint, Hat Yai-Padang Besar Border Checkpoint, Hat Yai-Sadao Border Checkpoint, and Hat Yai-Ban Prakob Border Checkpoint.

The route of Phang Nga-Krabi-Trang-Satun-Straits of Malacca Economic Corridor (EC2) in Thailand is divided into 5 sections namely Phang Nga Mueang District-Krabi Mueang District, Krabi Mueang District- Trang Mueang District, Trang Mueang District-Satun Mueang District, Satun Mueang District-Wangprachan Customs Checkpoint, and Satun Mueang District-Tammalang Port.

The route along the Ranong-Phuket-Phang Nga-Krabi-Aceh Economic Corridor (EC5) in Thailand starts at Mueang District, Ranong and ends at Mueang District, Krabi with the distance of 305 km (Figure 1). The route passes a wildlife sanctuary (Klong Nakha Wildlife Sanctuary) and a national park (Khao Lak-Lam Ru National Park) using Highway 4 as main route. From the city of Ranong to Ngao Subdistrict, Mueang District, Ranong, the Highway has 4 traffic lanes. But the route from there to over 250 kms on the Highways 401, 4090, 4240, and 4 until the intersection of Khok Loi Subdistrict, Takua Thung District, Phang Nga will be a Highway with 2 traffic lanes. The remaining section of the route will be Highway 402 heading to Phuket Municipality with 4 traffic lanes. The road surface is smooth in the

entire section. The route is safe, equipped with traffic signs, traffic lines, complete and undamaged safety equipment, curved guide posts, and complete guard rail in good condition.

A.Songkhla-Pattani-Yala-Narathiwat with the east coast to link with Malaysia at Perak and Kelantan Economic Corridor (EC6) in Thailand starts at Mueang District, Songkhla and ends at the Thai-Malaysian border in Yala and Narathiwat. The route is divided into six sections namely Songkhla Mueang District, Pattani Mueang District, Yala Mueang District, Yala Mueang District-Betong Border Checkpoint, Pattani Mueang District-Narathiwat Mueang District, Narathiwat Mueang District-Tak Bai Border Checkpoint, Narathiwat Mueang District-Sungai Kolok Border Checkpoint, and Narathiwat Mueang District-Buketa Border Checkpoint.

Table 1: Potential Industries in Economic Corridors

Potential Industries	EC1	EC2	EC5	EC6
Rubber and Rubber Products	✓	-	-	✓
Palm Oil	✓	✓	-	-

Source: Compiled by author.

Rubber and Rubber Products: Thailand focuses its activities on the production and export of latex and rubber sheets, while both Indonesia and Malaysia concentrate their activities on the production and export of block rubber. Those products are shipped in their raw material forms to countries such as China, Japan, United States and Europe to be processed into rubber products such as tires, industrial rubber goods, and consumer goods such as footwear. Indonesia and Malaysia have set out one of their major objectives to increase pre-export processing of their natural rubber in order to increase their value added in the industry. While Thailand would like to increase downstream activities, it currently only produces upstream and mid-stream rubber products.

The flow mechanism of raw materials in the rubber supply chain starts with the farmers in EC1 and EC6 who produce latex, cup lump, and unsmoked rubber sheets.

Asian countries are the world's major producers of natural rubber with the share of 90%. In 2024, Thailand produced 4.42 million tons of natural rubber or 35.9%, followed by Indonesia, Vietnam, China, Malaysia, and India with 26.0%, 8.6%, 8.0%, 5.5%, and 5.0% respectively.

Southern Thailand is rich in natural resources, which have played a major role in supporting local livelihoods and driving southern region economic growth. Forests, marine and mineral resources have all been a key in supporting the Thai manufacturing, export, and tourism industries. Therefore, the

local natural resources can develop and process into value added products and link with the regional supply chain.

Especially rubber are plants that are of economic importance. Which can generate a very high income with farmers in the South and the country. Therefore, the study and research of supply chain development patterns throughout the supply chain of the rubber industry in the southern in a qualitative analysis, from upstream, midstream and downstream to be one way to support the development strategy of the rubber industry of the south Along the IMT-GT economic corridors and use the information to increase the spatial potential.

Literature Reviews

Supply chain refers to the connection of units or points in the production of goods or services, starting from raw materials to the final point, the customer.

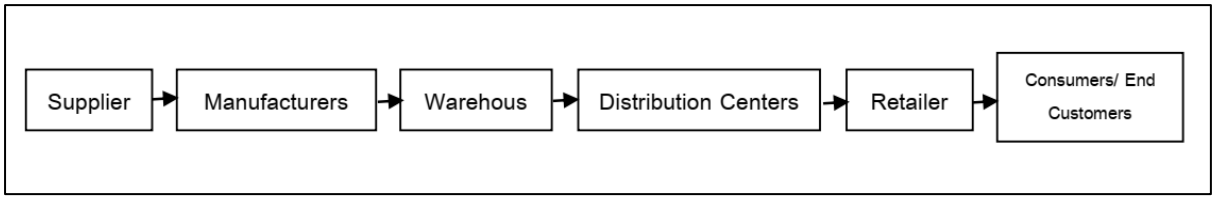

Figure 2: Logistics, The connection of units in the production of goods

Porter (1985) proposed a value chain model. by focusing on the importance of activities in the value chain of each business unit From the sourcing of raw materials, processing, as well as the delivery of goods and services to customer by creating business competitiveness by analyzing the added value that occurs in each process or activity. Therefore, the value chain is to connect activities that create added value and linkages with suppliers in the supply chain as well, outside the organization, affecting the competitiveness.

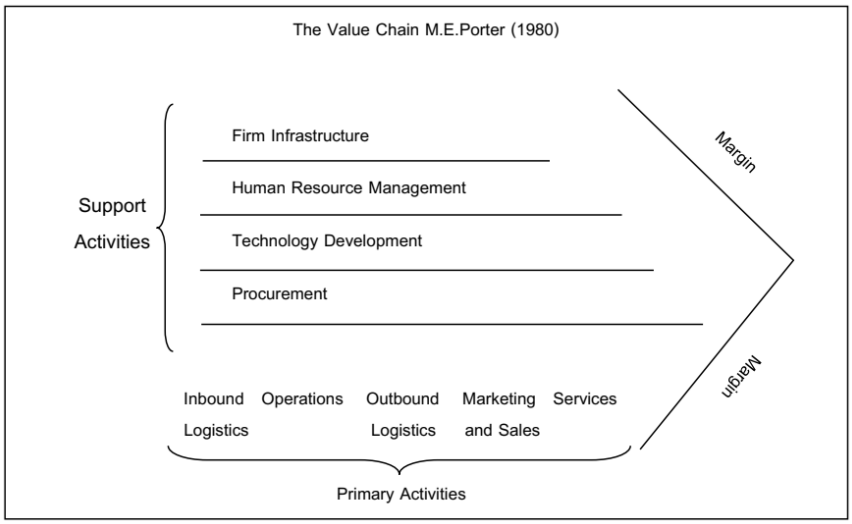

Figure 3: Value chain diagram (Food and Agriculture Organization, 1993)

Porter's categorized the value of activities within the organization into 2 activities: Primary activities and support activities all types of activities have contributed to value provide the company's products or services the 5 main activities are activities related to production or creation product or service marketing and transportation of goods or services to consumers, including

1) Inbound logistics, activities related to the acquisition, transportation, storage and distribution of raw materials.

2) Operations, related activities to change or transform raw materials into products. It is a production process.

3) Outbound logistics, activities that related to the storage, collection, distribution of goods and services to customers.

4) Marketing and sales, in addition to persuading customers to purchase products and services.

5) Customer services, activities that cover the provision of services to add value for products including after-sales service.

Supporting activities are activities that promote and support the main activities to be carried out consists of procurement activities in the acquisition - procurement of input to be used in the main technology development activities together with the development of technology that helps to increase value for goods and services or production processes human resource management activities related to human resource management from analyzing needs, recruiting and selecting, evaluating, developing, training the system salary, wages and labor firm infrastructure of the organization such as accounting system, system finance organization management. The above main activities will work well in coordination with each other to create value. Yes, it must rely on all 4 supporting activities and in addition to supporting activities, it will serve as support. In addition to the main activities, support activities must also serve to support each other and will be seen today. Information systems will be it is one of the components of the value chain in the technology development sector. To be used in planning, operations, decision-making and control, which must act to support and connect all activities an element of the value chain is a good way to create a competitive advantage for a business or organization.

Supply chain is a system of agencies to apply together such as using people, using technology, doing activities, gathering information resource use and recruiting resources for the movement of goods or services from upstream or supplier to Downstream customers Supply chain activities will the transformation of natural resources or Processing raw materials, other materials into finished goods and

sending them to the last customer. Supply chains are related to value chains. Process from upstream to downstream.

Supply Chain Management is the implementation of strategies, methods practices or theories to be applied in the management of the transfer of raw materials, goods or services from one unit in the supply chain to another unit efficiently at a cost the lowest total in the supply chain and receive raw materials, goods or services on time in this regard, cooperation has been established in sharing information and news, whether by any means To know the needs that are important factors that cause the forwarding of raw materials, goods or services, leading to mutual benefits of all parties (Tanit Soratt, 2007).

Supply Chain Macro Processes in a Firm

All supply chain process discussed can be classified into the following three macro process, as shown in Figure 2

1) Customer Relationship Management (CRM): all processes that focus on the interface between the firm and its customer

2) Internal Supply Chain Management (ISCM): all processes that are internal to the firm

3) Supplier Relationship Management (SRM): all processes that focus on the interface between the firm and its suppliers

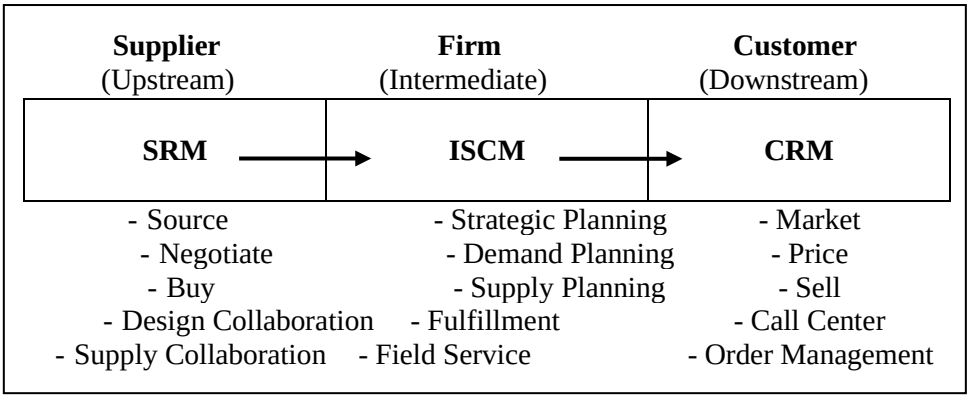

Figure 4: Supply chain macro processes (Sunil Chopra and Peter Meindl, 2013) and modified by the author

These three macro process manage the flow of information, product, and funds required to generate, receive, and fulfill a customer request. The CRM macro process aims to generate customer demand and facilitate the placement and tracking of order. It includes processes such as marketing, pricing, sales, order management, and call center management. At an industrial distributor, CRM processes include the preparation of catalogs and other marketing materials, management of the Web site, and management of the call center that takes orders and provides service. The ISCM macro

process aims to fulfill demand generated by the CRM process in a timely manner and at the lowest possible cost. ISCM processes include the planning of internal production and storage capacity, preparation of demand and supply plans, and fulfillment of actual orders, ISCM processes include planning for the location and size of warehouse; deciding which product to carry at each warehouse; preparing inventory management policies; and picking, packing, and shipping actual orders. The SRM macro process aims to arrange for and manage supply sources for various goods and services. SRM processes include the evaluation and selection of supplies, SRM processes include the selection of supplies for various products, negotiation of pricing and delivery terms with suppliers, sharing of demand and supply plans with suppliers, and the placement of replenishment order (Sunil Chopra and Peter Meindl, 2013)

Kanthicha Kotsanlee and Suthep Nimsai (2025), Prayoon Tosanguan (2025) Study of rubber supply chain for export for the rubber and rubber products industry in Thailand and enabling entrepreneurs to use it to measure efficiency and continuously develop ourselves because rubber is in the early stages of the upstream and midstream industries in the supply chain. It also supports strategies for developing the rubber industry and developing rubber products that meet international standards. innovation to increase the value of rubber, the development of rubber farmer cooperatives, rubber central markets, products in the automotive industry, products in the construction industry, products from concentrated latex, and rubber wood products.

Methodology

To demonstrate the potential of the rubber supply chain along the IMT-GT Economic Corridor, qualitative data analysis was conducted by collecting secondary data from 14 southern provinces of Thailand, namely Songkhla, Pattani, Narathiwat, Yala, Satun, Trang, Phatthalung, Nakhon Si Thammarat, Phuket, Phang Nga, Krabi, Ranong, Chumphon and Surat Thani, the connectivity of the economic corridor according to IMT-GT. According to the non-probability sampling plan, the reason is that it has the largest rubber plantation area in the country. The statistical data are calculated to include area size, production quantity, percentage, and percentile. The data set period is 2022. This research will study rubber products from upstream (farmers), midstream (intermediate product producers) and downstream (consumers).

Results and Discussion

Production (Upstream)

Natural Rubber in Thailand

Thailand is the world's number two in terms of rubber plantation areas, after Indonesia. In 2022, the total rubber plantation areas in Thailand were 28.13 million rais. The areas of tapped rubber were 20.09 million rais or up 4.12% from 2021. Most rubber plantation areas were situated in the south with 12.54 million rais (57.51%), followed by the northeast with 5.85 million rais (26.21%), the central plains with 2.25 million rais (10.27%), and the north with 1.32 million rais (6.01%) respectively.

Thailand is the world's number one producer and exporter of natural rubber. Thailand produces 4.42 million tons and exports 3.70 million tons of natural rubber (83% of the total output). Production for domestic consumption is 0.72 million tons (17% of the total output). In terms of intermediate processed rubber, Thailand produces most of technically specified rubber, followed by concentrated latex, mixture, ribbed smoked sheet, and other types of rubber such as compound rubber.

Rubber in Economic Corridors Provinces

Rubber is an economic crop which is crucial to the economy of the south and Thailand. It generates revenue into the country and increases farmers' income. The south is situated in a tropical zone which is suitable for rubber cultivation than other regions. Therefore, the south has the most rubber plantation areas or 57.51.40% of the total rubber plantation areas in the country. The rubber plantation areas of the provinces along the economic corridors constitute 50.94% of the rubber plantation areas nationwide. The three provinces with the highest share of rubber plantation areas include Surat Thani or 329,056 hectares (9.79%), followed by Songkhla or 309,650 hectares (8.40%), and Nakhon Si Thammarat or 280,110 hectares (8.14%), as well as Chumphon or 91,098 hectares (2.59%). They are situated in EC1 with the total area of 28.92%. Moreover, the rubber plantation areas in EC6 constitute 10.46% of the output. Therefore, the appropriate areas for the development of rubber supply chain will be the areas in EC1 and EC6 that collect, process, and distribute rubber products for domestic consumption and export. The output from rubber tapping is latex. Industrial plants will use it as a raw material to produce technically specified rubber, ribbed smoked sheet, concentrated latex, compound rubber, and mixture. They are mostly located in the EC1 provinces namely Songkhla, Surat Thani, Nakhon Si Thammarat, and Chumphon. The Rubber City in Songkhla processes rubber into auto tires, rubber gloves, condoms, conveyor belts, and rubber pipes, etc.

Table 2: Rubber value chain in economic corridor provinces in Thailand

EC	Provinces	Rubber Plantations			Processing	Distribution
		Area (hectares)	Production (Ton)	Share (%)		
1	Songkhla	309,650	411,181	8.40	1. Natural rubber - concentrate latex - ribbed Smoked Sheet - air Dried Sheets - block rubber - crepes rubber - skim rubber 2. Synthetic rubber 3. Rubber gloves 4. Condom 5. Latex pillow 6. Rubber shoes 7. Prayer mat 8. Rubber flooring 9. balloon	EC1 : Borders - Sadao BC - Padang Besar BC - Ban Prakob BC Ports - Penang Port - Port Klang - Songkhla Port - Coastal pier, Surat Thani go to Laem Chabang Port
	Surat Thani	329,056	478,893	9.79		
	Nakhon Si Thammarat	280,110	398,242	8.14		
	Chumphon	91,098	126,874	2.59		
				Sub-total		
				28.92		
2	Krabi	86,511	124,126	2.54	1. Natural rubber - concentrate latex - ribbed Smoked Sheet - air Dried Sheets - block rubber - crepes rubber - skim rubber 2. Pillow for health 3. Bull pillow, doll shaped pillow 4. Latex mattress 5. Sandals / Boots 6. other products - Carambola helps washing clothes wonders - Rubber outsole - Flooring rubber - Rubber squeeze ball for exercise - Frog fins from rubber - gloves	EC2: Ports - Penang Port - Port Klang - Laem Chabang Port
	Trang	190,146	264,326	5.40		
	Satun	68,939	99,432	2.03		
				Sub-total		
				9.97		

EC	Provinces	Rubber Plantations			Processing	Distribution
		Area (hectares)	Production (Ton)	Share (%)		
					- Carrying bag	
5	Ranong	47,462	66,410	1.36	1. Natural rubber - concentrate latex - ribbed smoked sheet - air dried sheets - block rubber - crepes rubber - skim rubber	EC5: Ports - Puket Port - Laem Chabang Port
	Phuket	9,963	11,275	0.23		
			Sub-total	1.59		
6	Pattani	58,138	82,021	1.68	1. Natural rubber - concentrate latex - ribbed smoked sheet - air dried sheets - block rubber - crepes rubber - skim rubber 2. Latex pillow 3. Rubber shoes 4. Heel rubber 5. Rubber sponge 6. Rubber products - Rubber band 3. Finished rubber (rubber mixed with chemicals) 4. Power wash ball	EC6: Borders - Sungaikolok BC - Tak Bai BC - Buketa BC - Batong BC 1. Natural rubber - concentrate latex - ribbed Smoked Sheet - air Dried Sheets - block rubber - crepes rubber - skim rubber 2. Synthetic rubber 3. Rubber gloves
	Yala	199,718	261,043	5.10		
	Narathiwat	137,102	180,224	3.68		
			Sub-total	10.46		
All ECs			Total	50.94		export to 78.8% China Malaysia EU Japan USA
Others	Phatthalung	144,256	202,336	4.14		
	Phangnga	82,092	118,930	2.43		
			Sub-total	6.57		
Southern			Total	57.51		
Other			total	42.49		
Thailand			Total	100.00		

Sources: Office of agriculture economic (2022), Compiled by the author

Thailand promotes FDI in rubber industry by providing incentives according to the criteria of the Board of Investment of Thailand (BOI) and the establishment of Rubber City in Songkhla with the area of 1,218 rais and with potential to accommodate investment of rubber innovation, concentrated latex, compound rubber, and continuous industries. Importantly, Thailand is wide open in searching for cooperation with trading partners in international rubber market to make Thailand into an Original Equipment Manufacturer (OEM). The comprehensive potential equips Thailand to be ready to become the center of OEM of rubber according to the needs of rubber entrepreneurs and import rubber worldwide which in the end will impact the stability of domestic rubber prices.

Processing (Intermediate)

The upstream industry involves rubber farmers and rubber tappers. Some farmers start to participate in rubber processing to add value to the primary production. Most of Thailand's primary production is used as input into the domestic intermediate industry and the rest for export. The primary product is tapped rubber (100%) which will be processed into three products namely:

1) Latex (59%) Presently, farmers in the south of Thailand tend to sell latex more for convenience and ability to reduce the risk of price fluctuation.

2) Raw rubber sheet (8%) The rubber sheet as produced by farmers are not smoked or processed by any other means.

3) Cup lump or rubber crumb (33%) The tapped rubber is latex that, when mixed with chemicals, will become coagulated rubber. The production of cup lump by farmers increases in many areas especially in Surat Thani, Pattani, Yala, and Narathiwat. Cup lump is an alternative for farmers in the south as it is easily produced, economical, consuming less time, and not labor-intensive. Quality cup lump is in the form of a cup, clean, beautiful color, without contaminants or foul order, with the weight of approximately 80-500 grams.

The intermediate industry or processors of natural rubber. The rubber from plantations are processed into semi-finished products such as ribbed smoked sheet (RSS), technically specified rubber/ standard Thai rubber (TSR/STR), concentrated latex, compound rubber, and skim rubber with necessary qualifications for domestic and international downstream producers. The product processing from the upstream industry used as raw material for rubber product industry includes concentrated latex, ribbed smoked sheet, and technically specified rubber, etc. The products are divided into four types namely block rubber (41%), rubber sheet (38%), concentrated latex (20%), and crepe rubber (1%).

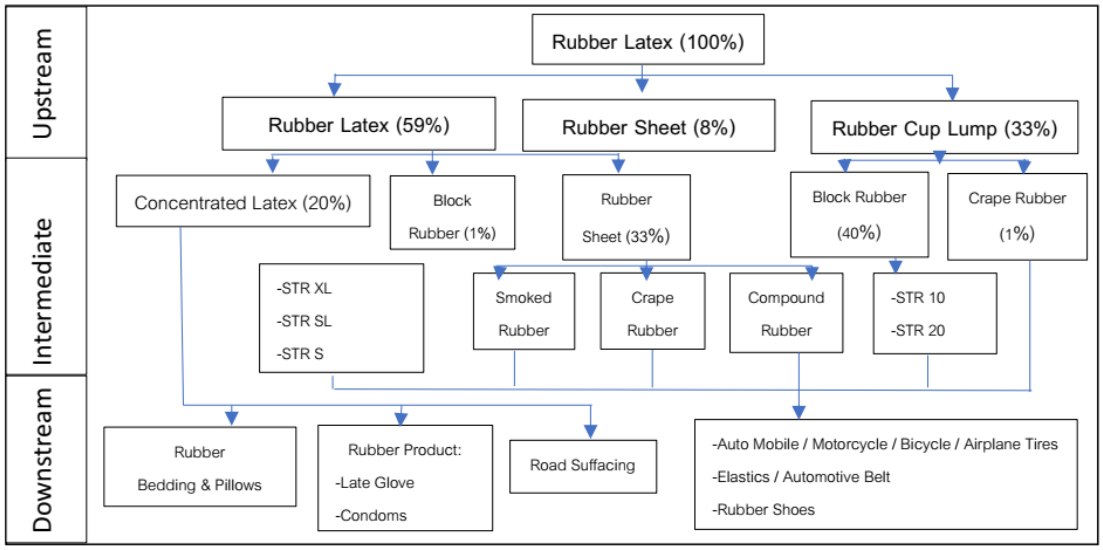

Figure 5: Thailand's Rubber Supply Chain (Chaiwat Sowcharoensuk, 2022)

Figure 6: Intermediate Rubber Products (Chaiwat Sowcharoensuk, 2022)

Distribution (Downstream)

The downstream industry is the industry to process raw materials from the intermediate industry into final products for consumers. The products include pillows, latex mattresses, rubber gloves, condoms, rubber roads, auto tires, motorcycle tires, aircraft tires, rubber bands, conveyor belts, athletic shoes, waterproof strips, and others. In some cases, synthetic rubber (SR), which is developed from the petrochemical sector, is an alternative to natural rubber or to mix with NR in order to enhance qualifications for each function.

As can be seen from Table 2, the analysis of potential areas for supply chain development is EC1 and EC6, which have rubber production, collection and processing and distributes rubber products for consumption both domestically and for export, with products from the intermediate industry including 1) concentrated latex, 2) rubber sheets, 3) block rubber and 4) crepe rubber.

In the downstream industry, the finished products produced for export abroad accounted for the largest proportion, namely medical gloves (93.8%), followed by elastics (91.7%), condoms (84.6%), rubber bands (74.2%), tires (37.4%), tires & tubes for motorcycle (24.3%), and others, respectively (Figure 6).

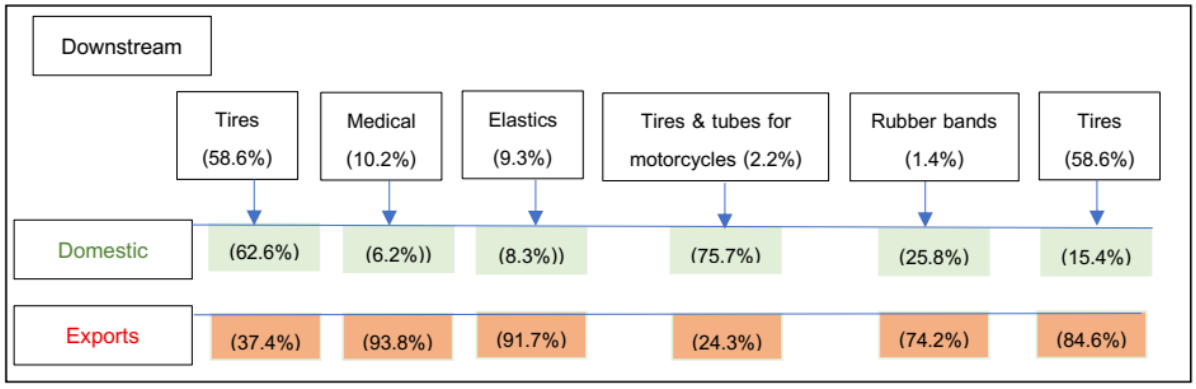

Figure 7: Downstream distribution (Chaiwat Sowcharoensuk, 2022)

The total distribution of rubber latex exports was 4,400,013 Metrictons, for 54.56% of exports to China, following by EU (8.79%), Malaysia (7.62%), Japan and USA (6.21%) and South Korea (4.85%) respectively. The total export contributes to approximately 80% of the rubber products that Thailand exports, divided into two groups namely:

1. Semi-finished rubber products or primary processed rubber products which are the output from the processing of tapped latex in various forms to be used as raw materials in rubber product industry.

1.1 Ribbed Smoked Sheet (RSS) is exported with the share of 13.48%. The main export markets include China, Japan, US, and EU. RSS will be visually graded (Visual Grading) and is divided into 5 levels according to the qualifications of clearness, dryness, consistency in colors and rubber content. RSS 1 is the best quality. But Thailand produces mostly RSS 3 and RSS 4 with medium quality and with combined share of approximately 95%.

1.2 Block Rubber (TSR) is exported with the share of 38.63% The main markets include China, EU, South Korea, and US. Thailand specifies the standards of rubber classification similarly to Malaysia and Indonesia. But the names are called according to their standards. In Thailand, it is called STR (Standard Thai Rubber) which is in compliance with international standards.

1.3 Concentrated Latex is exported with the share of 21.34%. The main markets include US, China, EU, and South Korea. Concentrated latex is an important raw material for rubber product industry using dipping process such as rubber gloves, condoms, medical devices, electronic parts, and balloons.

1.4 Compound Rubber is exported with the share of 22.89% to China.

1.5 Others is exported with the share of 3.66% to China.

2. Rubber finished products include medical gloves, elastics, condoms, rubber bands, tires, tires & tubes for motorcycle, etc. The share of 20% of the total output is used as raw materials for domestic production

Table 3: Export of Rubber by Country of Destination (Metrictons)

Year	Japen	China	U.S.A	Malaysia	South Korca	EU	Others	Total
2013	281,091	2,075,776	145,638	421,408	183,466	205,498	352,064	3,664,941
2014	256,578	2,142,199	146,794	406,025	188675	231,053	399,325	3,770,649
2015	220,700	2,136,493	153,790	431,615	156,261	246,505	404,092	3,749,456
2016	216,936	2,260,124	190,463	365,237	143,751	303,692	413,873	3,894,076
2017	218,622	2,789,495	178,304	407,456	118,485	283,139	447,781	4,443,283
2018	214,062	2,736,178	197,672	433,742	118,551	312,949	494,303	4,507,457
2019	201,451	2,305,341	228,462	398,372	106,283	351,854	444,067	4,035,830
2020	151,002	2,349,668	172,950	406,564	89,162	249,207	382,761	3,801,314
2021	205,177	2,213,223	263,275	407,197	131,207	387,257	569,193	4,176,529
2022	228,108	2,400,146	273,303	335,426	213,488	386,763	562,779	4,400,013

Sources: Ministry of Agriculture and cooperatives (2022)

The distribution of rubber products for export to destination countries includes major markets such as China, Malaysia, Japan, US, South Korea, and EU. The means of transport include the following:

1. Rubber goods are transported via sea mostly through Laem Chabang Port (48.24%). The rubber output from farmers include latex, raw rubber sheet, and cup lump or rubber crumb. Small retailers/rubber shops, farmer groups/farmer institutions, cooperatives, farmers, or central markets collect the output and transport it to factories to be used as raw materials in the processing of primary products or semi-finished products such as technically specified rubber, ribbed smoked sheet, concentrated latex, compound rubber, and mixture. The goods will then be transported from factories by land/the coastal port of Surat Thani to Laem Chabang port to destination countries.

2. Land transport via Padang Besar customs checkpoint (25.95%). The goods from factories include technically specified rubber, ribbed smoked sheet, concentrated latex, compound rubber, and mixture. The goods are transported by land via Padang Besar customs checkpoint to Penang port to Singapore port and then exported to destination countries.

3. Land transport via Sadao customs checkpoint (14.40) %. The goods from factories include technically specified rubber, ribbed smoked sheet, concentrated latex, compound rubber, and mixture. The goods are transported by land via Sadao customs checkpoint to Malaysia.

4. Sea transport via Songkhla port (4.64%). The goods from factories include technically specified rubber, ribbed smoked sheet, concentrated latex, compound rubber, and mixture. The goods are transported by land via Songkhla port, to Penang port, Singapore port, and then exported to destination countries.

5. Sea transport via Betong customs checkpoint (0.98%). The goods from factories include technically specified rubber, ribbed smoked sheet, concentrated latex, compound rubber, and mixture. The goods are transported by land via Kantang port, to Penang port, Singapore port, and then exported to destination countries.

6. Sea transport via Phuket port (1.93%). The goods from factories include technically specified rubber, ribbed smoked sheet, concentrated latex, compound rubber, and mixture. The goods are transported via land to Phuket port and then exported to destination countries.

7. Land transport via Chiang Khong/Chiang Saen customs checkpoints (0.01%). The goods from factories include technically specified rubber, ribbed smoked sheet, concentrated latex, compound rubber, and mixture. The goods are transported via land to Chiang Khong/Chiang Saen customs checkpoints, to border checkpoint in Lao PDR, to Sieng Kong Pier (Lao PDR), Sop Loei Pier (Myanmar), and then exported to China (Table 4).

Table 4: Export of NR by Port/Customs Houses (Metrictons)

Year	Bangkok	Songkha	Laemchabang	Padang Besar	Sadao	Betong	Phuket	Chiang Sean	Others	Total
2013	477,906	250,177	896,033	1,117,164	553,031	45,765	43,157	27,634	254,074	3,664,941
2014	507,513	156,121	1,101,050	1,054,480	554,042	45,305	36,973	25,816	289,349	3,770,649
2015	424,619	104,633	1,257,860	1,163,132	490,343	36,365	42,498	15,883	214,121	3,749,456
2016	389,535	105,405	1,390,487	1,288,169	414,825	43,620	46,073	27,375	188,587	3,894,076
2017	234,315	164,988	1,677,325	1,505,797	459,404	56,530	40,017	91,640	213,268	4,443,283
2018	182,076	186,658	1,830,233	1,460,187	538,677	55,008	47,223	53,335	154,060	4,507,457
2019	118,641	184,996	1,682,357	1,256,739	526,061	47,406	66,034	28,746	124,850	4,035,830
2020	146,528	167,177	1,581,200	1,023,418	607,334	50,086	44,591	13,541	167,439	3,801,314
2021	126,021	163,612	1,832,651	1,159,898	656,618	47,906	53,690	4,032	132,101	4,176,529
2022	26,601	204,191	2,122,517	1,141,636	633,534	43,121	84,958	593	142,862	4,400,013

Sources: Ministry of Agriculture and cooperatives (2022)

Conclusion and Recommendations

Conclusion

Rubber is an economic crop which is crucial to the economy of the south and Thailand. It generates revenue into the country and increases farmers' income. The south is situated in a tropical zone which is suitable for rubber cultivation than other regions. Therefore, the south has the most rubber plantation areas or 60.40% of the total rubber plantation areas in the country. The rubber plantation areas of the provinces along the economic corridors constitute 53.72% of the rubber plantation areas nationwide. The three provinces with the highest share of rubber plantation areas include Surat Thani or 407,113 hectares (11.29%), followed by Songkhla or 316,599 hectares (8.47%), and Nakhon Si Thammarat or 240,052 hectares (8.03%), as well as Chumphon or 83,895 hectares (2.32%). They are situated in EC1 with the total area of 30.11%. Moreover, the rubber plantation areas in EC6 constitute 11.22% of the output. Therefore, the appropriate areas for the development of rubber supply chain will be the areas in EC1 and EC6 that collect, process, and distribute rubber products for domestic consumption and export.

Production (Upstream), the south has the most rubber plantation areas or 60.40% of the total rubber plantation areas in the country. The rubber plantation areas of the provinces along the economic corridors constitute 53.72% of the rubber plantation areas nationwide. The three provinces with the highest share of rubber plantation areas include Surat Thani or 407,113 hectares (11.29%), followed by Songkhla or 316,599 hectares (8.47%), and Nakhon Si Thammarat or 240,052 hectares (8.03%), as well as Chumphon or 83,895 hectares (2.32%). They are situated in EC1 with the total area of 30.11%. Moreover, the rubber plantation areas in EC6 constitute 11.22% of the output. Therefore, the appropriate areas for the development of rubber supply chain will be the areas in EC1 and EC6 that collect, process, and distribute rubber products for domestic consumption and export.

Processing (Intermediate), the primary product is tapped rubber (100%) which will be processed into three products namely: 1) Latex (59%) Presently, farmers in the south of Thailand tend to sell latex more for convenience and ability to reduce the risk of price fluctuation. 2) Raw rubber sheet (8%) The rubber sheet as produced by farmers are not smoked or processed by any other means. 3) Cup lump or rubber crumb (33%) The tapped rubber is latex that, when mixed with chemicals, will become coagulated rubber.

Distribution (Downstream), the products from the intermediate industry include 1) Concentrated latex with 78% for export and 22% of final products processed for domestic consumption. They consist of rubber gloves (47%), condoms (7%), and others (46%) 2) Ribbed Smoked sheet with 88% for export and 12% of final products processed for domestic consumption 3) Technically specified rubber with 90% for export and 10% of final products processed for domestic consumption such as rubber tires (91%) and others (9%). The

downstream industry is the industry to process raw materials from the intermediate industry into final products for consumers. The products include pillows, latex mattresses, rubber gloves, condoms, rubber roads, auto tires, motorcycle tires, aircraft tires, rubber bands, conveyor belts, athletic shoes, waterproof strips, and others. In some cases, synthetic rubber (SR), which is developed from the petrochemical sector, is an alternative to natural rubber or to mix with NR in order to enhance qualifications for each function.

Recommendations

Thailand is the world's number one producer and exporter of natural rubber, In addition, Thai government try to promote Southern region to become rubber hub by established rubber city in Songkhla and provide investment previledge for rubber industry; especially, to process rubber into down steam industry.

Thailand, Malaysia and Indonesia can upgrade and integrate the value chain of rubber by focusing on research and development, and use of common innovation between all sectors to create demand of agricultural products in the sub-region from upstream, intermediate, and downstream industries, leading to the long-term value creation and employment generation, benefiting the development of IMT-GT economic corridors. Moreover, Thailand is well developing in upstream rubber production[1]

The EC1, EC5 and new EC6 will cover a wider area of rubber supply chain in IMT-GT Corridors. The new EC6 will be developed to support cross border supply chain, industry, commerce, border trade, and investment along the border in east region of Thailand and Malaysia. Moreover, the new EC6 will connect multi logistics system road, rail, waterway that will support economic and social activities for greater efficiency and improve labor and employment and thus improve incomes for local community. However, there are roads and infrastructure need to be developed.

The EC1 is serving as strategic gateway for rubber transportation and the new EC6 has great potential to become major gateway as well. To utilizing multi modal connectivity on the EC1 and EC6 as a Physical Connectivity Projects (PCPs) covering roads, rails, sea ports, airports, CIQs, SEZs, ICDs and relevant logistics facilities can be recommend as follows:

i) Constructing: 1) the 2nd Bridge across Golok River at Sunggai Golok - Rantau Panjang, 2) Bridge over Golok river at Tak Bai – Pengkalan Kubur and 3) upgrading Thailand-Malaysia Friendship bridge across Golok river at Buketa – Bukit Bunga to facilitate rubber supply chain, trade and other cargos to Kelantan, Kuantan and Penang Ports in Malaysia.

[1] There are midstream Michelin tire factory and world largest rubber glove factory and other rubber processing factories located in Rubber City in Songkhla.

ii) Connecting railway route from Sungai Golok Railway Station to Pasir Mas Railway Station, Kelantan, in Malaysia covers the distance of 20 kilometers (the distance of 2 kilometers in Thailand and 18 kilometers in Malaysia(in order to create alternative rubber product transport route via Kuantan port to China (Kuantan port designate as BRI port connecting to China)

iii) Stimulating the establishment of Narathiwat SEZ in order to promote and attract investors to invest in processed rubber, industries that can improve labor and employment in the EC6 and thus improve incomes.

iv) Connecting New Sadao border crossing with New Padang Besar border crossing in order to increase large scale of passengers and cargos crossing capacity.

v) Utilizing railway transportation at Padang Besar (Thailand and Malaysia) border crossing by establishing large scale of the CCA area to facilitate containers shipment to Penang port.

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