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## Supply Chain Management of Lac Production in Mae Tha District, Lampang Province, Thailand

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Lac is the scarlet resinous secretion of lac insects *Coccus laccae* (*Laccifer lacca* Kerr). It's often found in South and Southeast Asia, especially in Thailand and India. Lac production in Thailand is considered to be of great economic value in the north and northeast Thailand. The objective of this research was to study supply chain management (SCM) of lac production in Mae Tha district, Lampang province, Thailand. A structured interview and in-depth interview were used in data collection from three groups of participants within the supply chain, consisting of farmers, compilers and seedlac manufacturing plants in Lampang province. The results revealed that the main activities of farmers were broodlac procurement, lac infection, taking care and harvesting. The compilers could be categorized into two groups, namely minor and major compilers. Their main activities were sticklac collection and seed lac transportation to manufacturing plants. The minor compilers only purchased and sold stick lac while the major compilers purchased, sold and also dried stick lac before selling them. As for the activities of the seed lac manufacturing plants, they comprised the purchase of products from compilers and farmers for processing and distribution within the country and abroad.

**Keywords:** lac insect, supply chain management, Lampang province

### Introduction

Lac is the scarlet resinous material secreted by the lac insects *Coccus laccae* (*Laccifer lacca* Kerr) belonging to the family Lacciferidae. It is one of the most valuable gifts of Nature to man and only known natural commercial resin of animal origin. The resin so obtained after processing the raw Lac (Sticklac) comprised of a natural raw material with exceptional environmentally recognized as physically safe (Perveen *et al.*, 2013). Shellac

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that is the final product after processing. It consists of resin, wax, and dye, thus has a wide range of application in food, pharmaceuticals, cosmetics, perfumes, varnishes, paints, polishes, adhesive, jewelry and textile dyes, since ancient times (Perveen *et al.*, 2013; Raman, 2014; Shah *et al.*, 2015).

Lac is currently produced in India, Myanmar, Thailand, Malaya, Lao and Yuan province of China. India and Thailand are the main areas in the world (Perveen *et al.*, 2013). The lac insect *C. laccae* (*Laccifer lacca* Kerr) which produces the bulk of commercial lac is often found in South and Southeast Asia, especially in Thailand and India (Chairat *et al.*, 2005; Perveen *et al.*, 2013). It is plant sap feeders, therefore thrive well on certain plant species known as lac hosts. Rain tree (*Samanea saman* (Jacq.) Merr.) is the most common host for lac production in Thailand (Chairat *et al.*, 2005).

Lac production in Thailand is considered to be of great economic value in the north and northeast Thailand accounting for about 75% and 25%, respectively. Lampang province is the main lac growing area and distribution center of the country. This is due to fact that five seed lac manufacturing plants have been established in the area. The total capacities to produce seedlac is contributed to about 90% of the country's total lac production (Lampang Chamber of Commerce, 2013).

Recently, many public and private organizations in Lampang province are paying more interest in developing of lac cultivation. The aims are to generate income for farmers and produce sufficient lac products to meet the need of both domestic and international markets (National Farmers Federation, 2013; Lampang Chamber of Commerce, 2013). However, there is the lack of information and integration research that will reflect the relationship and collaboration from upstream to downstream of the supply chain management of lac production.

The purpose of this research was to explore the supply chain management of lac production in Mae Tha district, Lampang Province, Thailand.

## **Materials and methods**

The research conducted in Mae Tha district, Lampang province, northern Thailand. It is located on latitude 18°8'6"N and longitude 99°30'48"E. It comprises 10 Sub-districts, occupies an area of about 810.54 square kilometers and has a population of 59,645 people in 2014 (Wikipedia, 2015)

A structured interview and in-depth interview were employed to collect data from three groups of participants within the supply chain, including 1) Fourty lac farmers were selected purposive sampling from the farmers who have been cultivated lac as farming and through training on developing and promoting efficiency of lac farming project in fiscal year 20015 of the

Lampang Provincial Agricultural Extension Office (LPAEO) in Mae Tha district, Lampang province. 2) Five compilers that include two minor compilers and three major compilers selected by using a snowball sampling technique. 3) Four seed lac manufacturing plants were interviewed the company owner or manager. For data analysis, descriptive statistics were used, including frequency, percentage, mean, and standard deviation. The data collected from the in-depth interview was used to explore the relationship by content comparison technique as suggested by Chantawanich (1999). The results will be presented by providing a description and explanation.

## **Results and Discussions**

### ***Socio-demographic background of respondents***

#### **Farmer's characteristics**

The majority of respondents were male (80%) with the age between 56 – 70 years old (70%), indicating that interviewed farmers was economically active. Half of them completed elementary school (52.50%) with the average experience in lac farming about 31.02 years. The yield of lac farming was approximately 272.49 kilograms per household (using broodlac about 46.82 kilograms per household, which 1 kilogram of broodlac can produce sticklac about 5.82 kilograms). The yield is quite low compared with reported of Sumpawloy (2015). The average selling price was 59.28 baht per kilograms. Therefore, the farmers were generating income approximately 16,153.21 baht per household per year as shown in Table 1. However, the lac price was received by lac farmer wide fluctuation from place to place, year to year are the major hindrance for sustained lac production in this area.

**Table 1** Farmers characteristics.

Characteristics	Number (N=40)	Percentage
<b>Gender</b>		
Male	32	80.00
Female	8	20.00
<b>Age</b>		
Less than or equal to 40 years	1	2.50
41-55 years	8	20.00
56-70 years	28	70.00
More than 70 years	3	7.50
<b>Education</b>		
Elementary school	21	52.50
Junior high school	4	10.00
Senior high school	13	32.50
Technical college	2	5.00
	Average	S.D.
Experienced in culturing lac (year)	31.02	±12.76
Broodlac (kg/household/year)	46.82	±25.13
Yield approximately (kg/brood lac 1 kg/year)	5.82	±2.46
Price of product (stick lac) (baht/kg)	59.28	±3.68

**Compilers characteristics**

There were 5 compilers, all of them were male (100%) with the age between 51- 60 years old (80%), graduated from elementary school and senior high school in the same proportion which was 40%. The average experience in purchasing and collecting lac products was 21.60 years. The compilers can be categorized into 2 groups includes minor compilers and major compilers. 1) Minor compilers were only purchased and sell sticklac. The average sticklac that they purchased were 1,750 kilograms/person/year. The selling price was about 58.50 baht/kilograms. Therefore, the minor compilers were earned income about 102,375 baht/capita/year. 2) Major compilers were mainly

purchased sticklac and sell it or dry it before selling to seedlac manufacturing plants. The average sticklac that collected about 531,666.67 kilograms/capita/year and dry lac was about 11,166.67 kilograms/capita/year (1 kilograms of sticklac can be changed to dry lac about 0.75 kilograms). The selling price of sticklac was about 59.33 baht/kilograms, whereas the selling price of dry lac was about 80.67 baht/kilogram. Therefore, the major compilers were earned income about 32.45 million baht/capita/year (Table 2).

**Table 2** Compilers characteristics.

Characteristics	Number(N=5)	Percentage
Gender		
Male	5	100.00
Age		
Less than or equal to 50 years	1	20.00
51-60 years	4	80.00
Education		
Elementary school	2	40.00
Senior high school	2	40.00
Bachelor's degree	1	20.00
	Average	S.D.
Experienced (year)	21.60	±13.52
Minor compiler		
Sticklac (kg/year)	1,750.00	±353.55
Selling price of stick lac (baht/kg)	58.50	±0.71
Major compiler		
Sticklac (kg/year)	531,666.67	±278,851.81
Dry lac (kg/stick lac 1 kg/year)	0.75	±0.05
Total dry lac (kg/year)	11,166.67	±3,329.16
Selling price of sticklac (baht/kg)	59.33	±0.58
Selling price of dry lac (baht/kg)	80.67	±4.04

### Seedlac manufacturing plants characteristics

There were 4 seed lac manufacturing plants. The majority of them were male (75%) with the age between 50-69 years old (75%), half of them graduated bachelor's degree (50%), business types of them were a company limited (75%), having experiences in purchasing lac of about 43.25 years. The average purchasing price of sticklac and dry lac were 60.38 and 81.25 baht/kilogram, respectively. The average sticklac and dry lac that they purchased were 2,150,000 and 54,750 kg/capita/year, respectively. One kg of stick lac and dry lac could produce seed lac an average of 0.51 kg and 0.70 kg,

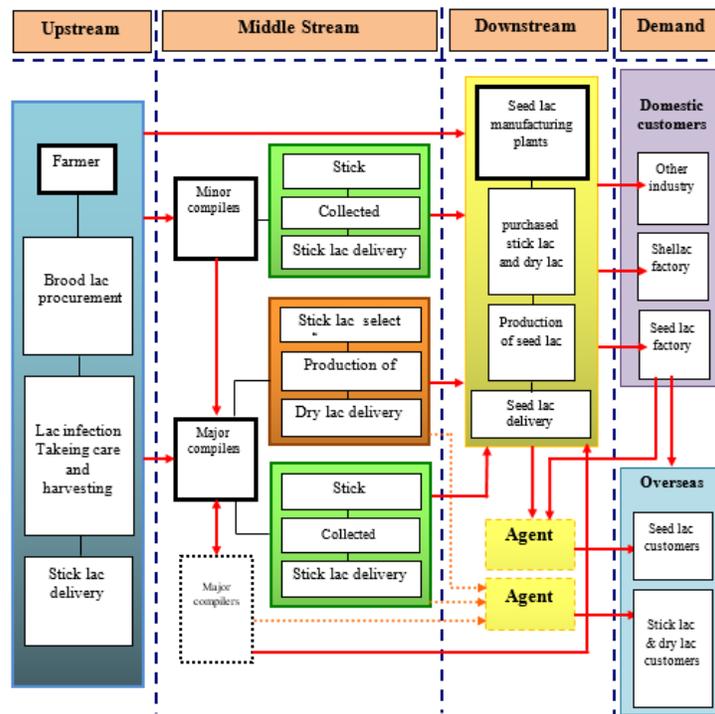
respectively. While domestic and export selling price of seed lac were 219.00 and 239 baht/kg, respectively (Table 3). In addition, the results of the study found that the seed lac production was 1,134, 825 kilograms per/capita/year and distribute to domestic and export market accounting for 23.75% and 76.25 %, respectively. Therefore, seed lac manufacturing plants can generate income approximately 265.83 million baht/capita/year.

**Table 3** Seedlac manufacturing plants characteristics

Characteristics (n=4)	Number	Percentage
<b>Gender</b>		
Male	3	75.00
Female	1	25.00
<b>Age</b>		
Less than or equal to 49 years	1	25.00
50-69 years	3	75.00
<b>Education</b>		
Technical college	1	25.00
Bachelor's degree	2	50.00
Master's degree	1	25.00
<b>Business type</b>		
A Company Limited	3	75.00
Partnership Limited	1	25.00
	<b>Average</b>	<b>S.D.</b>
Factory area (rai)	20.67	±21.08
Experienced (year)	43.25	±12.69
Purchase price of sticklac (baht/kg)	60.38	±0.48
Purchase price of dry lac (baht /kg)	81.25	±1.50
<b>Lac production</b>		
Sticklac (kg/year)	2,150,000.00	±1,206,924.47
Dry lac (kg/year)	54,750.00	±32,673.89
Seed lac yield (kg/sticklac1 kg/year)	0.51	±0.1
Seed lac yield (kg/dry lac1 kg/year)	0.70	±0.00
Domestic selling price of seedlac (baht/kg)	219.00	±4.54
Export selling price of seedlac (baht/kg)	239.00	±4.54

**Supply chain management (SCM) of lac production**

The SCM of lac production in Mae Tha district, Lampang province, Thailand can be categorized into 3 parts, including the upstream such as farmers, which the main activities were broodlac procurement, lac infection, taking care and harvesting. While the middle stream, such as the compilers could be categorized into two groups, namely minor and major compilers. Their main activities were sticklac collection and transportation to manufacturing plants. The minor compilers only purchased and sold sticklac whereas the major compilers purchased, sold and also dried stick lac before selling them. As for the downstream consists of seed lac manufacturing plants, their main activities were purchased sticklac products from farmers and compilers, then transform them into seedlac and sell in domestically or internationally as presented in Figure 1.



**Figure 1** SCM of lac production in Mae Tha district, Lampang province, Thailand

**Gross margin and value added of lac production in SCM**

The analysis to find the difference in price and gross margin in SCM of lac production from upstream to downstream involve 3 main players, including

farmers, compilers, and seedlac manufacturing plants detail as shown in Table 4.

1. Lac farmers are the one who brought sticklac and selling them to compilers or selling some proportion directly to the seedlac manufacturing plants. Gross Margin from selling sticklac can be calculated by minus the selling price with the cost. It was found that the selling price of sticklac was about 57.82 baht per kilograms. Whereas, the cost was 42.87 baht per kilograms. Thus, the net profit that the farmers would receive was 19.06 baht per kilograms. The farmers can produce sticklac 272.49 kilograms/ household/year. Therefore, they could earn profit about 5,193.66 baht/household/year.

2. Compilers categorized into two main groups as follows:

2.1 Minor compilers, purchase sticklac from farmers in their communities or other neighboring communities. They collected them together and pass it to major compilers or seedlac manufacturing plants. The selling price of sticklac was about 58.50 baht per kilograms; whereas, the cost was 56.24 baht per kilograms. Therefore, net profit that minor compilers would gained was 1.96 baht per kilograms.

2.2 Major compilers, purchase sticklac from farmers in Lampang province and from minor compilers within and out of the province. They collected them together and pass it to seedlac manufacturing plants in Lampang province who sell both sticklac and dry lac.

2.2.1 For sticklac, the selling price was about 59.33 baht per kilograms; whereas, the cost was 55.83 baht per kilograms. Therefore, the net profit that major compilers would earn from the sales of sticklac was 2.86 baht per kilograms.

2.2.2 For dry lac, the selling price was about 80.67 baht per kilograms; whereas, the cost was 74.66 baht per kilograms. Therefore, the net profit that major compilers would earn from the sales of dry lac was 5.15 baht per kilograms.

3. Seedlac manufacturing plants, there were two types of lac purchasing include 1) sticklac - it was contributed to be 97% of all lac production. The selling price was 60.38 baht per kilograms. Whereas, 1 kilogram of sticklac can be transformed to seedlac with the quantity of 0.51 kilograms. 2) Dry lac - it was contributed to be 3% of all lac production. The selling price was 81.25 baht per kilograms. Whereas, 1 kilogram of dry lac can be transformed to seedlac with the quantity of 0.7 kilograms. Those seedlac will be sold domestically and export to other countries. The selling price in the domestic market was 219 baht per kilograms; whereas, the cost was 124.88 baht per kilograms. Therefore, the net profit that would be received from the sales was 94.88 baht per kilograms. However, for the exportation, the selling

price was about 239 baht per kilograms; whereas, the cost was 132.12 baht per kilograms. Therefore, the net profit that would receive from the sales was 106.88 baht per kilograms.

**Table 4** Gross margin and value added of lac production in SCM.

Items	Farmers	Compilers		Seedlac manufacturing plants	
		Minor	Major	Domestic	Export
<b>Farmers</b>					
Broodlac cost	8.38 (±5.58)	-	-	-	-
Tool+lac infection+Harvesting	20.39 (±13.76)	-	-	-	-
Peel+maintenance+Transportation	11.45 (±4.71)	-	-	-	-
Total cost	40.22 (±25.07)	-	-	-	-
Selling price	59.28 (±3.68)	-	-	-	-
Value added	19.06 (±18.75)	-	-	-	-
<b>Sticklac collection</b>					
Lac cost	-	54.50 (±0.71)	55.83 (±1.44)	-	-
Tool+Labor+Transport cost	-	3.01 (±0.84)	0.64 (±0.39)	-	-
Total cost	-	57.51 (±1.55)	56.47 (±1.83)	-	-
Selling price	-	58.50 (±0.71)	59.33 (±0.58)	-	-
Value added	-	0.99 (±0.84)	2.86 (±2.11)	-	-
<b>Dry lac collection</b>					
Lac cost	-	-	74.66 (±5.21)	-	-
Tool+Labor+Transportation cost	-	-	0.86 (±0.55)	-	-
Total cost	-	-	75.52 (±5.76)	-	-
Selling price	-	-	80.67 (±4.04)	-	-
Value added	-	-	5.15 (±2.91)	-	-
<b>Seedlac manufacturing plants</b>					
Material cost	-	-	-	119.57 (±2.49)	119.57 (±2.49)
Tool cost	-	-	-	0.37(±0.01)	0.37(±0.01)
Labor+Transportation cost	-	-	-	3.02 (±1.03)	11.02 (±1.03)
Utility cost (electricity, water, etc.)	-	-	-	1.16 (±1.56)	1.16 (±1.56)
Total cost	-	-	-	124.12 (±5.09)	132.12 (±5.09)
Selling price	-	-	-	219.00 (±4.54)	239.00 (±4.54)
Value added	-	-	-	94.88 (±2.42)	106.88 (±2.42)

## Conclusion

The results revealed that the supply chain management of lac production in Mae Tha district, Lampang province, Thailand can be categorized into 3 parts, including the upstream, such as farmers, the main activities were broodlac procurement, lac infection, taking care and harvesting. The middle stream, the compilers could be categorized into two groups, namely minor and major compilers. Their main activities were sticklac collection and transportation to manufacturing plants. The minor compilers only purchased and sold sticklac while the major compilers purchased, sold and also dried sticklac before selling them. As for the downstream, it consists of the seedlac manufacturing plant, they comprised the purchase of products from compilers and farmers, then transform them into seedlac and sell domestically and internationally. In addition, the average annual income of lac farming is about 16,153.21 baht per household. As for the compilers, the minor and the major compilers were earned income about 102,375 and 32.45 million baht per capita per year, respectively. Whereas the seedlac manufacturing plants can generate income approximately 265.83 million baht/capita/year accounting for domestic and international market were 23.75% and 76.25 % respectively. However, the wide fluctuation in lac price year to year by lac farmers are the major hindrance for lac production in the area. Thus, the modern technology of lac cultivation to increase productivity and support price to enhance income of lac farmer, thereby helping them will be sustained lac cultivation and also provided training to utilize the unexploited host tree under lac cultivation.

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