COMPARATIVE STUDY OF COSTS AND BENEFITS ON PRODUCT TYPES OF RUBBER FIRMS IN MUDON TOWNSHIP

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COMPARATIVE STUDY OF COSTS AND BENEFITS ON PRODUCT TYPES OF RUBBER FIRMS IN MUDON TOWNSHIP

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A thesis submitted to the postgraduate committee of the Yezin Agricultural University as a partial fulfillment of the Requirements for the degree of Master of Agricultural Science (Agricultural Economics)

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The thesis attached here to, entitled **"Comparative Study of Costs and Benefits on Product Types of Rubber Firms in Mudon Township"** was prepared under the direction of the chairperson of the candidate supervisory committee and has been approved by all members of that committee and the board of examiners as a partial fulfillment of the requirements for the degree of **Master of Agricultural Science (Agricultural Economics)**.

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This thesis represents the original work of the author, except where otherwise stated. It has not been submitted previously for a degree at any other university.

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DEDICATED TO MY BELOVED PARENTS,

U THEIN AND DAW KHIN SAN SWE

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ABSTRACT

Due to high price fluctuation of rubber products, producers (farmers) were complicated for decision making in producing which product types. Therefore, this study was attempted to compare costs and benefits of rubber firms based on types of products in Mudon Township, Mon State. Sampled rubber producers were 36, 46 and 47 samples of field latex (FL), un smoked sheet 2 (USS 2) and un smoked sheet 1 (USS 1) rubber products farmers using post stratified sampling method. Analysis of descriptive on socio-economic characteristics of rubber producers, comparing costs and returns for three types of rubber products on one-year rubber producing activities and identifying determinant factors on profit per unit product of rubber firms were conducted. The results showed average age, schooling years and working experience of producers were 52, 26 and 5 years respectively. The average family members worked in their fields was 2. Regarding costs and returns analysis, benefit-cost ratios were 1.89, 2.22 and 2.02 in FL, USS 2 and USS 1 products respectively. In the light of regression analysis, firms were producing either USS 2 or USS 1 products, daily rubber yield and annual tapping days were positively and significantly related to profit per unit product at 1% level. The net profit per unit product of rubber firms was negatively and significantly related to tapping age, material and hired labour costs at 1% level. USS 2 product firms got the better profit than both USS 1 and FL products firms. It can also be said that producing in FL product firms would the less profit.

All of three different products firms could earn more profit over their total variable costs, some of firms still needed to choose proper product types which give most profit based on price differential between products and also to promote rubber yield and quality to sustain rubber income. In this regard, government should consider to upgrade the current rubber processing firms especially up to the farmers level by; disseminating of market information service for decision making in proper product type producing, using education and extension trainings through GAP production practices as well as processing technologies with systematic usage of formic acid. To achieve international rubber standard and market price, it is needed to focus on quality-oriented production. Thus, government intervention should be more actively involved in rubber market system especially for controlling on trading of low-quality rubber products by defining product grade with reasonable price.

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LIST OF ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations
BCR	Benefit-cost ratio
BLUE	Best linear unbiased estimate
BPM 24	Bank Pertanian Malaysia's rubber clone number 24
CL	Cup lump
DALMS	Department of Agriculture Land Management and Statistics
DMH	Department of Meteorology and Hydrology
DOA	Department of Agriculture
DOP	Department of Population
DRC	Dry rubber content
DTPCA	Department of Trade Promotion and Consumer Affairs
FL	Field latex
GT-1	Godng Tapen Indonesia’s rbber clone number 1
ha	Hectare
HLC	Hired labour cost
kg	Kilogram
km	Kilometer
MMK	Myanmar Kyat
MOALI	Ministry of Agriculture, Livestock and Irrigation
MOC	Ministry of Commerce
MSR	Myanmar specified rubber
MT	Metric ton
No.	Number
PB 235	Prang Besar Malaysia's rubber clone number 235
PB 600	Prang Besar Malaysia's rubber clone number 600
RAVC	Return above variable cost
RAVCC	Return above variable cash cost
RRIM 2000	Rubber Research Institute of Malaysia’s 2000 clone series
RSS	Ribbed smoked sheet
TMC	Total material costs
TR	Total revenue
TS	Thick slab

TSR	Technically specified rubber
TVC	Total variable cost
TVCC	Total variable cash cost
USD	United States of America's Dollar
USS	Un smoked sheet
VIF	Variance inflation factor

CHAPTER I
INTRODUCTION

1.1 Background Information

Natural rubber (*Hevea brasiliensis*) is a tree native to the tropical rain forests of Amazon and it was introduced on a commercial scale to the Far East during the last century (Anuja, 2012). Rubber trees can produce rubber latex by a process called tapping. Rubber latex is converted to a storable and marketable form by sheeting and shaping. It provides the principal raw material required for manufacturing in a wide variety of rubber products such as toys, balloons, tyre and medical instruments, etc. The market demand of natural rubber is increasing over the world and it leads an area expansion and increasing in production.

Rubber has been traditionally cropped in the equatorial zone between 10˚ North and 10˚ South latitudes in mainland Southeast Asia including the portion of Southern Thailand, South-eastern Vietnam and Southern Myanmar but more recently rubber plantations have been expanded non-traditional growing areas of China, Laos, Northeast Thailand, Vietnam, Cambodia and Northeast Myanmar (Fox & Castella, 2013). As most of Association of Southeast Asian Nations (ASEAN) countries are developing countries, natural rubber industry has been playing a major role in socio-economic fabric of the countries by providing many job opportunities and the major income source for millions of farmers (Zaw & Myint, 2016).

Myanmar is one of the largest natural rubber producing countries and has so many potentials for rubber cultivation such as favorable climate, availability of land and labour, etc. Rubber has been cultivated in Myanmar since the British colonial period in the early 20th century mostly in Mon State (Keong, 1973). In the early period, rubber was planted only in the Southern Myanmar contributing Mon and Kayin States and Tanintharyi Region. Over the past two decades, the plantation of rubber trees has expanded to non-traditional rubber growing areas contributing Shan, Kachin and Rakhine States as well as Bago, Ayeyawady, Yangon and Sagaing Regions. Consequently, Myanmar played the 6th largest place of the world natural rubber exporting countries and more than 90% of rubber produce was exported to other countries accounted USD 260 million, 2% of the world natural rubber export in 2018 (Garside 1 & 2, 2019, June 6).

Rubber area expansion in Myanmar was increased as a result of the government push to intensify and modernize agriculture through cash crop production, to alleviate poverty and encourage rural economic development. After adopting market-oriented economic policy, rubber industry has gradually developed by entering of new growers especially 90% of smallholders (Zaw & Myint, 2016). Consequently, rubber sown and harvested (tapping) areas and production were increased from 226,139 hectares, 108,170 hectares and 64,238 metric tons in 2006 to 657,190 hectares, 311,476 hectares and 238,030 metric tons in 2018 presented in Figure 1.1 (Department of Agriculture [DOA], 2018). Rubber yield was increased from 594 kg per hectare in 2006 to 777 kg per hectare in 2018 as shown in Figure 1.2 (DOA, 2018).

1.2 Types of Rubber Products Producing and Processing in Myanmar

Rubber product types mainly produced for exporting in Myanmar were ribbed smoked sheets (RSS) and technically specified rubber (TSR) or block rubber or Myanmar specified rubber (MSR) in Appendix 1. At farm gate level, rubber firms mainly produced primary types of rubber products were field latex (FL), un smoked sheet 2 (USS 2), un smoked sheet 1 (USS 1), high quality cup lump (CL) or cup coagulum and thick slabs (TS) in Appendix 2. Those primary types of rubber products were transformed into RSS by smoking of USS 1 and USS 2 products made from FL and transformed into TSR by crushing and blocking a mixture of high quality CL, TS, USS 2 products made from FL and tree lace and low quality CL (by products in tapping process) as shown in Figure 1.3 (Zaw, 2017). Smoke house possessing rubber processors buy FL, USS 1 and USS 2 sheets and then transform into RSS as like as smoke house possessing farmers who transformed RSS sheets. It is important to obtain the clean and uniform sheets in the production of high grade of RSS. In this rubber production process, FL farmers have to deliver FL to RSS processing factories. This would be a burden for farmers to deliver their latex to distant factories every day. RSS production was costlier than TSR as it required more labour in USS sheet making and quality checking for each production process to make pure rubber dry sheets. However, manual labour requirements at sheet making and quality checking led RSS to higher quality than TSR by reducing impurities at each production process (Yamamoto, 2016). TSR, a more recent mechanized technology and its processing steps involved dewatering, dirt removal, re-drying, crushing, blending and blocking. Farmers could sell USS 2 sheets, TS with slightly poor quality, low and high qualities CL for TSR factories. TSR blocks could save costs through labour saving mechanized technologies but it had still higher level of impurities (Yamamoto, 2016). Local collectors and traders were more preferable to collect poor quality USS 2 and TS as much lower price for TSR factories than quality USS 1. This might be a limitation to produce high quality products by rubber farmers and most of rubber firms could not get the premium price for their quality products.

1.3 Rubber Export from Myanmar

China, Malaysia, Singapore, Thailand and Japan were the major rubber importing countries from Myanmar in 2017 as presented in Table 1.1 (Department of Trade Promotion and Consumer Affairs. [DTPCA], 2017). Among them, China, the world biggest rubber consumer was the largest rubber imported country from Myanmar which contributed to 64.03% of Myanmar's total rubber export while 17.93% and 7.92% were exported to Malaysia and Singapore respectively in 2017.

Figure 1.4 presented yearly exported rubber in Myanmar from 2009 to 2017 (DTPCA, 2017). In 2017, the amount of total rubber export was 138,473 metric tons and its value was USD 197.89 million. Although total rubber exported volume in 2017 was higher than that of 2012, total exported value in 2017 was lesser than that of 2012. It was due to the world rubber price plunged down after 2012. In comparing the years 2012 and 2014, the total export volumes were 78,750 and 77,518 metric tons respectively. The price was decreased from USD 3,950 per metric ton in 2012 to USD 1,441 per metric ton in 2014. Consequently, total export value was decreased from USD 311.06 million in 2012 to USD 111.73 million in 2014. In 2015, Myanmar exported RSS and TSR to other countries by normal trading (overseas) and border trading presented in Appendix 3 (DTPCA, 2015).

1.4 Rubber Production in Mon State

In Myanmar, Mon, Kayin, Shan States and Tanintharyi and Bago Regions were the main rubber producing areas. Due to the favourable environment for rubber plantation, Mon State had the largest rubber sown and harvested areas and production in 2018 presented in Figure 1.5 (DOA, 2018). Thus, the current rubber plantation has been increasing in terms of acreage and economic contribution to this State. Rubber sown and harvested areas and production in Mon State were 200,340 hectares, 131,972 hectares and 108,352 metric tons respectively in 2018 presented in Table 1.2 (DOA, 2018).

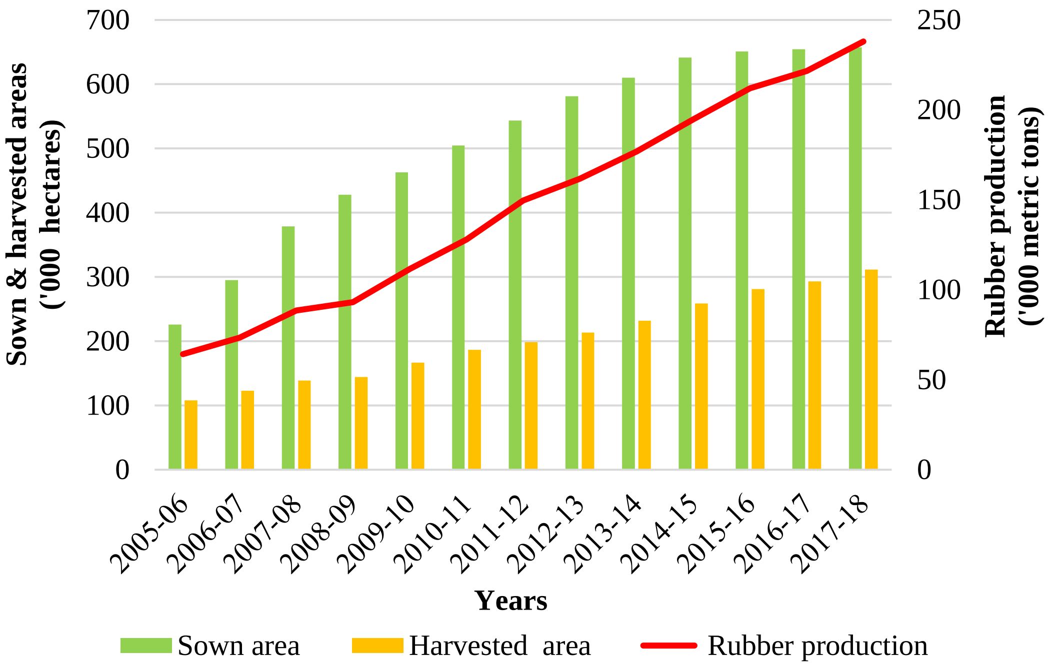

Figure 1.1 Trends of rubber sown, harvested (tapping) and production in Myanmar (2006-2018)

Source: DOA (2018)

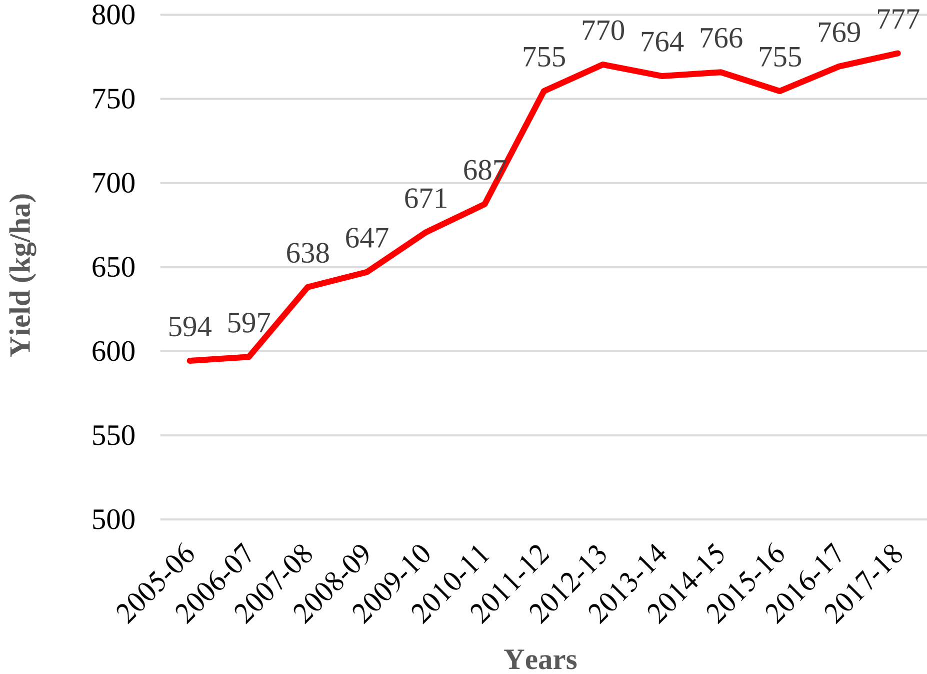

Figure 1.2 Trend of national average yield in Myanmar (2006-2018)

Source: DOA (2018)

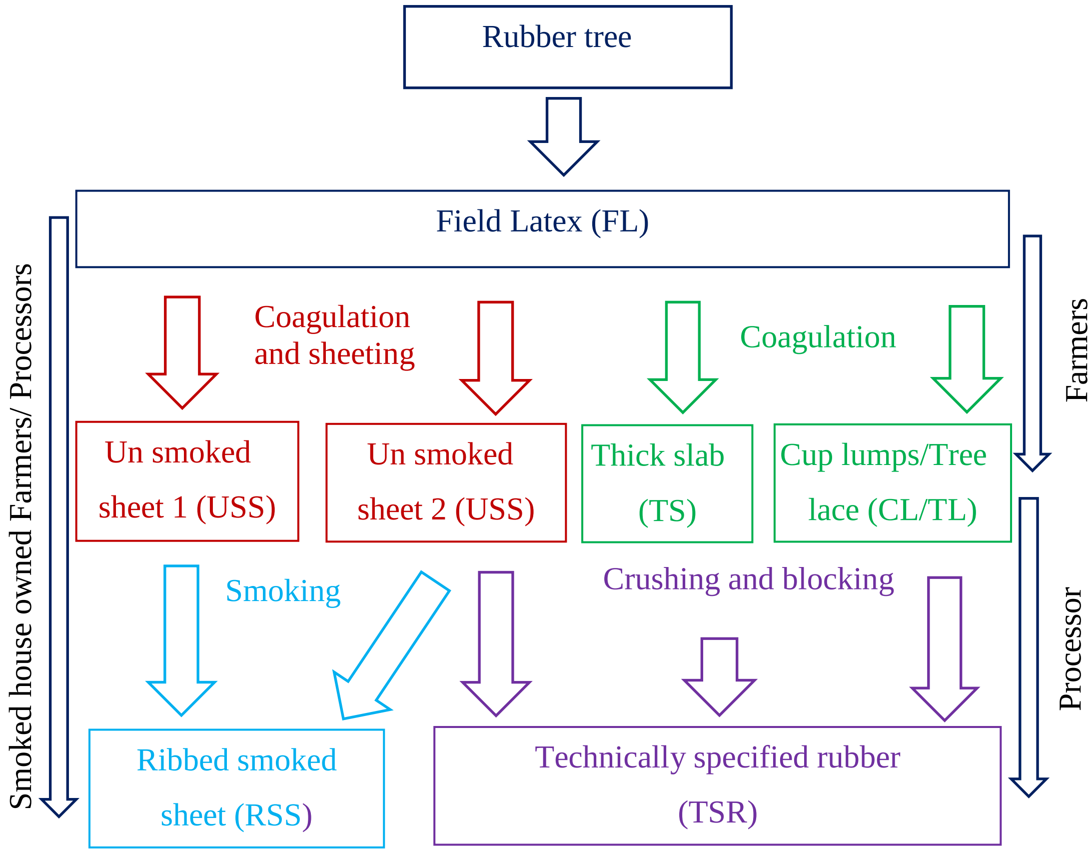

Figure 1.3 Types of rubber products producing in Myanmar

Source: Zaw (2017)

Table 1.1 Myanmar's rubber exported volume by imported countries (2017)

Exported countries	Exported volume (MT)	Exported percentage (%)
China	88,660	64.03
Malaysia	24,835	17.93
Singapore	10,970	7.92
Thailand	5,602	4.05
Japan	5,168	3.73
Korea	1,832	1.32
India	699	0.50
Australia	446	0.32
Vietnam	120	0.09
Indonesia	81	0.06
Pakistan	60	0.04
Total	**138,473**	**100**

Source: DTPCA (2017)

Table 1.2 Rubber sown, harvested and production in Mon State (2018)

District/Township	Sown area (ha)	Harvested area (ha)	Yield (kg/ha)	Production (MT)
Mawlamyine	901	687	813	550
Chaungzone	2,399	2,020	830	1,648
Kyaikmaraw	33,417	19,314	896	17,020
Mudon	24,304	16,189	841	13,391
Thanbyuzayat	26,322	20,597	830	16,810
Ye	61,484	46,578	854	39,116
Mawlamyine District	**148,827**	**105,386**	**854**	**88,535**
Kyaikto	14,802	5,696	735	4,114
Bilin	9,968	7,357	698	5,049
Thaton	18,940	9,887	810	7,877
Paung	7,802	3,647	774	2,777
Thaton District	**51,513**	**26,586**	**758**	**19,817**
Mon State	**200,340**	**131,972**	**835**	**108,352**

Source: DOA (2018)

In Mon State, there were two Disticts, Mawlamyine and Thaton Districts. In Mawlamyine District, Ye, Kyeikmayaw, Mudon and Thanphuzayet Townships were the main rubber producing areas. Among them, Mudon Township was selected as the study area because of rubber marketing in Myanmar was centered in this township and the business provided employment opportunity not only for local people living but also for other rural community's socio-economic development. In the study area, rubber sown and harvested areas and production were 24,304 hectares, 16,189 hectares and 13,391 metric tons respectively in 2018.

1.5 Rationale and Justification

Myanmar mainly exported RSS 1, RSS 3, RSS 5 and MSR 20 to other Asian countries. Currently the main rubber buyer, China imported all grades of blocks and sheets of rubber products from Myanmar. Consequently, collectors and traders bought all grades of rubber from farmers which resulted in poor quality of rubber products compared to other rubber producing countries. A large proportion of low quality products had been exported from Myanmar indicated that Myanmar rubber was becoming less competitive to global international market.

Moreover, rubber production in Myanmar had only a little effect on the country's rubber prices, processing factories set rubber prices based on international market prices and demand (Van Asselt, Htoo and Dorosh, 2017). Additionally, rubber farmers had a low bargaining power compared to the buyers who controllable prices of rubber products. These conditions led inferior price in domestic market and price differentials between different types of rubber products were highly volatile and rubber firms mainly depended on raw materials requirements of domestic processing factories.

In this situation, the international rubber price had plunged down during the last eight year, precisely since 2012. Figures 1.1 and 1.4 showing that the trends of rubber production and the volumes of rubber export increased gradually, the values of rubber export and prices were decreased in Myanmar after 2012. Consequently, rubber firm incomes reduced in the recent years. Thus, inferior price in local market and low farm income were main challenges for rubber firms to survive sustainably in the rubber industry.

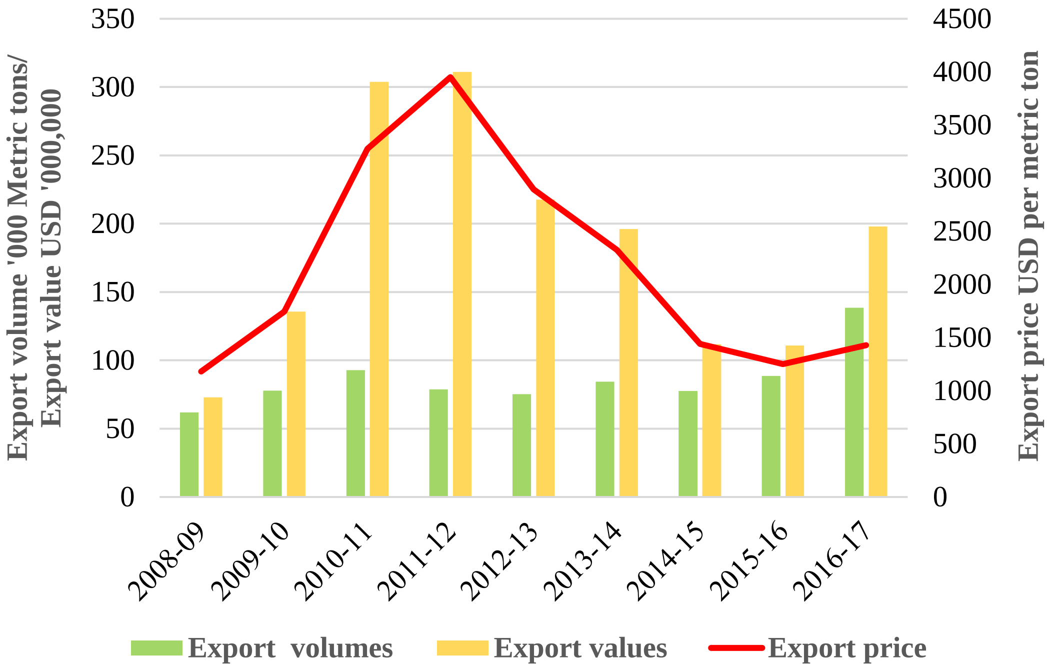

Figure 1.4 Trend of rubber export in Myanmar (2009-2017)

Source: DTPCA (2017)

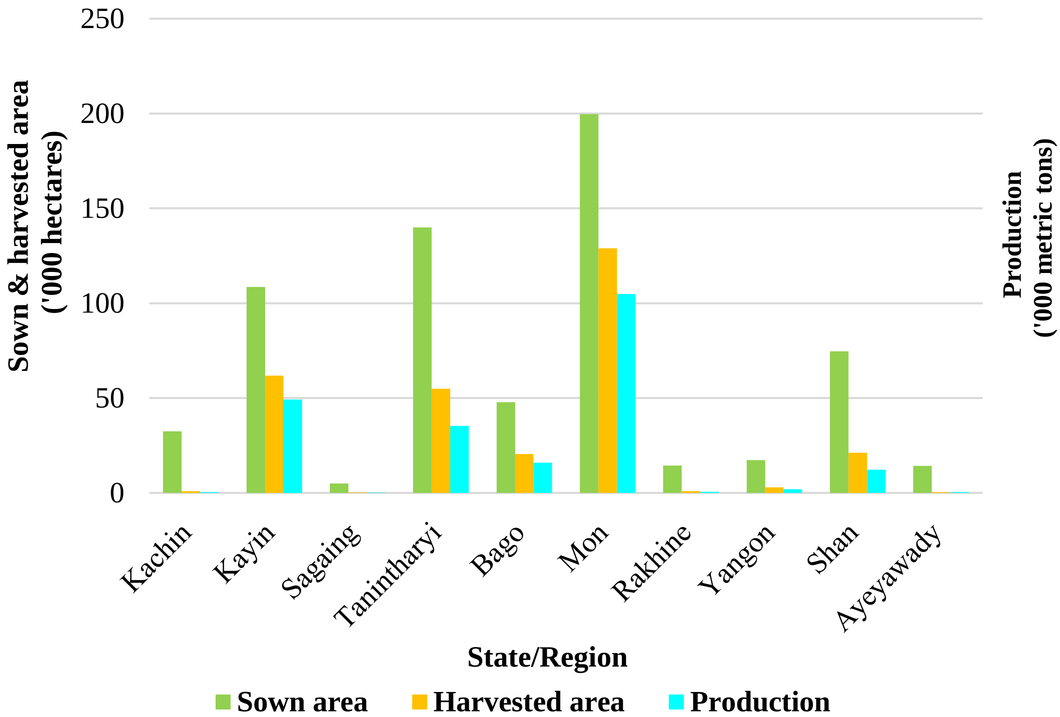

Figure 1.5 Rubber sown, harvested and production by States and Regions in Myanmar (2018)

Source: DOA (2018)

Still, rubber played the major income source and it provided employment opportunities for rubber producing households in Mon State. Because, most of rubber firms produced their products mainly rely on family members so as to increase their firm income by receiving family labour opportunity. Thus, rubber has been important to improve livelihood and to create job opportunities of rural people in Mon State. However, currently rubber production and marketing activities were highlighted with a low efficiency in production, processing and marketing. Even though, there was little information on rubber production, processing and marketing as the location of plantation and production are in the remote area. In these situations, cost and return analysis on different rubber product types was important for rubber firms how to allocate efficiently their resources to maximize profit. In this regard, this research was carried out to examine current conditions of costs and benefits on three product types (FL, USS 2 and USS 1) of rubber firms in Mudon Township.

1.6 Objectives

The objectives of this study were:

1. To describe socio-economic characteristics of sample rubber producers in the study area
2. To compare costs and benefits of three product types (FL, USS 2 and USS 1) of rubber firms in the study area
3. To identify determinant factors on profit of rubber firms in the study area

1.7 Hypotheses of the Study

Based on the objectives of the study, the following hypotheses were formulated:

1. Rubber firms can profit over total variable costs of rubber production in the study area
2. Firm profits of rubber products are different among three types of rubber products (FL, USS 2 and USS 1)
3. Some variables of rubber firms and different types of products critically influence on the profit of rubber firm; these variables assume that farmers' working experience (years), farmers' education (schooling year), tapping ages (years), tapping days (day/year), daily yield (kg/ha/day), distance between farm and home (km), average material costs (MMK/kg), average hired labour costs (MMK/kg), Dummy 1 (1 = USS 2, otherwise = 0) and Dummy 2 (1 = USS 1, otherwise = 0)

CHAPTER II
LITERATURE REVIEW

This chapter reviews some literatures dealing with costs and benefits associated with rubber production and processing. An attempt was made to conduct the research method dealing with profit margin of three different product types of rubber firms and determinants on rubber profit.

2.1 Concept of Profitability and Profit Margin

Jaggi & Considine (1990) stated that profitability is a crucial indicator for determining the financial position of the firm. The firm is considered financially weak when its profitability is sliding or the profitability is weak compared to other firms in the industry. Profitability consists of two words, profit and ability. It is the profit earning capacity and also considered to be the main factor influencing reputation and survival of firms. It can be measured as profit shown as percentage of sales known as profit margin (Bailo, 2009). In an agricultural project analysis, profitability is expressed as an index which characterizes the performance of the project over its whole life, not just one year at a time (Brown, 1980).

In a profit margin of a firm, revenue or benefit and costs were considered as important parameters as gross margin is obtained by subtracting cost from revenue. Determining the average profit margin of a small business depends on many factors including type of firm, the amount of labour and capital requirement, the location of firm, how efficiently new technology is employed and inventory and cost management systems (Bailo, 2009).

2.2 Concept of Gross Margin or Enterprise Budget Analysis

Economic analysis should serve the following purposes; (1) determine amount of benefits and costs (2) determine feasible projects and (3) array the various projects in the order of their relative efficiency in the use of economic resources (Panyadhibya, 1958). In literatures, benefit-cost analysis is one way to evaluate resource developments. However, it is not always the basic method used for approval or disapproval.

The evaluation and focus on the economic and technical performance of an individual farm enterprise is called an enterprise budget which is used to examine the profitability of specific farm enterprise and to compare the profitability of existing and proposed enterprises. Greaser & Harper (1994) stated that enterprise budget represents estimates of receipts (income), costs, and profits associated with the production of agricultural products. An enterprise budget analysis is constructed on a unit basis such as per hectare or per head to facilitate comparisons among alternative enterprises (Riggs, Curtis & Harris, 2005). Enterprise budget enables to evaluate the differences in net benefits under several resources situations is such a way as to help one make management decision (Olson, 2003).

Afeworki, Polasub, Chiu & Mullinix (2015) stated that an enterprise budget projects the costs and returns of growing and selling a particular crop or livestock over a period of time. It is manually used to study the performance of an enterprise that is the productive components of a firm to obtain information about the business strength or weakness (Bucket, 1988). It can help individual producer determines the most profitable crops to grow, develop marketing strategies and obtain financing necessary to implement production plants as well as make other farm business decisions (Olson, 2003).

In an enterprise budget analysis, the evaluation of benefits and costs having market value can be made through the benefit-cost ratio. A project having a benefit-cost ratio of 1 to 1, or greater than 1, may be considered as economically feasible. Riggs et al. (2005) stated that break-even analysis can be conducted in utilizing of enterprise budgets. The goal of calculating a break-even price is to find out at what price of a product would have to be sold for in the market place in order to pay for its production. In economics, break-even analysis can be performed at various levels. It is a break-even may be calculated to cover the total variable cost or the total cost. When evaluating a business survivability in the short-run, it will look at only variable costs. In this case, break-even price can be calculated by dividing total variable cost by the expected yield and break-even yield can be estimated by dividing total variable cost by expected price. In considering financial feasibility, returns or receipts might be received from the sale of products and all costs including the initial investment in land, labour, materials and subsequent costs for replacement and maintenance must be accurately estimate (Panyadhibya, 1958). In a budget analysis, profit is not the same as the net cash receipts as non-cash items may be included in the revenues of costs (Doll & Orazem, 1984). Revenue is calculated by taking cash receipts arising during the period, excluding any capital receipts and including changes in the valuation of stock output item, benefits in kind and adjustment for opening and closing debtors.

Total revenue depends on the quantity of production and the given price. Expense or cost is calculated taking cash payments, excluding any capital payments, personal drawings or tax payment and including changes in the valuation of stocks of purchasing inputs, benefits in kind, adjustments for opening and closing credits, and depreciation of wasting possession such as buildings and machinery (Warren, 1998).

Input and its price are the main part of the total costs. Different crops would lead to different inputs required. Nevertheless, there are some major inputs which have to be explained. Land is the most important input which has to be available. It also distinguishes the small and the large farm. Ellis (1996) stated that the small farms use resources more efficiently than larger farms. Labour utility in faming activities is a little bit different with the other activities because of the existence of family labour. Family labour represents another non-cash cost. When budgeting, charges can be made for family labour used on the farm. These charges represent salaries the farm operator and his family could earn if employed off the farm. Besides land and labour, there are so many inputs used in farming activities such as seed, fertilizer, herbicide and pesticide which form part of variable cost. These inputs also play important role in determining the amount of cost (Dewi, Nurmalina & Rifin, 2013). In a budget analysis, the interest was normally charged on cash expense for early in the growing season. This reflects that cash invested has an opportunity cost. Using the money to grow this crop precludes investment elsewhere (Olson, 2003). Just as with interest on investment and off-farm salaries represent an opportunity cost. Every resource used in the productive process has but one true cost as its opportunity cost. The opportunity cost of a resource is the return that the resource can earn when put to its best alternative use.

2.3 Concept of Multiple Linear Regression Analysis

Regression is a statistical technique to determine the linear relationship between two or more variables. It is primarily used for prediction and causal inference. Thus, it shows how variation in one variable co-occurs with variation in another. It is important to recognize that regression analysis is fundamentally different from ascertaining the correlations among different variables. Correlation determines the strength of the relationship between variables, while regression attempts to describe that relationship between these variables in more detail (Campbell & Campbell, 2008).

Multiple regression (multivariate regression) models described how a single response variable Y depends linearly on a number of predictor variables X_s. In a multiple linear regression analysis, the magnitude and direction of that relation are given by the slope parameters (β_s), and the status of the dependent variable when the independent variable absent is given by the intercept parameter (β_0). An error term (μ) captures the amount of variation not predicted by the slope and intercept terms. The regression coefficient (R^2) shows how well the values fit the data in a regression model. The linear model is sometimes referred to as the default functional form. If plotting the function in terms of X and Y generates a straight line then it can be said that linear in the variable. Thus, it is hypothesized that the slope of the relationship between Y and X can be expected to be constant then the linear functional form should be used (Studenmund, 2013).

Studenmund (2013) also stated that the intercept dummy does indeed change the intercept depending on the value of dummy but the slopes remain constant no matter what value dummy takes in a regression analysis. Two dummy variables used even though three were three conditions. This is because one fewer dummy variable is always constructed than all the conditions met to restrict perfect multicollinearity. This event not explicitly represented by a dummy variable, the omitted condition, forms the basis against which the included conditions are compared. In a three conditional regression equation, two dummy variables were estimated as:

$$D_{1i} = \begin{cases} 1 \text{ if the } i^{th} \text{ observation meets a particular condition} \\ 0 \text{ otherwise} \end{cases}$$

$$D_{2i} = \begin{cases} 1 \text{ if the } i^{th} \text{ observation meets with another particular condition} \\ 0 \text{ otherwise} \end{cases}$$

2.4 Review of Study on Rubber Profit and Profitability

Godsey (2008) stated that an enterprise budget provides a framework for reporting and monitoring the profitability of each enterprise and the cash flow plan provides the information necessary to assess and forecast the economic feasibility in perennial tree practice over time.

Somboonsuke, Pacheerat & Wettayaprasit (2009) studied a socio-economic simulation of rubber smallholding systems in Phatthalung and Songkhla Provinces, Southern Thailand by using current economic performances in the forms of gross margin , net farm income, net return to family labour, return to fixed cost and return to variable cost and the cost of production in terms of baht per hectare per year and the average price for 10 years of cultivation (1993-2003). The results revealed that rubber monoculture cultivation had the lowest benefit while rubber cultivation associated with other activities has more benefits. The results also indicated that the rubber-fruit tree farming system showed excellent economic performance in the study area.

Esekhade, Idoko, Lalabe & Abolagba (2012) studied profitability of bee keeping under mature rubber plantation in Edo State, Nigeria by using gross margin analysis. In the study, rubber yield is evaluated for sales on kilogram of dry rubber content (DRC) and bee yield is determined on per liter base. The study revealed that the gross margin and net income accrued to the sole rubber were Naira (N) 287,573 and N 228,215 and those of honey bee production under rubber tree were N 689,573 and N 615,596 respectively. The rates of return on two investments were found to be 31% and 53% for the sole rubber and both rubber and honey bee production with an operating ratio 0.61 and 0.41 respectively.

Giroh, Umar & Yakub (2010) had studied the structure, conduct and performance of farm gate marketing of natural rubber in Edo and Delta States of Nigeria by using budgetary technique. The results indicated that gross margin and net profit of farm gate marketers were N 17,821 and N 17,278 while the gross margin and net profit of farmers were N 62,588 and N 60,682 respectively. The marketing margin per hectare was 44.03% implied that farm gate marketers reaped 44.03% of the final price offered per hectare.

2.5 Review of Determinant Factors on Rubber Profit

Labour is an important factor influencing production, income, and profit. Statistically, labour can influence them with positive sign. The more labour is being used, the more product, income and profit are generated (Onoja, Deedam & Achike, 2012). It corresponds with a statement saying that farm activities always require labour in almost all production process. Thus, the use of labour has to notice the quality and quantity of labour (Dewi et al., 2013). Jayne, Khatri, Thirtle & Readon (1994) was found different results that labour has negative impact of profit.

Production capitals, in the form of material input costs may also have important role to determine amount of production, income, and profit. Most studies found that input use or cost significantly influences production, income, and profit with positive sign (Tumanggor, 2009). Dewi et al. (2013) stated that production costs would not be significant and negative sign. It may occur when there was inefficiency in input use. In some literatures, the plant age of rubber trees also influences production and which can affect income and profit. Tumanggor (2009) stated that the plant age significantly affected production with positive sign.

Rubber farmer's profit depends on quality and quantity of latex yield, the main product of rubber tree and the costs involving producing in it. Profit function is also engaged with the price, either output or input prices. Statistically, output price has positively influence on profit (Jayne et al., 2013).

Beside economic factors, social factors also influence production, income and profit. Those are farmer's education, age and working experience. Farmers can adopt technology, change ways of doing things and sell their product at the right time, if they have enough information and knowledge. Moreover, education enhances and stimulates economic growth by improving productive capacity of farmers. There is a well-known argument that increase in knowledge via education is an essential element for economic development (Asfaw & Admassie, 2004).

It should be considered as the age of farmers is a proxy for farmers' experience level. Farming experience was also important for farm profitability by the way of farmers are mostly depending on the prior knowledge of farming know-hows in the industry. However, Burton (2014) argued that older farmers do not have enough physical strength to perform their farming activities and reluctant to use new technologies.

Dewi et al. (2013) examined the determinant factors of the farm profitability of rubber and oil palm smallholders of Batangari, Jambi, Indonesia by using multiple linear regression function. The specific regression functions of farm profitability of rubber and oil palm were estimated by using independent variables. According to the study, farm profitability of rubber influences by plot size, tree age, herbicide application rate, number of productive trees, age of farmer, schooling year of farmer, household members' involvement in agriculture, farmer's cooperatives involvement and farmer having certificate.

2.6 Review of Study on Rubber Products

Wisunthorn Pansook, Chambon, Sainte-Beuve & Vaysse (2015) examined natural rubber quality of the smallholding farmers cup coagulum production in Southern Thailand. The study found that smallholders' harvesting and post-harvest practices were very diverse and the quality of Thai natural rubber starts to be established much earlier than on the factory processing line producing standard Thai rubber bales. Economically and environmentally, the processing of standard Thai rubber bales consumes large volumes of water for washing and cleaning to get rid of contaminants resulting in the production of polluting effluents and a large amount of solid waste/sludge. Technically, it is claimed by secondary processing manufacturers such as tyre manufacturers, that the presence of impurities even as small as grains of sand may cause product quality failure.

Zaw (2017) examined feasibility study of cup lump market in Mon State. It was measured by small trials of quality cup lump production from farmers to processors surveys and interviews to farmers, dealers and processors. The study found that there are three main types of raw rubber produced by rubber smallholders in Mon State namely FL, TS and USSs (USS 1 and USS 2). Local processors prefer to buy thick slab and low quality of USS 2 sheets as it can be lesser price than other quality USSs (USS 1 and USS 2) of rubber smallholders. TSR factories should improve quality and then could be exported at higher price.

Otene, Akeredolu, Obinne & Oladele (2015) had studied post-harvest handling of rubber coagula and constraints to use of indigenous climate change adaptation techniques by small-scale rubber farmers in Edo and Delta States of Nigeria. The study pointed out majority (73%) of respondents dispose their rubber coagula once a month to middlemen using auto coagulation means of preservation and the price of coagula per kg was N 130 and the average annual income of respondents from the sale of rubber coagula between N 40,000-50,000 were low. It was due to nearly all of the respondents are careless handling contaminates rubber coagula, quality and price. The study revealed that the major constraints to respondents' use of indigenous climate change adaptation techniques include low capital, poor infrastructural facilities, high cost of inputs, inadequate information on climate change, inadequate credit facilities, poor contact with agricultural extension agents.

Nithin & Mahajanashettis (2019) studied natural rubber marketing in Kerla, India to understand how rubber is being disposed of by the farmers and what benefits they are deriving from three different marketing channels; channel-1 (the movement of field latex from farmers to rubber producers' society to processing factories), channel-2 (movement of sheets from farmers to rubber producers' society to processing factories) and channel-3 (movement of sheet from farmers to primary dealers and thereafter secondary dealer to processing factories). The studied stated that 70% of the farmers preferred to sell rubber sheets to rubber producers' society in channel-2 and 64% of the products of sample farmers were channelized through this channel-2. In total marketing costs, transportation cost was found to be the major cost component among all major channels. The study also revealed that the price spread in channel-1 was found to be the lowest followed by channel-2 and then channel-3. The producers' share in consumers' rupee was the highest in channel-1 at 99% followed by channel-2 (96%) and channel-3 (96%).

Nosa Betty, A. i & E. o (2018) analyzed the value chain of natural rubber in Nigeria. The study specifically mapped the natural rubber value chain and identify the functions performed by the respondents in the chain; identified the existing marketing channels and estimated the marketing margin at each value addition point. The main value chain agencies were input suppliers or nursery farmers, rubber farmers, marketers or collectors, processor and manufacturers while the key product points along the chain were seeds, seedlings, budded stump, lump, latex concentrates, sheet and crumbs. Marketing margin analysis showed crumb having the highest margin (N 234.01) with processing cost having the major component. Value added by processing were N 14.36, N 115.16, N 136.14 and N 124.38 per budded stump, latex concentrate, crumb and sheet respectively.

CHAPTER III
RESEARCH METHODOLOGY

3.1 Description of the Study Area

3.1.1 Geography

Mudon is a township of Mawlamyine District in Mon State. It is situated beside the Mawlamyine-Thanphyuzayat Highway road. It is located at 16˚ 26' North latitudes and 97˚72' East longitudes on the Southern part of Myanmar. It is 18 miles far away from the capital city of Mon State (Mawlamyine) and it is the third largest city of the State with an area of about 73,016 ha. There are three ecological zones; coastal, lowland and upland areas based on topography. Elevation is gradually higher from West to East 0–9.4 meter above sea level in the lowest area and the highest area is 249–568 meter above sea level. A map in Mudon Township sample area is presented in Appendix 4.

3.1.2 Climate

The study area has a tropical climate and temperate as it is located in the low latitude zone and near the sea. The average temperature was 26.3˚C and the lowest monthly average is 24.2˚C (January) and the highest monthly average is 29.0˚C (April) in 2017. The seasons were defined as monsoon cycles; rainfall was totally about 3,608 mm per year and rain was especially heavy during June and August in 2017 as presented in Appendix 5 (Department of Meteorology and Hydrology [DMH], 2017).

3.1.3 Economy

In the study area, households derive livelihoods from a variety of income sources including agriculture, non-farm enterprise including wage labour, salary earnings, remittances and resource extraction. The main family income source comes from agriculture. Therefore, it is the predominant economic livelihood activity of local people. The two major crops in the study area are rubber and rice followed by orchards or fruit trees. Industries are mostly based on the processing of agricultural products especially primary rubber products (Htein, 2017).

Rubber plantation and orchards were found in the flat or mountainous areas from gentle to steep slope areas while coastal areas which were also occupied with related industries like production of dry shrimp, dry fish and fish sauce as well as salt (Htein, 2017). It was also the third largest rubber plantation area in Mon State and it singularly produced the State's standard quality dried rubber as well as the center of rubber marketing area in Myanmar. It has contributed to the national income through rubber production and export as well as an important livelihood system of local communities (Htein, 2017). There were also a large number of people who have migrated to Thailand which led increasing remittances from aboard but labour scarcity and the higher labour costs were occurred in the study area.

3.1.4 Land use

The total land area of study township was about 73,016 ha and it was composed of different kinds of land used as presented in Appendix 6. According to the Department of Agriculture Land Management and Statistics [DALMS], (2017), rice field was the dominant land use type with 26,407 ha (36%) followed by rubber plantation occupying 23,907 ha (33%). Forest land remaining in the study area was 9,003 ha (12%) and orchard area was about 5,841 ha (8%). Barren soil area 3,844 ha (5%) was wider than built up including agricultural industry area in urban and rural with 2,521 ha (4%). Mangrove palm or nipa palm area in the West part of study township as 770 ha (1%) and grass land area was also about 723 ha 1% of total land area.

3.1.5 Population

According to Myanmar Population and Housing Census in 2014, population in the study area was 190,737 people with a population density of 234 persons per km^2. There were 39,312 total numbers of households and its average household size was 4.6 persons. The population was comprised of 47.2% of male and 52.8% of female with a ratio of 1:1.2. In Mudon Township, 72.5% of populations were living in the rural area while only 27.5% were the urban population. The majority of population, about 78% were Mon ethnic group, 11% were Burmese and the rest 11% were the other ethnic groups. Buddhism was dominant religion in the study area with more than 90% of household heads were Buddhists (Department of Population [DOP], 2017).

3.2 Selection of the Study Area

Agriculture is the main economic activity of the study area and rubber is important as a major economic crop. In Mudon Township, large areas of primary forest, grassland areas and other crops areas had been cleared to grow rubber which was emerging as the most important smallholder tree plantation. Moreover, rubber provides employment opportunity not only for local people living but also for other rural community's socio-economic development especially in the rubber tapping seasons. As an advantage close to the border of Thailand, many local residents worked as migrant workers in Thailand too. Nevertheless, rubber plantation remains one of the major income sources in the state. The study area also played an indispensable role in providing rubber products especially rubber sheets for domestic and export markets. Thus, it was selected as the study township. There are 33 village tracts and 9 wards in the study township. Among them, Seintaung, Theinkone, Kalawthawt, Satthwe, Nhepadaw, Yaungdaung and Kunhlar village tracts and Myoma (4) ward were selected as the study areas in Mudon Township.

3.3 Sampling Procedure

First, sample was collected from the rubber firms in the study area. After that these sample rubber firms were divided into six groups based on their producing rubber product types. In these six groups, USS 1 sample firms contributed to 30% of total 129 sample firms and followed by 27% and 26% of USS 2 and FL samples firms respectively as presented in Table 3.1. Among them, the last three groups contributed to 17% of total 129 sample firms which produced two product types. In the last three groups, most of rubber firms produced FL only in the early months of tapping season (September to October) after then they produced USS 1 or USS 2 sheets for the rest entire tapping season (November to May). Among these sample farmers groups, classification based on the main production of their weighted produces. It means even the farmers produce two types of rubber products for example FL and USS 1, these farmers classification fell under the more produced products either FL or USS 1. Therefore, all of the total 129 samples were again divided into the three groups (FL, USS 1 and USS 2) based on the main production of their weighted produces. Table 3.2 presented the differentiation of sample firms based on types of rubber products in their respective villages including 36 samples for FL, 46 samples for USS 2 and 47 samples for USS 1.

3.4 Data Source and Data Collection

The study used both primary and secondary data. Primary data were collected by using post stratified sampling method with the usage of questionnaire prepared on all information about rubber production.

Table 3.1 Sample firms based on different rubber product types in the study area

Product types	Rubber firms	
	Frequency	Percentage (%)
USS 1 production	39	30
USS 2 production	35	27
FL production	33	26
FL & USS 2 production	11	9
FL & USS 1 production	7	5
USS 1 & USS 2 production	4	3
Total	**129**	**100**

Table 3.2 Differentiation of the sample firms based on types of rubber products in the sample villages

Sample village tracts/ ward	Rubber firms			
	FL	USS 2	USS 1	Total
Kunlar	19	7	11	37
Nhepadaw	-	12	6	18
Kalawthaut	6	24	4	34
Satthwe	-	1	11	12
Yaungdaung	7	-	3	10
Kamarwat	4	2	10	16
Myoma (4)	-	-	2	2
Total	**36**	**46**	**47**	**129**
Percentage (%)	**28**	**36**	**36**	**100**

Demographic characteristics of the sample households were collected such as age, education level, farming experience, family size, number of family labour worked in their field and their firm assets. Farming practices and production techniques were also collected including land ownership of rubber area, tapping area, tapping age, number of tapping plants per hectare, daily yield, planting method, planting material, fertilizer application, weed control, fire protection and respective prices of inputs incurred as well as product prices. Yield, revenue of rubber production, detail costs of and constraints sample rubber firms were collected.

Secondary data were also gathered from the published and official records of Perennial Crops Division and Mudon Township offices of DOA and DALMS under Minstry of Agriculture, Livestock and Irrigation (MOALI), DTPCA under Ministry of Commerce (MOC), Mudon Township office of DMH and DOP under Ministry of Immigration and Population (MOIP).

3.5 Data Analyzing Methods

Microsoft Excel program was used for entering and tabulating for collected data. Descriptive, enterprise budgeting and regression analyses were estimated by using SPSS version 25.0 Software. Descriptive statistics included frequency counts, means and percentages. F test was used for comparing demographic information. Chi square test was employed while comparing of productive assets. Budgeting technique was used to compare net incomes generated from rubber production. The specific type of budgeting technique used was the return above total variable costs (RAVC) or gross margin above total variable costs. RAVC is the difference between total revenue (TR) and the total variable costs (TVC) of its production. To find out determinant factors on profit of three different rubber firms, multiple linear regression model was used.

3.5.1 Enterprise budget analysis on three different types of rubber firms

In some literatures, profitability analysis of rubber was studied by using cash flow analysis. However, some of studies had used rubber profit margin or enterprise budget analysis. According to the lack of adequate record keeping by the rubber firms on the long-life span of rubber tree (perennial crop), enterprise budget analysis was used to compare costs and benefits of three product types of rubber firms. Thus, it was estimated based on one-year rubber producing activities of the respective rubber firms.

In a profit margin analysis, total revenue was measured by the multiplication of the yield and price. In a budget analysis, economic budget (rather than cash budgets) is incorporated by both monetary costs and ‘perceived’ non-cash costs or opportunity costs into the expenses of raising any particular crop or product. Thus, the variable costs in rubber production, processing and marketing were included two categories; cash cost and non-cash cost.

Cash cost included:

(1) Cash items for material costs

(2) Hired labour costs and

(3) Interest on cash cost.

In this study, the counted interest rate was 10% for tapping period of 9 months. In a budget analysis, family labour costs and farm own material costs are widely used as non-cash costs. For example, the opportunity costs of a farm operator’s management, his farm family labours and his materials are used in several types of budgets used for analyzing farm profit. These opportunity costs of farm family labours and materials would earn in its next best alternative use. That alternative use could be non-farm employment. It might also be employment in another farm or ranch enterprise. These kinds of opportunities costs are considered as non-cash costs.

Non-cash costs included:

(1) Family labour cost

(2) Non-cash items for material cost such as farm-owned farm yard manure and machines.

The cost of family labor was calculated as the opportunity labor cost on the basis of prevailing wage rate in the study area. To compare the profitability of three different types of rubber firms, the concept of enterprise budget was used by the following formulae:

Total revenue (TR)	=	Annual yield*Annual selling price
Total variable cash cost (TVCC)	=	Total material cash cost+Total hired labour cost + Interest on cash cost
Total variable non-cash cost	=	Total farm-own material costs+Total family labour costs
Total variable cost (TVC)	=	Total variable cash cost+Total variable non-cash costs

Return above variable cash costs	=	Total revenue-Total variable cash cost
RAVCC	=	TR-TVCC
Return above variable cost	=	Total revenue-Total variable cost
RAVC	=	TR-TVC
Benefit-cost ratio	=	Total revenue/Total variable cost
BCR	=	TR/TVC
Break-even yield	=	Total variable cost/Average price per kg
Break-even price	=	Total variable cost/Average yield per ha

3.5.2 Determinant factors on rubber profit in the study area

Determinant profit factor analysis was used by multiple linear regression analysis. A multiple regression model can control many other factors that simultaneously affect the dependent variables. The general multiple regressions for determinant factors on the profit of the selected rubber firms can be written as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ... + \beta_k X_k + \mu$$

Where,

β_0 = Intercept

β_1 = Parameter associated with X_1 (the same meaning until β_k).

μ = Error term or disturbance

β_1 to β_k parameters are also called as slope parameters which determine the relationship between dependent and each of an independent variable. The dependent variable was profit received by sample rubber firms and independent variables were schooling year, working experience, tapping age, distance between rubber farm and home, annual tapping day, daily rubber yield, material cost and hired labour cost for per unit product.

The two dummy variables, the two product types chosen by rubber farmers were also included as independent variables. It is important that all independent variables are uncorrelated with error term and the observations of error term are uncorrelated to each other. The homoscedasticity assumption states that the variance of error of dependent variables should be constant, which is one of the assumptions to make best linear unbiased estimators (BLUE). Thus, the model constructed in the research was as follows:

$$Yi=\beta_0+\beta_1X_{1i}+\beta_2X_{2i}+\beta_3X_{3i}+\beta_4X_{4i}+\beta_5X_{5i}+\beta_6X_{6i}+\beta_7X_{7i}+\beta_8X_{8i}+b_1D_{1i}+b_2D_{2i}+\mu_i$$

Where,

Y_i	=	profit per unit product (MMK/kg)
X_{1i}	=	schooling years (year)
X_{2i}	=	working experience (year)
X_{3i}	=	tapping age (year)
X_{4i}	=	distance between rubber farm and home (km)
X_{5i}	=	annual tapping day (day/year)
X_{6i}	=	daily rubber yield (kg/ha/day)
X_{7i}	=	material cost per unit product (MMK/kg)
X_{8i}	=	hired labour cost per unit product (MMK/kg)
D_{1i}	=	Dummy 1 (1 = USS 2, 0 = otherwise)
D_{2i}	=	Dummy 2 (1 = USS 1, 0 = otherwise)
β_0	=	constant
β_1 to β_8	=	unknown parameters to be estimated
b_1 to b_2	=	dummy variables to be estimated
μ_i	=	error term
i	=	i^{th} firm in the sample

The study expected independent variables which affected the factors influencing for rubber profit in the study area. A complete decision of variables and types of measures that have been employed are presented in Table 3.3.

Table 3.3 Expected signs of the variables in rubber profit

Independent variables	Units	Expected signs
Schooling years	year	(+)
Working experiences	year	(+/-)
Tapping age	year	(+/-)
Distance between farm and home	km	(-)
Annual tapping days	day/year	(+/-)
Daily yield	kg/ha/day	(+)
Material costs	MMK/kg	(+/-)
Hired labour cost	MMK/kg	(+/-)
Dummy 1 (1=USS2, 0=otherwise)	MMK/kg	(+/-)
Dummy 2 (1=USS1, 0=otherwise)	MMK/kg	(+/-)

CHAPTER IV
RESULTS AND DISCUSSION

4.1 Types of Rubber Products Producing and Selling in Mudon Township

Three main types of primary products were produced by rubber firms in Mudon Township. These products were field latex (FL), un smoked sheet 2 (USS 2) and un smoked sheet 1 (USS 1) products. The most significant differences between USS 2 and USS 1 were the number of sheeting times, drying period and quality. In general, USS 1 had higher quality than USS 2. The type of product produced by rubber firms was influenced by tapping area, tapping payment systems, availability of water sources and accessibilities to the market.

In Mudon Township, FL was produced without any processing and it was immediately sold after tapping as presented in Figure 4.1. Mostly, it was found that processing factory of FL was not too far from rubber firms. FL price was different based on the obtainable dry rubber content (DRC). DRC was evaluated by taking sample sheets and the payment of purchasing was normally carried out after testing DRC in FL. Rubber firms produced FL during the early months of tapping season because they required money for material and labour inputs and firm family's immediate needs and wants.

The production of USS 2 and USS 1 rubber sheets based on large tapping area, share tapping payment systems, available water sources. Moreover, these two products were also produced when the firm had too far from FL processing factories. In USS 2 production, FL was mixed with formic acid or sulphuric acid and water to produce coagulated latex. This coagulated latex was sheeted with rubber roller machine and dried under the sun by hanging on the bamboo pole placed horizontally at a certain height. Normally, USS 2 required 2-3 times of sheeting and 1-2 days of sun drying presented in Figure 4.2 whereas USS 1 required 4-6 times of sheeting, 2-3 days of sun drying and about 2 weeks of shading rubber sheets for completely drying to get rubber quality presented in Figure 4.3.

In rubber marketing, some firms directly sold FL to local private sectors which manufactured rubber bands and balloons. Although rubber sheets can be stored for a long time, USS 2 firms sold out their products immediately in order to avoid the losing weights of rubber sheets. The processing factories without smoke house purchased FL to produce high quality USS 1 and then these factories sold those sheets to domestic sandal manufacturers. The processing factories with smoke houses also purchased FL to produce export quality ribbed smoked sheets (RSSs) by the smoking of USS 1. When price was attractive, those factories often directly sold USS 1 to domestic traders or sandal manufacturers without any smoking.

In sheets rubber USS 2 and USS 1 marketing, most of rubber firms sold their sheets to local collectors. However, some of rubber firms were located too close to cities so they directly sold to the township level traders. There were also a number of traders who travelled and collected up to rubber plantation farms or at homes for a large amount of volume. Farmers sold rubber to the traders and collectors who can offer the highest price. Local collectors sold rubber to the township level traders as well as directly to technically specified rubber (TSR) factories. These factories used USS 2 as the raw materials to mix with cup lump and tree lace to produce TSR and also stored USS 2 as the stock for the rainy season. Township level traders sold rubber sheets to TSR processing companies in Mudon that offered the highest price. Low quality cup lump and tree lace were by-products of tapping process. Some firms sold these products as their by-products while some firms allowed these by-products to take tappers. Local collectors also collected by-product and they sold to TSR processors as it was also a major raw material for those factories.

4.2 Socio-economic Characteristics of the Sample Rubber Firms

4.2.1 Demographic information of the sample firms

Table 4.1 presented the demographic characteristics of sample firms. In the study area, the average age of FL product sample farmers was nearly 52 years old. It was about 50 and 52 years in USS 2 and USS 1 products sample farmers. Among the three different groups of sample farmers, their ages were ranged from 36 to 80 years in FL product farmers, 20 to 72 years in USS 2 product farmers and 23 to 71 years in USS 1 product farmers. In order to know management efficiency among them, their working experience years in rubber production activities and the education level of firms' household heads were identified. The mean values of working experiences of sample farmers were nearly 26 years in FL product farmers with ranging between 7 and 60 years, 23 years in USS 2 product farmers with ranging between 3 and 53 years and 30 years in USS 1 product farmers with ranging between 5 and 56 years. It can be seen that USS 1 product sample farmers had the highest average working experience whereas the figure was the lowest in USS 2 product sample farmers.

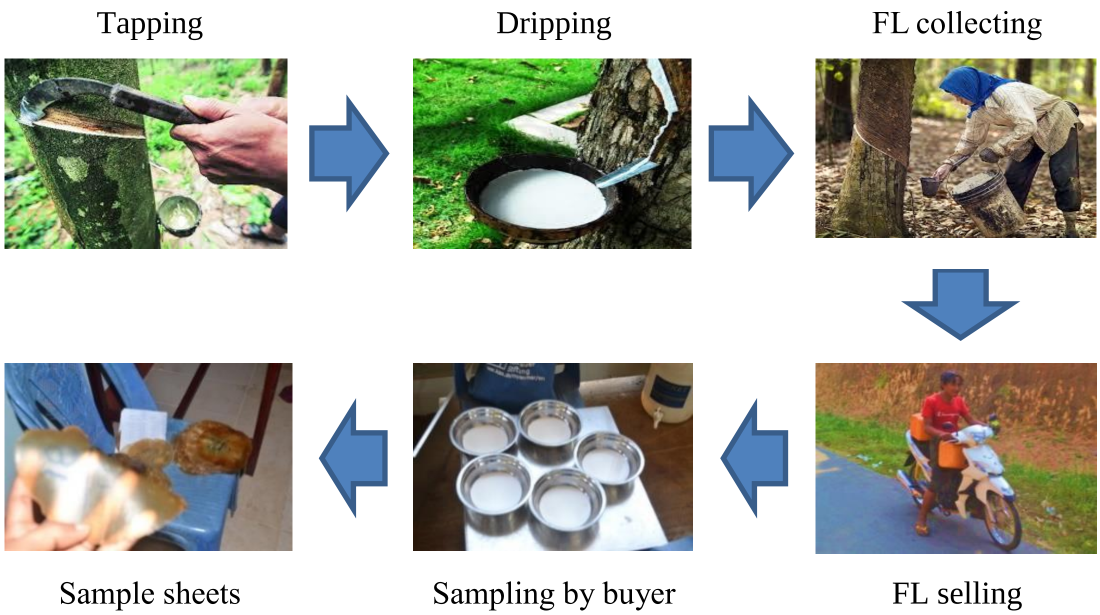

Figure 4.1 FL collecting and selling steps

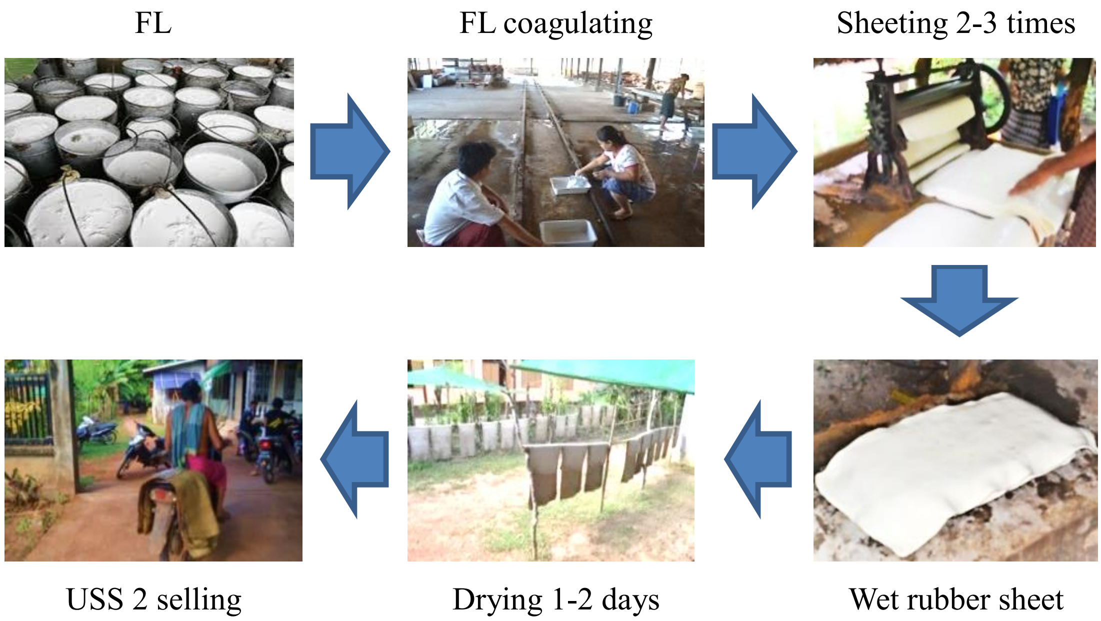

Figure 4.2 Processing steps of USS 2

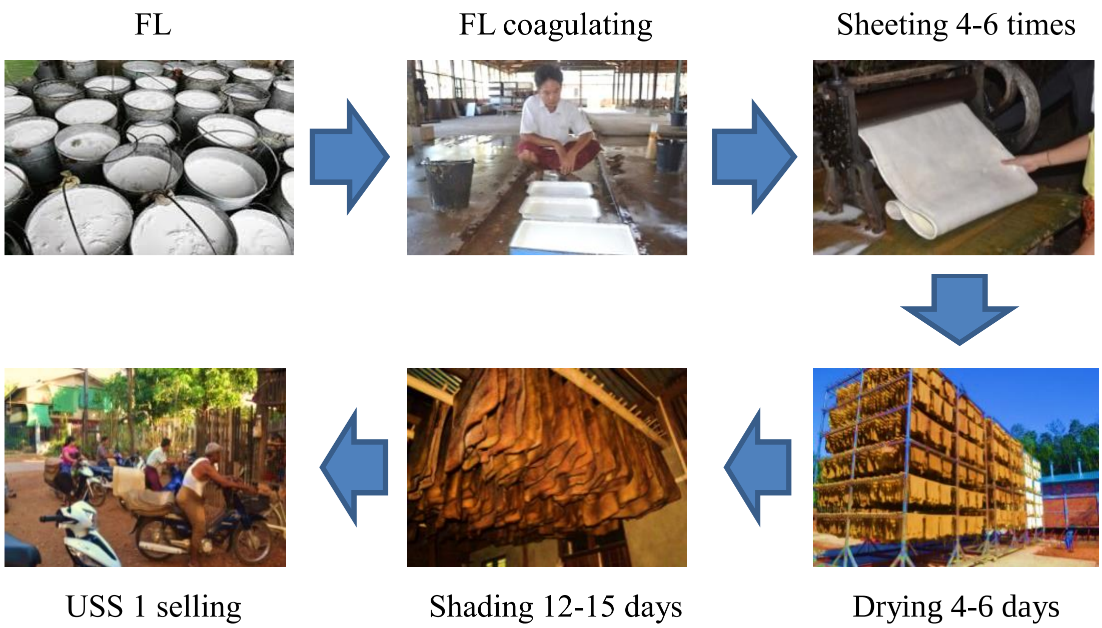

Figure 4.3 Processing steps of USS 1

The next indicator of management efficiency of sample farmers was their education level that meant schooling years. The average schooling years of sample household heads were 4, 5 and 6 schooling years for FL, USS 2 and USS 1 products farmers respectively. Their schooling years were varied from illiterate to graduate level. According to the results, the average education level of total sample farmers was middle school education level. The mean values of family sizes per household were about 4 members and ranged from 2 to 10 people in all three different product types of sample rubber firms. In the study area, most of rubber farm family members worked in their own fields. In all three different sample firms, the average family farm labours worked in their fields was 2 people and it was ranged from 0 to 7 persons. However, there were a very few farm households that family member couldn’t participate in their field activities. The results of F test showed only the average working experience years were statistically significant at 5% level among the three different sample farmers’ groups. The mean values of farmer’s ages, schooling years, family sizes and family farm labours were not significantly different among them.

4.2.2 Productive assets of the sample rubber firms

Possessing of agricultural equipment and machineries was one of the important indicators for the improvement of firm’s performance and efficiency in their field works. Table 4.2 presented the productive assets of sample firms. Only 53% of FL product sample firms possessed rubber roller it also indicated that they can also produce USS 1 or USS 2 products based on the attractive prices of rubber sheets. The majority of 94% of USS 2 product sample firms had rubber roller. The remaining 6% of them made USS 2 sheets in rubber sheeted houses of their neighbors with payment or their relatives without payment. Payment based on the portion of total rubber sheets. About 88% of USS 1 product sample firms had rubber roller and the rest 12% of them made USS 1 rubber sheets with or without payments like USS 2 product sample firms. Rubber sheeted house possessed by FL product sample firms was only 31% whereas the figures were 74% and 75% in USS 2 and USS 1 products sample firms. It can be seen that some firms owned rubber roller while they had no sheeted houses. In the study area 31%, 46%, 72% of FL, USS 2 and USS 1 products sample firms possessed grass cutting machine for weeding and fire protection. Grass cutting machines were important for producers because rubber plantation sometimes needed to have measures for fire protection from adjacent fields or forests and it was also required for weeding that tappers can enter the rubber field easily and safety. The percentages of labour hut possessing in FL, USS 2 and USS 1 products sample firms were 42%, 26% and 47% respectively. The majority of sample rubber firms possessed a range of rubber productive implements based on the types of product producing. In farm machineries, the assets of power tiller were 3%, 7% and 2% in FL, USS 2 and USS 1 products sample firms while 3% of FL and each 2% of USS 2 and USS 1 products sample firms owned tractor. It was found that farm mechanization was not so much familiar to rubber production. The results of Chi-square test showed the possessing of rubber roller machine, rubber sheeted house and grass cutting machine were statistically significant at 1% level among the three different sample firms. There was no significantly difference in possessing of labour hut, power tiller and tractor among them.

4.2.3 Productive figures and distance between farm and home of the sample firms

On rubber farm, the first tapping occurs 5-6 years after planting and the tree would productive until 30 years old (Dewi et al., 2013). In the study area, sample rubber firms had different plantation periods depending on the amount of their un-cultivated area, the amount of their own capital investments and the availabilities of replacing their old rubber trees, etc. Because of different plantation periods, some of sample farmers had both mature and immature rubber trees within one productive year. Table 4.3 presented average productive figures and distance between farm and home of the sample rubber firms. Among the three different rubber firms, average sown areas were 2.2 ha, 2.4 ha and 5.0 ha in FL, USS 2 and USS 1 products sample firms respectively. In total firms, the average sown area was 3.3 ha and ranged from 0.4 to 81.0 ha. Average tapping areas were 1.9 ha, 1.5 ha and 2.8 ha in FL, USS 2 and USS 1 products sample firms respectively. In total firms, the average tapping area was 2.1 ha and ranged from 0.2 to 14.2 ha. It was indicated that USS 1 product sample firms had the largest rubber tapping area while USS 2 product sample firms possessed the smallest in that area.

The average number of tapping plants per hectare was 482 plants with ranging between 326 to 865 plants in FL product sample firms. It was 550 plants with ranging between 346 and 1,235 plants in USS 2 product sample firms and 508 plants with ranging between 247 and 1,098 plants in USS 1 product sample firms. The mean values of tapping ages were 7.6 years, 9.4 years and 8.7 years in FL, USS 2 and USS 1 products sample firms with a range from 1 to 30 years in total rubber firms. Averages of distances between rubber field and home were 6.3 km, 3.9 km and 5.7 km in FL, USS 2 and USS 1 products sample firms respectively. Tapping days were calculated based on total tapped days in a year. In the study area, rubber firms tapped their trees every day or three days tapped with one day rest during the tapping period. The average annual tapping days were 133, 121 and 130 days in FL, USS 2 and USS 1 products sample firms. It was ranged from 60 to 176 days in total rubber firms. Respecting to productive efficiency in a day, FL product sample firms produced the average daily yield 10 kg/ha/day and it was 15 kg/ha/day and 12 kg/ha/day in USS 2 and USS 1 products sample firms. It was ranged from 3 to 38 kg/ha/day in total rubber firms. The results of F tests showed the mean values of tapping area and daily yield were statistically significant at 5% level among the three different rubber firms. Tapping plants per hectare was statistically significant at 10% level among them. There was no significant difference in rubber sown area, tapping age, distance between farm and home and number of tapping days were not statistically different among them.

4.2.4 Sources of incomes among the sample firms

Mon State was one of major rubber producing areas in Myanmar and played the main source of income for farmers together with other income sources including other crop production, own business, government and private staff as well as remittance. Figure 4.4 presented the percentages of various income sources of sample firms. The percentages of only one rubber income source sample firms were 78%, 59% and 70% in FL, USS 2 and USS 1 products sample firms. The percentages of two income sources rubber firms which contributing rubber and the other crops production were 5%, 17% and 18% in FL, USS 2 and USS 1 products sample firms respectively. The contribution of rubber and remittance income sources were 8%, 11% and 4% in FL, USS 2 and USS 1 products sample firms respectively. The contribution of rubber production and own business income sources were 3%, 11% and 4% in FL, USS 2 and USS 1 products sample firms respectively. The contribution of rubber and other small income sources were working as government staffs 6% and 4% in FL and USS 1 products sample firms and the rest working as private staff with rubber production that contributed 2% to USS 2 product sample firms.

Table 4.1 Socio-economic characteristics of the sample rubber firms

Items	Units	Rubber firms FL (n=36)	USS 2 (n=46)	USS 1 (n=47)	F test	Total (n=129)
Average farmer's age	year	52.33	50.06	52.32	0.21^{ns}	51.84
Range		(36-80)	(20-72)	(23-71)		(20-80)
Average working experience	year	25.78	22.72	29.57	3.29^{**}	26.07
Range		(7-60)	(3-53)	(5-56)		(3-60)
Average schooling year	year	4.39	5.11	6.04	2.03^{ns}	5.25
Range		(1-11)	(1-16)	(1-15)		(1-16)
Average family size	No.	4.22	4.02	3.77	1.09^{ns}	3.98
Range		(2-10)	(2-8)	(2-7)		(2-10)
Average family farm labor	No.	2.19	2.41	2.30	0.21^{ns}	2.31
Range		(0-5)	(0-7)	(0-7)		(0-7)

Note: *, ** and *** denote significant differences at 10%, 5% and 1% levels, ns = non-significant.

Table 4.2 Average productive assets of the sample rubber firms

Items	Rubber firms FL (n=36)	USS 2 (n=46)	USS 1 (n=47)	x^2	Total (n=129)
Rubber roller machine	19(53)	43(94)	41(88)	23.3^{***}	103(80)
Rubber sheeted house	11(31)	34(74)	35(75)	17.4^{***}	80(62)
Grass cutting machine	11(31)	21(46)	34(72)	15.1^{***}	66(51)
Labour hut	15(42)	12(26)	22(47)	3.3^{ns}	35(27)
Power tiller	1(3)	3(7)	1(2)	2.6^{ns}	5(4)
Tractor	1(3)	1(2)	1(2)	1.2^{ns}	3(2)

Note: *, ** and *** denote significant differences at 10%, 5% and 1% levels, ns = non-significant. Values in parentheses represent percentage.

Table 4.3 Averages of productive figures and distance between farm and home of the sample firms

Items	Units	Rubber firms FL (n=36)	USS 2 (n=46)	USS 1 (n=47)	F test	Total (n=129)
Sown area	ha	2.2	2.4	5.0	1.9^{ns}	3.3
Range		(0.4-12.2)	(0.4-15.4)	(0.4-81.0)		(0.4-81.0)
Tapping area	ha	1.9	1.5	2.8	4.79**	2.1
Range		(0.4-12.2)	(0.4-4.0)	(0.2-14.2)		(0.2-14.2)
Tapping plants	No./ha	482	550	508	3.0^{*}	516
Range		(326-865)	(346-1,235)	(247-1,098)		(247-1,235)
Tapping age	year	7.6	9.4	8.7	0.9^{ns}	8.6
Range		(1-30)	(1-25)	(1-26)		(1-30)
Distance between farm and home	km	6.3	3.9	5.7	1.9^{ns}	5.2
Range		(0.4-35.2)	(0.0-24.0)	(0.0-24.0)		(0.0-35.2)
Tapping days	day/year	133	121	130	2.2^{ns}	128
Range		(80-176)	(60-176)	(66-167)		(60-176)
Daily yield	kg/ha/day	10	15	12	4.01**	13
Range		(4-22)	(5-35)	(3-38)		(3-38)

Note: *, ** and *** denote significant differences at 10%, 5% and 1% levels, ns = non-significant.

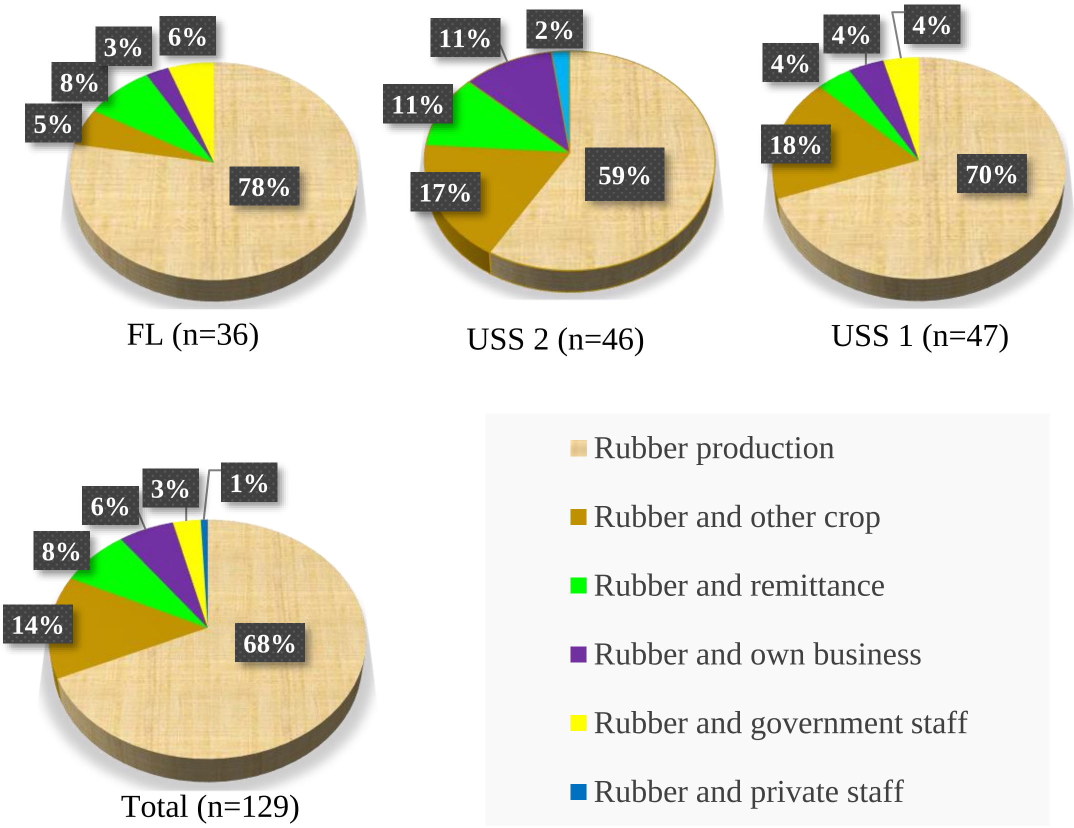

Figure 4.4 Income sources of the sample rubber firms

4.2.5 Cultivated varieties among the sample firms

As rubber tree could produce latex commercially about 25 years, it is important to use a proper variety. In the study area, the currently cultivated high yield varieties were BPM 24 (Bank Pertanian Malaysia's rubber clone number 24), PB 260 (Prang Besar Malaysia's rubber clone number 260), PB 235 (Prang Besar Malaysia's rubber clone number 235), GT 1 (Godng Tapen Indonesia’s rbber clone number 1) and RRIM 2000 series (Rubber Research Institute of Malaysia’s 2000 clone series), etc. In some areas, rubber firms had still used traditionally wild types varieties.

Figure 4.5 presented the percentages of cultivated varieties of sample rubber firms. Among three different rubber firms, the percentages of rubber firms that cultivated wild types varieties were 19%, 30% and 36% in FL, USS 2 and USS 1 products sample firms respectively. The percentage of rubber firms that had been planted both high yield and wild type varieties were 17%, 20% and 2% in FL, USS 2 and USS 1 products sample firms respectively. Although 58% of total sample firms had completely changed with high yield varieties, about 12% of them had both wild types and high yield varieties. Thus, the remaining 30% of total sample rubber firms had already cultivated wild types varieties.

4.2.6 Planting methods among the sample firms

In the study area, the most commonly used planting methods were bud grafting and seed sowing methods. Figure 4.6 presented the percentages of these two planting methods among sample rubber firms. Bud grafting method was used in para rubber genotypes selected for their capacity to produce high latex yield because it could be higher and more uniform productivity of the plantations than when established from seedling. Although bud grafting method could increase yield and it was popular in the study area, 31%, 22% and 38% of FL, USS 2 and USS 1 products sample firms had still used seed sowing method. Therefore, 29% of total sample firms had still seed sowing method.

4.3 Rubber Yields and Selling Prices of the Sample Firms

Rubber profit was mostly compatible with rubber yield and output price. Thus, comparing the yields and prices of rubber firms can help to determine which product type to produce by firms.

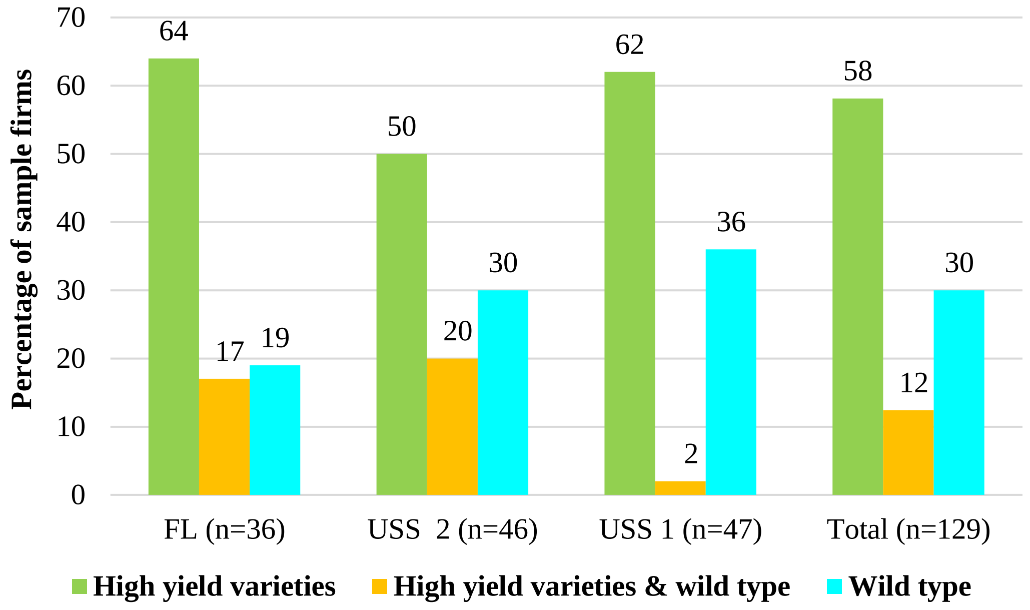

Figure 4.5 Cultivated varieties of the sample firms

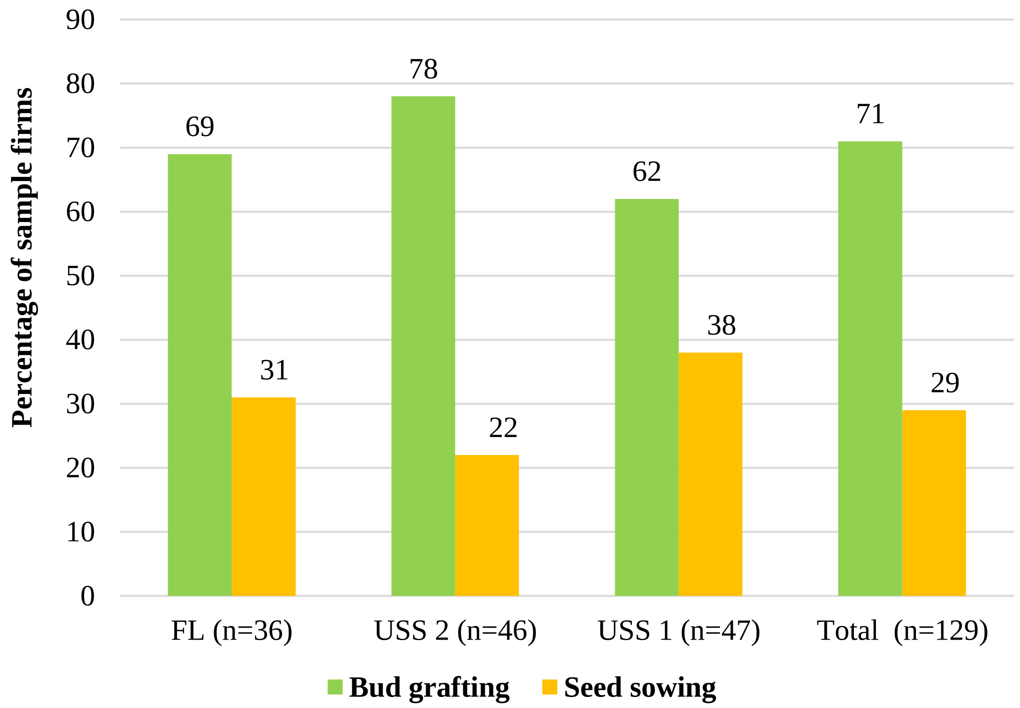

Figure 4.6 Planting methods of the sample firms

Table 4.4 presented the monthly average yields of sample firms from September 2017 to August 2018. Firms obtained the higher monthly yields during October to December in 2017. It was varied from 223 to 241 kg/ha in FL product sample firms, 300 to 339 kg/ha in USS 2 product sample firms and 236 to 244 kg/ha in USS 1 product sample firms. The monthly rubber yield was as high as 241 kg/ha in FL product sample firms whereas the figures were 339 kg/ha and 244 kg/ha in USS 2 and USS 1 products sample firms during these three months. On the other hand, the lower monthly rubber yields were obtained from April to May in 2018. Monthly yields were declined from 88 to 37 kg/ha in FL product sample firms, 72 to 0 kg/ha in USS 2 product sample firms and 48 to 4 kg/ha in USS 1 product sample firms during these two months. It can be seen that higher rubber yields were obtained in the winter (peak season) and lower rubber production were occurred in the summer (hard season).

Annual rubber yields were calculated based on farmers' actual monthly yields from September, 2017 to May, 2018. According to the study analysis, annual rubber yields were 1,247 kg/ha, 1,484 kg/ha and 1,221 kg/ha of FL, USS 2 and USS 1 products sample firms respectively and it was ranged from 385 to 2,957 kg/ha in total rubber firms. In comparing three product types of rubber firms, FL sample firms were the poor bargaining power and their weighted rubber was mainly depended on the buyers' estimation. This condition led a considerable amount of weight reducing in FL sample firms. It can be seen that USS 2 product sample firms obtained the highest annual yield while USS 1 product sample firms had the lowest in that yield. It was because USS 2 product sample firms could sell their products immediately after 1-2 days of sun drying while USS 1 firms products required prolong sun drying and shading period (2-3 days of sun drying and about two weeks of shading). This condition led a large amount of weight loss in USS 1 sample firms. In comparing rubber yield respective to the tapping area, USS 2 product sample firms gained the highest rubber yield with the smallest tapping area while USS 1 product sample firms obtained the lowest rubber yield with the largest tapping area. Moreover, USS 2 product sample firms had the highest number of tapping plants 550 plants/ha which could increase the rubber yield when being compared to 508 plants/ha and 482 plants/ha of USS 1 and FL products sample firms. Although USS 1 product sample firms had the larger tapping plants per hectare than FL product sample firms, the lower annual yield were observed in USS 1 product sample firms. It was because USS 1 producers faced the more weight loss when being compared to weight reducing faced by FL producers. The result of F test showed annual average yields were statistically significant at 10% level among the three different firms.

Table 4.5 showed monthly average rubber prices based on different types of rubber product. Rubber can tap all around the year while the off season was February (the leaf falling period) and June up to August (heavy rainfall period) in the study area. Therefore, there was no price determination for FL products during leaf falling and heavy rainy seasons. USS 2 and USS 1 products could be stored for a longer period led these products can trade all the time. In the study area, the highest monthly prices were found from January to March in 2018. FL price was 2,357 MMK/ha in March, 2018 whereas the prices of USS 2 and USS 1 products were as high as 2,552 MMK/kg and 2,715 MMK/kg in February, 2018. The lower monthly prices were got from October to December in 2017. The lowest monthly prices received by FL and USS 2 products were 1,454 MMK/kg and 1,608 MMK/kg in October, 2017 while USS 1 product got the lowest monthly price 1,797 MMK/kg in November, 2017. It can be seen that monthly rubber prices were highly fluctuated in the study area.

Rubber prices were increased when the commodities were scared (lower supply) and decreased when plenty of rubber production (higher supply). The reasons of low rubber product price were the immediate needs and wants of the family and also favourable weather condition in winter led to the higher rubber production. TSR processing factories purchased more rubber to maintain stocks for raining season when production decreased during the dry season (January to March) led rubber prices rose in summer. Annual price was based on average monthly prices from September, 2017 to August, 2018. Regarding to product quality, FL product firms obtained the lowest annual selling price 1,771 MMK/kg when being compared to the annual selling prices 1,920 MMK/kg and 2,061 MMK/kg of USS 2 and USS 1 products sample firms. It was ranged from 1,416 to 2,350 MMK/kg in total rubber firms. The result of F test showed annual average prices were statistically significant at 1% level among the three different firms.

4.4 Annual Costs and Returns of the Sample Rubber Firms

In the section, costs and returns analysis of sample rubber firms were described by the data collected on per hectare basic in one-year activities of the respective firms.

Table 4.4 Rubber yields of the sample firms from September, 2017 to August, 2018

(kg/ha)

Months	Rubber firms		
	FL (n=36)	**USS 2 (n=46)**	**USS 1 (n=47)**
September	110	126	129
October	223	300	244
November	241	302	235
December	239	339	236
January	199	204	205
February	-	-	-
March	110	129	121
April	88	72	48
May	37	-	4
June	-	-	-
July	-	-	-
August	-	-	-
Annual average yield	1,247	1,484	1,221
Range	(512-2,327)	(468-2,971)	(385-2,957)
Annual total firms average yield (n=129)		1,322	
Range		(385-2,957)	
F value		2.59*	

Note: *, ** and *** denote significant differences at 10%, 5% and 1% levels, ns = non-significant.

Table 4.5 Rubber prices of the sample firms from September, 2017 to August, 2018

(MMK/kg)

Months	Rubber firms		
	FL (n=36)	**USS 2 (n=46)**	**USS 1 (n=47)**
September	1,797	1,929	2,132
October	1,454	1,608	1,817
November	1,551	1,705	1,797
December	1,537	1,692	1,780
January	2,257	2,423	2,599
February	-	2,552	2,715
March	2,357	2,511	2,694
April	1,936	2,090	2,128
May	1,801	1,872	1,956
June	-	1,651	1,907
July	-	1,762	2,088
August	-	17,95	2,099
Annual average price	1,771	1,920	2,061
Range	(1,416-1,996)	(1,668-1,992)	(1,545-2,350)
Annual total firm average price (n=129)		1,928	
Range		(1,416-2,350)	
F value		46.31***	

Note: *, ** and *** denote significant differences at 10%, 5% and 1% levels, ns = non-significant.

Table 4.6 described the mean values of total variable costs (TVC) of sample firms including materials costs, family labour costs, hired labour costs and interest on cash cost. The items included in costs figures were related to plant maintenance, tapping, latex processing and transporting costs. In total materials costs, the costs of urea, compound fertilizers and petrol for weeding machine were plant maintenance costs. The costs of spoons, latex dripping cups, head lumps, tapping knives and tappers jungle boots were tapping materials costs. The costs of latex coagulated acid and bamboo for drying were processing material costs. For transporting material costs, only the petrol cost was needed. The cost of family labour was calculated as the opportunity cost on the basis of prevailing wage rate 6,000 MMK/man day and the interest on cash costs was considered 10% in 9 months only for materials and hired labour costs.

According to the nature of product types, although FL product sample firms were not necessary to incur latex processing material cost, the transportation of FL from farmers to the buyers for every tapped day led the higher market transporting costs while most of USS 2 product firms sold their products only 1-2 times in a week depended on a considerable amount of rubber to be sold and to avoid the weight loss. In order to obtain rubber quality, USS 1 product sample firms incurred the highest latex processing and handling costs. However, most of USS 1 producers usually sold their products only 2-4 times at home for large amount of volume as they had a storage nature. In this case, USS 1 producers no needed to incur market transporting fuel cost. Thus, USS 1 products sample firms were the lowest in market transporting costs while FL product sample firms faced the highest in that cost. The values of total materials costs were 215,930 MMK/ha, 231,113 MMK/ha and 203,247 MMK/ha in FL, USS 2 and USS1 products sample firms. Respecting to the rubber yield, the highest total materials cost was observed in USS 2 product sample firms while that of USS 1 product sample firm was the lowest. The highest total family labour cost was 819,825 MMK/ha in FL product sample firms followed by 784,806 MMK/ha and 763,805 MMK/ha of USS 2 and USS 1 products sample firms. In comparing hired labour costs, FL product firms incurred 99,554 MMK/ha was the lowest whereas the figures were 221,500 MMK/ha and 233,616 MMK/ha in USS 2 and USS 1 products sample firms. Average total interest on cash costs were 31,549 MMK/ha, 45,261 MMK/ha and 43,686 MMK/ha in FL, USS 2 and USS 1 products sample firms. The highest total interest on cash cost was observed in USS 2 product sample firms while that of FL product sample firms was the lowest. The lowest total variable cash cost (TVCC) 347,033 MMK/ ha was observed in FL product sample firms when being compared to 497,874 MMK/ha and 480,549 MMK/ha of USS 2 and USS 1 products sample firms. The lowest TVC 1,166,859 MMK/ha was resulted in FL product sample firms whereas the figures were 1,282,680 MMK/ha and 1,244,354 MMK/ha in USS 2 and USS 1 products sample firms.

Enterprise budget analysis could help to discover the direction of product types change. It was analyzed to find out costs and returns based on variable costs of sample firms as presented in Table 4.7. Benefits-costs ratios (BCR) were computed among the three different rubber firms. BCR indicated that how much gross return from a given rubber product type was received by the investing one kyat in the production of that product. Investing in a crop enterprise with BCR greater than one was profitable. The detail estimation of FL, USS 2 and USS 1 products firms' enterprise budget analyses were presented in Appendices 7, 8 and 9. According to the nature of product types, FL product sample firms obtained the lowest total revenue 2,208,639 MMK/ha when being compared to 2,850,390 MMK/ha and 2,516,053 MMK/ha of USS 2 and USS 1 products sample firms. FL product sample firms received the minimum average return above of total variable cash costs (RAVCC) 1,861,605 MMK/ha whereas the figure were 2,352,516 MMK/ha and 2,035,504 MMK/ha of USS 2 and USS 1 products sample firms. In comparing return above of total variable costs (RAVC), FL product sample firms received 1,041,780 MMK/ha was the lowest whereas the figures were 1,567,711 MMK/ha and 1,271,699 MMK/ha in USS 2 and USS 1 products sample firms. It was also found that USS 2 product sample firms obtained the largest RAVC while they incurred in the highest average TVC. It meant that USS 2 firms were more cost efficient due to the higher production in these firms.

The mean values of BCR were about 1.89, 2.22 and 2.02 in FL, USS 2 and USS 1 products sample firms. It was indicated that all three different sample firms can earn more profit over their TVC. Among them, FL product sample firms obtained the lowest BCR while that of USS 2 product sample firms was the highest. FL product sample firms resulted the break-even yield 659 kg/ha whereas the figures were 668 kg/ha and 605 kg/ha in USS 2 and USS 1 products sample firms respectively. In comparing break-even prices, FL product sample firms resulted 936 MMK/kg whereas the figures were 864 MMK/kg and 1,019 MMK/kg in USS 2 and USS 1 products sample firms respectively.

Table 4.6 Annual costs of the sample rubber firms

Items	Units	Rubber firm		
		FL (n=36)	**USS 2 (n=46)**	**USS 1 (n=47)**
(1) Material costs				
Plant maintenance inputs	MMK/ha	133,365	130,722	105,401
Tapping	MMK/ha	41,930	40,630	42,800
Latex processing and handling	MMK/ha	0	40,464	47,317
Fuel for market transporting	MMK/ha	40,638	19,297	8,639
Total material costs (a)	MMK/ha	215,930	231,113	203,247
(2) Family labour costs				
Plant maintenance	MMK/ha	66,453	62,609	57,256
Tapping	MMK/ha	711,259	647,194	621,318
Latex processing and handling	MMK/ha	0	57,893	73,631
Transporting	MMK/ha	42,114	17,110	11,600
Total family labour costs (b)	MMK/ha	819,825	784,806	763,805
(3) Hired labour costs				
Plant maintenance	MMK/ha	13,104	15,185	10,695
Tapping	MMK/ha	86,450	191,962	180,170
Latex processing and handling	MMK/ha	0	14,353	42,751
Transporting	MMK/ha	0	0	0
Total hired labour costs (c)	MMK/ha	99,554	221,500	233,616
(4) Interest on cash cost				
Interest on material cash costs	MMK/ha	21,593	23,111	20,325
Interest on hired labour cash cost	MMK/ha	9,955	22,150	23,362
Total interest on cash cost (d)	MMK/ha	31,549	45,261	43,686
Total variable cash costs (a+c+d)	MMK/ha	347,033	497,874	480,549
Total variable costs (a+b+c+d)	MMK/ha	1,166,859	1,282,680	1,244,354

Table 4.7 Annual costs and returns of the sample rubber firms

Items	Unit	Rubber firms		
		FL (n=36)	**USS 2 (n=46)**	**USS 1 (n=47)**
Annual average yield	kg/ha	1,247	1,484	1,221
Annual average price	MMK/kg	1,771	1,920	2,061
Total revenue (TR)	MMK/ha	2,208,639	2,850,390	2,516,053
Total material costs (a)	MMK/ha	215,930	231,113	203,247
Total family labour costs (b)	MMK/ha	819,825	784,806	763,805
Total hired labour costs (c)	MMK/ha	99,554	221,500	233,616
Total interest on cash cost (d)	MMK/ha	31,549	45,261	43,686
Total variable cash costs (TVCC=a+c+d)	MMK/ha	347,033	497,874	480,549
Total variable costs (TVC=a+b+c+d)	MMK/ha	1,166,859	1,282,680	1,244,354
Return above variable cash costs (RAVCC=TR-TVCC)	MMK/ha	1,861,605	2,352,516	2,035,504
Return above variable costs (RAVC=TR-TVC)	MMK/ha	1,041,780	1,567,711	1,271,699
Benefit-cost ratio (BCR=TR/TVC)	-	1.89	2.22	2.02
Break-even yield (TVC/average price per kg)	kg/ha	659	668	605
Break-even price (TVC/average yield per ha)	MMK/kg	936	864	1,019

4.5 Descriptive Statistics of Rubber Profit per unit Product

The estimated variables should be as possible as the exact amount necessary to compensate for the change in the units of measurement in a regression analysis (Studenmund, 2013). In the study, determinant factors of rubber profit would be estimated based on per unit product of sample firms. Thus, regressor variables were based on per unit product. The annual average prices, profits and costs on per unit product of three different sample firms presented in Table 4.8. In comparing total materials costs per unit product of sample firms, FL product firms incurred the highest 174 MMK/kg when being compared to 150 MMK/kg and 166 MMK/kg of USS 2 and USS 1 products firms. It was because, FL product firms needed to transport their product to the buyers for every tap day led the higher market transporting material costs. USS 1 product firms had no need to incur transporting cost for their products as they sold their products at home while they incurred the highest latex processing and handling costs. In comparing total variable costs per unit product, FL product firms incurred 936 MMK/kg whereas the figures were 864 MMK/kg and 1,019 MMK/kg in USS 2 and USS 1 products firms respectively. In comparing profit per unit product of sample firms, FL product firms obtain the lowest profit 835 MMK/kg when being compared to the profits 1,056 MMK/kg and 1,042 MMK/kg of USS 2 and USS 1 products firms. It can be seen that FL product firms were the lesser input utilization efficiency or poor utility while that of USS 2 was the best. It can be seen that value added in FL product earned more profit per unit product.

The mean values of quantitative dependent and independent variables of all sample firms are as presented in Table 4.9. According to the descriptive statistics, average profit per unit product was 993 MMK/kg. The mean values of schooling years and working experience of sample farmers were 5 years and 26 years. The mean values of tapping ages, distances between farm and home and annual tapping days were 9 years, 5.2 km and 128 days/year respectively. The mean values of daily production, material costs and hired labour costs for per unit product of rubber firms were resulted 13 kg/ha/day, 164 MMK/kg and 145 MMK/kg respectively.

4.6 Determinant Factors Affecting on Profit of the Sample Rubber Firms

This section indicated the results of factors affecting on the profit of selected rubber firms in the study area. To determine factors affecting rubber profit, multiple linear regression function was employed. The specific profit function of rubber firms was estimated by using 10 independent variables. Among them, 8 variables were quantitative including schooling year, working experience, tapping age, distance between rubber farm and home, annual tapping day, daily yield, material cost and hired labour cost for per unit product. The rest two variables were qualitative and they were measured as dummy variables in the study. Thus, the two dummy variables of products types chosen by rubber farmers were Dummy 1 (1=USS 2 product, 0=otherwise) and Dummy 2 (1=USS 1 product, 0=otherwise).

The estimated regression model results and related statistical tests are presented in Table 4.10. Independent variables included in the model have showed at 67% the variations on profit per kg of rubber firms (R^2 =0.67). The (β) values depicted in quantitative independent variable and (b) values in dummy variables were the estimated coefficient values. Each coefficient (β) demonstrates the amount of change in dependent variable against each 1 unit of change on independent variable holding constant the influence of the other variables in the equation.

The coefficient (b_1) shows the amount of change in dependent variable if rubber firm chosen in USS 2 production and (b_2) shows the impact of rubber firm chosen in USS 1 production on dependent variable (profit per unit product). The existence of any violation of the assumptions made in regression estimation have been tested with variance inflation factor (VIF) and Durbin-Watson statistics in Table 4.10 and the correlation matrix in Appendix 10. Among all of the independent variables, VIF values lesser than 2 indicated that there was no serious multicollinearity problem. Durbin-Watson statistic value 1.80 can be seen that it approached to the benchmark of 2 and that signified the absent of serious autocorrelation and heteroscedasticity problems.

In the light of multiple regression analysis, profit per unit product of sample rubber firms was positively and significantly influenced by firm producers chose in the production of USS 2 and USS 1 products at 1% level ($P < 0.01$) as presented in Table 4.10. It was possible to predict the coefficient values (b_1=85.51) that USS 2 firm producers would lead to increase profit per unit product 85.51 MMK/kg and (b_2=81.15) indicated that USS 1 production would cause an increase on per unit rubber profit 81.15 MMK/kg. The results showed that USS 2 and USS 1 products firm producers would receive more profit because production in these products were a great effect on profit.

Profit per unit product of sample rubber firm was also positively and significantly related to daily yield and annual tapping days at 1% level ($P < 0.01$). The coefficient value (β_6=20.03) indicated that the rose in 1 kg of daily rubber per hectare would increase per unit rubber profit 20.03 MMK/kg. It meant that firm producers increased their daily rubber by using with improve production and processing technologies obviously dominated on profit. Similarly, the coefficient value (β_5=4.95) indicated that the rose in 1 day of annual tapping would increase per unit rubber profit 4.95 MMK/kg. It indicated that firm producers who received higher annual tapping days by lengthening their production period for one more day on full month tapping of their rubber trees (September to May) which also dominated on profit.

Profit per unit product was negatively and significantly influenced by tapping age at 1% level ($P < 0.01$). The beta value (β_3=-10.95) meant that 1 year elder in tapping age of sample firms would reduce per unit rubber profit 10.95 MMK/kg and the less amount of profit by possessing the old rubber trees. Material cost and hired labour cost of rubber firms were negatively and significantly influence factors for profit per unit product at 1% level ($P < 0.01$). The coefficient value (β_7=-2.33) presented as 1 MMK increased in material cost would decrease profit per unit product 2.33 MMK/kg. The beta value (β_8=-0.25) showed that 1 MMK rose in hired labour cost would have a slightly negative effect on per unit rubber profit 0.25 MMK/kg. The results indicated that some of the firm producers suffered high values of material cost and hired labour cost on rubber production.

4.7 General Constraints for Production, Processing and Marketing of the Sample Rubber Firms

In rubber production, almost all of the sample farmers in the study areas had to face different constraints of rubber production, processing and marketing. The farmers' perception of constraints in rubber production, processing and marketing were presented in Figure 4.7. Major constraints mentioned by the sample farmers were price fluctuation, climate change impact and high input price. Over 80% of sample farmers complained about those problems. Insufficient capital, poor access to market information and limited of extension service were faced by about half of sample farmers. Moreover, high transportation cost and skill labour scarcity were also responded by about 33% of sample farmers as their constraints.

Table 4.8 Annual average price, costs and profit for per unit product of the sample rubber firms

(MMK/kg)

Items	Rubber firms FL (n=36)	Rubber firms USS 2 (n=46)	Rubber firms USS 1 (n=47)	Total (n=129)
Annual average price (a)	1,771	1,920	2,061	1,928
Total material costs per unit product (i)	174	150	166	164
Total hired labour costs per unit product (ii)	80	155	191	145
Total family labour costs per unit product (iii)	657	529	626	595
Interest on cash costs per unit product (iv)	25	30	36	31
Total variable costs per unit product (b=i+ii+iii+iv)	936	864	1,019	935
Profit per unit product (a-b)	835	1,056	1,042	993

Table 4.9 Descriptive statistics of variables in rubber profit

(n=129)

Variables	Units	Mean	SD
Profit per unit product	MMK/kg	993	435
Schooling years	year	5	4
Working experiences	year	26	13
Tapping age	year	9	7
Distance between farm and home	km	5.2	0.5
Annual tapping days	day/year	128	27
Daily yield	kg/ha/day	13	8
Material costs per unit product	MMK/kg	164	92
Hired labour cost per unit product	MMK/kg	145	386

Table 4.10 Determinant factors affecting on profit of the sample rubber firms

(n=129)

Independent variables	Unstandardized Coefficients		t value	*P* value	VIF
	β/b	Std. Error			
(Constant)	β_0 = 417.00**	174.70	2.39	0.019	
Schooling years	β_1 = 4.59^{ns}	6.41	0.72	0.476	1.09
Working experiences	β_2 =-2.04 ^{ns}	1.88	-1.08	0.281	1.14
Tapping age	β_3 = -10.95***	3.54	-3.09	0.002	1.16
Distance between farm & home	β_4 = -3.35 ^{ns}	4.09	-0.82	0.414	1.10
Annual tapping days	β_5 = 4.95***	0.93	5.31	<0.001	1.20
Daily yield	β_6 = 20.03***	3.40	5.89	<0.001	1.26
Material cost	β_7 = -2.33***	0.27	-8.66	<0.001	1.12
Hired labour cost	β_8 = -0.25***	0.07	-3.60	<0.001	1.14
Dummy 1 (1=USS 2, 0=otherwise)	b_1 = 85.51***	30.82	2.77	0.006	1.65
Dummy 2 (1=USS 1, 0=otherwise)	b_2 = 81.15***	19.87	4.08	<0.001	1.54
R^2	0.67				
Adjusted R^2	0.64				
Durbin-Watson	1.80				

Note: *, ** and *** denote significant differences at 10%, 5% and 1% levels and ns = non-significant.

4.7.1 Price fluctuation

The most serious problem faced by the sample farmers in Mudon Township was price fluctuation. About 94% of sample farmers mentioned the price fluctuation as a most serious problem. In the study area, when the supply was higher than demand, the price was low while the supply was lower than demand, the price was high.

This phenomenon was due to the concept of supply and demand. In rubber plantation, it takes a long period (7 years) to become economic production stage. In this period, market situation may change with a negative trend by its supply and demand. However, it is difficult to change the investment of rubber production to the other crops enterprises easily as it is quite expensive. This inability to change quickly and a large amount of investment on rubber plantation led price uncertainties and high risk for firm producers. Thus, they claimed that the price was low and highly fluctuated in the study area.

4.7.2 Climate change impact

About 84% of selected sample firms were reported that decreasing yield due to the longer rainy period in the study area. As mentioned in the previous section, rubber trees could not be taped during heavy raining period. Thus, rubber firms should use rain guard tapping method to cope climate change impact.

4.7.3 High input price

High input price was a common problem for rubber production. About 81% of sample firms claimed the gradual high price of inputs including fertilizer and tapping materials, coagulated acid, rubber roller and weeding machine, etc. Therefore, some of firms can use low quality materials and inputs in rubber production and processing activities.

4.7.4 Insufficient capital

In the study areas, insufficient capital on investment was one of the problems for some of firm producers who had less than 2 hectares of tapping area. About 59% of sample rubber firms stated this as a problem. Due to the limited capital, some of USS 2 and USS 1 product firms immediately sold before favourable and reliable the price of the products.

4.7.5 Poor access to market information

Limited market information was also one of the problems faced by some rubber firms in the study area. As rubber prices were highly fluctuated, limited information on market price, demand and supply was also mentioned a problem by rubber firms. About 57% of sample firms disappointed with this problem. As USS 2 and USS 1 products could be stored for a long time, firm producers needed to make decision for these products either immediately sold or stored until the price higher again. In this situation, disseminating of market information services are important.

4.7.6 Limited of extension service

The extension service can give awareness and information concerned with updated high production and processing technologies, new released crop varieties and market information, etc. Only 50% of sample firms received extension services in the study area.

4.7.7 High market transporting cost

In the study area, most of rubber firms sold their products to the traders by means of delivering product system. This led to high cost of transportation for sample farmers. About 33% of sample producers stated this as constraint for them especially sample firms which had a larger distance between selling places and home or farm.

4.7.8 Skill labour scarcity

In rubber harvesting, availability of skillful labour during the tapping period was essential. Unless they had enough skilled labour, rubber yield could reduce. Many people in the study areas migrated to Thailand for job opportunities which led skill labour scarcity. About 33% of sample firm producers mentioned it as a problem.

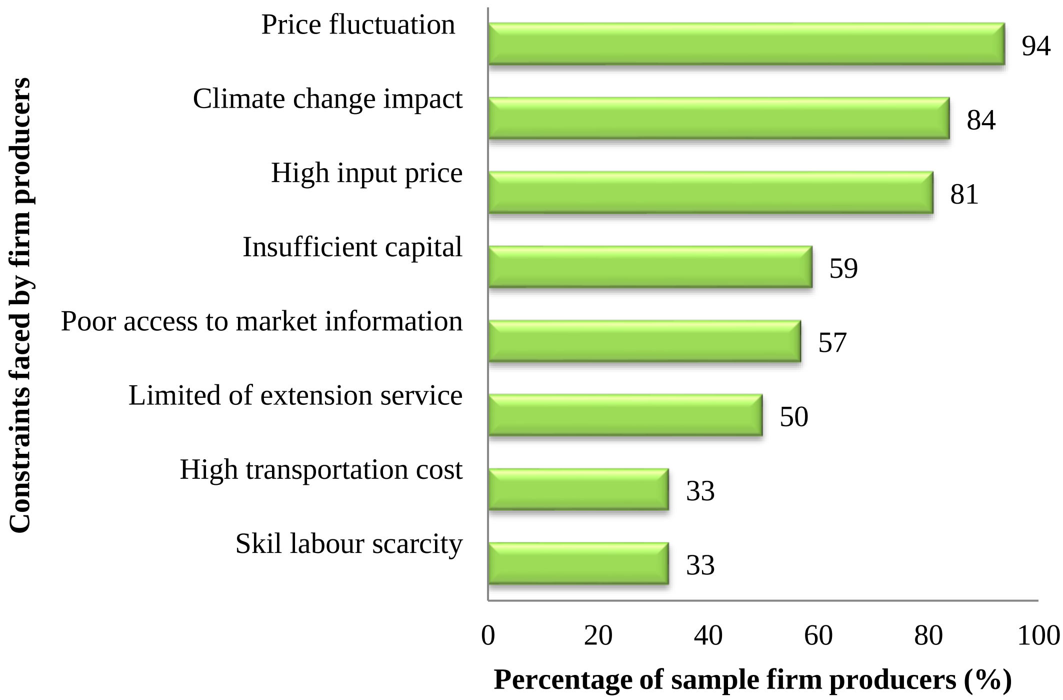

Figure 4.7 Constraints faced by the sample rubber firms

CHAPTER V
SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

In the study area, the average age of both FL and USS 1 products farmers was nearly 52 years old while it was about 50 years in USS 2 product farmers. The working experiences were 26, 23 and 30 years in FL, USS 2 and USS 1 products farmers respectively. The average education levels of all sample farmers were middle school education level. The average number of family labours worked in their rubber fields was 2 persons while they had 4 members of family size. It could be noticed that the majority of firm family members worked in their own fields and rubber was important for creating their job opportunities. It was also found that most of firms had still possessed the traditional farming tools as their productive assets. When comparing farming assets of the three different rubber firms, FL product firms owned relatively smaller number of rubber roller, rubber sheeted house and grass cutting machine whereas the majority of USS 2 and USS 1 products firms had those farm assets.

Rubber stands as the main income source in the study area both in mono income and combined with other sources of incomes. Other sources of income were rice, pulses and fruit tree productions, remittance, own business, job in government and private sectors. Among three different rubber firms, 78%, 59% and 70% of FL, USS 2 and USS 1 product firms had only one rubber income source. In total rubber firms, 30% still needed to improve with using high yield varieties while 29% still needed to use bud grafting method to increase rubber yields.

Among the productive figures of three different rubber firms, USS 2 product firms had the lowest rubber tapping area while USS 1 product firms had the highest in that area. The tapping ages were not much different among them. FL product firms had the lowest numbers of tapping plants per hectare while USS 2 product firms had the highest in that figure. Rubber firms tapped their trees every day or three days tapped with one day rest during tapping period. FL product firms obtained the highest annual tapping days whereas USS 2 product firms had the lowest in that tapping days. The highest annual rubber yield was obtained by USS 2 product firms whereas the figure was the lowest in USS 1 products firms. It was noticed that USS 2 product firms obtained the highest annual yield with the smallest tapping area whereas USS 1 product firms obtained the lowest yield with the largest tapping area. The result of

F test showed annual average yields were statistically significant at 10% level among three different firms. Among the price figures, monthly rubber prices for respective products were highly fluctuated in the study area. Rubber prices were increased when the commodities were scared (from January to March) and prices were decreased when products were plentiful (from October to December). The lowest annual average selling price was received by FL product while USS 1 product obtained the highest in that price. The result of F test showed annual average prices were statistically significant at 1% level among three different firms.

In the comparing of costs and returns figures, total materials costs were 215,930 MMK/ha, 231,113 MMK/ha and 203,247 MMK/ha in FL, USS 2 and USS1 products sample firms respectively. The highest total family labor cost was resulted 819,825 MMK/ha in FL product sample firms followed by 784,806 MMK/ha and 763,805 MMK/ha of USS 2 and USS 1 products sample firms. In hired labour cost, FL product sample firms incurred 99,554 MMK/ha was the lowest when being compared to 221,500 MMK/ha and 233,616 MMK/ha of USS 2 and USS 1 products sample firms. The mean values of total interest on cash costs were 31,549 MMK/ha, 45,261 MMK/ha and 43,686 MMK/ha in FL, USS 2 and USS 1 products sample firms respectively. Thus, the lowest TVCC was 347,033 MMK/ ha in FL product sample firms when being compared to the cash costs 497,874 MMK/ha and 480,549 MMK/ha of USS 2 and USS 1 products sample firms. The lowest TVC was 1,166,859 MMK/ha in FL product sample firms whereas the figures were 1,282,680 MMK/ha and 1,244,354 MMK/ha in USS 2 and USS 1 products sample firms. FL product sample firms received the minimum average RAVCC 1,861,605 MMK/ha when being compared to 2,352,516 MMK/ha and 2,035,504 MMK/ha of USS 2 and USS 1 products sample firms. In comparing RAVC, FL product sample firms received 1,041,780 MMK/ha was the lowest whereas the figures were 1,567,711 MMK/ha and 1,271,699 MMK/ha in USS 2 and USS 1 products sample firms. The mean values of BCR were about 1.89, 2.22 and 2.02 in FL, USS 2 and USS 1 products sample firms respectively.

In profit function analysis, firm producers chose in USS 2 production was measured as dummy 1 variable and chose in USS 1 production was dummy 2 variable. In Mudon Township, profit per unit product of the sample rubber firm was positively and significantly influenced by firm producers chose in USS 2 and USS 1 products production. It was possible to predict that firm producers chose in USS 2 production would lead to increase on profit per unit product 85.51 MMK/kg and they chose in USS 1 production would cause an increase on per unit rubber profit 81.15 MMK/kg. The increment in 1 kg of daily rubber per hectare would obviously increase per unit rubber profit 20.03 MMK/kg. Similarly, the rose in 1 day of annual tapping would increase per unit rubber profit 4.95 MMK/kg. The material costs, hired labour costs and tapping ages on rubber firms were negatively and significantly influence factors on profit per unit product. It was indicated that 1 year elder in tapping ages of sample firms would reduce per unit rubber profit 10.95 MMK/kg. It was possible to interpret that if 1 MMK increment in material cost would decrease the profit per unit product 2.33 MMK/kg as well as 1 MMK rise in hired labour costs would have a slightly negative effect on per unit rubber profit 0.25 MMK/kg.

5.2 Conclusion

In the study area, most of rubber farmers had enough experience and potential for decision making in rubber production because of their ages and working experiences. The majority of rubber firms possessed a range of rubber productive implements depended on the type of product they produced. Farm mechanization was not so much familiar to rubber production except using grass cutting machine. There was not much difference in their demographic characteristics and productive assets except in working experience, possessing of rubber roller, rubber sheeted house and grass cutting machine among the three different rubber firms. In Mon State, there were also a large number of people who have migrated to Thailand. This led labour scarcity and the higher labour costs. In rubber farming, tapping required not only a large amount of labour utilization but also skill labour for tapping. Currently in the study area, tapping was done mostly by farm family members. This led increasing firm income by receiving their family farm labour opportunities. Moreover, the majority of rubber firms had no other income sources and they entirely depended on rubber production. Thus, rubber was important for creating job opportunities and improving rural livelihood in the state. In the study area, about one third of total rubber firms had still needed to improve with high yield varieties and bud grafting to increase their yield.

In comparing productive figures, USS 2 product sample firms gained the highest rubber yield with the smallest tapping area while USS 1 product sample firms obtained the lowest yield with the largest tapping area. This condition highlighted that most of rubber firms were inefficient input used and the more tapping area generated the less rubber yield in the study area. Depending on the nature of product types, FL product firms had no value-added situation so it led the lowest benefit compared to USS 2 and USS 1 products firms. Rubber sheets can be stored for a long time but most of USS 2 product firms sold out their products immediately in order to avoid the losing weight of rubber sheets. However, USS 1 product required more sun drying days and needed to took under a shelter for two weeks in order to get better rubber quality. Accordingly, USS 1 firms producers faced more price fluctuation and more weight loss compared to USS 2 product firms. In the study, USS 2 product firms incurred the highest TVC and TVCC whereas FL product firms had relatively the lowest in these costs. However, USS 2 product firms obtained the maximum RAVC and RATVCC due to their highest yield led the minimum total revenue over these costs. This condition led USS 2 product firms obtained the highest BCR while that of FL product firms were the lowest. It was found that USS 2 rubber firms produced the highest yield per ha and also the most profitable while FL rubber firms produced the medium yield and the least profitable for rubber farmers. In terms of quality, USS 1 product is the best; however, it made lower yield because of weight loss during long shading period and its profit for rubber producers was lower than that of USS 2 product. It can be seen that, the benefit from rubber was more dependent on rubber production rather than quality which determine the price.

The regression results show that firm producers chose on USS 2 and USS 1 production received more profit in the study area. It can be seen that firm producers increased their daily rubber by using improve production and processing technologies obviously dominated on profit. Firms producers received high annual tapping days by lengthening the production period for one more day on full month tapping of their rubber tree which also dominated on profit. The result indicated that some of the firm producers suffered high value of material cost and hired labour cost on rubber production and the less amount of profit by possessing the old rubber trees.

In these situations, traders and local collectors determined the quality and price of rubber sheets by visual inspection and collected all grades of rubber from farmers resulting in low-quality rubber products and uncertain premium rubber price at farm gate marketing. Moreover, quality of rubber products could be improved by using formic acid in coagulating stage. Nearly all of rubber farmers used sulphuric acid with cheaper price because they want to save their production costs. These conditions led lower rubber quality and price compared to other rubber producing countries. In these regards, the current rubber quality improvement and becoming certain premium price could also be another important criterion to obtain more benefit for rubber firms.

5.3 Recommendation

In the study area, the sample firms had been running with profitable condition for all three types of rubber products. In the rubber producing process, there can be seen high labour requirement pointed out there have been an incentive industry of rubber production for growers not only increase income but also the employment opportunity in the study area. Thus, it is important to become sustainable rubber production and processing systems in the study area. In these regards, rubber firms should choose the product type based on price differential and better effected yield. Thus, the government necessary to perform more market information service for decision making in the proper product type choosing of rubber farmers. In the light of study results, value added in FL products are vital for increasing rubber profit.

Thus, government should encourage not only FL rubber farmers to be value added into USS products but also encourage small & medium enterprise and invite foreign investment to be value added into other forms of rubber products such as rubber gloves, slippers, balloons and rubber rings, etc. By this way, it can search a broadening of the market not only export but also domestic. Moreover, it is necessary to focus on quality-oriented rubber production to achieve international rubber standard and market price. To achieve quality, systematic processing techniques including the use of formic acid, high cleanliness of processing materials and uniform sheet making and proper drying methods are important. However, the current rubber production, processing and marketing are highlighted with low efficiency when being compared to other rubber producing countries.

In this situation, the function and involvement of government is very important. Government should be more actively involved in rubber market system especially for controlling on the trading of low-quality rubber products by determining grades and reasonable products prices. Government should also consider to upgrade the current rubber processing firms especially up to the farmers (producers) levels by using education and extension trainings through GAP production practices as well as processing technologies.

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APPENDICES

Appendix 1 Rubber product types export by Myanmar

RSS

TSR

Appendix 2 Rubber firms producing product types at farm gate level

FL

TS

USS 2

USS 1

Cup lump (high quality)

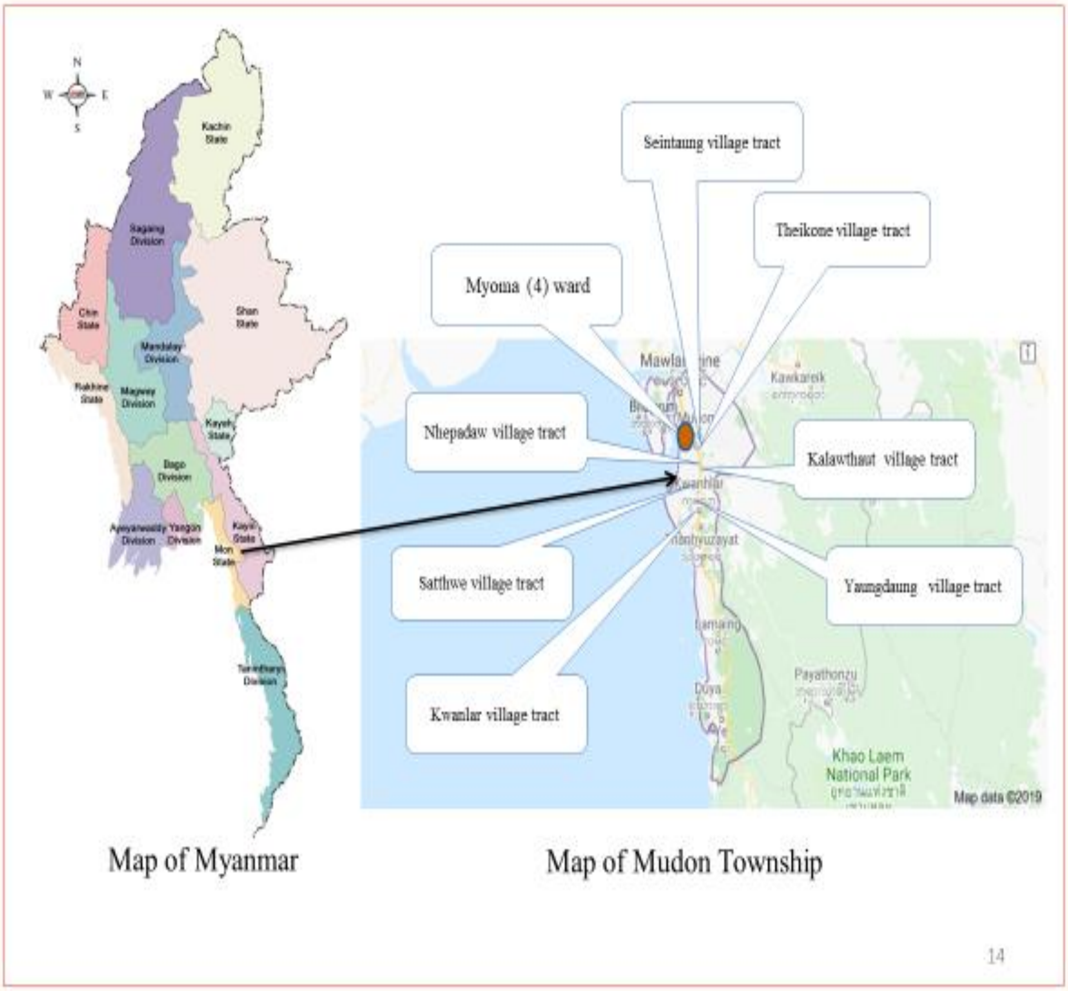
Tree lace (by products)

Appendix 3 Volumes of rubber products export by Myanmar (2015)

Product types	Overseas trade (MT)	Border trade (MT)	Total export (MT)	Percentage (%)
MSR 20	10,373	9,915	20,288	26
MSR 50	962	1,032	1,994	3
RSS 1	40	864	904	1
RSS 3	15,703	36,500	52,203	67
RSS 5	675	1,437	2,112	3
Others	0	17	17	0
Total	**27,753**	**49,765**	**77,518**	**100**

Source: DTPCA (2015)

Appendix 4 Map of sample village tracts and ward in Mudon Township



Appendix 5 Climate and weather condition in Mudon Township (2017)

Months	Rain fall (mm)	Temperature			Relative humidity (%)
		Minimum (˚C)	Maximum (˚C)	Average (˚C)	
January	20.5	11.0	34.5	24.2	68
February	0.0	12.0	36.7	25.5	62
March	0.0	16.0	37.3	27.5	66
April	102.5	18.5	37.5	29.0	74
May	363.5	18.5	36.8	27.7	80
June	783.8	18.5	33.2	26.1	89
July	1,069.8	19.7	31.2	25.6	93
August	678.8	23.4	32.8	25.6	89
September	309.5	23.4	34.0	26.1	87
October	253.5	23.0	34.2	27.0	85
November	22.8	20.4	35.7	26.4	72
December	4.0	16.0	34.5	24.9	66
Annual average	**-**	**-**	**-**	**26.3**	**76**
Annual total	**3,608.5**	**-**	**-**	**-**	**-**

Source: DMH (2017)

Appendix 6 Land used information about Mudon Township (2017)

Type of land	Area (ha)	Percentage
Rice field	26,407	36
Rubber plantation	23,907	33
Forest reserve area	9,003	12
Orchard	5,841	8
Barren	3,844	5
Agro-industrial area	2,521	4
Mangroove	770	1
Grass land	723	1
Total	**73,016**	**100**

Source: DALMS (2017)

Appendix 7 Enterprise budget for FL sample rubber firms

(n=36)

Item	**Unit**	**Level**	**Effective price MMK/unit**	**Total value MMK/ha**
(A) Total Revenue (TR)				
FL yield	kg/ha	1,247	1,771	2,208,639
(B) Variable costs				
(a) Materials costs				
(1) Plant maintenance	MMK/ha	-	-	133,363
- Urea fertilizer	kg/ha	94.09	426	40,027
- Compound fertilizer	kg/ha	135	685	92,478
- Petrol for weeding	liter/ha	1	1,000	858
(2) Tapping materials	MMK/ha	-	-	41,930
(3) Fuel cost for marketing	liter/ha	41	1,000	40,638
Total material cost (a=1+2+3)	MMK/ha	-	-	**215,930**
(b) Family labour costs				
(4) Plant maintenance	MMK/ha	-	-	66,453
- Manual weeding	Man day/ha	6.5	6,000	39,023
- Fertilizer application	Man day/ha	3	6,000	16,281
- Fire protection	Man day/ha	2	6,000	11,149
(5) Tapping family labour cost	MMK/ha			711,258
(6) FL market transporting	MMK/ha	7.02	6,000	42,114
Total family labour costs (b=4+5+6)	MMK/ha	**-**	**-**	**819,825**
(c) Hired labour costs				
(7) Plant maintenance	MMK/ha	-	-	13,104
- Manual weeding	Man day/ha	1.04	6,000	6,244
- Fertilizer application	Man day/ha	0	6,000	2,058
- Fire protection	Man day/ha	1	6,000	4,802
(8) Tapping family labour cost	MMK/ha	14.01	6,000	86,450
Total hired labour costs (c=7+8)	MMK/ha	-	-	**99,554**
(d) Interest on cash cost	MMK/ha	-	-	-

(9) Material costs interest	MMK/ha			21,593
(10) Hired labour costs interest	MMK/ha			9,955
Total interest on cash cost (d=9+10)	MMK/ha	-	-	**31,549**
Total variable cash cost (TVCC=a+c+d)	MMK/ha	-	-	**347,033**
Total variable cost (TVC=a+b+c+d)	MMK/ha	-	-	**1,166,859**
Return above variable cash cost (TR-TVCC)	MMK/ha	-	-	**1,861,605**
Return above variable cost (TR-TVC)	MMK/ha	-	-	**1,041,780**
Benefit-cost ratio above TVC (TR/TVC)	-	-	-	**1.89**
Break-even yield (TVC/price)	kg/ha	-	-	**659**
Break-even price (TVC/yield)	MMK/kg	-	-	**936**

Appendix 8 Enterprise budget for USS 2 sample rubber firms

(n=46)

Item	Unit	Level	Effective price MMK/unit	Total value MMK/ha
(A) Total Revenue (TR)				
USS 2 yield	kg/ha	1,484	1,920	2,850,390
(B) Variable costs				
(a) Materials costs				
(1) Plant maintenance	MMK/ha	-	-	130,722
- Urea fertilizer	kg/ha	102	433	44,245
- Compound fertilizer	kg/ha	127	681	86,477
- Petrol for weeding	liter/ha	0	0	0
(2) Tapping materials	MMK/ha	-	-	40,630
(3) Latex processing	MMK/ha	-	-	40,464
- Latex transporting	liter/ha	28.22	1,000	28,224
- Latex coagulating acid	liter/ha	11.6	1,000	11,600
- Bamboo for sheet drying	no./ha	1.28	500	640
(4) Petrol for market transport	liter/ha	19.3	1,000	19,297
Total material cost (a=1+2+3+4)	MMK/ha			**231,113**
(b) Family labour costs				
(5) Plant maintenance	MMK/ha	-	-	62,609
- Manual weeding	Man day/ha	4.75	6,000	28,271
- Fertilizer application	Man day/ha	1.96	6,000	11,947
- Fire protection	Man day/ha	3.7	6,000	23,408
(6) Tapping family labour costs	MMK/ha	-	-	647,194
(7) Latex processing	MMK/ha	-	-	57,893
- Latex transporting	Man hr/ha	24.69	750	18,518
- Coagulation and sheeting	Man hr/ha	44.35	750	33,260
- Latex sheet drying	Man hr/ha	8.15	750	6,115
(8) Rubber market transporting	MMK/ha	22.81	750	17,110
Total family labour costs (b=5+6+7+8)	MMK/ha	-	-	**784,806**
(c) Hired labour costs				

(9) Plant maintenance	MMK/ha	-	-	15,185
- Manual weeding	Man day/ha	1.51	6,000	9,075
- Fertilizer application	Man day/ha	0.79	6,000	4,768
- Fire protection	Man day/ha	0.22	6,000	1,342
(10) Tapping hired labour costs	MMK/ha	-	-	191,962
(11) Latex processing	MMK/ha	-	-	14,353
- Latex transporting	Man hr/ha	4.78	750	3,583
- Coagulation and sheeting	Man hr/ha	12.68	750	9,509
- Latex sheet drying	Man hr/ha	1.68	750	1,260
Total hired labour costs (c=9+10+11)	MMK/ha	-	-	**221,500**
(d) Interest on cash costs				
(12) Material costs interest	MMK/ha	-	-	23,111
(13) Hired labour costs interest	MMK/ha	-	-	22,150
Total interest on cash cost (d=12+13)	MMK/ha	-	-	**45,261**
Total variable cash cost (TVCC=a+c+d)	MMK/ha	-	-	**497,874**
Total variable cost (TVC=a+b+c+d)	MMK/ha	-	-	**1,282,680**
Return above variable cash cost (TR-TVCC)	MMK/ha	-	-	**2,352,516**
Return above variable cost (TR-TVC)	MMK/ha	-	-	**1,567,711**
Benefit-cost ratio above TVC (TR-TVC)	-	-	-	**2.22**
Break-even yield (TVC/price)	kg/ha	-	-	**668**
Break-even price (TVC/yield)	MMK/kg	-	-	**864**

Appendix 9 Enterprise budget for USS 1 sample rubber firms

(n=47)

Item	**Unit**	**Level**	**Effective price MMK/unit**	**Total value MMK/ha**
(A) Total Revenue (TR)				
USS 1 yield	kg/ha	1,221	2,061	2,516,053
(B) Variable costs				
(a) Materials costs				
(1) Plant maintenance	MMK/ha	-	-	105,401
- Urea fertilizer	kg/ha	55.5	529	23,507
- Compound fertilizer	kg/ha	127	642	81,536
- Petrol for weeding	liter/ha	0.35	1,000	358
(2) Tapping materials	MMK/ha	-	-	41,890
(3) Latex processing	MMK/ha	-	-	47,317
- Latex transporting	liter/ha	33.27	1,000	33,269
- Latex coagulated acid	liter/ha	11.81	1,000	11,812
- Bamboo for sheet drying	no./ha	4.47	500	2,236
(4) Petrol for market transport	liter/ha	8.63	1,000	8,639
Total material costs (a=1+2+3+4)	MMK/ha	-	-	**203,247**
(b) Family labour costs				
(5) Plant maintenance	MMK/ha	-	-	57,256
- Manual weeding	Man day/ha	5.27	6,000	31,584
- Fertilizer application	Man day/ha	2.03	6,000	12,018
- Fire protection	Man day/ha	2.28	6,000	13,653
(6) Tapping family labour costs	MMK/ha	-	-	621,318
(7) Latex processing	MMK/ha	-	-	73,631
- transporting	Man hr/ha	28.47	750	21,358
- Coagulation & sheeting	Man hr/ha	54.47	750	40,857
- Latex sheet drying	Man hr/ha	15.12	750	11,416
(8) Rubber market transporting	MMK/ha	15.46	750	11,600
Total family labour costs (b=5+6+7+8)		-	-	**763,805**
(c) Hired labour costs				

(9) Plant maintenance	MMK/ha	-	-	10,695
- Manual weeding	Man day/ha	1.07	6,000	6,438
- Fertilizer application	Man day/ha	0.49	6,000	2,917
- Fire protection	Man day/ha	0.22	6,000	1,340
(10) Tapping hired labour costs	MMK/ha	-	-	180,170
(11) Latex processing	MMK/ha	-	-	42,751
- Latex transporting	Man hr/ha	7.52	750	5,792
- Coagulation & sheeting	Man hr/ha	42.38	750	31,783
- Latex sheet drying	Man hr/ha	6.9	750	5,176
Total hired labour costs (c=9+10+11)	MMK/ha	-	-	**233,616**
(d) Interest on cash costs				
(12) Material costs interest	MMK/ha	-	-	20,324
(13) Hired labour costs interest	MMK/ha	-	-	23,362
Total interest on cash cost (d=12+13)	MMK/ha	-	-	**43,686**
Total variable cash cost (TVCC=a+c+d)	MMK/ha	-	-	**480,549**
Total variable cost (TVC=a+b+c+d)	MMK/ha	-	-	**1,244,354**
Return above variable cash cost (TR-TVCC)	MMK/ha	-	-	**2,035,504**
Return above variable cost (TR-TVC)	MMK/ha	-	-	**1,271,699**
Benefit-cost ratio above TVC (TR/TVC)	-	-	-	**2.02**
Break-even yield (TVC/price)	kg/ha	-	-	**605**
Break-even price (TVC/yield)	MMK/kg	-	-	**1,019**

Appendix 10 Correlation matrix of variables included in regression analysis

(n=129)

Variables	Y_i	X_{1i}	X_{2i}	X_{3i}	X_{4i}	X_{5i}	X_{6i}	X_{7i}	X_{8i}	D_{1i}	D_{2i}
Y_i	1										
X_{1i}	0.10	1									
X_{2i}	-0.07	-0.04	1								
X_{3i}	-0.14	-0.10	0.15	1							
X_{4i}	-0.06	0.02	-0.15	-0.17	1						
X_{5i}	0.27	0.03	0.00	0.10	0.04	1					
X_{6i}	0.41	0.04	0.01	-0.16	-0.03	-0.30	1				
X_{7i}	-0.59	-0.02	0.03	-0.15	0.12	-0.15	-0.13	1			
X_{8i}	-0.32	0.17	-0.02	0.11	-0.08	-0.13	-0.11	0.13	1		
D_{1i}	0.11	0.01	-0.21	0.07	-0.14	-0.18	0.24	-0.07	0.01	1	
D_{2i}	0.11	0.16	0.20	0.01	0.06	0.07	-0.04	0.05	0.13	-0.54	1

Note: Y_i = Profit per unit product, X_{1i} = Schooling year, X_{2i} = Working experiences, X_{3i} = Tapping age, X_{4i} = Distance between farm and home, X_{5i} = Annual tapping days, X_{6i} = Daily yield, X_{7i} = TMC per unit product, X_{8i} = HLC per unit product, D_{1i} = (1=USS 2, 0=otherwise) and D_{2i} = (1=USS 1, 0=otherwise).