International Journal of Agricultural Technology 2020 Vol. 16(4): 995-1012
Available online http://www.ijat-aatsea.com
ISSN 2630-0192 (Online)

The sustainable rubber management of meeting the FSC standard of Myanmar smallholding rubber farms: A case study in Mon State, Myanmar

Saw, H. S.[1*], Somboonsuke, B.[2] and Yincharoen, A.[2]

[1]Department of Natural Rubber Production, Technology and Management, Faculty of Natural Resources, Prince of Songkla University, Hat Yai Campus, Thailand; [2]Department of Agricultural Development, Faculty of Natural Resources, Prince of Songkla University, Hat Yai Campus, Thailand.

Saw, H. S., Somboonsuke, B. and Yincharoen, A. (2020). The sustainable rubber management of meeting the FSC standard of Myanmar smallholding rubber farms: A case study in Mon State, Myanmar. International Journal of Agricultural Technology 16(4): 995-1012.

Abstract Results showed that farmers had inadequate expertise on four main aspects of sustainable rubber management that were farm management, land ownership, fertilizer usage, and community management. The study revealed that Myanmar rubber industry had not received significantly to support from the government. It is suggested that Myanmar rubber smallholding farms still needed to improve in many aspects in order to meet the Forest Stewardship Council (FSC)- standards. It is concluded that the government should increase to support the smallholder by the aforementioned aspects in order to improve rubber sector in Myanmar.

Keywords: Sustainable rubber management, Myanmar rubber smallholders, Myanmar Rubber FSC's standard

Introduction

In Myanmar, natural rubber production has become one of the fastest-growing sectors among other commodities for many decades. Due to constantly increasing number of manufacturers, market share of the industry is challenged while the quality has been improved to some extent, owing to increase market competition. As Myanmar is regarded as one of the major rubber producing countries in South East Asia, the falling price of rubber has a huge impact on socioeconomic and environmental conditions of smallholders in Myanmar (Oberndorf, 2012; DCID, 2015). The majority of rubber producers are smallholders who own less than 8 hectares of lands and their livelihoods are solely dependent on rubber farms (ANRPC, 2014). The smallholders mainly grow rubber in southern part of the country. The economic well-being of smallholders is mainly dependent on rubber price which has shown a steady

[*] **Corresponding Author:** Saw Han Saw; **Email:** sawhansaw@gmail.com

decline in recent years. In some situations, the production cost may be due to higher than the income. As a result of these impacts from rubber price instability, more and more smallholders who own the aged rubber trees are trying to change their livelihoods by chopping down and shifting their plantations from rubber to other seasonal crops or more profitable crops for their living. In fact, the question for this situation is "where do all these rubber woods go to?" In most cases, rubber woods usually end up in local wood factories for furniture production processes. The rubber woods had been used for local energy consumption. For example, rubber woods are sources of energy for cooking in local restaurants which the price is much lower than rubber woods actually deserved. Experts and scholars for the industry had highlighted that the pattern had adversed a socio-economic and environmental impacts on both growers and the industry. Yee (2008) mentioned that Myanmar had been producing timber for both domestic and export markets while conserving the soil and water of the forest environment. Since Myanmar's economy has been mainly dependent on agriculture, then conservation of water and maintenance of environmental stability should be the national priority not only for the sake of forestry sector but also for agricultural sustainability.

Myanmar's smallholder rubber production situation is to know the background of rubber production in Southern Myanmar that could be traced back to the British colonial era (Keong, 1973). The rubber industry had attracted many smallholding plantation owners during an increased in the price of rubber in the 1990s. Currently, those of smallholding rubber plantations are predominantly found in Mon State, Southern Myanmar. It is found in less percentage in Kayin State, Tanintharyi Region, Bago Region, and Ayarwaddy Region (Kenny-Lazar and Wong, 2016; Zaw and Myint, 2016)). According to MRPPA, as of 2017-2018, recorded that rubber plantations covered 656,924 hectares of the whole country. The rubber plantations in Mon State covered 200,259 hectares and had produced 110,090 tons in 2017-18 (MRPPA, 2018). Majority of rubber holdings are smallholdings with less than 8 hectares which represent 92% in number and 64% in area. Medium-sized holdings of 8 - 40 hectares contribute 8% in number and 25% in area (Myint, 2013 and Global Witness, 2014).

The Forest Stewardship Council (FSC) was founded in 1993, as a result of Earth Summit 1992 in agreement to stop deforestation. The organization was founded by a committed group of businesses, environmentalists, and community leaders with the revolutionary concept to take a voluntary and market-based approach to support environmentally suitable, socially beneficial, and economically viable management of the world's forest (FSC, 2018). FSC is an international organization that provides a system for voluntary accreditation and stands as an independent third-party certification (Forest Stewardship Council,

2015). Environment, social, and economic stakeholders formed FSC certification system as a joint or third-party organization with the ambition to provide environmentally responsible, socially beneficial, and economically practicable management of the world's forests. FSC is the critical connection for the consumers and manufacturers, traders and suppliers who take responsibility for environment and social awareness. FSC certified wood products are 100% trustworthy, and customers can be supported for a well-managed forest to be environmentally responsible, socially beneficial, and economically practicable (Amarasekera *et al.,* 2006). Over the past decade, more than 60 countries had been certified with 42 million hectares according to FSC standards, while several thousand products had been produced by using FSC certified wood (Amarasekera *et al.,* 2006). Farmers with certificates are permitted to sell the aged trees on the market after rubber trees that reached their certain age. This serves as the result of environmentally appropriate, socially beneficial, and economically viable forest management. Meeting the FSC standards, FSC provides a system of certification for businesses seeking to market their products as FSC certified (Forest Stewardship Council, 2015). Previous studies showed that higher cost for the certification seemed quite difficult for most of rubber farmers to earn the certificate. Currently, majority of rubber farmers are not likely to have FSC certificate due to the high cost of certification. But most farmers consider that FSC certified rubberwood system is beneficial in the long-term and will bring significant benefits for their supply chain in FSC certified woods as those woods are usually offered higher price in the market (Amarasekera *et al.,* 2006). However, the criteria and demand of FSC certified forest products have only mainly increased in Europe and UK (Amarasekera *et al.,* 2006) and have not enough influenced in Asia and other developing countries' markets.

Materials and methods

Study location and sample size

The study site is located in Mon State, Myanmar, and the total area of Mon State covers 12,296.6 km^2 (4,747.7 sq. mi). Mon State is the largest rubber-producing region of Myanmar with smallholding rubber farms which produced 110,090 tons in years 2017-2018 (MRPPA reports, 2018). There are six major districts with large city and towns in Mon State, namely Mawlamyine (Capital of Mon state), Thaton, Thanbyuzayat, Ye, Kyaikmaraw, Kyaikhto, Bakwai, and Chaungzon. The study was conducted at two main sites, Mawlamyine and Thaton: two of the most effective and productive rubber areas in Mon State (Table 1).

Table 1. The situation of rubber production in Myanmar 2018

No.	State/Region	Planted Area (ha)	Productive Area (ha)	Yield (kg/ha/yr)	Production (tons)
1	Napyitaw	0	0	0.00	0
2	Kachin	32,590	2,934	667.58	1,959
3	Kayar	27	0	0.00	0
4	Kayin	108,885	68,000	811.31	55,178
5	Chin	4	0	0.00	0
6	Sagaing	5,055	244	470.71	115
7	Tanintharyi	140,626	58,335	694.01	40,492
8	Bago	47,793	20,610	787.27	16,229
9	Magwe	0	0	0.00	0
10	Mandalay	46	0	0.00	0
11	Mon	200,259	131,919	834.39	110,090
12	Rakhine	14,404	1,002	704.06	706
13	Yangon	17,444	3,461	608.91	2,108
14	Shan	74,917	23,476	588.52	13,819
15	Irrawaddy	14,874	1,369	843.14	1,155
	Total	**656,924**	**311,351**	**776.64**	**241,851**

Source: Myanmar Rubber Planters and Producers Association (MRPPA, 2018).

The studied population was 46,519 households, which covered all over Mon State with smallholding households (Applied Research Center for Perennial Crops, Myanmar, The samples were collected from two main sites of Mon State, which were Mawlamyine (Capital of Mon State) and Thaton districts with approximate numbers of 7,753 households and 7,753 households, respectively. Thus, the total population was 15,506 households approximately. “Taro Yamane” sampling method was used for the sample size in this study as follows (Yamane, 1967):

$$n = \frac{N}{1 + N(e)^2}$$

where n=sample size, N=population, e =error of sampling that determine no less than 5%, (e=0.05). So, $n = \frac{15,506}{1+15,506(0.05)^2}$ and n=389 households.

Research tools, data collection and analysis

There were divided to 3 sections in questionnaire that Section I related to social issues, e.g., gender, age, education, occupation, ethnic group, religion etc., Section II related to economic issues, e.g., daily expenses, financial resources, land tenure, taxation, labor situation, production, income etc., and Section III related to environmental issues, e.g., farm management, weed control, wastewater control, soil degradation, conservation, fertilizer control, pollution etc.

Structured interview was developed with the questions related to socio-economic and environmental aspects that used to gather qualitative data from rubber smallholding farms. The descriptive research method was used for data collection and both primary and secondary data were also recorded. Primary data were collected from 389 farms and households by using structured questionnaires for sampling method and in-depth interviews with responsible persons from Mon State. Secondary data were collected from previous studies, papers, documents, internet, website, journals, magazines, and data related to socioeconomic and environmental aspects. Microsoft Excel was used for data analysis with three main types of quantitative questionnaires collected based on social, economic, and environmental aspects answered by Myanmar rubber smallholding farmers.

Results

Social characteristics of smallholding rubber farmer households

Results indicated that the majority of rubber farmers were male for 74.74% and female for only 25.26%. The average age of the farmers was 41.5 years old, and farmers were middle-aged farmers. Being a predominantly Buddhist country, most of the farmers are Buddhists over 86.08%, the rest of 13.92% of farmer households are Christians. In terms of marital status, 86.60% of the respondents were married, 9.28% were single, and the last 4.12% were divorced ones. The educational status of farmers stopped educations at the high

school level. It showed that none of the farmers were uneducated but all farmers were educated enough to pursue alternative livelihoods. Most farmer households had worked at their rubber plantations as the main occupations, and the business was the primary source of income for many households. Findings showed that 86.06% of farmers solely relied on the rubber for their incomes and some farmer households had rice farming as their main occupations which were only 13.92% (Table 2). In terms of household livelihood choices, collected data showed that rubber plantations and rice farming ranked the highest in percentages as traditional occupations for farmers with 30.41% and 30.93%, respectively. Trading, fruit estate, animal farming, and crop farming were minor occupations taken up by farmer households that represented 14.95%, 9.79%, 4.64% and 4.12% percent, respectively.

Table 2. Social characteristics of smallholding rubber farmer households

Social Characteristics	Units	Results
1.Gender	Percentage	Male (74.74), Female (25.26)
2.Age	Year	An average (41.5), Max. (56.6), Min. (26.7)
3.Religion	Percentage	Buddhist (86.08), Christian (13.92)
4.Marital status	Percentage	Married (86.60), Single (9.28), Divorce (4.12)
5.Education	Percentage	Secondary school (56.10), High school (43.90)
6.Main occupations	Percentage	Rubber occupation (86.08), Rice occupation (13.92)

Remark: Sample was a group of 389 rubber smallholders.

Characteristics of labor used in smallholding rubber plantation

Result showed information on labor usage and management details of labor types, labor wages, and labor welfare that provided by farmer households. For average labor of rubber farmer households, there were 3.02 people/household. The most types of labor was worked in rubber plantation were labor's parent and temporary workers or seasonal labors for 65.98%. The owner of rubber plantation was labor's parent , permanently hired labors, and temporary workers were totally covered 24.74%. The rest of household labors for 9.27% were children and relative labors which represented 5.15% and 4.12%, respectively. The averaged labor wage rate was 4,515.46 kyats per day with the minimum and maximum rates at 3,000 and 6,000 kyats, respectively per day. 75.26% of permanent hired labors which provided housing and the rest for 24.74% were only provided living cost from farmer households. According to the study, all temporarily hired labors would be provided with basic health care (Table 3).

Table 3. Characteristics of labor used in smallholding rubber plantation

Labor Characteristics	Units	Results
Household labor	Person	An average (3.02), Max. (5.10), Min. (1.25)
Types of labor in the household	Percentage	Household labor (39.18), Both household labor and hired labor (60.82)
Types of household labor used for rubber plantation	Percentage	Parent labor/Children labor (5.15) Parent labor, Regularly hired labor, Temporary hired labor (24.74) Parent labor, Relatives labor (4.12) Parent labor, Temporary hired labor (65.98)
Wages rate for rubber plantation	Kyats/day	An average (4,515.46), Max. (6,314.45), Min. (3,120.65)
Welfares for regularly hired labor	Percentage	Basic expenses for healthcare and other minor welfares (100.00)

Remark: Sample was a group of 389 rubber smallholders.

Table 4. Land holding characteristics of smallholding rubber farmer households

Land Holding Characteristics	Units	Results
Land acquisition for rubber plantation	Percentage	Received transferred ownership (30 years) (30.41), Lease land (30 years) (40.21), Received land allocated from the government (29.38)
Tax amount for rubber land	(Kyats/year)	An average (12,917.52), Max. (56,000.23), Min. (11,238.45)
Rubber farm size for the tax amount		
1- 5 acres	Kyats/year	1,000-5,000 (25.26)
5-10 acres	(percentage)	5,001-10,000 (18.56)
over 10 acres		More than 10,000 (56.19)
4.Source of information	Percentage	Received the government policy and Extension Staff (17.53), Community leaders (82.47)

Remark: Sample was a group of 389 rubber smallholders.

Land holding characteristics of smallholding rubber farmer households

The study showed characteristics of land ownership, land use, and land utilization related to government sectors. The main type of land used by rubber farmer households was leasing land from government with thirty-year contract which totally represented 40.21%. Other two types of land used by farmers were transferred the ownership and received land that allocated from government of 30.41% and 29.38%, respectively. Rubber farmer households

have no any ownership documents, but operated rubber plantation business were not protected from the government. 56.19% of farmer households had over ten acres of land that paid 10,000 kyats annually for tax while 25.26% of farmer households who owned 1- 5 acres of land paid 1,000-5,000 kyats per year for tax. The rest was 18.56% of farmer households who owned 5-10 acres of land who paid the amount of 5,001-10,000 kyats. 82.47% of rubber farmer households received information on government policies from their community leaders while the rest for 17.53% of farmer households received information from government staffs (Table 4).

Economic characteristic of smallholding rubber farmer households

The average income of farmer households depended on how much land they own. The average farmer households earned 1,144,845.36 kyats per year. The minimum earning rate was 1,000,000 kyats per year while the maximum earning rate was 44,800,000 kyats per year. An average of 602,061.85 kyats per year was used for farmer expenses with the minimum and maximum expenses being at 350,000 and 35,000,000 kyats per year. The average saving rate for the farmer was 524,690.72 kyats per year. 29.90% of farmer households saved less than 1,000,000 kyats per year while 1,000,000 – 5,000,000 kyats were saved at the highest value for 50.52% of farmer households. The rest 40% of farmer households saved at the rates between 5,100,000-1,000,000 kyats and over 10,000,000 kyats which resulted in 10.31% and 9.28%, respectively. Most farmer households had no planned to expand or reduced rubber productions in the next 5 years. 34.54% of total farmer households were planning to expand their production in upcoming next 5 years. 56.72% of farmer households had planned to expand rubber plantations in next 5 years and 43.28% of farmer households had planned to expand their rubber plantations with intercropping (Table 5).

Table 5. Economic characteristics of smallholding rubber farmer households

Economic Characteristics	Units	Results
Earning for household	Kyats/year	An Average (1,144,845.36), Max. (44,800,000.22), Min. (1,240,000.34)
Expenses for household (kyats/year)	Kyats/year	An Average (602,061.85), Max. (35,032,411.55), Min. (350,241.27)
Saving (kyats/year)	Kyats/year	An Average (524,690.72), Max. (760,251.33), Min. (321,156.45)
Planning of rubber farming for 5 years in future	Percentage	Expand rubber plantation (56.72), Intercropping with rubber (43.28)

Remark: Sample was a group of 389 rubber smallholders.

Production management of smallholding rubber farmer household

Findings showed that the average farmer household owned 13.19 acres for tapping area. The average age of rubber trees was tapped at the age of 10.06 years. Most of the farmers planted 210 trees per acres resulted at 45.36% in total. Most of them used the common tree spacing 20x10 feet resulted at 71.13% in total, and the rest used other tree spacing distances such as 18x9 feet, 24x9 feet and 20x11 feet. Mostly found rubber clones within their plantation sites were BPM-24 with 45.88% in total. The frequency for organic fertilizer usage had an average at 1.35 times per year. Only 30.41% of farmer households used organic fertilizer for their plantations and the rest for 69.59% of total farmer households did not use organic fertilizer for their plantations. Chemical pesticide was used by 86.60% of farmers for 1.72 times a year. Only 13.40% did not use chemical pesticide which the prices were between 552.60-910.34 kyats per time. All rubber farmer households practiced weed control with the price ranges starting from less than 69,000 kyats to over 100,000 kyats. Almost all rubber farmers trimmed the branches at the early age of trees and only 4.64% of farmers did not trim their trees at an early age. Only 19.07% of farmers had experienced forest fire and the rest for 80.93% that never had experienced in forest fire problems. The average tapping labor number was 4.10 people and most of them were hired trappers hired by farmer households. 41.32% of rubber farmers practiced 1/2S d2 tapping system. The majority of rubber farmer households produced Unsmoked Sheet (USS) with only 5.39% of farmers produced Ribbed Smoked Sheet (RSS). Every rubber farmer household usually sold their products to local buyers within the price ranges between less than 2,400 kyats and more than 2,700 kyats per kilogram depending on the grades of their products. The average production of rubber farmer was 6,870.65 kilograms per year (Table 6).

Table 6. Production management of smallholding rubber farmer households

Rubber Production Management	Units	Results
Tapping area of rubber plantation	Acre	An average (13.19), Max. (46.23), Min. (2.11)
Age of tapping trees	Acre	An average (10.06), Max. (21.35), Min. (6.11)
Rubber clones	Percentage	BPM24 (45.88), RRIM937 (14.95), RRIM703 (4.64), RRIM712 (4.64), PB235 (20.10), GT1 (4.64), PB260 (5.15)
Tree spacing	Feet	20x11 (14.95), 20x10 (71.13), 18x9 (8.76), 24x9(5.15)
Number of trees per acre	Trees	200 (34.54), 210 (45.36), 220 (20.10)
Using chemical fertilizer	Percentage	Yes (86.60), No (13.40)

Table 6. (con.)

Rubber Production Management	Units	Results
Frequency of chemical fertilizer usage	Times/year	An average (1.72), Max. (2.51), Min. (1.00)
The quantity of chemical fertilizer usage	Kg/acre/time	An average (81.25), Max. (105.11), Min. (52.50)
Price of chemical fertilizer	Kyats/kg	An average (726.19), Max. (910.34), Min. (552.60)
Using organic fertilizer	Percentage	Yes (30.41), No (65.59)
Frequency of organic fertilizer usage	Times/year	An average (1.35), Max. (2.19), Min. (1.10)
The quantity of organic fertilizer usage	Kg/acre/times	An average (80.08), Max. (97.75), Min. (54.21)
Price of organic fertilizer	Kyats/kg	An average (533.89), Max. (921.08), Min. (180.77)
Disease/pest control in rubber plantation	Percentage	Yes (13.92), No (86.08)
Methods of disease\pest control in rubber plantation	Percentage	Using chemical (100.00)
Frequency of disease/pest control in the rubber plantation	Times/year	An average (1.85), Max. (2.56), Min. (1.43)
Expenses for disease/pest control in rubber plantation	Kyats/times	An average (11,016.94), Max. (50,211.32), Min. (9,755.25)
Weed control in rubber plantation	Percentage	Yes (100.00)
19.Frequency of weed control in rubber plantation	Times/year	An average (2.07), Max. (2.18), Min. (1.93)
20.Method of weed control in rubber plantation	Percentage	Chemicals, Tractor, Lawnmower (4.64), Chemicals, Manpower (40.72), Lawnmower (14.43), Chemical (24.74), Manpower (15.46)
Expenses for weed control in rubber plantation	Kyats/times	An average (184,329.89), Max. (712,024) Min. (69,000)
Trimming rubber branches at the age of 0-3 years	Percentage	Yes (95.36), No (4.64)
Having a forest fire problem	Percentage	Yes (80.93), No (19.07)
Practice rubber tapping system	Percentage	1/2S d/2 (41.32), 1/2S 3d/4 (28.74), 1/3S 3d/4 (29.94)
Types of tapping labor	Percentage	Household labor (11.38), Hired tapper (71.26) Household labor, Hired labor (17.37)
Number of tapping labor	Person	An average (4.10), Max. (7.25), Min. (1.20)
Types of production	Percentage	Ribbed smoked sheet (5.39), Unsmoked Sheet (94.61)
Sources of selling rubber	Percentage	Local buyers (100.00)
Production	Kg/year	An average (6,870.65), Max. (18,200.30), Min. (4,100.26)
Local rubber price	Kyats/kg	An average (2,533.53), Max. (2,700), Min. (2,400)

Remark: Sample was a group of 389 rubber smallholders.

Sustainable rubber management indicators of Myanmar rubber smallholding farms

Social indicators: there are 8 social indicators for Myanmar rubber smallholding farms as an access to land and land ownership (land title, available land rights, and land tenures under different categories without deprivation of rights of the other individuals and communities), the farmers' access to knowledge on the best practice of rubber plantation (the best breed, farm management, fertilizer application, tapping system, agriculture techniques for different purposes, and products), co-operatives of farmers are existing and helping with price negotiation, technical support, and financial mechanism access which will generate the knowledge sharing and network of Sustainable Rubber Farmer (SAF), having in place a system and negotiation process to reduce the conflicts and misunderstanding with other individuals and communities, having access and encourage to participate with government agencies to access the training facilities and information, having in place a market information system, opportunities to generate income from other sources apart from existing rubber plantation with accessibility to farmers and apply the rubber integrated system under Sufficiency Economy Theory and access for the farmer to increase technical and management capabilities such as increasing tapping techniques, market analysis, and value-added product (Table 7).

Economic indicators: there were 5 economic indicators as the generated income by applying inter-cropping and integrated cropping such as rubber with annual crop and animal, rubber with animal and fishery, accessed to additional loan with low interest to manage the plantation apart from the Myanmar government support, reduced the cost from casual labor by using more household labor and reduced the cost for chemical fertilizers by replacing with organic fertilizers that produced on site, assessed their household economy by accounting saving and debts and set-up of rubber farmer group structure helped to innovate the value-added (Table 7).

Environmental and farm management indicators: there were 9 environmental and farm management indicators as land tenure right, land ownership, tax payment which are presented and farmer own land legally, no use of chemical fertilizer, promoted to use of organic fertilizer, intercropping and multicrop were applied, pruning activity for rubber unproductive period (1-until tapping year of rubber, accessed and used the high-quality breeding and planting materials that is qualified and resistant to diseases and climatic conditions, used the tapping system under Myanmar Government Guidelines which should not be more frequently than 2 days in a row, no tapping when the

tree is immatured, applied the recommended fertilizers from Myanmar Government and added about human-animal conflict resolution system in place and around rivers and HCV map existing (Table 7).

Table 7. Economic characteristics of smallholding rubber farmer household

Social aspect	Economic aspect	Environmental and farm management aspect
Access to land and land ownership – land title, available land rights, and land tenures under different categories without deprivation of rights of the other individuals and communities	Generate income by applying inter-cropping and integrated cropping (such as rubber with annual crop and animal, rubber with animal and fishery, etc.)	Land tenure right Land ownership, Tax payment are present Farmer own land legally
Access by farmers to knowledge about best practice of rubber plantation such as the best breed, farm management, fertilizer application, tapping system, silviculture techniques for different purposes and products	Be able to access to an additional loan with low interest to manage the plantation apart from the Myanmar government support.	No use of chemical fertilizer Promotion and use of organic fertilizer
Co-Operative of farmers are existing and helping with price negotiation, technical support and financial mechanism access which will generate the knowledge sharing and network of Sustainable Rubber Farmer (SAF).	Reduce the cost from casual labor by using more household labor. reduce the cost for chemical fertilizers by replacing with organic fertilizers produced on site	Intercropping (1-3 rubber-year-olds and multicrop (>3 rubber years olds) to be applied
Having in place a system and negotiation process to reduce the conflicts and misunderstanding with other individuals and communities.	Assess their household economy by accounting saving and debts	Pruning activity for rubber unproductive period (1-until tapping year of rubber).
Having access and encourage to participate with government agencies to access the training facilities and information	Set-up of rubber farmer group structure that will help to innovate the value-added products from rubber apart from selling crude rubber latex, cup lump only.	Access and Use the high-quality breed and planting material that was qualified and resistant to diseases and climatic condition such
Have in place a market information system		Use the tapping system under Myanmar Government guidelines which should not be more frequently than 2 days in a row.

Table 7. (con.)

Social aspect	Economic aspect	Environmental and farm management aspect
Opportunities to Generate income from other sources apart from rubber plantation exist and are accessible to farmers		NO tapping when the tree is immature
Apply the rubber integrated system under sufficiency Economy Theory		
Access for the farmer to increase technical and management capabilities such as increase tapping techniques, market analysis, and value-added product		Apply the recommended fertilizer formula from the Myanmar Government
		We should add about human-animal conflict resolution system in place
		Around rivers and HCV map existing

Remark: Sample was a group of 389 rubber smallholders.

Relationship between Myanmar sustainable rubber management criteria (MSRMC) and FSC standards

Result explained the relationship between FSC principles and MSRMC as follows: compliance with laws and FSC principles reflected on the social aspect of MSRMC, tenure, land use rights and responsibilities corresponded with economic aspect of MSRMC, concerned with indigenous people's rights and customary rights of ownership related to both social, environmental and farm management aspects of MSRMC, stated to maintain social and economic well-being of local communities which reflected on both social and economic aspects of MSRMC, benefits from the forest should be faced sustainability and stability of economic and social status, presented to conserve and restore ecosystem, mitigating negative environmental impacts corresponded to the environmental and farm management aspects of MSRMC, The most aspects were respectively stated the benefits from the forest, management plan, monitoring, assessment and management plan with social, economic and environmental criteria that set by FSC organization to reflect on all three aspects of MSRMC and maintenance of high conservation value forest conformed to the environmental and farm management aspect of MSRMC (Table 8).

Table 8. Relationship between Myanmar sustainable rubber management criteria (MSRMC) and FSC standards

FSC 's Principle	The Application FSC's Principle to Natural Rubber	MSRMC		
		Social	Economics	Environmental and Farm Management Aspect
Compliance with laws and FSC Principles	Rubber Farmers who will manage rubber plantation must be approved for rubber forest management and have to respect and obey laws regulated by that country	•		
Tenure and land use rights and responsibilities	Rubber farmer needs to be specified for the right of land ownership, processing of work, and using benefits from the rubber plantation area		•	
Indigenous peoples' rights	Rubber farmer has to respect the rights of local people living in the community of local plantation without creating conflict	•		•
Maintain the social and economic wellbeing of local communities	Rubber farmer must create relationships with community and maintain rights of working labor in their farms	•	•	
Benefits from the forest	Rubber farmer has to process the management of production and market effectively with also having sustainability and stability of the economic and social status	•	•	•
Environmental impact	In managing rubber farm, the farmer needs to limit the effect that affects the environment by no using chemical but try to improve organic agriculture in their farms			•
Management plan	Rubber farmer has to be set the management plan such as written, implemented, and kept up to date, the long term objectives of management, and the means of achieving them shall be clearly stated.	•	•	•
Monitoring and assessment	Rubber farmer should be Monitoring and assessment conducted: appropriate to the scale and intensity of forest management, to assess the condition of the forest, yields of forest products, chain of custody, management activities, and their social and environmental impacts.	•	•	•
Maintenance of high conservation value forests	Rubber farmers have to manage the activities in high conservation value forests shall maintain or enhance the attributes, which define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach.			•
Plantations shall be planned and managed in accordance with Principles and Criteria 1 - 9 and Principle 10 and its Criteria.	Rubber farmers should complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests.	•	•	•

Discussion

The research finding indicateded that many factors are still required to promote by Myanmar rubber smallholdings farms in order to meet FSC standards. According to the interviews with MRPPA officials, the rubber industry has none or very little supported from the government over the past decades. First of all, the government should encourage rubber growers and manufacturers to practice sustainable methods to meet FSC standards in the future. However, farmers should follow the practice instructed by MRPPA, HIDA (Human Resource and Industrial Development Association), and Japan which is currently working to promote sustainable rubber production in Myanmar. The study indicated that further study is needed to investigate in detail on how to set up sustainable and systematic rubber sectors to meet the FSC certification. It is suggested that government central rubber markets should be established in rubber-producing regions that will help rubber growers to sell their produced rubbers easily, controlled and announced the daily price officially and helped the buyers to obtain the correct grades of rubber as well.

Lastly, all farmers should have the official land ownership documents from the government, which is under the Vacant, Fallow and Virgins management law (Myint, 2012). Their lands should comply with the laws to follow the government's rules and regulations and land taxation payment. It is observed that almost all of the rubber growers used chemical fertilizers and the number of farmers who used organic fertilizers was very little or none. Thus, the government and authorized organizations should promote farmers to use more organic fertilizer instead of chemical fertilizer for sustainable environment. The government should promote the advanced knowledge and training for building capacity for intercropping and multiple-cropping system with rubber farms to earn more income with sustainable environmental practice (Kenny-Lazar and Wong, 2016). The government or any other private organizations should provide the recommended rubber clones for the growers that are suitable to their regions to be possible meet the best yield and should be useful for rubberwood after service age. The rubber growers should follow the rubber tree management system under the guidelines of MRPPA collaboration of IRRDB. For example, tapping should not proceed when the trees are at an immature age and should only apply the recommended fertilizers.

The growers should have the official land certificates from the government without having any conflicts or problems with individuals and any other societies. The government or private organizations should investigate the livelihood of growers to really understand their needs and wants. Setting up rubber communities across the region will help improve information sharing

and networking among growers. The government should also concern about the farms that are close to religious places, ethnic races, and human-animal conflicts to ensure that these rubber farms do not have any conflicts among the religious places, ethnic group, and endanger animals.

Training for building capacity is required for growers to increase the production of quality rubber to meet the international standards consistently which can give growers better price compared to the local price (Soe, 2004). The study suggests that Group Processing Factories (GPF) should be built for smallholders who are not able to produce good quality rubber on their own. Some advantages of GPF are related to that factory can produce good quality rubber, reduce the processing cost, labor cost which growers can finish their daily work earlier, and factory is easy to be managed (Barlow *et al.*, 2011). The research finding showed that only few growers practice intercropping system in their rubber farms. Thus, growers should practice more intercropping system and multiple-cropping system in their farms to earn more income with sustainable environmental practices (Viswanathan, 2008). The government should also support long-term financial loans for growers to promote rubber sectors with sustainable rubber practice. In brief, Myanmar rubber industry has developed to some extent compared to a few decades. Rubber industry becomes much different because of private organizations and international organizations that have collaborated together and helped to improve rubber sectors. However, the government organization still needs to be supported by many aspects to improve rubber sector.

Acknowledgments

First of all, I would like to express special thanks to my main advisor who supported everything for this work, Prof. Dr. Buncha Somboonsuke, Department of Agricultural Development, Faculty of Natural Resources, Prince of Songkla University. I would also like to thank Assoc. Prof. Dr. Sayan Sdoodee, Chairman of Natural Rubber Production, Technology, and Management, Faculty of Natural Resources, Prince of Songkla University for his willingness and guideline. Prince of Songkla University has gorgeously supported funding for this work. Lastly, I would like to thank the managers from Naunggalar Rubber Estate NRE, Mon State, Myanmar, who helped to collect the valuable data for this work. My huge thanks to Myanmar Rubber Planters and Producers Association for supporting data provided for this work.

References

Amarasekera, H. S., Perera, P. K. P. and De Silva, N. (2006). Potential of Forest Stewardship Certification (FSC) as a marketing tool through examining the existence of price

premiums for FSC Certified Timber. Available from: http://dr.lib.sjp.ac.lk/handle/123456789/354 [Accessed 16 June 2017].

ANRPC (2014). Annual report. Kuala Lumpur: Association of Natural Rubber Producing Countries.

Barlow, C., Jayasuriya, S. and Tan, S. (2011). The world rubber industry. 2nd ed. Abingdon: Routledge.

Department of Industrial Crop Development (DICD) (2015). The annual report of DICD 2014. Ministry of Agricultural and Irrigation. Nay Pyi Daw.

Forest Stewardship Council (2015). FSC Principles and Criteria for Forest Stewardship. Available from: https://ic.fsc.org/preview.fsc-principles-and-criteria-for-forest-stewardship-fsstd-01-001-v5-2-en-print-version.a-4843.pdf [Accessed 4 June 2017].

Forest Stewardship Council (2018). 25 Years of FSC. Available from: https://fsc.org/en/page/about-us [Accessed 8 May 2017].

Global Witness (2014). What future for the rubber industry in Myanmar? Available from: http://www.globalwitness.org/library/what-future-rubber-industry-myanmar_[Accessed 6 June 2017].

Kenney-Lazar, M. (2016). Assessment of governance mechanisms, livelihood outcomes and incentive instruments for Green rubber in Myanmar. Bogor: Center for International Forestry Research (CIFOR).

Kenny-Lazar, M. and Wong, G. (2016). Challenges and opportunities for sustainable rubber in Myanmar. Centre for International Forestry Research (CIFOR), 154.

Keong, V. P. (1973). The rubber industry of Burma, 1876-1964. Journal of Southeast Asian Studies, 4:216-228.

MRPPA (2018). Overview of natural rubber industry in Myanmar, Myanmar Rubber Planters & Producers Association.

Myint, H. (2013). Rubber planting industry in Myanmar: current situation and potentials. (Presentation: ASEAN Plus 2013 Rubber Conference). Phuket, Thailand.

Myint, H. (2012). Vacant fallow and virgin lands management rules. The Republic of the Union of Myanmar: Ministry of Agriculture and Irrigation. Available from: http://www.burmalibrary.org/docs14/VFVM_Rules-en.pdf [Accessed 21 August 2017].

Oberndorf, R. B. (2012). Legal review of recently enacted farmland law and vacant, fallow and virgin lands management law: improving the legal & policy frameworks relating to land management in Myanmar. Land Core Group (LCG) of the Food Security Working Group (FSWG), Yangon, Myanmar.

Soe, T. (2004). Myanmar in economic transition: Constraints and related issues affecting the agriculture sector. Asian Journal of Agriculture and Development, 1:57-68.

Viswanathan, P. K. (2008). Emerging smallholder rubber farming systems in India and Thailand: A comparative economic analysis. Asian Journal of Agriculture and Development, 5:1-20.

Yamane, T. (1967). *S*tatistics, An introductory analysis, 2nd Ed., New York: Harper and Row.

Yee, S. (2008) Information on situation of Myanmar Teak, hardwood & rubber plantation in Brief: Promotion of rubber wood processing technology in the Asia-Pacific region.

Proceedings of the ITTO/CFC International Rubber Wood Workshop December, 8-10, Haikou, China.

Zaw, Z. N. and Myint, H. (2016). Common agricultural practices and constraints of natural rubber industry in Myanmar. Songklanakarin Journal of Plant Science, 3:1-8.

(Received: 23 July 2019, accepted: 20 June 2020)