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# Evaluation of 'greenness' in the manufacture of Ribbed Smoke Rubber sheets and bulk rubber by SMEs: A case study

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## Abstract

Smallholders engage in manufacturing ribbed smoked rubber sheets (RSS) and bulk rubber at small and medium scale level enterprise level (SMEs). The 'greenness' (manufacturing efficacy, profitability and benefits to people and the planet) was assessed using a questionnaire survey (n=60) in Kalutara, Kegalle, Gampaha and Kurunegala districts focusing on material recycling, minimization of hazards, energy and wastes, skilled labour and safety, optimum resource usage and cost effectiveness. Data were analyzed using SPSS software. Skilled labour was mainly provided by males >60 yrs. Only 15% processing centers were in par with recommendations of manufacturing of high quality RSS (grade1) which are sold at a high price. Although SMEs had a good networking among latex suppliers, they were not checking the quality of latex being brought. SMEs were aware of the safety aspects during the use of chemicals, maintenance of machinery but had not paid attention on costing aspects other than the cost for chemicals, production efficacy, optimization of resource use, minimization of smoke emissions, hazards and risks in the working environment, release of waste products, saving energy and water, use of ecofriendly material for wrapping, multitask storage and transportation. The reasons for their poor knowledge in greening aspects could be due to their 'trial and error' working pattern, negligence on the recommendations provided, and not getting involvement of the younger generation, who may be much aware of the aspects given above. SMEs involved in rubber latex processing are not 'green' at present, hence conducting awareness on cost effectiveness, material use efficacy, minimization of environmental impacts during production and strict adherence to recommendations is vital for the efficiency, profitability and sustainability of the sheet rubber manufacturing SME's.

# 1. Introduction

## 1.1 Rubber Industry in Sri Lanka

Latex of Rubber (*Hevea brasiliensis*) is used to manufacture a wide range of products; industrial and surgical gloves, toys, footwear, tires & tubes, hoses, accessories and many more. Sri Lanka's natural rubber has a high global demand due to its best quality. With the increase of the demand for natural rubber at the current pandemic situation the demand and prices for good quality rubber sheets has been increased. As a producer Sri Lanka had a current market share of 0.6 percent (2018) of the global natural rubber market (https://www.rubberstudy.org/sri-lanka). Sri Lanka's 78,206 MT rubber production accounted for US$ 30 million export earning in 2020 was increased to US$ 1 Bn in 2021. In 2015 the Government of Sri Lanka has validated a "Sri Lanka Rubber Industry Master Plan 2017-2026" to promote further the rubber industry development to ensure sustainable delivery of added value products to the market and the country intends to increase it further to US$ 3 Bn by 2025 (https://www.Srilanka business.com/news/rubber-product-sector-achieved-1-bn-target-in-2021. html). There are more than 100 rubber and rubber-based export companies in Sri Lanka and about 50,000 workers are employed in these firms (both BOI and non-BOI). The rubber industry provides livelihoods to about 300,000 people via direct and indirect jobs. (EDB, 2021)

## 1.2 Green Manufacturing

Going "Green" has become the newest trend in many sectors and disciplines. As far as Sri Lanka is concerned, in the recent past, various programs have been conducted with the view of popularizing this concept and encouraging green practices. The term "Green" has been used as a more or less an interchangeable term with "sustainability" which entails taking a holistic view of the environmentally, socially and economically friendly human activities. Tim Baines et al (2012) emphasized the usage of key words such as "green", "environmentally clean" or "cleaner", "ecological" or "eco-efficient" in production sector and defined "Green production" as the application of environmentally and socially sensitive practices to reduce the negative impact of various aspects of manufacturing activities while, at the same time, harmonizing the pursuit of economic benefits.".

Green Manufacturing is defined as an environmentally friendly way of conducting a production process to increase the profitability and benefits to people and the planet. It encompasses environment responsible activities throughout the life cycle of a product such as the

optimization of the efficiency of the operations by saving water and energy, reducing of pollution and waste, maintaining resource efficiency, and occupational hygiene of the workers. Adopting green practices is advantageous to the manufacturer to achieve products that fits into a sustainable economy by improving business competitiveness, lowering their operating costs, access to new markets, and increasing resilience. (Baines et al. 2012, Mafini & Loury Okoumba, 2018, Sathana et al, 2019).

There is no doubt that green practices among the SMEs involved in manufacture of rubber sheet can help to achieve the sustainability of the rubber product sector.

### 1.3 Ribbed Smoke Sheet (RSS) production in Sri Lanka

As a raw material Ribbed Smoked Rubber sheets (RSS) contribute for 40% of the natural rubber demand for industrial products. Many smallholders adopt a group approach as SMEs for manufacturing of Ribbed Smoked Rubber sheets up to 40 kg of rubber per day (Tillekeratne *et al*, 2003). Simplicity and low cost of the processing machinery, easily adaptable processing technology applicable to large volume of latex had been key reasons that popularize RSS production in Sri Lanka since 1909 (RRISL 2014).

RSS are graded into six categories along a gradient of high to low quality; RSS No.1X, RSS No. 1, RSS No. 2, RSS No. 3. RSS No. 4 and RSS No. 5 (bulk) respectively, based on physical appearance of sheets. Generally, the high quality grades are transparent and low quality ones (especially the bulk) are opaque sheets. The grading also reflects the degree of cleanliness of the rubber sheets resulted in due to maintenance of the precision levels during the manufacturing process.

High quality RSS categories are auctioned at a high price compared to the low quality ones (Table 1). Nevertheless only a small percentage of RSS is produced by the SMEs to reach the best quality (RSS No. 01) and the majority is being sold to a low price as the bulk. Thus it is of utmost importance that the SMEs pay attention to improve the manufacturing process to produce a higher proportion of RSS of superior quality to benefit the industry and themselves.

**Plate 1:** Rubber sheets of different RSS categories.

*Source:* Face Book- Lanka Rubber Merchants

**Table 1:** Comparison of the Average Prices for high RSS (RSS1) and low quality (RSS3) quality sheet rubber at Colombo Rubber Auction (2010- 2020).

| Year | RSS 1 (Rs) | RSS 3 (Rs) |
|---|---|---|
| 2010 | 402.71 | 390.63 |
| 2011 | 513.05 | 492.45 |
| 2012 | 416.27 | 395.13 |
| 2013 | 376.78 | 360.70 |
| 2014 | 285.76 | 268.50 |
| 2015 | 245.93 | 235.18 |
| 2016 | 238.97 | 231.36 |
| 2017 | 337.27 | 324.5 |
| 2018 | 281.64 | 253.93 |
| 2019 | 288.44 | 272. |
| 2020 | 387.33 | 348.33 |
| 2021 | 477.5 | 425 |

*Source:* Rubber Research Institute

Latex of rubber needs to be transformed to sheet rubber which is a suitable form for manufacture of variety of rubber goods. This is conducted at factory level in plantation companies were as the small holders conduct it in small -scale units. It is mandatory to follow all recommended procedures to produce high-quality sheet rubber and this does not

involve any additional costs. The only requirement is the strict adherence to the procedures recommended by the authorities.

The process of RSS production consists of the following recommended steps (RRISL, 2014).

i) Latex collection and straining: rubber latex is obtained through tapping of mature rubber trees methodologically by shaving a thin strip of the bark of the tree halfway round the tree trunk.
Latex collected are strained through gauze to remove dirt at the latex- collection centers, the volume and the dry rubber content is measured.

ii) Standardization of latex: this process requires the latex to achieve the correct consistency, hence it is diluted by adding water and allow to settle in bulk-trays.

iii) Re-straining helps to purify the latex by further removal of dirt particles.

iv) Preparation of diluted acid solutions of formic acid is done according to the given procedures and safety guidelines.

v) Addition of acid and removal of froth: this step is necessary and carried out under safety guidelines

vi) Coagulation: the trays will be closed with a suitable sheet and kept undisturbed until the rubber latex is coagulated.

vii) Milling: the coagulated rubber is passed through rollers to remove the water and made into thin layers suitable for drying

viii) Washing of the sheets is done by soaking them in water.

ix) Dripping is necessary to get rid of the excess water

x) Smoking: this is done in a smoke house constructed either in a traditional way as per the recommendations of the RRISL, however takes 4-5 days to finish the drying process. Recently, a more efficient method of drying smoke house is designed and introduced by RRISL (single -day drying smoke house). A traditional type of a smoke house contains a chamber to which the rubber sheets are loaded.

xi) Grading and storing of the sheets: The dried sheets are removed from the smoke house and inspected thoroughly by holding against the light and graded

**Plate 2:** (A) Conventional smoke house

*Source:* RRISL

**Plate 2:** B) One day frying cabinet

*Source:* http://archives.dailynews.lk/2012/09/06/news43.asp

This study was conducted to assess the extent of adoption of green practices in the manufacture process of Ribbed Smoke Sheets by Small and Medium Scale Enterprises. The study also identified current weaknesses and/or lapses in RSS manufacture and suggest recommendations.

## 2.0 Methodology

### 2.1 Source and data collection

Sixty respondents were randomly chosen from the list of RSS manufactures available at the RRISL and visited between February - April 2021. These represented major rubber growing areas: Kalutara, Kegalle, Gampaha and Kurunegala districts.

### 2.2 Questionnaire Survey

A qualitative approach was adopted to answer the research questions arranged in a form of Questionnaire consist with two sections A and B. Section A consisted with general information of the SME owners and Section B contained modified questions based on Melegoda *et. al.,* (2020). The 48 questions were categorized into six aspects: (i) planning; reuse/recycling of material, minimization of hazards and wastes, effects on the environment, safety of employees (ii) raw materials and suppliers; safe delivery and storage of quality raw materials, networking with suppliers, (iii) costing; cost effectiveness, optimum space and resource usage (iv)

production; reduce resource wastage, maintenance of machines, sorting wastes for recycling and disposal, control of gas emissions and release of effluents, saving of energy and water (v) product storage; safe and suitable conditions, use of ecofriendly material, multitask storage and transport, (vi) worker's health; skilled labour and occupational health and safety aspects.

The questions were designed to obtain responses on Likert scale (1 to 5 ranks for 'Strongly disagree',' Disagree', 'Neutral', 'Agree', 'Strongly agree' respectively) and additional notes and observations were made during face to face interviews. The respondents read the questions, interpret what is expected and then marked the answers by themselves.

The consent of the respondents was taken before requesting information for the questionnaire. During the survey anonymity and privacy of all respondents were regarded highly, and confidentially.

Data were analyzed using SPSS version 25.

## 3.0 Findings and Discussion

Skilled labour force for production of RSS was supplied by males (86.7%) between age (45-60), majority being over 60 years. Most of them had school education up to G.C. E. (ordinary level), and did not have vocational education or training either. Although majority (68.3 %) were members of 'Thurusaviya' society, they were not under any subsidy scheme for operation.

SMEs were aware of the production techniques, however majority (53.3%) of the processing centers of SMEs smoke houses of traditional type built according to recommendations of RRISL. However 21.7% had traditional type of smoke houses and these were of non-recommended type as per the officials of the RRISL. Only 15% centers were in par with an updated one- day- drying -system recommended by RRISL for efficient manufacturing of quality products. Those who had one-day drying system and/or recommended type of traditional smoke houses were able to produce the best grade of RSS (RSS1). Several authors have proven the advantages of the one day drying system as it reduces the drying time and increase the drying efficiency and properties (Ratnayake, 2010) and decrease the global warming potential and cost of manufacture (Dunuwila et al, 2018). To improve the product quality further, a solar-heated rubber sheet dryer can also be developed.

As majority of the SMEs intend to produce 'bulk rubber' instead RSS, they have been continuing the curing process in a non- recommended way. The use of recommended type of

smoke houses and curing methods would have given them an opportunity to produce superior quality RSS which could have sold at a high price than the bulk rubber.

SMEs had a good networking among suppliers of latex, and had suitable storage facilities, but were not concerned on the quality of latex being brought. They were not aware of the costing aspects at all and seems to be not 'bothered' except for the cost that they pay for the chemicals, probably due to the unawareness on cost effectiveness, optimum space and resource usage or material use efficacy in the manufacturing process.

Respondents had a fair knowledge on the basic safety aspects during use of toxic chemicals and the majority were wearing rubber boots and gloves while handling chemicals. They were also well aware on proper maintenance of the utensils and machinery (rollers) used, and had attended to regular maintenance (lubrication and repair) of the rollers. However, they were not concerned on harmful impacts on exposure to wood smoke in the smoking process of the sheets. Almost all respondents used rubber wood to provide the energy during smoking, and were used to be exposed to the cloud of smoke produced within. The respondents were aware of the suitable locations for construction of smoke houses in their farmlands. Although many of them had selected the center location of the land to minimize hazards and disturbances to the neighborhood there had been few instances where complaints were made by the neighborhood when smoke was carried away out of the smoke house to the environment. It was reported that many respondents had incorporated biodegradable items and 'already used items' during construction of the processing centers.

SMEs were used to sort rubber waste before discarding, however, they were not aware on aspects such as efficacy of the resource use, minimization and eco- friendly way of smoke emissions, release of other waste products (especially the used untreated water to the environment), methods of saving energy and water use, minimization of wastes, release of effluents and safety of workers. It was noticed that SMEs had paid poor attention on these aspects during the planning process. Almost all SMEs had no idea on the need of skilled labor or prior training for production efficiency, the need to minimize hazards and risks in the working environment, storage and transport of products, the use of ecofriendly material for wrapping, multitask storage and transportation, and the importance of the safety measures that could be considered throughout the life cycle of the product. A Life cycle analysis conducted by Dunuwila et al, (2018) also identifies that disobeying to the standards by SMEs is the prime cause for the high uncertainties of the volume and cost of raw materials used for RSS

manufacture. Dayaratne and Gunawardana (2014) also conclude that, "….the SMEs are still reluctant to adopt energy-efficient and environmentally sound technologies due to their inherent characteristics and resistance to change." The reason for their poor knowledge in greening aspects and resistant to change could be due the fact that most of SMEs had been continued as a secondary income, a property that inherited from their parents and managed by a group of elder group of citizens working at a 'trial and error' basis. However, they expressed their interest to be modernized with regard to manufacture process but complained about labor shortage and lack of involvement of younger generation equipped with much boarder knowledge on related technological aspects. Another main obstacle for 'not being interested' was the financial instability due to the varying rubber prices. RSS and price are influenced by political stability, macro-economic fundamental, weather conditions, inflation, crude oil prices interest rates and government policies. To meet high demand of RSS, several factors are to be put into consideration, such as production capacity, input and processing costs, price differential with synthetic rubber and technological changes.

However, over the past two years the rubber prices have been significantly increased and this could be considered as an encouragement at present.

RSS manufacture creates substantial amount of waste water in several stages; water collected in the containers, wasted during wet milling and released directly to the environment. According to Gamaralalage et al (2016), 3-5 l of water is required per production of one kilogram of RSS and released without any treatment. This could be avoided if water with reuse of water or using water of substandard quality.

In general, processing of rubber sheets is considered as one of the activities that has deviated from greenness. (Ranaweera, 1991), Although rubber industry is well-established in Sri Lanka, treatment of rubber wastewater is an unsettled issue. Research is underway at RRISL to develop a productive mechanism of the use of this water.

## 4.0 Conclusion

This study reveals that the SMEs involved in RSS processing are not being uplifted to a 'green' status and need improvements in many aspects. Hence it is vital task of the authorities to make them aware about transforming into a green practices that could contribute for the efficiency, profitability and sustainability of their business and protection of the environment.

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