

# Barriers to Optimize the Upstream of the Tea Smallholding Supply Chain in Sri Lanka

Sri Lanka is the world's fourth-largest tea producer and prime orthodox variety supplier. In Sri Lanka, tea export earnings peaked in 2014 at USD 1.56 billion, and the industry managed to record USD 1.3 billion in 2021, regardless of the increased cost of production and lower yields. The majority (75%) of total tea production is supplied by tea smallholders whose land extent is less than ten acres [1]. Tea is grown in 14 districts, and smallholder farmers play a significant role in Rathnapura, Galle, Matara, Kandy, Kalutara, and Kegalle districts. Smallholder farmers cultivate 61% of the total tea-grown land, which amounts to 200,000 hectares. According to the Tea Small Holdings Development Authority (TSHDA), approximately 75% of smallholder land plots are less than one acre, demonstrating the notable contribution of micro-level farming to the industry [2].

In comparison to its competitors, Sri Lanka's tea estate land productivity is relatively low. The yield per hectare (YPH) in Sri Lanka is 1,532.8 kgs, while in Kenya, it is 21,77.2 kgs, and in India, it is 2,143.3 kgs. Possible causes for the low YPH include slow replanting rates, ageing plant stock, soil fertility degradation, lack of attention to proper agricultural practices, and other supply chain vulnerabilities. Currently, the Center for Supply Chain, Operations and Logistics Optimization (SCOLO) and the Department of Transport Management & Logistics Engineering (TMLE) of the University of Moratuwa is involved in a project to enhance lean practices of the tea smallholders' supply chain through digitalization with the assistance of NORHED II grant (Grant ID-68085) in collaboration with the University of Stavanger, Norway. This project plans to employ "risk-based thinking" along with ISO standards (ISO 9001:2015 and 14001:2015) to minimize the waste in tea in the supply chain [3]. The primary objective of this project is to empower farming communities while adding value to Sri Lanka's tea supply chain.



Figure 1: Workshop held for smallholder farmers in Kolonna area.

As a part of this project, SCOLO is conducting a series of workshops for tea smallholders to provide inspiration to transform their businesses through digitization. Based on data collected during such a workshop, we attempted to identify the barriers to improving lean practices in the tea smallholding supply chain in Sri Lanka. According to the TSHDA, proper report maintenance is lacking among tea smallholder farmers resulting in many supply chain inefficiencies. The main goal of the workshop series is to encourage farmers to properly maintain reports while also gathering data for the researchers at SCOLO to make inferences on the present state of the tea smallholder supply chain. Maintaining proper reports is an important first step toward digitization. This can be followed up by digitalization and, finally, digital transformation. The data was gathered through informal discussions with farmers, tea inspector officers, and assistant regional managers. Later, this data was analyzed and summarized into a fishbone diagram to discern the barriers to optimizing smallholder farmers' tea yield and quality. The fishbone diagram, derived by triangulating the information collected during the workshops, is shown in Figure 2 [4].

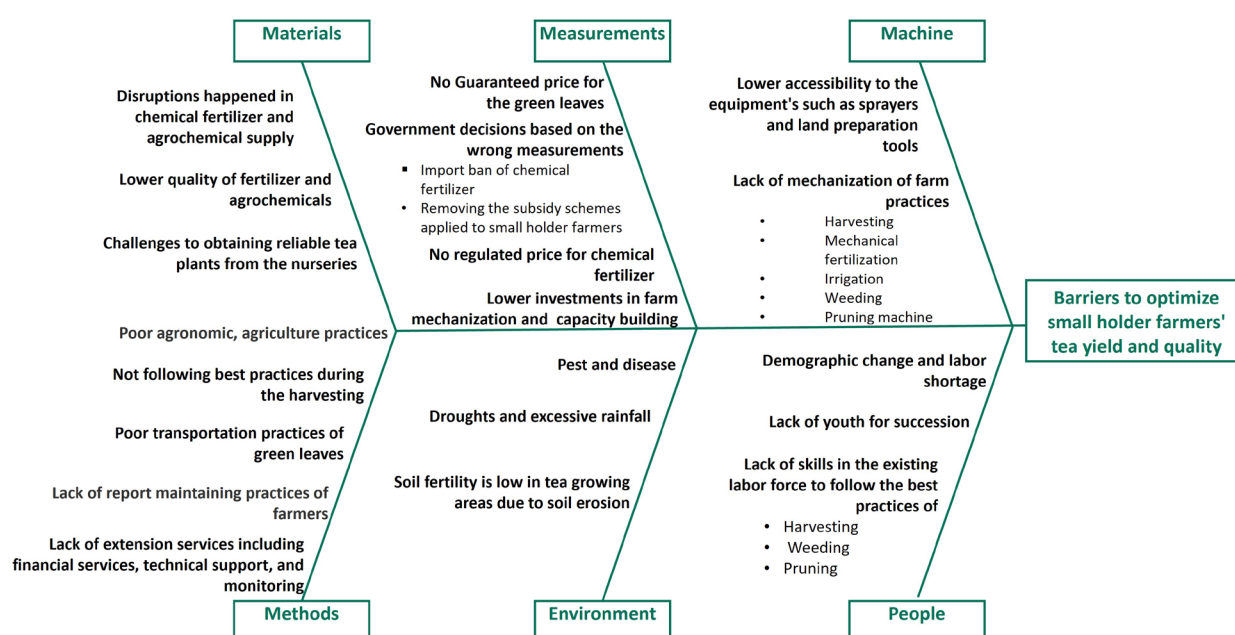


Figure 2: Root cause analysis: Barriers to optimizing smallholder farmers' tea yield and quality

As per Figure 2, six categories of barriers that affect to the tea yield and quality have been summarized. According to tea industry practitioners, the lack of materials, including chemical fertilizer, agrochemicals, and reliable tea plants, has significantly impacted tea yield and quality. Smallholder farmers use vegetatively propagated tea plants which are clonal hybrids. These clonal hybrids need proper nitrogen quantities to give their maximum annual production of more than 3,000 kg of tea per hectare. The types and amounts of fertilizer needed for a tea field depend on the plant's age and the soil fertility. Failure to apply the proper amount and quality of fertilizer results in yellowish tea leaves and reduce the tea grade. In addition to the fertilizer issue, farmers purchase tea plants from tea nurseries that are not authorized by the TSHDA, which lowers both quality and productivity.

Good agronomic and agricultural practices are essential for growing healthy tea bushes. When farmers do not methodologically maintain tea bushes, it significantly impacts the overall yield. Farmers are instructed to harvest green leaves every 6–7 days to maintain quality. However, due to labor constraints, they harvest in every 10–11 days. Further, farmers are reluctant to use special crates provided by the TSHDA to collect tea leaves, and it degrades the quality of the harvest [5]. As previously stated, the lack of proper reporting practices is an inherent problem in the system of tea smallholder farmers. According to the TSHDA, one of the most difficult challenges in tracking farmers' poor agronomic and agricultural practices is the lack of

proper report maintenance. This problem leads to hidden inefficiencies in the supply chain, affecting tea yield and quality. In addition to the farmers' poor agricultural and operation practices, the shortcomings of extension services such as financial services, technical support, and monitoring result in a decrease in tea yield and quality.

The lack of a guaranteed price for green leaves is a major issue that smallholder farmers are facing. Farmers are arbitrarily offered different prices by tea factories, and it demotivates them. In addition, the government decisions such as the ban on the import of chemical fertilizer and the reduction of small holder farmer subsidy schemes negatively impact the tea yield. Lower investments in farm mechanization and capacity building are significant impediments to optimizing smallholder farmers' tea yield. Further, not having a regulated price for fertilizer is significantly increasing the cost of production. Environment factors, pests & disease, droughts & excessive rainfalls, and lowering soil fertility due to soil erosion negatively affect the tea yield.

Shortages of farming tools such as sprayers and land preparation tools were highlighted by farmers as a barrier to smooth operations. In Sri Lanka, the tea small holding sector is still highly dependent on traditional farming methods and a lack of mechanization is a constraint to increasing productivity. For instance, smallholder farmers who use mechanical irrigation methods obtain 300–400% more tea yield compared to farmers who follow normal practices. Therefore, the lack of mechanization of harvesting, fertilization, irrigation, weeding, and pruning processes could be highlighted as barriers to optimizing tea yield.

All the farmers affirmed that one of the major issues they face is a shortage of skilled workers. Other barriers, such as improper agricultural and harvesting practices, stem from the labor issue. The tea small holding sector is facing a major challenge due to a lack of skilled workers to carry out harvesting, weeding, and pruning. Furthermore, the next generation of smallholder farmers is abandoning the industry owing to lower profitability and other industry challenges. As an industry, the lack of youth succession is a major challenge that must be addressed.

The next step in the research is to simulate the aforementioned barriers and assess their impact on tea yield and quality. The ultimate objective of this research is to empower smallholder farmers by maximizing the tea yield, quality, and income through a digitalized solution.

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