2016 International Conference on

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Sustainability Accounting for Eco- innovations: The Case of Commercial Tea Plantations Industry in Sri Lanka

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Discovered about 2700BC, tea (*Camellia sinensis*) is the manufactured drink most consumed in the world. With its 5 million tonnes of annual production (Chang, 2015), tea industry places a significant role in the world beverage market. Among the tea producing and exporting countries, Sri Lanka is on the top and Ceylon tea always demands premium prices due to its high quality (Sri Lanka Tea Board- SLTB, 2015). However, the gradual escalation of the cost of production within the past two decades has made the commercial tea plantations in Sri Lanka gradually loss making. Thus, the future of the commercial tea plantations in the country would be uncertain unless there are real breakthroughs achieved in terms of productivity and marketing. Productivity improvements leading to economic success should be achieved while preserving the eco systems of the plantations and enhancing the social justice. It is in this context, eco-innovations become crucial in the plantations sector to progress towards the goal of sustainable development through reducing impacts on environment or achieving a more efficient use of resources (European Commission, 2012). While much has been written on eco-innovations in the manufacturing sector, there is a dearth of research on the same in the plantations sector in general, and in the tea plantations in particular. The study is important at a time when the tea industry in its future outlook, "tea 2030", identifies the competition for land and productivity as one of the ten challenges that the industry is facing (Forum for the Future, n.a). Hence, the paper attempts to address this gap by focusing on how sustainability accounting can be used to foster eco-innovations in the Sri Lankan plantations sector through the concept of *Strip-Spreading of Tea Bushes* (SSTB).

Under commercial conditions, a tea plant is trained into a dwarf and dense bush (Tea Research Association-TRA, 2015) of between 0.6 to 1.3 meters of height with spread branches purely for the convenience of harvesting. Commercial tea bushes are subjected to

periodic pruning almost every four years or so, with the objectives of rejuvenation, attain high quality crop, and control bush height. Yet, this pruning process causes fluctuating productivity levels over the pruning cycle, high cost of weeding and other agricultural inputs, continuous soil degradation, due to the sudden loss of bush canopy at the beginning of pruning cycle. Further, the conventional way of training/spreading tea bushes by tipping after pruning, has limitations on expanding the bush frames and takes 36- 42 months to re-develop the canopy cover causing serious stress on tea plant and gradual debilitation of same. The concept of *SSTB* instead of *Conventional Tipping of Tea Bushes* (CTTB)[1] after pruning, offers the opportunity of early re-establishment of canopy by engineering existing bush frames of tea, resolving many of the negative factors inherent in the present practice while ensuring a sustainable tea sector for the planet.

An experimental study was launched in year 2015 in Hapugastenne Tea Garden .(lat 6.872°, lon 80.530°), Maskeliya, Sri Lanka to determine the impact by early re-establishment of bush canopy by *stripe-spreading* in after pruning. The purpose was to ascertain and compare regeneration of bush frame by *stripe-spreading* method (treatment) against current conventional post pruning practice of *tipping* (control). Randomly selected 10m X 20m experimental plots in clusters of four pairs of replicates were established in Vegetatively Propagated Tea (VPT) fields aged between 25 to 54 years from planting at three different elevation ranges. Recovering tea bushes from pruning were allowed to grow up to 120 days and then, radial spread of shoots was done using tight parallel stripes arranged along the tea rows instead of *tipping* in the treatment plots, whilst practicing conventional *tipping* in the control plots declared adjoining them with the same cultivar of tea. Both experimental and control plots were treated alike, with all other agricultural practices. Data was collected paying special attention to crop harvested, canopy cover area in both *treated* and *control* plots in the next 60 days. The results were analyzed from economic and environmental perspectives mainly to be in line with eco-innovations perspective. In analyzing results, both monetary and physical sustainability accounting information was used to compare the results.

It was observed that in the treatment area, bush canopies developed to 1.5m^2-2.6m^2 by 05 months from pruning, forming 85-95% ground cover overlapping branches with neighboring

[1] Conventional *tipping* refers to trimming of growing shoots of recovering tea bushes from pruning, to a level parallel to the ground, to obtain a green carpet surface for the convenience of harvesting.

tea bushes (refer Annexture 02). Whereas, bushes in the control plot developed only 0.45m – 0.75m canopy area whilst achieving 30- 40% ground cover (refer Annexture 01).

The economic perspective of this eco-innovation was measured mainly through monetary sustainability information such as productivity, cost of foliar spray[2] and weeding cost. Treated plots gave 30-35% rise in crop compared to control plots at 150-180 days. The wastage of foliar spray inputs was minimal on the treated plots due to greater and thicker bush canopy area (refer Annexture 02), whereas over 50-60% of the same was wasted and reached ground level promoting weed growth in the control section due to minor bush canopy (refer Annexture 01). Consequently, a marked reduction in weed growth in treatment plots too was observed resulting 30-40% lesser weeding cost compared to control plots.

The positive environmental impacts in the treatment plots, which were mainly assessed through physical sustainability information, were harnessed mainly due to the canopy area development (Harris, 1992). This increased the natural resource use efficiency of tea bushes such as sunlight, moisture and reduced foliar spray wastage. In addition, the treatment plot had shown the ability to protect tea soil by enclosing from exposure to direct sunlight and rainfall, enhancing soil moisture retention whilst preventing erosion and degradation of soil, assuring healthy growth of the tea bush.

Moreover, from a social perspective the treatment plot resulted in better income for the workers due to improved land productivity. Conservation of soil, improved the water sources and the quality of water for the workers and community in general. While some of these monetary and physical benefits were quantified others were not yet done since the study is ongoing.

The results show that *SSTB* is a promising eco-innovative tool to engineer existing bush frames to re-establish quick canopy cover in tea, when pruned, compared to *CCTB*. SSTB is capable of giving additional in-situ monetary benefits to the estate, worker community and broader benefits at national and global level by safe, efficient resource utilization and minimized pollution. In this study, these benefits were supported and convinced by careful

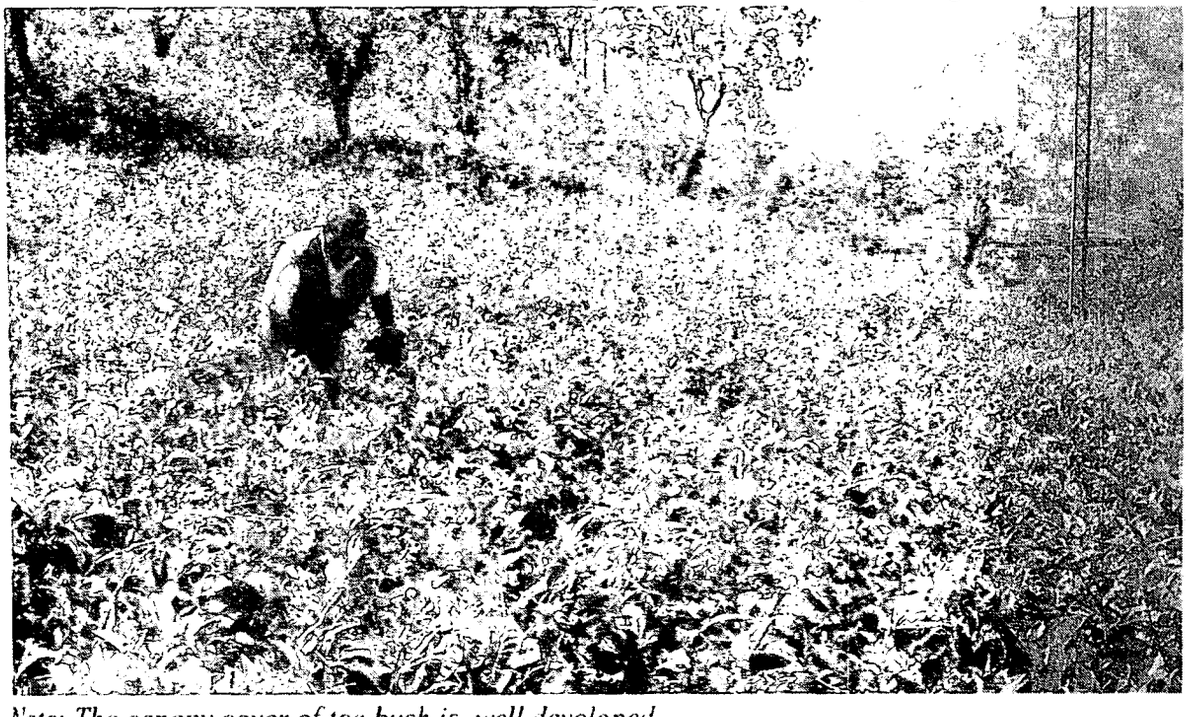
[2] Foliar spray is the direct application of agricultural inputs as watery droplets on crop foliage expecting a quick response.

application of physical as well as monetary sustainability accounting information. Future work will lead to ascertain other possible applications and benefits of SSTB in many different lines of sustainable agriculture.

Annexture 01: Tea field under *conventional tipping* at 18 months from pruning

Note: Tea land is still open for waste of resources & growth of weeds.

Annexture 02: Tea field under strip- spreading at 05 months from pruning



Note: The canopy cover of tea bush is well developed.