Comparative Analysis of Manual and Mechanical Tea Harvesting

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Introduction

Harvesting operation was critically defined as the most labour intensive and most costly field operation at a tea plantation and therefore the need of innovative strategies to setup for this step was highlighted by the economic evaluations. The setting for a new strategy in harvesting became more difficult and caused to more criticisms, because the economic profitability and quality of output were two different ends of a product or an output. Therefore, the developing of integrated approach to assure the better output requires great potential. The concept of mechanical harvesting was given an innovative potential to the plantations as the best solution for labour shortage at the harvesting operation. Therefore the plantation people were looking for a better harvesting approach from that. However, the leading solution from existing mechanical harvesting is not efficient to overcome the labour shortage and high cost of production. This research is to evaluate the impacts of mechanical harvesting using the experimental data obtained for harvesting with different mechanical devices against the manual harvesting.

Methodology

Second year Vegetative Propagated (VP) tea field was alienated and plot was made which included 3000 tea bushes. Uniformity of each bush was assured with the age, soil quality etc. Field experiment was conducted with the Completely Randomized Block Design that followed 3 treatments, 3 replicates and 3 blocks. There were 3 treatments namely machine (T1), shear (T2) and manual harvesting (T3). Three blocks were established in terms of the variability of slope at the land (A, B, C). Therefore the nuisance factor was the slope. Each block was divided into three plots that each had 333 plants. These plots were again divided into three sub plots that each had 111 plants. Plot which consisted of 111 plants was taken as one replicate and therefore one block contained three treatments and three replicates and altogether 09 experimental units. Three blocks contained total 27 experimental units. Randomization procedure was done by using the lottery method. Independent variable was the method of harvesting. Profitability of each method was reviewed by concerning the various aspects of output including the indicators for productivity and quality. Those dependent variables are the yield (Kg Ha Round^{-1}), Acceptable flush (%), Harvesting capacity (Ha Day Labour^{-1}), Productivity (Kg Day Labour^{-1}), Cost component 01 (Cost Ha Round^{-1}), Cost component 02 (Cost GL^{-1}). Quality of harvested green leaves was monitored by concentrating on harvesting policies and shoot growth pattern. Data collection was carried out for 10 consecutive plucking rounds.

Results and Discussion

The results of turkey comparison at General Linier Model revealed that significance of each variable towards the evaluation of harvesting methods ($p<0.05$). Table 1 shows that capacity of machine harvesting is significantly higher compared to both shear and machine harvesting. Non-selective harvesting nature of machine does not emphasize the need of harvesting policy maintenance during the operation and time allocated to harvest unit area is very limited and achieved the highest harvesting capacity per day.

Productivity at machine, shear and manual harvesting were significantly different for each treatment (Table 2). It was the highest at machine harvesting because the machine can harvest more shoots per unit time, but shear is a selective harvesting option. Therefore it takes more time to harvest the same quantity of flush compared to machine harvesting. Therefore, though the shear is a mechanical harvesting option, its productivity is low in compare to machine harvesting. Manual harvesting conveyed the lowest productivity because this is directly affected by the labour efficiency.

Table 1. Mean of harvesting capacity.

Harvesting method	Mean	Grouping
Machine	0.179	A
Shear	0.087	B
Manual	0.069	C

Table 2. Mean of productivity.

Harvesting method	Mean	Grouping
Machine	30.8	A
Shear	24.2	B
Manual	18.6	C

Table 3. Yield component.

Harvesting method	Mean	Grouping
Machine	159.8	B
Shear	241.4	A
Manual	248.2	A

Table 4. Best leaf %.

Harvesting method	Mean	Grouping
Machine	53	C
Shear	55	B
Manual	57	A

There was significant variation in between the yield of machine and shear harvesting and also in between machine and manual harvesting (Table 3). But there was no significant variation in between the yield of shear and manual harvesting. Because the selective and non-selective nature of harvesting operations are differently affected to the yield components. However, selective harvesting that removes the standard shoots leaving arimbus, and can minimize the deterioration of sink capacity of the tea bush while non-selective harvesting removes almost all the shoot generations without leaving arimbus. (Wijerathne, 2001). Because of that, machine harvesting reduced the yield at field. Best leaf percentage at machine, shear and manual harvesting were significantly different with each other (Table 04). Machine harvesting is a non-selective harvesting method; therefore it harvests coarse leaves and arimbus as well. Then leaf standards are depressed and cause to reduce the best leaf % at machine harvesting. Though the shear is a mechanical device, due to its selective harvesting, harvested flush contains less amount of damaged leaves and coarse leaves compared to machine harvesting. Manual harvesting showed the highest best leaf percentage, because it was engaged with the fully selective harvesting.

Table 5. Cost component 1.

Harvesting Method	Mean	Grouping
Machine	7020.9	B
Shear	7402.9	C
Manual	11587.6	A

Table 6. Cost component 2.

Harvesting Method	Mean	Grouping
Machine	44	B
Shear	30.6	C
Manual	46.7	A

Result of Turkey comparison indicated that the cost per hectare at machine, shear and manual harvesting were significantly different (Table 5). Manual harvesting was shown the highest unit cost per hectare, because the labour allocation for manual harvesting was significantly high with the highest Labour Per Hactare (LPH) value in manual harvesting. Also number of days required to harvest one hectare was approximately high (1.249) in manual harvesting. Shear harvesting showed next highest cost component. Though the machine harvesting demonstrated the lowest LPH, more man hours was consumed to harvest one hectare (1.737 days) compared to man hour requirement in shear harvesting (1.248 days). Therefore, concentrating both man

hour requirement and labour allocation rate, machine harvesting has the lowest cost component to harvest one hectare. Though the machine harvesting showed the lowest LPH value, due to the low yield per hectare demonstrated significantly a higher value for unit cost per 1 kg of green leaf compared to shear harvesting (Table 6). Cost of shear harvesting per kg of green leaf was comparatively low because the LPH value was low and the yield per hectare value was comparatively higher.

Table 7. Leaf standards.

Harvesting Method	Immature shoots (%)	Standard Shoots (%)	Immature Banji (%)	Mature Banji (%)	Coarse leaves	Damaged Leaves
Machine	13	41	12	14	2	16
Shear	9	42	15	19	1	14
Manual	8	42	15	19	1	14

Leaf damage is a drawback with the machine harvesting. The leaves get damaged due to the presence of a sharp blade and while pushing the leaves into the collecting bag by rotating plastic blade at harvesting edge of the machine. Therefore, bad leaf component (coarse leaves+ damaged leaves) was higher in machine harvesting. Dormant shoots (banji) percentage was higher at each method due to prevailing dry weather and the harvesting nature (Table 7). Plucking round of machine and shear harvesting was higher compared to manual harvesting. The plucking round for manual, shear and machine harvesting was 8 days, 9 days and 10 days respectively. This may be due to the continuous removal of immature shoots/arimbus which decreased the shoot density. 46 to 58 days were taken for the shoot generation after the manual harvesting and more than 58 days were taken by the shear and machine harvesting.

Conclusions

Manual harvesting was ensuring the highest quality in the output compared to other two methods. Then shear is also maintaining the plucking policies in acceptable ranged where it was much weakened in machine harvesting. Shoot growth was much higher in manual harvesting where the adaptation for prevailing weather patterns also in a good condition. Shear is also has preferable shoot growth. Therefore shear is a very effective and efficient harvesting approach that emphasized both quality and quantity of output towards the enhancement of economic sustainability at the plantation sector.

References

Wijerathne, M.A., 2001. Shoot growth and harvesting of tea. Tea Research Institute of Sri Lanka Thalawakelle.