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## **THE INFLUENCE OF MECHANICAL PLUCKING MACHINES ON EMPLOYEES INCOME IN SOTIK TEA COMPANIES LIMITED, BURETI DISTRICT, KENYA**

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### **Abstract**

Tea industry is a major foreign exchange earner for the Kenyan economy. Kenya is the third largest producer of black tea in the world after China and India. Tea has put Kenya on the world map with over fifty countries importing Kenyan tea. The country contributes 10% of the total global tea production, commands a remarkable 27% of the global tea exports hence the global export leader. Besides providing foreign exchange, the tea industry supports close to 3 million Kenyans directly and indirectly. It forms one of the key pillars in the Agricultural sector, contributing 14% of the Agricultural GDP and 4% of the Gross Domestic Product. Tea plucking is one of the major operations in tea production and constitutes 60-70% of production cost. Due to large cost component and continued declines in the long term prices of tea, companies have opted to reduce costs through the introduction of tea plucking machines. This study undertook to find out the extent to which the adoption of the plucking machines had affected employees' income in Sotik Tea Company Limited, Bureti District Kenya. The study analyzed the influence the use of mechanical tea harvesters had on employees income among the over 600 employees who were involved in both hand plucking and machine plucking in the company. Chi-square test and univariate analysis of variance were used to test the relationship between machine plucking and employees income at a p value of 0.05. From the results, it was established that the adoption of the mechanical plucking machines had no statistically significant effect on employees' income in Sotik Tea Company as the incomes from the machine pluckers and the hand pluckers were comparable. There is need for the tea companies to embrace and adopt mechanical tea harvesting

as employees income was not significantly affected by the use of mechanical tea harvesters and for the sustainability of the tea sector due to the ever escalating cost of hand plucking.

Key words — machine plucking, hand plucking, production costs, employees' income.

## 1 Introduction

Tea industry is a major foreign exchange earner for the Kenyan economy. Kenya is indeed the third largest producer of tea in the world after China and India (Food and Agriculture Organization (FAO), 2005). Tea has therefore put Kenya squarely on the world map with over fifty countries importing Kenyan tea. The country contributes 10% of the total global tea production and commands a remarkable 27% of the global tea exports with Sri Lanka coming second at 26% (FAO, 2005). Kenyan tea export for the year 2010 and 2011 was valued at Ksh.97,489.7 billion and 109 billion respectively (Kenya National Bureau of Statistics (KNBS), 2011, Tea Board of Kenya (TBoK), 2012). This was in comparison to coffee and horticultural exports which were valued at Ksh.20,140.9 billion and Ksh 29,282 billion respectively for the same period. Besides providing foreign exchange, the tea industry also supports close to 5 million Kenyans who are directly and indirectly employed by the industry (Tea Board of Kenya (TBoK), 2014). Indeed the tea sub-sector is the largest sub-sector in the agricultural sector in Kenya.

Agricultural wages earned by laborers in the tea industry is a major source of livelihood for households in Bureti District, Kenya. The earnings constitute a major source of income for these households, enabling them to educate their children, access health care facilities and thus improving their general social status. However, due to depressed tea prices in the world market and increasing cost of production, multinational companies have opted to reduce production costs by introducing mechanical tea harvesting. This had elicited industrial unrest in these companies particularly in Kenya since the year 2006 due to perceived negative socio-economic influence of the machines on employees involved in plucking. Consequently, manual workers especially pluckers had resisted attempts to introduce mechanized tea harvesting and pruning as many workers were paid per weight of harvested green tea leaf and therefore machines use may mean no work for them. While these machines presented a major cost cutting strategy for companies, there was a general perception among workers that the machines could reduce income for employees employed in tea plucking thereby changing and affecting their livelihood.

Tea plucking is a crucial and costly operation in the process of tea production. The operation is labour intensive - constituting up to 70-80 per cent of the total cost of green leaf production (Institute for Himalayan Bioresearches Technology, 2000; Sotik Tea Companies Limited, 2009; Tea Research Institute of Sri Lanka 2008). According to Tea Research Institute of Sri Lanka (2008), manual plucking in major tea growing countries like China, India and Kenya is the highest single component of cost of production (COP) of tea and harvesting accounts for about 35% of the COP as a result of its labour intensive nature. Hindu Business Line (2000), the manual hand plucking labour cost is the largest cost component in tea production but can be reduced by 60% through tea plucking mechanization. In Kenya labour cost increases annually by between 10-12% with relatively static real tea prices globally (Collective Bargaining Agreement (CBA) between Kenya Tea Growers Association (KTGA) and Kenya Plantation Agricultural Workers Union (KPAWU), 2008/2009). This necessitated the introduction and use of

mechanical tea harvesters to mitigate the ever escalating production costs. This may have resulted into lay-off of workers especially the manual hand pluckers as one machine may lay off an average of between 15-20 people. Apart from employees' lay-offs, the machines may have affected workers by reducing their working hours which could have directly affected pluckers' income. Since many employees in Sotik Tea Company depended on manual plucking and pruning for their livelihood as a source of income, the introduction and use of the plucking and pruning machines may likely affect their income levels. This is because most of the fields that were being plucked by hand would be put under machine plucking thus leaving many hand pluckers with few hectares to pluck. This could have resulted to high competition and scrambling for the little leaf offering which may eventually lead to depressed earnings. This is because the plucking round for fields harvested by machines takes between 20-28 days as opposed to the 8-12 days plucking rounds in hand plucking (Sotik Tea Companies, 2009). This may reduce the frequency of leaf harvesting from the fields thereby reducing the working hours for employees involved in plucking operation. The machine influence on employees income in this study was therefore designed to assist the employees, the employer and other stakeholders in the tea industry in making decisions that will promote long term sustainability of the use of the plucking machines including economic prosperity, a healthy community and the social wellbeing of the employees (Edwards 2000). Wijeratne (2000), of The Tea Research Institute of Sri Lanka, commented on the plucking machine importance that the significance of its invention lies in its potential for increasing worker productivity. According to Wijeratne (2001), as far as the tea industry is concerned, a socially and economically acceptable mechanical harvesting system should give high output per worker, low plucking cost, harvesting of shoots with acceptable quality, preservation of health, vigour of bush and improved worker comfort with least impact on the environment. The output obtained from the various machines in use in the central African region is extremely variable. Approximate figures given at the workshop at The Tea Research Foundation of Central Africa, indicated the harvesting of 350 kg green leaf per day for a single-man, hand-held machine, and of 900-1500 kg green leaf per day (0.7-1.2 hectares per day) for 2-man, hand-held machines (Tea & Coffee Trade Journal, 1999). These compares with 60-70 kg green leaf per person per day with hand plucking, and about 20% above this in the peak season with shear plucking. Although output per machine is important, several participants noted that output per operator could be considerably depressed by the necessity to use extra operators or leaf carriers where terrain or field layout was not optimal. In Sotik Tea Companies, four people were used per machine i.e. two machine operators, one person offloading the plucked leaf and the last person to sort the plucked leaf before leaf weighing the leaf at the leaf shades. According to the socioeconomic and environmental assessment of base case and consensus land use plan by Gary et al (1996), technological change or industry rationalization puts jobs at risk resulting to job losses and reduction of employees' income. Jobs are put at risk because of uncertainties inherent in technological introductions and employees are socially impacted through difficulties in adjustments for individual workers and their families who are displaced and cannot find alternative employments. The study would therefore establish whether the perceived increased productivity by employees as a result of the use of mechanical tea harvesting machines has resulted to improved economic standards of the employees involved in plucking operations

### **1.1 The Study Area**

The study was carried out in Sotik Tea Company Limited located in Sotik, Bureti District, Bomet County, Kenya. This area lies between 1400-1800m above sea level and it is in the Kenya

highlands where tea growing is the main economic activity. It borders Nyamira District to the West, Borabu District to the South, Sotik District to the East and Kericho County to the North. The company has a total of 1808 hectares under tea with over 600 employees, with majority working in the fields where plucking operations are undertaken. This location was selected for study because it had raised the levels of plucking mechanization to over 65% of the total tea acreage which was high compared to other Tea Companies in the Country.

## **2 RESEARCH METHODOLOGY**

### **Population of the Study, Sample Size and Sampling Procedure**

The study was conducted within a population of 503 employees who were directly involved in plucking operations which was used as accessible population. This included machine pluckers (200) and hand pluckers (303) in the Company. 120 respondents who were obtained using proportionate simple random sampling from each stratum was used in this study. The population was stratified by categories of workers namely hand pluckers and machine pluckers. The respondents were interviewed on various changes in their income as a result of the use of mechanical pluckers.

#### **2.1 Data Collection and Analysis Procedure**

Data was collected from the selected respondents using interview guides which contained both open and closed ended questions. The interview guides focused on the perception of employees on the effect of the plucking machines on income, analysis of average monthly income for the two categories of plucking, green leaf pay rate for the two categories of plucking, and average quantities of green leaf plucked by pluckers from the two categories of plucking during peak production season and low production season. The resulting data was analyzed descriptively using frequencies, percentages and cross tabulations with univariate analysis of variance for testing significance of association between variables.

## **3 RESEARCH FINDINGS AND DISCUSSIONS**

### **3.1 Respondents Composition**

The respondents in the study were categorized into hand pluckers and machine pluckers or machine operators. According to Table 1, 66.7 percent of the respondents were hand pluckers while 33.3 percent were machine pluckers, an indication that the hand pluckers were the majority. This depicts that the level of adoption of tea plucking machines will still have to be integrated with manual hand plucking before full mechanization can be achieved. Mechanization or technology advancement is presumed to allow the scarce resources of people to be employed differently and more productively. This can be explained from the natural attrition policy of the tea Companies of phasing out hand pluckers gradually before full mechanization of the plucking operation can be attained (Sotik Tea Company, 2009). Farms show a strong preference for natural employment attrition over costly layoffs as a tool for reducing employment since this system mitigates industrial disputes companies engage in with employees (Davis, et al, 2006).

**Table 1: Pluckers Identification**

Category	Frequency	Percent
Hand Plucker	80	66.7
Machine Plucker	40	33.3
Total	120	100.0

From the literature review, sloppy areas and the edges of rugged terrains cannot be plucked by machines hence integration of the two plucking systems is inevitable (Sotik Tea Company, 2009). According to Tea Research Institute of Sri Lanka, (2008), the tea harvesting machines are advisable to be used during peak cropping months (rush crop) to reduce the crop loss to about 20-30% which shows that hand pluckers will still be engaged in plucking despite the use of the plucking machines. It's evident according to Wijeratne (2001), that mechanical harvesting cannot simply replace manual plucking particularly where the quality of the product is concerned hence mechanical harvesting system should not be introduced as a single system but can effectively be used in a package of systems for enhancing the productivity of workers.

### **3.2 Demographic characteristics of the respondents**

The study participants varied by gender, marital status, years of service and categories of plucking as indicated in Table 2.

**Table 2: Demographic Characteristics of Respondents**

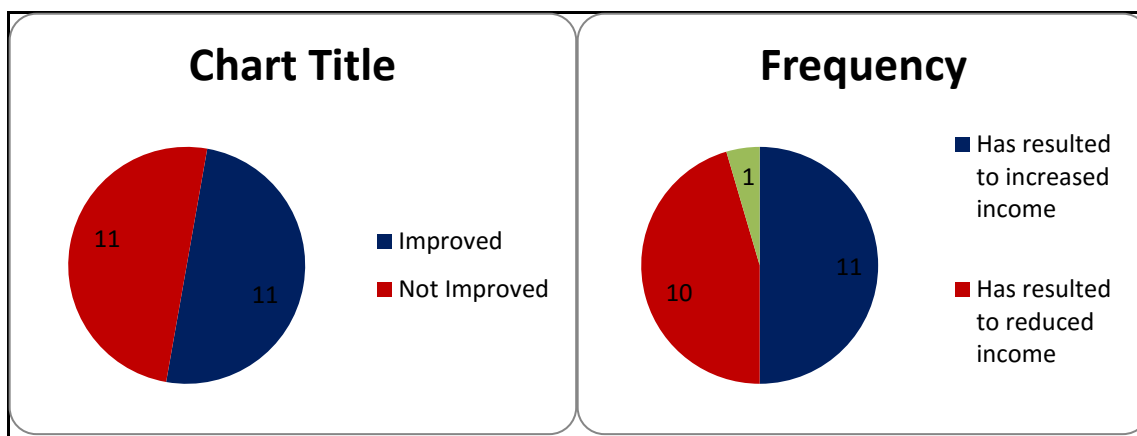
	Category	Frequency	Percent
Gender	Male	62	51.7
	Female	58	48.3
	<b>Total</b>	<b>120</b>	<b>100.0</b>
Marital Status	Married	60	50.0
	Divorced	27	22.6
	Separated	7	5.8
	Widowed	13	10.8

	Category	Frequency	Percent
Gender	Male	62	51.7
	Female	58	48.3
	Single	13	10.8
<b>Total</b>		<b>120</b>	<b>100.0</b>
Age	16-20 Years	4	3.3
	21-25 Years	22	18.3
	26-30 Years	22	18.3
	31-35 Years	20	16.7
	36-40 Years	20	16.7
	41-45 Years	18	15.0
	Above 45 Years	14	11.7
<b>Total</b>		<b>120</b>	<b>100.0</b>
Years of service	Below 2 years	31	25.8
	2-5 Years	16	13.4
	6-10 Years	18	15.0
	11-15 Years	24	20.0
	Above 15 Year	31	25.8
	<b>Total</b>	<b>120</b>	<b>100.0</b>

According to Table 2, 51.7 percent of the respondents were male and 48.3 percent were female, an indication of equal representation of both gender in terms of employment opportunities in the Company. The respondents were composed primarily of married individuals, with the group accounting for 50 percent of the respondents. 36.6 percent of the respondents were in the 21-30 years age bracket and constituted the bulk of the sample while an overall of 73.3% of the respondents were below the age of forty years an indication that the tasks of tea plucking

required a lot of energy hence undertaken by relatively young labour force. On the years of service, 39.2% of the respondents reported 0-5 years of experience in tea plucking with 60.8% of the respondents reporting above 6 years of tea plucking experience. This shows that majority of the plucking labour force had more plucking experience especially in hand plucking where over 40% of the respondents had plucking experience above 10year an indication that there was still an integration of the two plucking categories in undertaking plucking operations in the company. Machine plucking was a new plucking technology which had been used for less than 10 years since introduction and majority of those employed in machine plucking had not worked for a period exceeding 10 years.

### 3.3 Pluckers income comparison after machine plucking adoption



**Figure 1: Income Comparison after adoption of mechanical harvesters**

The respondents were asked to compare their income before and after automation. Figure 7 indicates that there was equal percentage number of the respondents at 50% who indicated that machine introduction improved their income and the ones who believed the introduction of machine plucking did not improve their income. The same was affirmed by the respondents' perception of the use of mechanical plucking machine where 50% of the respondents believed that the use of the plucking machines had resulted to increased income with 45% of the respondents stating that income had actually reduced with the introduction of tea plucking machines. Only 5% of the respondents believed that pluckers' income had remained the same despite the introduction of the plucking machines in plucking operations. The results from the respondents could be attributed to the differences in green leaf pay rate between hand pluckers and machine pluckers. Pluckers' years of experience in plucking could also be a factor that determined the earnings as efficiencies of plucking in both plucking categories could have been influenced by individuals experience in plucking operations and individuals effort. The hand pluckers' green leaf pay per kilogram of green leaf rate was at Ksh. 9.28 as shown in Table 13 while machine pluckers' green leaf pay rate per kilogram was at Ksh. 2.25. The expected quantity of green leaf plucked by hand pluckers to earn a daily rate was 33.25Kg per day while machine pluckers were expected to pluck a minimum of 600Kgs of green leaf to earn a day as shown in Table 13.

**Table 1: Pluckers Category and Green Leaf Pay Rate**

Category	Frequency	Green Leaf Rate of pay/Kg	Green Leaf Daily Task	Percent
Hand Plucker	80	Ksh. 9.28	33.25Kg	66.7
Machine Plucker	40	Ksh. 2.25	600Kgs	33.3
Total	120			100.0

Pluckers' category also varied with the green leaf pay rate. According to Table 3, hand pluckers were being paid higher rates per kilogram of plucked leaf of Ksh. 9.28 as compared to the machine pluckers who were being paid at a rate of Ksh. 2.25. Even though the rates of pay for machine pluckers was lower, every machine plucking group was expected to pluck a minimum of 600Kg of green leaf to earn a day's income as shown in Table 3 as compared to hand pluckers who were expected to pluck 33.25Kgs of green leaf to earn a day's income. This made the income earned by both categories of plucking to be competitive.

From the estimated daily green leaf averages harvested during the peak production season in Table 4, 55.8% of the pluckers harvested between 31-50Kgs of green leaf daily with 21.6% of the pluckers harvesting above 191Kgs of green leaf a day. Majority of hand pluckers fell within the 55.8% bracket of pluckers who harvested between 31-50Kgs per day with machine pluckers having the majority number of pluckers who harvested leaf above 191Kgs a day. The disparities in the quantities harvested per day per person in the two plucking categories cancelled out in earnings due to the different green leaf rates paid for the two categories of pluckers. This made the income earned by these categories of plucking to be competitive hence the acceptance of this hypothesis.



**Table 2: Estimated Daily Green Leaf Averages Harvested during Peak Production Season**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 31-50Kg	67	55.8	55.8	55.8
51-70Kg	15	12.5	12.5	68.3
91-110Kg	5	4.2	4.2	72.5
110-150Kg	5	4.2	4.2	76.7
151-190Kgs	2	1.7	1.7	78.4
Above 191Kgs	26	21.6	21.6	100.0
Total	120	100.0	100.0	

Table 5 below shows the estimated quantities of green leaf harvested by the two plucking categories during low production season. According to Table 5, 46.7% of the respondents estimated that they harvested between 11-20Kgs of green leaf daily during the low production season especially during drought and the cold season with 9.2% of the respondents who were mainly machine pluckers harvesting above 151Kgs of green leaf daily during this season. The earnings of pluckers who harvested between 20Kgs -150Kgs of green leaf per day during the low production season were comparable depending on the pluckers plucking category with the exception of the 13.3% of pluckers who harvested less than 10Kg of green leaf per day and the 9.2% of the pluckers who harvested more than 151Kgs of green leaf a day. These disparities could be associated to the individual efforts in hand plucking category and the group effort or synergy effect from the members of machine operators per plucking machine.

**Table 3: Daily Green Leaf Averages Harvested during Low Production Season**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 10Kg	16	13.3	13.3	13.3
	11-20Kg	56	46.7	46.7	60.0
	21-30Kg	16	13.3	13.3	73.3
	31-40Kg	4	3.3	3.3	76.6
	61-70Kkgs	4	3.3	3.3	79.9
	71-110Kgs	7	5.9	5.9	85.8
	111-150Kg	6	5.0	5.0	90.8
	Above 151Kgs	11	9.2	9.2	100.0
	Total	120	100.0	100.0	

### **3.4 Average monthly income comparison between hand pluckers and machine pluckers**

Table 6 shows the analysis of average monthly income from both categories of plucking. Majority (47.5 %) of pluckers within the category of hand plucking earned an average monthly income of between Ksh. 6001-8000/= while majority (47.5%) of the machine pluckers earned monthly average income of between Ksh. 8001-10,000/=. Only 8.8% of the hand pluckers earned an average monthly income of between Ksh. 8001-10,000/=. Hand plucking is an individual task hence personal commitment, effort and crop offering (volumes of green leaf available in the field) highly affects income while machine plucking depended on the group effort and not individuals effort hence group synergy determined income. 17.5% of the machine pluckers earned between Ksh. 2001-4000/= as compared to 21.1% of hand pluckers in the same income category while a higher number of machine pluckers (12.5%) earned an average monthly income below Ksh.2000/= as opposed to a paltry 2.5% in the hand plucking category.

**Table 4: Pluckers Identification vs. Monthly Gross Earnings**

			<b>Less than</b>						
			<b>2000/=</b>	<b>2001-4000/=</b>	<b>4001-6000/=</b>	<b>6001-8000/=</b>	<b>8001-10000/=</b>	<b>10001-12000/=</b>	<b>Total</b>
Pluckers Identification	Hand Plucker	Count	2	11	17	38	7	5	80
		% Pluckers	2.5%	13.8%	21.1%	47.5%	8.8%	6.3%	100.0%
		% Average Monthly Gross Earnings	25.0%	60.0%	81.8%	87.5%	28.6%	100.0%	66.7%
Machine Plucker		Count	5	7	4	5	19	0	40
		% Pluckers	12.5%	17.5%	10.0%	12.5%	47.5%	.0%	100.0%
		% Average Monthly Gross Earnings	75.0%	40.0%	18.2%	12.5%	71.4%	.0%	33.3%
Total		Count	7	18	21	43	26	5	120
		% Pluckers	5.8%	15.0%	17.5%	35.8%	21.7%	4.2%	100.0%
		% Average Monthly Gross Earnings	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

The high number of machine pluckers earning an average income of below Ksh. 2000/= could be attributed to the high number of personnel involved in plucking per machine. Four people were being used to operate one machine resulting to the leaf plucked per machine being shared by members working with the machine; hence team work and effort was imperative to higher productivity and income per operator. The varied number of years of experience of the machine pluckers could also be a determining factor in income earned by the plucking groups per machine because inexperienced machine operators may not have been as effective in plucking machine operation. Only hand plucking category had workers who earned an average incomes of above Ksh. 10,000/=. Majority of workers in both categories of plucking earned between Ksh. 6001-8000/=.

**3.5 Hypothesis : There is no statistically significant influence of the use of mechanical tea harvesting machines on employees' income in Sotik Tea Company, Bureti District.**

Univariate analysis of variance was used to test the hypothesis. Income was measured using the estimated monthly earnings employees received from the plucking operations, the average quantity of green leaf employees harvested during peak production season , the quantity of green leaf employees plucked during low production season and the rate of pay of green leaf per kilogram harvested by the employees within the two plucking categories. Employees' perception on the perceived effect of the introduction and adoption of the mechanical tea harvesting machines on income was also used during this hypothesis analysis.

Univariate analysis of variance was used to investigate the relationship between the adoption of the mechanical plucking machines and its effect on income. As seen in Table 7, there was no statistically significant relationship between the adoption of mechanical plucking machines and its effect on income. In this case,  $R = .249$  indicates that there is a weak correlation between the dependent variable (income) and the independent variable (Pluckers Identification – both manual pluckers and machine pluckers).

**Table 5: Univariate Analysis of Variance on Relationship between Machine Adoption and Income**

Model	R	R Square	Adjusted Square	R	Std. Error of the Estimate
1	.249(a)	.062	.047		.16988

a Predictors: (Constant), Pluckers Identification

The plucker identification was therefore not a significant determinant of income of both respective groups. This can be confirmed from the literature review that showed that although the output per machine was important and was higher, it was noted that output per operator could be depressed considerably by the use of extra operators of leaf carriers and sorters (Tea & Coffee Journal, 1999). In Sotik Tea Company where the research was conducted, four people were used to operate one machine that is two machine operators, one leaf carrier and one person to do leaf sorting hence the overall kilograms plucked per machine had to be divided by four operators which lowered the productivity per plucker. Plucker productivity regardless of the plucking category was therefore competitive. From the information gathered in terms of income from the respondents, the rate of pay for a kilogram of leaf plucked by machine operators was significantly lower than the rate of pay for a kilogram of leaf plucked by hand pluckers. The quantities plucked by machine pluckers was higher but the low pay rate for machine plucked leaf made the income from both categories of pluckers competitive and comparable. The average incomes earned by both categories from Table 6 indicated that the income earned by both plucking categories were not significantly different hence the confirmation of the hypothesis that there was no statistically significant effect of the use of mechanical tea plucking machines on employees income in Sotik Tea Companies.

## 4 CONCLUSIONS AND RECOMMENDATIONS

### 4.1 Conclusion

The adoption of the mechanical plucking machines had no statistically significant influence on employees' income in Sotik Tea Company, Bureti District, Kenya since the income earned by the two categories of plucking were competitive and comparable.

The study findings may therefore be used to provide knowledge on policy formulation especially with regards to sustainable introduction of mechanical tea pluckers in the tea industry and provide useful information for developing guidelines on influence of technical innovations to be introduced in the tea industry as well as other agricultural sub-sectors.

### 4.2 Recommendations

In view of the above conclusions, this study recommends that Tea companies should embrace and adopt mechanical tea harvesting as employees income was not significantly affected by the use of mechanical tea harvesters and for the sustainability of the tea sector due to the ever escalating cost of hand plucking. The machines are therefore only meant for improving plucking efficiencies, reduce production costs for the sustainability of the tea sector.

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