

# **Assessment of Levels of Adoption of Some Important Cultural Practices Recommended to the Corporate Sector Estates by the Tea Research Institute of Sri Lanka**

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## **ABSTRACT**

Tea has, over the years, become the lifeline of the Sri Lankan economy and contributes extensively to the country's wellbeing. Out of a total extent of 221,969 ha of tea in Sri Lanka, 79,372.29 ha belongs to the corporate sector and is managed through the 20 Regional Plantations Companies (RPC). At the national level, tea production averages about 1645 kg made tea per ha per year, which is considered as one of the lowest among tea producing countries, whilst at the same time recording the highest cost of production (COP) per kg made tea in the world. Therefore, there is a need to enhance productivity of tea in Sri Lanka, by the adoption of practices evolved through scientific research, so as to be competitive in the world tea trade. The Tea Research Institute of Sri Lanka (TRI) is mandated to undertake research on tea and to disseminate relevant information to the growers in the country. Dissemination of information is done mainly through the Advisory and Extension arm of the TRI, which has been in operation for a considerable period of time. Yet, no proper mechanism was in place to monitor the implementation process of TRI recommendations in the plantation sector. A census study, which was undertaken in 2003 was the first systematic attempt made in this direction and this was later followed by the diagnostic census in 2007/2008. The latter study attempted to gather data on the levels of adoption of TRI recommendations made to the industry over the years. Primary data, both quantitative and qualitative, was collected with the help of a pre-prepared questionnaire, which covered all 307 estates in Up, Mid and Low country and the Uva region. The data thus gathered on various aspects of agricultural operations was statistically analyzed and tabulated and these results are discussed in this paper with appropriate conclusions.

**Key words:** Census study, corporate sector tea estates, diagnostic survey, level of adoption

## INTRODUCTION

Tea continues to remain as the major plantation crop in the country and provides substantial support to the national economy. It is the major export earning crop grown in Sri Lanka (Anon, 2006). Tea industry not only provides the much needed foreign exchange to the country but also provides livelihood to around 2 million people directly and indirectly.

In 2009, Sri Lanka produced 290 million kg of made tea (MT) and was regarded as the fourth largest tea producer in the world. In the same year, the country exported 239 million kg of made tea, which was 83% of the total production and contributed 10.9 percent to the Gross Domestic Product (GDP) (Anon, 2009) and earned over 1 billion US \$ as foreign exchange. Currently, Sri Lanka is the second largest tea exporting country in the world.

Out of the total tea extent of 221,969 ha in Sri Lanka, 79,372.29 ha belongs to the corporate sector and managed through the 20 Regional Plantation Companies (RPC) (Samansiri *et al.*, unpublished data). According to the Sri Lanka Tea Board Annual Report, 2008 the national productivity of Sri Lanka is 1645 kg MT per ha per year, which is far below that of other major tea producing countries (Table 1).

Table 1. Productivity of tea lands in major tea producing countries

Country	Productivity kg MT per ha per year
Kenya	2479
Turkey	2317
India	1995
Japan	1613
Sri Lanka	1645

Source: Sri Lanka Tea Board Annual Report, 2008

The highest cost of production (COP) per kg of made tea is also reported from Sri Lanka. Therefore, there is a strong need to enhance productivity of Sri Lankan tea lands, through scientific research, to be more competitive in the world tea market. The Tea Research Institute of Sri Lanka (TRI) is well aware of this situation and addresses the relevant issues on a regular basis since the TRI is the only institute mandated to undertake research on all aspects of tea cultivation, processing, product development and technology dissemination for the corporate tea sector.

Realizing the need for a properly operational and inbuilt feedback mechanism, the TRI has, from time to time, undertaken census studies to ascertain the situation with regard

to the adoption of its recommendations in the plantation sector. As a result, much needed feedback has been gathered to be passed on to the relevant research disciplines for refinement or further experimentation if necessary.

The first attempt was made in 2003 with the involvement of TRI Advisory & Extension staff covering all tea growing areas (Anon, 2003). The second agricultural census in the corporate sector tea plantations, covering 307 units managed by 20 RPCs, was undertaken during the period from August 2007 to September 2008. Information on tea nursery management, management of new clearings, fertilizer usage in tea, plucking, pruning practices, weed management, shade management, and pest & disease management practices were collected from the estates during the study.

## **METHODOLOGY**

Both quantitative and qualitative primary data was collected using a pre-prepared questionnaire during the field study conducted from August 2007 to September 2008, covering all the corporate sector tea plantations (307) in Up country (above 1200 m from mean sea level), Mid country (between 600 -1200 m), Uva (600 – 1200 m) and Low country (below 600 m).

In order to get perceptions on various cultural practices being recommended by the TRI, an interview was held with the executive or the manager of each estate, as a part of this study. All the tea nurseries and selected fields were visited by the TRI Advisory & Extension staff to make further observations in addition to the information collected through the questionnaire. Secondary data was collected from each estate with particular reference to inputs and yield. In this study, adoption level of all important cultural practices was considered from nursery management to plucking. In identifying variables for the study, their relevance to establishment and maintenance of successful tea cultivation was given due consideration. Certain nursery practices adopted were evaluated as 'Good', 'Average' and 'Poor' based on the extent to which TRI recommendation for that particular practice was adopted in the nursery.

Data collected was analyzed using SPSS and is presented in tabular format as percentages.

## **RESULTS AND DISCUSSION**

### **Nursery practices**

Successful tea cultivation depends mainly on the quality of the nursery plants used as the starting material. Health and vigour of nursery plants play an important role in bringing about the expected results once they are planted in the field. It was in the early 1950s that the TRI mastered the vegetatively propagated (VP) technique, which

virtually revolutionized tea husbandry. Knowledge base was constantly being improved with scientific findings, which empowered the growers with the ability of raising pest and diseases free plants. Through the diagnostic survey, the TRI Advisory & Extension staff assessed the *status-quo* of nurseries in the plantation sector with a view to identifying adoption levels, and the gaps remaining in order to give feedback to the research domain with the problems that need rational and urgent answers.

It was revealed that, more than 80% of the sites selected for the nursery were good and around 18% sites could be described as average. It appears that the overall adoption level of TRI recommendations on nursery management was very high. Adequate steps have been taken in a majority of estate nurseries to improve drainage, with properly constructed drains, while only a few estates (6%) seemed to have ignored the importance of having a proper drainage system in place. Soil selected for nursery work was extremely good in about 73% nurseries while the attention given to soil was average in around 26% nurseries. Only a very few estates have selected unsuitable soil for nursery work.

It was apparent from the data collected that the great majority of nurseries have used 5” x 9” or bigger nursery bags to raise plants. This could be attributed as a major factor responsible for high percentage of success achieved in corporate sector new clearings. Although 72% of the estates had fumigated the soil before being used for their nurseries, a significant number has not carried out this important operation. Since nursery is a focal point of nematode infestation that could spread to un-infested areas, urgent attention should be paid to remedy the situation.

As shown in Table 2, out of the estates undertaking soil fumigation, about 77% opted for ‘Basamid’ as a means of soil fumigation, while 21% used ‘Metam sodium’ for the purpose. Only a couple of estates have used soil substitutes to control nematodes in their nurseries.

Table 2. Fumigation method used

Method	No. of estates	Percentage
Basamid	86	77
Metam sodium	22	21
Soil substitute	2	2
Total	110	100

Nearly 86% estates have used natural/ stream water for their nurseries. Others have used tap and well water for watering. However, it has to be borne in mind that those who are using stream water run a risk of being infested with nematodes through the water source

they use unless sedimentation tanks are used in the nursery. Although the TRI recommends establishing sedimentation tanks in nurseries, adoption level of this important practice was alarmingly low *i.e.* around 23%. Since majority of estates make use of stream water, the absence of sedimentation tanks in nurseries posed a great threat in terms of nematode infestation that could take place through irrigation water.

Nearly 76% of the estates got their soil tested for pH before using it for nursery work while around 24% estate have not bothered to get the soil analyzed.

Table 3 shows that 99 out of 219 respondents have used cuttings from their own mother bushes for multiplication purposes. While 70 responded that they obtained planting materials from the TRI, 37 and 13 responded that they used planting materials obtained from pruned fields and from other estates, respectively.

Table 3. Source of cuttings

Source	No. of estates	Percentage
Estate mother bushes	99	65.1
TRI	70	46.0
Normal pruned fields	37	24.3
Other estates	13	8.5
Total	219*	

\* Multiple responses

During this survey, very high adoption level was observed in the case of TRI recommended tea nursery mixture 'T-65' and only a couple of estates used urea as the nursery fertilizer. It was interesting to note that few estates, which used 'T-65' have also used urea in nurseries. Zinc sulphate is recommended in nurseries to break dormancy of nursery plants at the early stages. Adoption level of zinc sulphate use in tea nurseries was about 90% and hence could be considered as very satisfactory.

All nurseries practiced restacking as a routine nursery operation. It is apparent from the data that 96% estates adopted hardening-off of nursery plants which could be considered as a very satisfactory situation while only 4% ignored this operation.

### **New clearing work**

Success of tea plantations depends mainly on the type of raw materials used and the practices undertaken in the early stages to support the establishment of new plants. This involves land selection, land preparation, soil & moisture conservation practices, soil rehabilitation, establishment of shade trees, planting tea and aftercare operations.

As shown in Table 4, it was noted that replanting was carried out only in 239 estates out of a total of 307 estates. Of the 239 estates, 154 estates (64%) employed manual labour for uprooting of old tea while 33% of the estates preferred the use of back-hoe for this operation. Another 1% of the estate opted for a combination of manual and mechanical methods for uprooting.

Table 4. Method of uprooting old tea

Method	Frequency	Percentage
Manual	154	64
Using winch	0	0
Using back-hoe	79	33
Manual and using back-hoe	3	1
Total	239	100

Table 5 indicates that 63% of the estates, where replanting was undertaken, ring-barked shade trees in advance and removed them after the stipulated time, while 22% removed trees immediately after ring-barking, which served no purpose. About 7% of the estates had cut down shade trees without ring barking and another 8% practiced uprooting of the entire shade tree with roots intact. About 90% of the estates adopted soil rehabilitation prior to replanting, as recommended by the TRI, while another 10% opted for direct planting.

Table 5. Method of removal of old shade trees

Method	Frequency	Percentage
Ring-bark in advance and remove after sometime	149	63
Cut down without ring-barking	16	7
Ring-bark and remove immediately	51	22
Uproot	19	8
Total	239	100

Data in Table 6 indicates that 36% estates that practiced direct planting added compost into the planting holes as a substitute for soil rehabilitation while 28% could not afford rehabilitation because of the high cost involved. Interestingly, 12% of estates had found rehabilitation to be a time consuming operation. Another 4% did not rehabilitate soil as they thought it was not necessary. Still, another 4% of estates opted for growing potatoes prior to planting tea as a method of rehabilitating soil. However, about 16% did not give any response to the query. Contrary to the TRI recommendation, about 96% estates has not used any fertilizer for the grass during the rehabilitation period.

Table 6. Reasons for skipping soil rehabilitation

Reason	Frequency	Percentage
Costly operation	7	28
Time consuming	3	12
Not necessary	1	4
Add compost to planting hole.	9	36
Grow potato	1	4
No response	4	16
Total	25	100

Table 7 shows that 94% of estates used cut across as a means of bringing young plants into bearing, which could be considered as a good achievement. Only 0.8% of estates practiced bending and pegging, while 4.2% of estates used a combination of cut across and bending and pegging method.

Table 7. Method of bringing into bearing

Method	Frequency	Percentage
Cut across	226	94.6
Bending and pegging (BP)	2	0.8
Combination of cut across & BP	10	4.2
Breaking branches	1	0.4
Total	239	100

### **Fertilizer related practices**

One of the main objectives of this study was to evaluate the level of adoption in relation to TRI fertilizer recommendations. The parameters evaluated in this diagnostic study were levels of adoption on the use of dolomite in mature tea fields and related practices, use of different fertilizer mixtures and the reasons for deviating from the TRI recommended fertilizer mixtures, the basis for calculating the nitrogen requirement for mature tea *etc.*

It was found in this study that, 7 estates which is 4% of the total number of estates was applying TRI recommended fertilizer mixture (U-625) for rehabilitation grass while 96% ignored the recommendation.

The TRI recommends the application of dolomite at different rates for mature tea fields based on soil pH of the field prior to pruning. About 98% of the respondents have reported that they generally apply dolomite to mature fields.

Table 8 indicates that 86% of the total respondents were aware only of the soil amelioration function of dolomite, while 2.7% was only aware of the function of dolomite as a source of Mg and Ca for plant growth. Only 10.3% of the respondents replied accurately identifying the role of dolomite as a source of plant nutrition as well as soil ameliorating agent. Although the respondents were not fully aware of the reasons for dolomite applications, adoption levels of dolomite applications can be rated as very high.

Table 8. Knowledge on the reason for applying dolomite

Reason for applying dolomite	Responses	
	No.	Percentage
To correct pH	260	86.3
To provide Mg	8	2.7
To correct pH & to provide Mg	31	10.3
No response	02	0.7
Total	301	100.0

In order to achieve maximum benefits of applying dolomite, the TRI recommends that it be applied just prior to the commencement of pruning. Table 9 indicates that only 49% respondents apply dolomite at the correct time. A further 24% of the respondents apply dolomite before pruning along with the practice of mid cycle dolomite application and also after pruning. Data also indicated that 93% of the respondents checked soil pH before applying dolomite, and this could be considered as a very satisfactory situation.

Table 9. The time of dolomite application

Time of dolomite application	Responses	
	No.	Percentage
Before pruning	148	49.2
After pruning	65	21.6
Before pruning and at mid cycle	47	15.7
Before or after pruning	27	9.0
Other	14	4.7
Total	301	100.0

According to the TRI recommendation, the amount of dolomite to be applied is based on soil pH value in the field. Besides the fact that 93% of respondents get the soil tested for pH prior to applying dolomite, only 80.7% are found to follow the correct method in calculating the amount of dolomite to be applied based on soil pH values (Table 10).

About 17.6% indicated that they apply dolomite at a fixed rate for every tea field while the rest apply dolomite based on the yield of the particular field.

The TRI recommends that 'T-200' mixture be applied for young tea in their first and second year after planting. Only about 74% of the respondents followed TRI recommendation. The others were using fertilizer mixtures of different composition, with 24% of the total having reported that they use 'T-250' mixture, which contains more magnesium and potassium.

Table 10. Basis for calculating the amount of dolomite to be applied

Basis	Responses	
	No.	Percentage
Based on the pH values	248	80.7
At a fixed rate	54	17.6
On yield basis	5	1.7
Total	307	100.0

The TRI recommends that 'T-750' fertilizer mixture be applied for immature tea fields from their third year from planting until the first (formative) pruning. Table 11 reveals that almost 83% of the estates adopted the recommendation and used only 'T-750' fertilizer mixture for immature tea. The rest of the estates use different fertilizer mixtures such as 'T-800', which are fortified with increased magnesium and potassium levels. It was also seen that 'T-200' mixture which is recommended for first and second year fields and mixtures containing urea as the source of nitrogen are also being used.

Table 11. Application of fertilizer to immature tea (from 3<sup>rd</sup> year up to 1<sup>st</sup> prune)

Fertilizer mixture	Responses	
	No.	Percentage
T 750	199	83.2
T 800	21	8.7
T 200	6	2.5
U 200	8	3.5
Others	5	2.1
Total	239	100.0

The TRI recommends six different region-based fertilizer mixtures for both mature VP and seedling tea fields taking into consideration the differences in soil nutrient levels in different tea growing regions. This replaced the recommendation of using 'U-709' mixture for mature VP tea fields in all tea growing regions of the country. According to

Table 12, while 40.7% of the respondents used the fertilizer mixtures recommended by the TRI, the rest used other different fertilizer mixtures. About 44% of the estates continued to use 'U-709', which is an old fertilizer recommendation of the TRI. Two estates did not use any chemical fertilizer but they provided the entire nutrient requirement through organic sources. A further 6.8% (21 estates), reported that they use 'UT-901' fertilizer mixture for mature tea fields.

Table 12. Application of fertilizer to mature tea fields

Fertilizer mixture	Responses	
	No.	Percentage
Fertilizer mixtures recommended for mature tea	125	40.7
U-709	135	44.0
U-300	8	2.6
UT-901	21	6.8
U-606	12	3.9
Other	4	2.0
Total	307	100.0

Out of the 182 estates, that did not apply TRI recommended fertilizer mixtures, 160 estates (88%) stated that their fertilizer policy was decided by the company, which had thus deviated from the TRI recommendation. A further 4.3% had decided to use fertilizer mixtures other than the mixtures recommended by the TRI for economic and technical reasons as shown in Table 13.

Table 13. Reasons for not applying TRI recommended fertilizer mixtures

Reasons	Responses	
	No.	Percentage
Company policy	160	88
Decided by the estate	5	3
More expensive	2	1
No crop responses	15	8
Total	182	100

About 42% of the respondents reported that they calculated the required amount of nitrogen to be applied to mature tea fields on the basis of potential yield as well as on a replacement basis, while 20.1% calculated their requirement only on potential yield. Another 32.2% calculated their fertilizer requirement on a replacement basis. Out of 307 respondents, about 94.2% reported that they do not follow the system of site-

specific fertilizer application. Only 18 estates (5.8%) reported that they adopted site-specific fertilizer application to varying degrees for selected mature fields.

### **Plucking**

Harvesting (plucking) is a process of picking the desirable part of shoots from tea bushes for the purpose of manufacturing the end product. It is the most labour intensive field operation in tea cultivation. Therefore, it is important to study the various dimension of worker utilization for plucking and related issues.

According to Table 14, a majority of estates are found to deploy 9-10 workers per round to harvest the crop in one hectare of VP field. The number of workers required to harvest an unit area appears to correspond to the land productivity, which is as expected because, workers have to reach more number of plucking points in relatively low yielding fields.

**Table 14. Worker deployment for plucking in VP fields and their average productivity**

Level of labor use	Percentage of labour use (%)	Average productivity of VP field/s (kg MT per ha per year)
Low (less than 9)	27.2	1716
Average (9 – 10 )	44.2	1809
High (more than 10)	28.6	2037
<b>Total</b>	<b>100.0</b>	

### **TRI Selective Tea Harvester (Shear)**

The TRI has introduced a manually operated harvesting device known as the ‘TRI Selective Tea Harvester’ (Shear), in the late 90s, to address certain labour related issues such as labour shortage. From time to time various awareness programs, skill development programs and extension campaigns were conducted in the plantation sector to popularize the shear among workers. This study also evaluated the current use of ‘TRI Selective Tea Harvester’ (Shear) on estates.

This study revealed that a very small percent of estates (16%) were using the shears. The managers of estates in this study gave the highest ranking to shortage of workers/skilled workers as one of the serious problems. Despite the shortage of labour, low adoption level of shear harvesting has to be considered as a point of investigation by both research and extension staff of the TRI. About 44% of the estates had used the shear at least once. The cumulative adoption level of the use of shear, at least once, has dropped to very low level by 63.5%. This scenario further indicates that the innovators or early adaptors have given up this technology for some reasons.

The estate managers who had never used shears as well as those who had given up the use of shears were asked to indicate the reason(s) for not adopting it. The reasons attributed are given in summary form in Table 15. About 44% of the managers were of the view that it was not necessary and this contradicted their own assertion of worker shortage. However the reason 'not necessary' may be linked with two factors *i.e.* no severe labour shortage as claimed by them or less capacity/ inability of particular tool to ease the labour shortage. Nevertheless, it is worthy to note that 50% of estate managers directly or indirectly pointed out the reason being inadequate technical feasibility of the innovation.

Table 15. Reasons given by the estate managers for low adoption rate of shear

Condition	Number of estates	Percentage
Not necessary	114	44.3
Not convenient/not suitable	28	10.8
Pluckers do not like	36	13.9
Not available	14	5.4
Not effective	34	13.2
Not effective/pluckers do not like	32	12.4
Total	258	100

Table 16 reveals that those who used the shear did so to overcome their labour scarcity in relation to crop. Although, labour shortage is more severe in the low country estates (Jayakody, 2001), shears are being used in relatively higher numbers in the Up country and Uva estates. This indicates that the use of shear is not a fully efficient alternative to handle the labour shortage faced by Low country estates.

Table 16. Time of using the shear

Time to use	Number of estates	Percentage
During cropping months	17	34.7
No specific period	4	8.2
During cropping months and during labor shortage	25	51.0
Other	3	6.1
Total	49	100.0

### **Pruning and related cultivation practices**

Pruning can be considered as the second most important cultivation practice which has a long term impact on the sustainability and productivity of tea fields. The TRI Advisory Circulars carry all recommendations on pruning cycle length, pruning height and pruning style for the different elevation ranges.

This study attempted to assess the present status of pruning practices adopted in all mature tea fields in the 307 estates. Data on the length of the last completed pruning cycle and the productivity of fields was collected, in order to study the levels of adoption of TRI recommendations, and thereby suggest possibilities of fine-tuning existing recommendations.

Table 17 showed that a large extent of mature tea fields in Low country have been pruned once in every 30–42 months (mid-point 36 months), which is the recommended length of pruning cycle for VP tea fields in the Low country. Though the highest productivity has been recorded in fields that have been pruned between 28–24 months, this is only marginally higher than that given in the 30–42 month cycle.

The Mid country region was similar to the Low country, had the largest extent of VP fields pruned on three year cycles. Even though the TRI recommendation for pruning cycles for Mid country VP tea fields is four years, the three year cycle has recorded the highest productivity.

Although, the pruning cycle recommended by the TRI for the Up country VP fields is five years, this study revealed that the majority of Up country VP tea fields have been pruned in 43-53 months (4 year pruning cycle). However, the VP fields which have extended pruning cycles (more than 65 months) have recorded the highest productivity. The reason for this result could be due to the harvesting of such fields at the expense of bush health *etc.* The second largest extent has been pruned on five years cycles.

The majority of the VP tea extent in Uva region has been pruned on four year cycles and this is in line with the recommendations made by the TRI for Uva region.

Table 17. Distribution of VP tea extents in different pruning cycles and their productivity in elevation ranges

Region	Pruning cycle length (months)	Extent (ha)	Average productivity (kg MT per ha per year)
Low country	Less than 18	33.96	1104
	18-29	483.23	1797
	30-42	6926.85	1714
	43-53	478.94	1625
	54-65	19.76	1500
Mid country	Less than 18	54.67	1364
	18-29	895.27	1690
	30-42	2111.25	1880
	43-53	342.60	1765
	54-65	3.00	1359
Up country	18-29	5.5	1978
	30-42	2082.89	2015
	43-53	9738.74	2077
	54-65	5991.14	2056
	More than 65	536.10	2168
Uva	18-29	38.87	1415
	30-42	762.93	1580
	43-53	4356.22	1729
	54-65	761.04	1717
	More than 65	nil	

Drawing up of a proper forward pruning program is the first step towards planning of pruning tea in a proper manner. This study revealed that about 76% of the respondents followed a forward pruning program to decide the extent to be pruned in a particular year and the year of pruning of each field. The other respondents did not follow any rigid pruning program for the estate.

Table 18 shows the different pruning methods adopted by estates. The majority (79.4%) reported that they follow the system of lung pruning as the main style of pruning in VP fields. A further 7% follow lung pruning with a certain amount of cleaning of the bushes. Another 7% follow mainly cut-across pruning in their fields.

Table 18. Style of pruning adopted

Style of pruning	No. of estates	Percentage
Lung pruning	243	79
Cut-across pruning	22	7
Lung pruning with cleaning	21	7
Clean pruning (without leaving lungs)	15	5
Lung pruning without cleaning/ Cut-across pruning	6	2
Total	307	100.0

As shown in Table 19, when asked the reason for selecting lung pruning, 50.8% reported faster recovery and 46.5% reported assured recovery as their main reasons for selecting lung pruning method for their fields. A further 6.5% stated that lung pruning style is followed as their company policy. It was found that in this study only 43% of the estates bury prunings in the fields to improve soil fertility.

The TRI recommends the practice of tipping for bringing pruned fields into plucking, and results indicated that 61% of the respondents follow same. However, some estates follow the plucking-in practice by commencing the bringing into bearing operation early.

Table 19. Reason/s for following the method of lung pruning

Reasons	Responses*	
	No. of estates	Percentage
Fast recovery after pruning	156	50.8
Assured recovery	143	46.5
Company policy	20	6.5
Labor availability	2	0.65
More convenient	8	2.6
Cleaning possible	5	1.6
	334	

\* Multiple responses

The TRI recommends forking of tea fields according to guidelines issued. This operation is undertaken at the time of bringing the fields into plucking, following pruning, *i.e.* to improve soil aeration, particularly on fields where burying of pruning was not undertaken. As indicated in Table 20, only 34% of the estates undertook this good agricultural practice even though it gives a higher average productivity.

Table 20. Forking the field

Response	No. of Estates	Percentage	Average productivity (kg MT per ha per year)
Not forking	202	66	1775
Fork the fields	105	34	1948
Total	307	100	

### Shade management

Tea being a shade loving plant, it thrives well under a certain amount of shade. The shade is provided by establishing high and medium shade trees in tea plantations. Besides providing shade, these trees also provide much needed organic matter to the soil in addition to making some nutrients available for plant growth.

Establishment of high shade trees in a replanting field should be undertaken at the correct time *i.e.*, when rehabilitation grasses. This would ensure the proper shade level at the time of planting of tea. Around 88% of estates established shade at the time of grass planting. When undertaking tea replanting, a majority of estates plant high shade trees at the correct spacing. However, as shown in Table 21, some estates (14.2%) plant the shade tree at the correct time but not at the correct spacing. Nevertheless, the data revealed that some of the estates that had not planted shade trees at the correct spacing initially, have taken some measures to adjust the final spacing to meet required standard and therefore, adoption level of the final spacing of high shade is higher than that of the initial stage.

Table 21. Planting spacing of high shade

Option	Initial spacing		Final spacing	
	Frequency	Percentage	Frequency	Percentage
Correct spacing	205	85.7	213	89.1
Incorrect spacing	34	14.2	26	10.9
Total	239	100	239	100

Data showed that the percent of estates that plant medium shade trees at the correct time (74%) was somewhat lower when compared to high shade planting (88%).

### Weed management

Different kinds of weed management methods are practiced in tea plantations. They can be broadly classified as manual weeding, chemical weeding, cultural methods and mechanical methods. Suitability of these methods depends on the growth stage of tea. Chemical weeding is not suitable during the young stage of tea. Generally some of the mechanical method such as use of *Mammoty* and *Sorandy* are not recommended for tea

fields after planting of tea due to soil erosion. Therefore, it is important to examine weed management practices in tea plantations in relation to the different growth stage of tea.

According to Table 22, appreciably high percent of estates practiced hand weeding in young tea fields without the use of agrochemicals, which is the ideal method of weed management under the particular situation. About 8% of the estate used chemical methods along with hand weeding. Although use of chemical for weed control is low, Glyphosate and Paraquat are the widely used herbicides in young tea. A favorable weed control method recommended for young tea clearings, known as thatching, was not found to be adopted widely. It is noteworthy that only 1% of the estates practiced scraping.

Table 22. Use of herbicides in young tea fields

Method	Frequency	Percentage
No chemical use	281	91
Glyphosate	8	3
Paraquat	13	4
Diuron	1	0
Glyphosate and Paraquat	4	1
Total	307	100

The pattern of herbicide use in mature tea fields is completely different from that of immature fields. Table 23 reveals that chemical weed management is the major weed control method used in mature tea fields. The estates that do not use herbicide are as low as 3.5%. Of the chemicals, use of Glyphosate is significantly high and this is in par with findings in smallholdings, according to the survey carried out in 2006. Except in a few circumstances (pruning fields and fields that are recovering from stress conditions), restricted use of Glyphosate in mature tea fields is not contrary to the TRI recommendations. Hence, use of herbicide should be evaluated along with its frequency and the dosage to have a better picture. Results revealed that, almost 99% estates practiced TRI recommendation by using 1 or 2 Glyphosate applications per year in mature tea field, which should be commended.

Table 23. Use of herbicides in mature tea fields

Method	Frequency	Percentage
No chemical use	11	3.5
Glyphosate	279	91.2
Paraquat	12	3.8
Glyphosate and Diuron	1	0.3
Others	4	1.2
Total	307	100.0

## CONCLUSIONS

It appeared that the level of adoption of important cultural practices recommended by the TRI was high in corporate sector estates and only a few practices being recorded at low levels. The overall adoption level of the TRI recommendations on nursery management was very high. Adoption level of important nursery practices such as selection of suitable site, selection of good textured soil, correct bag size, fumigation of soil, source of water, testing of soil pH, using 'T-65' fertilizer mixture, using ZnSO<sub>4</sub>, and hardening of nursery plants were recorded as high, while the adoption level of only a few other nursery recommendations remained low. Level of adoption of practices related to new clearing work was high, except for a few deviations. Use of 'U-625' grass fertilizer was recorded to be at a very low level of adoption probably due to lack of immediate returns.

Although the respondents were not fully aware of the reasons for dolomite applications, its adoption level can be rated as very high. Adoption level of dolomite application related recommendations was very high. Fertilizer mixtures used for immature plants showed a high adoption rate, but region or side or both region & site specific fertilizer recommendation for mature tea was poorly adopted. The main reason given for poor adoption is that it was a company policy. Although the TRI selective tea harvester was introduced to the industry in the 90's, it has recorded very low level of adoption even now. Though a large number of estates have tried it out at least once, it has failed to impress the end users so far in a meaningful manner, and this merits further investigation. Shade management practices adopted by the corporate sector could be described as very satisfactory on a majority of tea estates. An appreciable number of corporate sector tea estates follow suitable weed control methods for new clearings. Great majority of corporate sector tea estates use herbicides to control weeds in mature tea fields. Even though almost all the estate was using chemicals, it was done in a restricted manner and this is in par with the TRI recommendations. Therefore, it could be recorded that weed management practices adopted by estates are very much compatible with the TRI recommendations and hence, described as satisfactory.

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