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# IMPACT OF FACTORY MODEL CULTIVATION ON TEA INPUT AND OUTPUT QUALITY: A STUDY IN SELECTED TEA FACTORIES IN RUHUNU REGION, SRI LANKA

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**Abstract:**
The tea industry has long been acknowledged as a major source of livelihood in Sri Lanka with regards as the biggest provider of employment, export earnings and government revenue. Kenya, India, China, Vietnam, Malawi and Indonesia are emerging as competitors for Sri Lankan tea industry in the international market. Ceylon tea still has golden opportunity to compete in the global tea market with respect to high quality tea products. Factory model cultivation is initiated to encourage tea factories to control their tea input quality, in turn improves tea output quality. Based on this premise, this study aims to identify the impact of factory model cultivation on tea input and output quality of tea factories in Sri Lanka. An empirical investigation was conducted on a sample comprising 74 tea factories in Ruhunu region, Sri Lanka. A personally-administered structured questionnaire was used to collect data. The independent sample t-test and the multiple regression analysis were employed to test the hypotheses. The findings offer useful insights not only in terms of understanding the link between tea input quality and output quality of tea production, but also the impact of factory model plantation on controllability of the external suppliers input quality. The study has extended the understanding of the extent of applicability of the factory model cultivation to upgrade input and output quality of tea as well as controlling abilities towards input quality of external suppliers.

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**Keywords:** Ceylon tea; factory model cultivation; input and output quality; Galle district

## 1. Introduction

Tea is one of the major drinks of ordinary people in the world. For Sri Lanka, tea industry still continues to occupy an important place in the economy, even though the relative contribution has declined in recent years. For more than a century, tea industry has been the biggest provider of employment, export earnings and government revenue. The tea exports account for about 15% percent for the total exports and about 65% contributes for the total agriculture exports in the country (Central Bank Report, 2015). The tea sector is expected to achieve the export target of US $ 3,000 Million in year 2020.

Table 1 illustrates that the export revenue has been increased over the last two years and slightly dropped in year 2015 due to the economic crisis in few top importing countries.

**Table 1:** Ceylon Tea Products Export Performance

| Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| Export Value* | 1025.11 | 1271.06 | 1185.43 | 1439.16 | 14776.18 | 1397.92 | 1526.74 | 1609.71 | 1324.51 | 1144.11 |

*US $ million

**Source:** Central Bank Reports, Sri Lanka

According to Chang (2015), Kenya, India, China, Vietnam, Malawi and other tea producing countries are exporting bulk as well as value added tea at a lower price comparing with Sri Lanka. Hence, the competition among exporting countries is taking place on price not on quality. This is one of the foremost reasons of declining in competitiveness of Sri Lankan tea in the global market due to the popularity of the CTC (cut, tear and curl) tea it produces and has been capturing many markets due to the higher demand for CTC tea at low price. Although the competitive activities of Vietnam and Indonesia are insignificant for Sri Lankan tea industry, they are emerging as competitors for Sri Lankan tea industry in the international market.

However, Sri Lanka is producing orthodox tea which is higher price with high quality when compare with other orthodox tea producers such as Vietnam and Indonesia whose price is cheaper than Sri Lankan orthodox tea (Dulekha, 2008). Further, it has been identified that ultimate consumers need value for money so that most of the developed countries' consumers demand for quality tea from overseas retailers. Then, the overseas retailers will demand premium quality tea for gaining brand loyalty from their customers (Outschoorn, 2000). The Sri Lankan Tea industry maintains the highest quality in the world market and ISO 3720 is the minimum standard applied for the products. The Country has the capability to produce the cleanest tea in the world in terms of minimum pesticides and residues (Wijeratne, 2003). Therefore, Sri Lankan tea has been identified as an "ozone free tea" in the world trade. Sri Lanka is also adjusting well to the stringent ISO 22000 series and to the health and safety regulations stipulated by the European Community (Colombo Tea Traders' Association, 2017). In this way, still Ceylon tea has golden opportunity to compete in the global tea market with respect to high quality tea products. In order to produce high quality output, it is essential to have high quality input and high-quality production process (Botheju et al., 2000).

The main input of tea product is tea leave. There are key factors that determine the quality of tea leaves namely plucking standards (B+2 and B+3 plucking standards - two leaves and a bud and three leaves and a bud), harvesting interval (7 and 10 days intervals), storing in plucking basket and speedy removal of the leaves to the factory (Sylvestre et al., 2014). There are prior studies conducted to determine the effect of required standards on both quantity and quality of tea green leaves. Sylvestre et al. (2014) revealed that the appropriate harvesting interval for quality and quantity of green leaves is range between 10 and 13 days. Botheju et al. (2000) indicated that Normal plucking standard executed significantly high quantity of production than the B+2 and B+3 plucking standards. However, the quality of the teas produced by adopting the B+2 and B+3 plucking standard was significantly higher than teas from normal plucking. Further, it was vital to pluck 2-3 tender leaves that are free of physical damage in order to produce quality tea. Tender leaf is usually defined as good leaf or the standard shoot because it contains 20% more polyphenols than mature leaf (Karunaratne et al., 2014). Hence, it is emphasised that in order to obtain high quality tea product, tea factories need to acquire high quality tea leaves.

With respect to input factor, there are main six principal regions planting tea in Sri Lanka such as Nuwara Eliya, Dimbula, Kandy, Udapussellawa, Uva Province and Southern Province (Tea Board Statistics, 2015). Based on the six principal regions, tea planted areas are categorised into three elevations as shown in Table 2.

**Table 2:** Area of Tea Planted in Sri Lanka

| Elevation | Planted (Hectare) | Share |
|---|---|---|
| High Grown<br>(Nuwara Eliya, Dimbula, Kandy, Udapussellawa, Uva) | 41,137 | 19% |
| Mid Grown<br>(Kandy) | 71,018 | 32% |
| Low Grown<br>(Sabaragamuwa, Ruhuna) | 109,814 | 49% |
| **Total** | 221,969 | 100% |

**Source:** Tea Board Statistics (2015)

The main input contribution of tea industry consists with two sectors namely tea smallholders and tea plantations. Table 3 shows the comparison of main tea contributors in terms of employability, production and generation of income. Accordingly, tea smallholders obtain the highest land consumption and generate low production with low productivity level compared to the tea plantations.

**Table 3:** Indicators for Tea Industry by Sector

| Indicator | Smallholdings | Plantations |
|---|---|---|
| Employment (No. of People) | 700000 | 350000 |
| Contribution to National Tea Income (%) | 30 | 70 |
| Land Consumption (% of total Lands) | 60 | 40 |
| Production (%) | 39 | 55 |
| Productivity-Yield (kg/ha) | 1,275 | 2,450 |
| Labour Productivity (persons/ha) | 6.14 | 4.61 |

**Source:** Sri Lanka Tea Board Statistics (2010)

Tea leaves provided from estate belongs to the tea factory are called 'own leaves' and leaves supplied from the outside estates and small holders are called 'other estate leaves' and 'bought leaves' respectively. Eventhough there are required standards, there is little impulse to maintain such quality, especially in tea smallholders (Botheju et al., 2000; Wijeratne, 2003). As survey mentioned (Botheju et al., 2000), smallholders are plucking mature leaf other than the recommended two leaves and a bud, leaves are crammed into bags to increase weight and taking 8–12 hours in collecting the leaves from the gardens and delivering it to the collection centres/agents.

In order to overcome the issues in tea input quality of external suppliers, management solution was introduced. Factory model cultivation is initiated to encourage tea factories to control their tea input quality and impulse smallholders to maintain quality standards of tea leaves (Noorain, 2014). In the factory model cultivation, tea factories are upheld their own tea estates as well as taking tea leaves from external suppliers. While maintaining their own tea estates, factories are expected to improve technologies on commercial cultivation especially application of fertilizer, crop management, irrigation systems, optimum input applications, pest and disease control, post-harvest management, quality storing techniques and improve transportation methods. The model plantation is long time strategy for increase quality. If factories are continuing this model long time, they can reduce production cost, consolidate their assets, decrease leaves exhaustion and wastage and ultimately get high price for the final product.

There are considerable studies conducted regarding the tea industry in Sri Lanka (Ariyawardana, 2003; Ethugala, 2011; Fonseka, 2009; Herath and De Silva, 2011; Sachitra and Kumarasinghe, 2014; 2015). However, evidence is still not enough to identify the impact of factory model plantation on input and output quality of tea. As pointed out by Botheju et al. (2000; 2001); Noorain (2014) and Wijeratne (2003), in order to obtain high quality tea product, tea factories need to acquire high quality tea leaves. Tea factories get tea leaves from their own estates as well as external suppliers. Since external suppliers are not providing required quality tea leaves, tea factory owners are encouraged to establish factory model cultivation. The present study intends to investigate whether factory model cultivation impacts tea input and output quality. In addition, the study aims to identify whether factory model plantation able to control the external suppliers input quality.

## 2. Methodology

### 2.1 Sample and data

The scope of this study included tea factories in low grown area of tea planted in Sri Lanka. Their importance is reflected in their significant contributions in terms of total area of tea planted (Table 2). Among the area, tea factories in Ruhunu planted (Galle and Matara Districts) areas have been selected as they are adapting factory model plantation speedily than other districts (Tea Board Statistics, 2015). There are 111 tea factories in Galle district and 89 tea factories in Matara district. Hence, there are 200 tea factories consisted in the target population of the study. The study selected 120 tea factories (67 from Galle and 53 from Matara), using proportionate random sampling technique. The factory managers constitute the unit of analysis.

A personally-administered structured questionnaire was used to collect data. The questionnaire comprised a total of 20 items. This included ownership of tea cultivated land, six items of input quality standards and thirteen items of ability of controlling external suppliers input quality. Input quality standards and factory control ability were measured based on criteria developed by Sylvestre et al. (2014) and Wijeratne (2003). The six items of input quality standards represented tea leave freshness, polyphenol content, plucking standard, tea leave storage time in plucking basket, tea leave transport time to factory and tea leave receiving to factory. These six items were measured as categorical items. The remaining 13 items ability of controlling external suppliers input quality were measured on a five-point Likert-scale, ranging from highest ability (1) and lowest ability (5). Output quality was measured using reasonable price sales of selected tea factories which were collected from Tea Board Statistics. Based on the average reasonable price sales of last ten years, the study has categorised the output quality as low (*Less than Rs.650 per tea Kg*), moderate (*Rs.675 to Rs.650 per tea Kg)* and high (*More than Rs.675 per tea Kg)*. The method is proposed by Sri Lanka Tea Board.

The independent sample t-test was employed to determine whether factory model cultivation impacts tea input quality and tea output quality and factory model plantation able to control the external suppliers input quality. Further, the multiple regression analysis was performed to identify the effect of tea input quality on tea output quality.

**2.2 Findings**

The completed questionnaires were collected from 74 tea factories (40 and 34 from Galle and Matara respectively), resulting in an 61.7% response rate. The sample of the study possess 36 tea factories with owned tea estates (21 from Galle and 15 from Matara) and 38 tea factories without ownership of tea cultivated land (18 from Galle and 20 from Matara).

The distribution value of average reasonable price sales showed that all the constructs were within the normal range of skewness (i.e. within ±1) and p-value of Kolmogorov-Smirnov test was more than 0.05. Hence, the data can be assumed to be normally distributed (Hair et al., 2010).

Since the study focused on the two different districts, it is imperative to test if there are significant differences in the average reasonable price sales and input quality measures between the selected districts. The independent sample t-test was used to test the mean differences. For the average reasonable price sales, the result of Levene's Test of Equality of Variances was 0.382 ($P > 0.05$), suggesting that the assumption on the homogeneity of variances was not violated (Leech et al., 2005). The p-value was 0.145, which is greater than 0.05. Hence, there is no significant differences between two districts with regards to the average reasonable price sales of tea factories selected in this study. For input quality measures, p-values for tea leave freshness, polyphenol content, plucking standard, tea leave storage time in plucking basket, tea leave transport time to factory and tea leave receiving to factory were 0.095, 0.174, 0.163, 0.102, 0.089 and 0.067 respectively. Since the p-values were greater than 0.05, it can be concluded that there are no significant differences between two districts with regards to input quality standards of this study.

Table 4 and 5 show the input quality categorization based on six criteria used in this study and output quality categorization based on reasonable price sales. The results indicated that the extent of input and output quality of the selected tea factories varies.

**Table 4:** Input Quality Categorization based on six criteria

| Criteria | Frequency (%) | | |
|---|---|---|---|
| | **High** | **Moderate** | **Low** |
| Tea Leaves Freshness | 58 (78.4) | 9 (12.2) | 7 (9.5) |
| Polyphenol Content | 38 (51.4) | 26 (35.1) | 10 (13.5) |
| Plucking Standard | 17 (23.0) | 39 (52.7) | 18 (24.3) |
| Tea Leaves Storage Time in Plucking Basket | 31 (41.9) | 26 (35.1) | 17 (23.0) |
| Tea Leaves Transport Time to Factory | 27 (36.5) | 26 (35.1) | 21 (28.4) |
| Tea Leaves Receiving to Factory | 18 (24.3) | 32 (43.2) | 24 (32.4) |

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**Table 5:** Output Quality Categorization

| Criteria | Frequency (%) | | |
|---|---|---|---|
| | **High** | **Moderate** | **Low** |
| Reasonable Price Sales | 22 (29.7) | 39 (52.7) | 13 (17.6) |

Since the study focused on impact of factory model cultivation on tea input and output quality, it is imperative to test if there are significant differences input and output quality between tea factories with and without owned tea estates. To do so, independent sample t-test was used to test the mean differences. Table 6 and 7 illustrate the independent sample test results of input and output quality differences respectively.

**Table 6:** Independent sample test result of input quality differences

| Criteria | Levene's Test for Equality of Variances (sig) | t-test for Equality of Means | | | |
|---|---|---|---|---|---|
| | | **t** | **Sig. (2-tailed)** | **Mean Difference** | **Std. Error Difference** |
| Tea Leaves Freshness | .655 | 1.538 | .128 | .22661 | .14736 |
| Polyphenol Content | .083 | 3.645 | .001 | .56140 | .15403 |
| Plucking Standard | .065 | .506 | .614 | .08187 | .16184 |
| Tea Leaves Storage Time in Plucking Basket | .889 | 2.175 | .033 | .389 | .179 |
| Tea Leaves Transport | .481 | 2.088 | .040 | .383 | .183 |

| | | | | | |
|---|---|---|---|---|---|
| Time to Factory | | | | | |
| Tea Leaves Receiving to Factory | .400 | 1.856 | .068 | .320 | .173 |

**Table 7:** Independent sample test result of output quality differences

| Criteria | Levene's Test for Equality of Variances (sig) | t-test for Equality of Means | | | |
|---|---|---|---|---|---|
| | | t | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Reasonable Price Sales | .658 | 2.327 | .023 | .35819 | .15392 |

The results of Levene's Test of Equality of Variances (Table 6 and 7) were greater than 0.05, suggesting that the assumption on the homogeneity of variances was not violated. Among six criteria (Table 6), the p-values of polyphenol content, tea leaves storage time in plucking basket and tea leaves transport time to factory were less than 0.05. Hence, there are statistically significant differences between tea factories with and without owned tea estates with regards to the tea input quality of polyphenol content, tea leaves storage time in plucking basket and tea leaves transport time to factory. For output quality (Table 7), the p-value was less than 0.05. It can be concluded that there is statistically significant difference between tea factories with and without owned tea estates with regards to the tea output quality.

As specific objective, the study attempted to identify the relationship between tea input quality and tea output quality. The study adapted six items of input quality standards namely tea leave freshness, polyphenol content, plucking standard, tea leave storage time in plucking basket, tea leave transport time to factory and tea leave receiving to factory. Thus, there were six independent variables and dependent variable (tea output quality, measured from average reasonable price sales). Tables 8a, 8b and 8c indicate the result of multiple regression analysis results.

**Table 8a:** Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .843[a] | .710 | .684 | .38281 |

a. Predictors: (Constant), Tea Leaves Freshness, Polyphenol Content, Plucking Standard, Tea Leaves Storage Time in Plucking Basket, Tea Leaves Transport Time to Factory, Tea Leaves Receiving to Factory

**Table 8b: ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 24.087 | 6 | 4.014 | 27.394 | .000[b] |
| | Residual | 9.819 | 67 | .147 | | |
| | Total | 33.905 | 73 | | | |

a. Dependent Variable: Output Quality

b. Predictors: (Constant), Tea Leaves Freshness, Polyphenol Content, Plucking Standard, Tea Leaves Storage Time in Plucking Basket, Tea Leaves Transport Time to Factory, Tea Leaves Receiving to Factory

**Table 8c: Coefficients[a]**

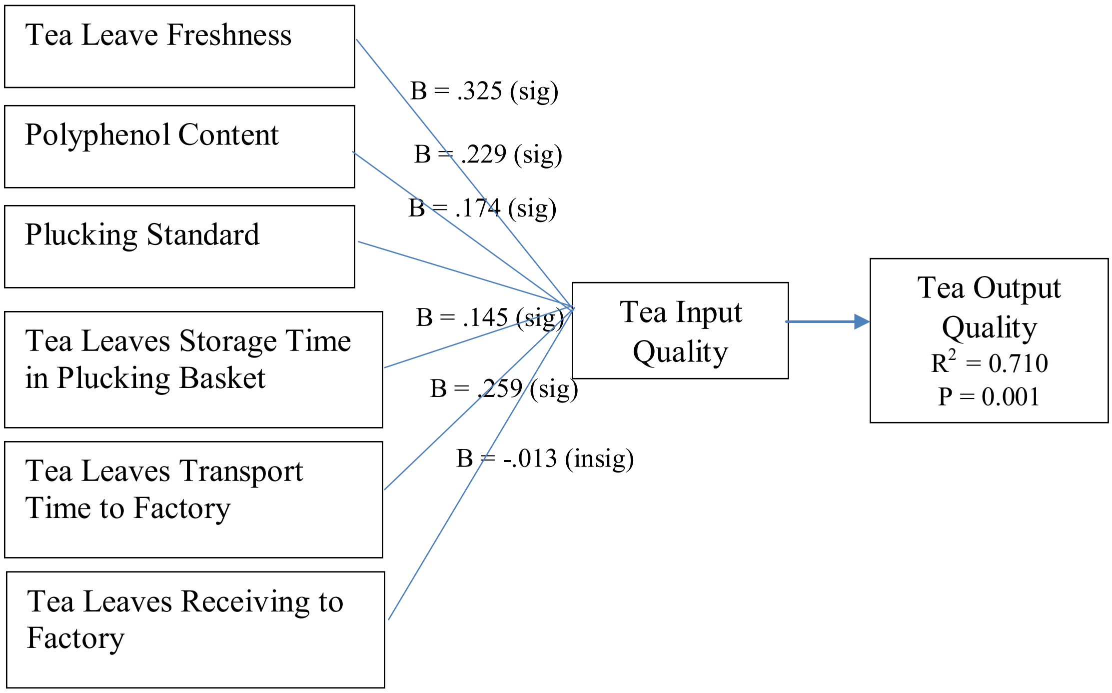
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | .001 | .184 | | .005 | .996 |
| | Tea Leaves Freshness | .325 | .091 | .315 | 3.559 | .001 |
| | Polyphenol Content | .229 | .077 | .240 | 2.990 | .004 |
| | Plucking Standard | .174 | .072 | .176 | 2.429 | .018 |
| | Tea Leaves Storage Tim | .145 | .071 | .168 | 2.032 | .046 |
| | Tea Leaves Transport Time | .259 | .069 | .306 | 3.764 | .000 |
| | Tea Leaves Receiving to Factory | -.013 | .068 | -.015 | -.195 | .846 |

a. Dependent Variable: Output Quality

The $R^2$ value (Table 8a) was 0.710, which implies that 71% of the variation in tea output quality can be explained by six input quality standards identified in this study. In Table 8b, the p-value for input standards was less than 0.001. Hence, tea output quality depends on tea input quality. The Durbin-Watson (DW) statistics was 1.721, which falls within the acceptance range of 1.53 to 2.50 in order to ensure that there is no autocorrelation problem in the data (Chittithaworn et al., 2011). In residual diagnostics, the residuals were independent and normally distributed. Hence, there is no violation of the assumption of homoscedasticity.

As shown in Table 8c, the p-values of tea leave freshness, polyphenol content, plucking standard, tea leave storage time in plucking basket and tea leave transport time to factory were less than 0.05. Hence, those tea input quality standards have significant effect on tea output quality. Among five standards, tea leave freshness recorded the highest beta value (beta = 0.325, $p < 0.05$) and tea leave transport time to factory recorded the second highest value (beta = 0.259, $p < 0.05$). However, days of tea leave receiving to factory has no significant effect on tea output quality. Figure 1 illustrates the research framework of the study.

**Figure 1:** Research Model




Next, the impact of factory model plantation on controlling the external suppliers input quality was identified separately. Table 9 presents the descriptive group statistics of 13 items used to measure the ability of controlling external suppliers input quality of the selected tea factories [measured on a five-point Likert-scale, ranging from highest ability (1) and lowest ability (5)].

**Table 9:** Descriptive Group Statistics

| **Items** | **Owned tea estates** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
|---|---|---|---|---|
| Control tea leave freshness | Yes | 1.97 | .506 | .084 |
| | No | 2.08 | .428 | .069 |
| Increase polyphenol content | Yes | 2.19 | .749 | .125 |
| | No | 3.11 | .831 | .135 |
| Increase plucking standard | Yes | 2.08 | .604 | .101 |
| | No | 2.97 | .716 | .116 |
| Reduce plucking days | Yes | 2.11 | .820 | .137 |
| | No | 3.11 | .689 | .112 |
| Reduce transport time of tea leaves to factory | Yes | 2.58 | .649 | .108 |
| | No | 2.68 | .775 | .126 |
| Reduce tea leave storage time in plucking basket | Yes | 2.39 | .645 | .107 |
| | No | 2.66 | .708 | .115 |
| Control receiving trash (dust, stone) with tea leaves | Yes | 2.47 | .506 | .084 |
| | No | 2.45 | .760 | .123 |
| | Yes | 2.44 | .843 | .141 |

| | | | | |
|---|---|---|---|---|
| | No | 3.29 | .694 | .113 |
| Manage tea leaves quality at festival time seasons | Yes | 2.39 | .645 | .107 |
| | No | 3.05 | .837 | .136 |
| Apply good agricultural practices | Yes | 2.22 | .591 | .098 |
| | No | 3.61 | .887 | .144 |
| Practice Just-in-time approach | Yes | 2.50 | .609 | .102 |
| | No | 3.84 | .916 | .149 |
| Impose rules and regulations on tea leave quality | Yes | 2.06 | .583 | .097 |
| | No | 3.18 | .926 | .150 |
| Reject low quality tea leaves | Yes | 2.33 | .756 | .126 |
| | No | 3.00 | 1.013 | .164 |

Table 10 shows the independent sample test results of controlling ability of tea factories with and without owned tea estates.

**Table 10:** Independent sample test result of controlling ability of tea factories

| | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | Lower | Upper |
| Control tea leave freshness | .094 | .760 | -.982 | 72 | .330 | -.107 | .109 | -.323 | .110 |
| Increase polyphenol content | .873 | .353 | -4.94 | 72 | .000 | -.911 | .184 | -1.27 | -.543 |
| Increase plucking standard | 1.788 | .185 | -5.76 | 72 | .000 | -.890 | .154 | -1.19 | -.583 |
| Reduce plucking days | .130 | .720 | -5.65 | 72 | .000 | -.994 | .176 | -1.34 | -.644 |
| Reduce transport time of tea leaves to factory | .731 | .395 | -.605 | 72 | .547 | -.101 | .167 | -.433 | .231 |
| Reduce tea leave storage time in plucking basket | .305 | .583 | -1.70 | 72 | .092 | -.269 | .158 | -.583 | .045 |
| Control receiving trash (dust, stone) with tea leaves | .713 | .387 | .165 | 72 | .870 | .025 | .151 | -.276 | .326 |
| Manage tea leaves quality at opposed weather condition | 1.371 | .246 | -4.71 | 72 | .000 | -.845 | .179 | -1.20 | -.488 |
| Manage tea leaves quality at festival time seasons | 1.512 | .223 | -3.80 | 72 | .000 | -.664 | .174 | -1.01 | -.316 |
| Apply good agricultural practices | .790 | .311 | -7.85 | 72 | .000 | -1.383 | .176 | -1.73 | -1.032 |
| Practice Just-in-time approach | 3.403 | .069 | -7.37 | 72 | .000 | -1.342 | .182 | -1.70 | -.979 |
| Impose rules and regulations on tea leave quality | 1.408 | .215 | -6.23 | 72 | .000 | -1.129 | .181 | -1.48 | -.768 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Reject low quality tea leaves | .662 | .418 | -3.19 | 72 | .002 | -.667 | .209 | -1.08 | -.251 |

According to Table 10, the results of Levene's Test of Equality of Variances were greater than 0.05, suggesting that the assumption on the homogeneity of variances was not violated. Among 13 items, the p-value of 9 items were less than 0.05. It can be concluded that there are statistically significant differences of controlling ability of tea factories except tea leave freshness, transport time, storage time and receiving trash.

## 3. Discussion and Conclusion

The main intentions of introducing factory model cultivation are to encourage tea factories to control their tea input quality and impulse smallholders to maintain quality standards of tea leaves. On this score, this study fetches important empirical implications to support this argument. Accordingly, this study has extended the understanding of the extent of applicability of the factory model cultivation to upgrade input and output quality of tea. This study has also confirmed the importance of estate owned factories with regard to their controlling abilities towards input quality of external suppliers.

The findings of this study have confirmed the literature on importance of tea input quality to improve the quality of tea output as evident from the $R^2$ values obtained (Botheju et al., 2000; 2001; Noorain, 2014; Wijeratne, 2003). Overall, the findings suggest that tea leave freshness, polyphenol content, plucking standard, tea leave storage time in plucking basket and tea leave transport time to factory significantly influence output quality of tea. Hence, this create an obligation for tea leave suppliers (own leaves, other estate leaves and bought leaves) to meet certain quality standards with regard to maintain tea leave freshness and polyphenol content, apply proper plucking technique, keep low storage time in plucking basket and speedy transportation of tea leave to the factory.

Moreover, the ability to control the input quality of external suppliers, explaining the importance of applying factory model cultivation to upgrade input and output quality of tea. The findings suggest that tea factories with owned tea estate have more ability to control polyphenol content, plucking standards and days, quality at apposed weather condition and festival time seasons, to apply good agricultural practice and just-in-time approach, to impose rules and regulation regarding tea leave quality and to reject low quality leaves than tea factories with non-owned tea estate.

From the practical perspective, the findings imply that tea factories with owned tea estate create additional pressure to tea smallholders to maintain required quality standards of tea leaves. Hence, this leads tea smallholders to reduce leaves exhaustion and wastage and ultimately get high price for the tea leaves.

Aforementioned, factory model cultivation is long time strategy for increase input and output quality of tea. As such, it is important to create awareness amongst the tea factories owners on the importance enhancing tea input and output quality by executing factory model cultivation. The study has contributed to a better understanding of the role of factory model cultivation as the key dimension of tea quality enhancement. Hence, this study provides the incentive for more studies to be conducted in the future, especially in mid grown tea planted area. In addition, as quality requirements change over time, a longitudinal study becomes necessary to capture more details.

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