Causes for Non-Compliance of Made Black Tea with the Main-Relevant-Grade

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Abstract**—*"Ceylon Tea," Sri Lankan tea delights connoisseurs worldwide with its exquisite taste and captivating aroma. On the international stage, Sri Lanka proudly stands as the fourth-largest tea exporter. Although the country's export-oriented tea processing facilities consistently strive for enhancement, adopting cutting-edge technologies to meet and exceed stringent global quality standards,it was revealed that more than 75,000 main grade sample lots tend to be labeled as their secondary grades per annum, and it was evident that the trend of the percentage of sample lots labeled as the secondary grades of the relevant main grade is increasing. The economic loss caused by this for the last twelve months was calculated to be US$ 97.5million. The objective of this study is to disclose the causes for non-compliance of made black tea with the main relevant grade. The data were collected using the Simple Random Sampling technique (n=383). Data analysis was performed using SPSS (version 23.0). The dependent variable of the study is 'samples labeled as their secondary grades (SG)' while seven independent variables have been recognised: Bold leaf (BL), Ragged leaf(RL), Unstilish leaf(UL), Broken leaf(BrL), Mixed leaf(ML), Flaky leaf (FL), and Stalk or Fibre(SF). The hypothesis was tested using correlation analysis. The regression results of measuring relationships between BL and SG, RL and SG, FL and SG, and SF and SG, signify valid regression models (p< 0.005), which explain 67.5%, 59.7%, 54.2%, and 55.3% of the variance of the outcome variables, respectively. The analysis showed that BL (Broken Leaf), RL (Ragged Leaf), FL (Fannings Leaf), and SF (Small Leaf) are significant predictors (p < 0.005) of SG (Secondary Grades) since their beta coefficient values exceeded 0.7. This study aims to provide valuable insights to all stakeholders in the tea industry, guiding their efforts towards reducing secondary type grades. According to the findings, the primary contributors to secondary type grades are high levels of Ragged leaf and Bold leaf. Hence, it is essential to implement proper handling techniques for tea processing to address this issue effectively.*

Keywords— *Bold leaf , Ragged leaf, Flakey leaf, Stalk or Fiber, and Secondary grades*

I. INTRODUCTION

Sri Lanka holds the position of the world's fourth-largest tea producer and exporter. The country's economic success is closely tied to the productivity of its tea industry, contributing significantly to its net foreign currency income. Its inherent advantages compared to other major tea producers have positioned Sri Lanka among the leading global tea producers, with the potential to become the world's largest tea exporter (Ariyawardena, 2001). However, the present scenario indicates a departure from these advantageous positions, suggesting that the country is currently facing challenges in maintaining its previous accomplishments in the tea industry.

Merely possessing tea plantations and favourable climates does not guarantee additional trade gains. To harness the potential benefits, it becomes crucial to utilise these resources effectively and efficiently. Presently, the Sri Lankan tea industry faces the challenge of having the highest cost structure compared to other major tea producers. What is most imperative is implementing productivity improvements. Therefore, it is essential for the Sri Lankan tea industry to adopt a more strategic approach to ensure its survival and sustained growth.

Sri Lankan Tea Producers manufacture over 90 percent of black tea. These black tea batches are then sent to Tea Brokers for cataloguing. In instances where the received black tea sample lots do not comply with the main relevant grade, these black tea sample lots are catalogued as secondary grades of the main grade, which is a considerable economic loss to the country. It was revealed that more than 75,000 main grade sample lots tend to be labeled as their secondary grades per annum, and it was evident that the trend of the percentage of sample lots labeled as their secondary grades is increasing. The economic loss caused by this for the last twelve months was calculated to be US$ 97.5million. This is because, there is a considerable price difference between fairly make or true-to-type main grades and their secondary grades (Megodawickrama, 2013).

Cataloguing black tea sample lots as secondary grades of the main grade is not limited to an economic loss to the country, yet it diminishes the good name and reputation earned by the tea industry for Ceylon Tea since the real reason behind cataloguing black tea sample lots as secondary grades is the substandard quality of the made black tea. Hence, it is vital to identify the primary reasons for the non-compliance of made black tea with the relevant main grade. It is necessary to address the root causes effectively and implement appropriate corrective measures.

The objective of the current study is to disclose the main causes of non-compliance of made black tea with the main relevant grade.

II. METHODOLOGY

The current study follows a deductive research approach. The epistemology of the present study is positivism, and the ontology of this research is objectivism. The research design is correlational in nature.

The study formulated hypotheses and subjected them to tests for acceptance or rejection. Its primary focus was to analyze relationships between each tested specification and the samples labeled as their Secondary Grades (SG). Being quantitative and correlational in nature, the research minimized interference, with the researcher refraining from leading the investigation. A non-contrived setting was utilized for the study.

The study specifically examined the factors contributing to secondary type grades (SG) within the relevant main grades of made black tea. The conceptual framework for the investigation is as follows:

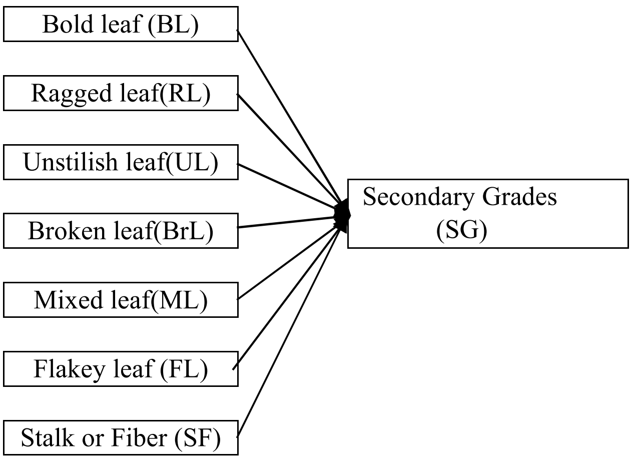

Figure 1: The Conceptual Framework

Following the conceptual framework, the research considers Secondary Grades (SG) as the dependent variable, while Bold leaf (BL), Ragged leaf (RL), Unstylish leaf (UL), Broken leaf (BrL), Mixed leaf (ML), Flakey leaf (FL), and Stalk or Fiber (SF) serve as the independent variables. The study tested the following hypotheses:

Hypothesis 1:
H_0: There is no relationship between Bold leaf (BL) and Secondary Grades (SG)
H_1: There is a relationship between Bold leaf (BL) and Secondary Grades (SG)

Hypothesis 2:
H_0: There is no relationship between Ragged leaf(RL)and Secondary Grades (SG)
H_2: There is a relationship between Ragged leaf(RL) and Secondary Grades (SG)

Hypothesis 3:
H_0: There is no relationship between Unstilish leaf(UL) and Secondary Grades (SG)
H_3: There is a relationship between Unstilish leaf(UL) and Secondary Grades (SG)

Hypothesis 4:
H_0: There is no relationship between Broken leaf(BrL) and Secondary Grades (SG)
H_4: There is a relationship between Broken leaf(BrL) and Secondary Grades (SG)

Hypothesis 5:
H_0: There is no relationship between Mixed leaf(ML) and Secondary Grades (SG)
H_5: There is a relationship between Mixed leaf(ML) and Secondary Grades (SG)

Hypothesis 6:
H_0: There is no relationship between Flakey leaf(ML) and Secondary Grades (SG)
H_6: There is a relationship between Flakey leaf(ML) and Secondary Grades (SG)

Hypothesis 7:
H_0: There is no relationship between Stalk or Fiber (SF) and Secondary Grades (SG)
H_7: There is a relationship between Stalk or Fiber (SF) and Secondary Grades (SG)

This research relied on secondary data, which was sourced from the Registered Tea Brokering Firms and The Qeekly Market Reports. The sampling unit considered in the study was sample lots labeled as the secondary grades of the relevant main grade during the last twelve months. The population included samples from throughout Sri Lanka and totaled 78054 samples. The sample size was calculated based on the population size under the 95% confidence level and resulted in 383 as the sample size. Given the availability of a finite population, the research employed a simple random sampling technique. Random numbers were generated using a random number generator when selecting the samples. The sample size obtained was compatible with the requirements for path analysis and structural equation modeling, which typically necessitate a minimum of 150-200 samples (Ullman & Bentler, 2004; Hair, Black, Babin, & Anderson, 2009).

The data were analyzed using SPSS (version 23.0), and tests were conducted to assess construct validity. Construct validity evaluates how well the results obtained from a measure align with the theory for which the test was designed. Unidimensionality, convergent validity, and discriminant validity were examined to verify construct validity.

Correlation analysis was performed to investigate relationships between Secondary Grades (SG) and the independent variables: Bold leaf (BL), Ragged leaf (RL), Unstylish leaf (UL), Broken leaf (BrL), Mixed leaf (ML), Flakey leaf (FL), and Stalk or Fiber (SF). Finally, a regression analysis was carried out to check the hypotheses.

III. RESULTS

To assess normality, the P values of the Shapiro-Wilk test were examined, along with the range of Z values for Skewness and Kurtosis. Descriptive statistics were utilized to examine the mean values and standard deviations of the variables and dimensions employed in the research. The Shapiro-Wilk test revealed P values of 0.667, 0.643, 0.321, 0.351, 0.324, 0.301, 0.203, and 0.452 for the seven main constructs, indicating values higher than 0.05, suggesting normality. The calculated Z values for skewness and kurtosis also fell within the standard range, supporting normal distribution. Additionally, all KMO estimations exceeded 0.50, affirming sampling adequacy. Furthermore, the BTS (Bartlett's Test of Sphericity) yielded a significant result at 0.001 (i.e., $p < 0.001$), confirming convergent validity. To evaluate reliability, Cronbach's coefficient alpha values were computed, with all values surpassing 0.7, indicating the scale's internal consistency and reliability. The mean values obtained were 31.0834 (SD=0.22453), 7.4234 (SD=0.33672), 7.3562 (SD=0.45367), 4.5656 (SD=0.57564), 4.3265 (SD=0.65137), 3.7945 (SD=0.39812), 5.5652 (SD=0.39802), and 5.1498 (SD=0.23891) for Secondary Grades (SG), Bold leaf (BL), Ragged leaf(RL), Unstilish leaf(UL), Broken leaf(BrL), Mixed leaf(ML), Flakey leaf (FL) and Stalk or Fiber (SF) respectively.

Correlation tests were conducted to examine the aforementioned hypotheses, revealing significant relationships between the following pairs: Bold leaf (BL) and Secondary Grades (SG) (correlation coefficient value: 0.804), Ragged leaf (RL) and Secondary Grades (SG) (correlation coefficient value: 0.799), Flakey leaf (FL) and Secondary Grades (SG) (correlation coefficient value: 0.744), and Flakey leaf (FL) and Secondary Grades (SG) and Stalk or Fiber (SF) (correlation coefficient value: 0.708). These correlations were found to be significant at the 0.01 level. However, based on the correlation tests, no significant relationships were observed between the following pairs: Unstylish leaf (UL) and Secondary Grades (SG) (correlation coefficient value: 0.112), Broken leaf (BrL) and Secondary Grades (SG) (correlation coefficient value: 0.315), and Mixed leaf (ML) and Secondary Grades (SG) (correlation coefficient value: 0.238).

To examine the relationships between the variables, a regression analysis was conducted for Bold leaf (BL) and Secondary Grades (SG), Ragged leaf (RL) and Secondary Grades (SG), Flakey leaf (FL) and Secondary Grades (SG), as well as Secondary Grades (SG) and Stalk or Fiber (SF).

Relationship between Bold leaf (BL) and Secondary Grades (SG)

Table 1. Model Summary for the relationship between Bold leaf (BL) and Secondary Grades (SG)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.804*	.712	.675	.20043

a. Predictor: (Constant), Bold leaf (BL)

Table 2. Coefficients table for the relationship between Bold leaf (BL) and Secondary Grades (SG)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-4.634	.034		-23.321	.000
1 Bold leaf (BL)	2.376	.026	**.804**	12.074	.000

a. Dependent Variable: Secondary Grades (SG)

The regression analysis results, examining the relationships between Bold leaf (BL) and Secondary Grades (SG), indicate valid regression models ($p < 0.005$) that account for 67.5% of the variance in the outcome variables. It is evident that Bold leaf (BL) serves as a significant predictor ($p < 0.005$) of Secondary Grades (SG) (beta coefficient: 0.804), confirming support for H_1.

Relationship between Ragged leaf (RL) and Secondary Grades (SG)

Table 3. Model Summary for the relationship between Ragged leaf (RL) and Secondary Grades (SG)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.799*	.623	.597	.15609

a. Predictor: (Constant), Ragged leaf (RL)

Table 4. Coefficients table for the relationship between Ragged leaf (RL) and Secondary Grades (SG)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.458	.034		2.587	.000
1 Ragged leaf (RL)	.482	.098	**.799**	86.392	.000

a. Dependent Variable: Secondary Grades (SG)

The regression analysis results, investigating the relationships between Ragged leaf (RL) and Secondary Grades (SG), reveal valid regression models ($p < 0.005$) that account for 59.7% of the variance in the outcome variables. It can be asserted that Ragged leaf (RL) is a significant predictor ($p < 0.005$) of Secondary Grades (SG) (beta coefficient: 0.799), supporting for H_2.

Relationship between Flakey leaf (FL) and Secondary Grades (SG)

Table 5. Model Summary for the relationship between Flakey leaf (FL) and Secondary Grades (SG)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.744*	.561	.542	.20459

a. Predictor: (Constant), Flakey leaf (FL)

Table 6. Coefficients table for the relationship between Flakey leaf (FL) and Secondary Grades (SG)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-4.192	.176		-26.98	.000
1 Flakey leaf (FL)	2.319	.059	**.744**	51.781	.005

a. Dependent Variable: Secondary Grades (SG)

The regression analysis results, evaluating the connections between Flakey leaf (FL) and Secondary Grades (SG), demonstrate reliable regression models ($p < 0.005$) explaining 54.2% of the variance in the outcome variables. It is evident that Flakey leaf (FL) is a significant predictor ($p < 0.005$) of Secondary Grades (SG) (beta coefficient: 0.744), thus H_6 Is supported.

Relationship between Stalk or Fiber (SF) and Secondary Grades (SG)

Table 5. Model Summary for the relationship between Stalk or Fiber (SF) and Secondary Grades (SG)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.708*	.564	.553	.20982

a. Predictor: (Constant), Stalk or Fiber (SF)

Table 6. Coefficients table for the relationship between Stalk or Fiber (SF) and Secondary Grades (SG)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-4.502	.173		-23.98	.000
1 Stalk or Fiber (SF)	3.782	.092	**.708**	44.970	.000

b. Dependent Variable: Secondary Grades (SG)

The regression analysis findings, examining the relationships between Stalk or Fiber (SF) and Secondary Grades (SG), reveal reliable regression models ($p < 0.005$) explaining 55.3% of the variance in the outcome variables. It can be concluded that Stalk or Fiber (SF) is a significant predictor ($p < 0.005$) of Secondary Grades (SG) (beta coefficient: 0.708), thus H_7 is supported.

IV. DISCUSSION AND CONCLUSION

Key Findings— Based on the obtained results, the first, second, sixth, and seventh hypotheses were supported, leading to the following conclusions:

- There exists a significant relationship between Bold leaf (BL) and Secondary Grades (SG).
- There exists a significant relationship between Ragged leaf (RL) and Secondary Grades (SG).
- There exists a significant relationship between Flakey leaf (FL) and Secondary Grades (SG).
- There exists a significant relationship between Stalk or Fiber (SF) and Secondary Grades (SG).
- The primary contributors to Secondary Grades (SG) are Bold leaf (BL) and Ragged leaf (RL).

Samaraweera and Kandappah (1986) stated that the percentages of main types of teas cannot be changed ad-hoc without sacrificing the style of the grades and hence the price, producers must however be very careful in attempting to reduce the percentage of broken grades, as it can adversely affect the style of main grades. In all instances, it is crucial to adhere to accepted styles, sizes, and characteristics to maintain the quality and consistency of the tea grades.

The primary objective of this study is to investigate the main reasons for the non-compliance of made black tea with the main relevant grade, whereas the insights derived from this research would contribute significantly to enhance the overall revenue generated by the tea industry. By effectively applying the research findings, policymakers and other stakeholders in the tea industry can take appropriate measures to minimize Bold leaf (BL), Ragged leaf (RL), Flakey leaf (FL), and Stalk or Fiber (SF). This, in turn, has the potential to substantially increase the contribution of tea exports to the national GDP.

Maintaining the cleanliness of tea grades is of paramount importance, and the removal of stalk and fiber is crucial, and fiber can be effectively eliminated using mini pickers, while Electrostatic Stalk Extractors and Myddletons can be employed to remove stalk (Samaraweera and Kandappah, 1986).

As a key recommendation, tea producers should prioritize upholding the quality of the made tea to ensure it remains true to its designated grade (true to grade). Such measures will go a long way towards sustaining and enhancing the reputation and market value of Sri Lankan tea.

It is important to acknowledge that while there have been research efforts dedicated to tea, there seems to be a notable absence of studies specifically focusing on the "reduction of non-compliance of made black tea with the main relevant grade." This particular area holds great significance for its potential contribution to the tea industry and Sri Lanka's economy. The current research study endeavours to address this knowledge gap by exploring the "reduction of non-compliance of made black tea with the main relevant grade through proper handling and management practices of tea." By doing so, it aims to provide valuable insights and data that can be utilized by policymakers and industry leaders in the tea business to foster growth and progress in the industry. This study fills a critical void in the field and has the potential to positively impact the tea sector and the overall economy.

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