

Consumer Expenditure Elasticity and Value of Household Food Waste: A Case Study in Kurunegala District

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Abstract

Household food waste is driven by consumer habits and behaviour, varying with demographic, social, and economic factors. This study aims to determine whether household food waste is a luxury good and identify how demographic and socioeconomic factors affect household food waste. A Quadratic Almost Ideal Demand System (QUAIDS) model was used, augmented with demographic, socioeconomic, and expenditure controls. Data from 195 respondents via an online survey in the Kurunegala district (October 2022) covered food habits and waste. Food categories included rice, cereals, pulses, fruits, vegetables, meat, fish, dairy, eggs, and miscellaneous foods. The value of Household food waste was estimated using a proxy value derived from multiplying waste amounts by monthly grocery expenditures. The demand system estimation showed that all food waste categories were normal goods. Rice, cereals, pulses, fruits, vegetables, and miscellaneous foods were necessity goods, while meat, fish, dairy, and eggs were luxury goods. Expenditure share on household food waste varies with residence area and income level, and most households practice waste management and have positive attitudes toward minimizing waste.

Keywords: *Household food waste, Almost ideal demand system, QUAIDS, Expenditure elasticity*

I. INTRODUCTION

According to estimates, nearly one-third of the food produced worldwide is wasted. In Sri Lanka and other developing nations, food loss and waste play a crucial role in reducing hunger, raising incomes, and strengthening food security. When crops are produced, harvested, and processed, there is a loss of food, both in terms of quantity and quality. Developing nations are more likely to experience this. Food loss includes food waste, which is the act of discarding edible food at the consumer and retail levels. Food waste is particularly prevalent in industrialized nations,

where it accounts for more than 40% of all food losses and waste at the retail and household levels (FAO, 2015).

Household Food waste (FW) means all edible food and beverages grown at home or purchased from outside but discarded at home, because of spoilage or with an expired date. Usually after a meal at home, edible food and beverages are thrown out as FW. Bones, shells, peels, curry leaves like un-edible parts and any food or beverages that are eaten away from home are not included as household FW. That represents a major component of all food waste. Typical household features are more or less likely to influence food waste. One food waste for one household may not be food waste for another household, it depends on a broad range of categories. It varies on a wide range of cultural, social, and economic factors. There is a personal dimension linked to socio-demographic factors, knowledge about food waste, and personal beliefs which are also influenced by cultural context and social norms (Gjerris and Gaiani, 2013).

Quantifying the amount of food waste during each step of the food supply chain significantly reduces food waste. But quantifying the amount of household food waste is QUAIDS-specified, not easy due to the lack of standard methodologies. Therefore, this is a problem with the reduction of household waste. Current consumer FW research concurs with the food categories that are most often wasted at home. Vegetables, fruits, and bread are the top wasted products, even though prevalence among these categories depends much on the household's dietary preferences. Limited information about inedible parts of food discarded at the household level is available. Because most studies focused on avoidable FW (Vargas-Lopez et al., 2022).

Demand estimation describes changes in consumer behavior concerning the price of the

product, consumer income, or any other factors that affect or impact demand. One of the most popular consumer demand measures is the income or expenditure elasticity in classical microeconomic theory. During this study, expenditure elasticity is used to determine whether household FW is a luxury good or not. That means changes in consumer behavior related to the diverse types of food waste of main food categories concerning monthly expenditure on each food category. Our approach contributes to the relevant literature by supplying a first attempt to quantify FW within households in the Kurunegala district. Moreover, by evaluating and studying household FW value and consumer responsiveness, we provide proxy value for FW at the household level. The definition of demand-side perspectives allows us to place FW in the context of elasticities and estimate its total expenditure changes, the value of waste produced, and price changes (Vargas-Lopez et al., 2022).

An almost ideal demand (AIDS) system is used to evaluate demand analysis related to household food waste. The flexible functional form of the property of the AIDS cost function shows that the demand functions are obtained from its first-order approximation to any set of demand functions acquired from utility-maximizing behavior. The set of demand equations is used to obtain values for parameters (Deaton and Muellbauer, 1980). The Quadratic Almost Ideal Demand System (QUAIDS) model is an extended form of the AIDS model, and it is developed by Banks, Blundell, and Lewbel (1997) and the introduction of demographics described in Poi (2012).

According to the AIDS model's Quadratic Almost Ideal Demand System (QUAIDS), expenditure elasticity for each FW of each food category is estimated. Based on the elasticity value of each home food waste of a chosen food category, it is determined whether a household produces luxury food waste. A luxury good is one for which demand grows more than proportionally as income rises in economics. The desire for luxury items is known to be highly income elastic. In other words, consumers will increasingly purchase luxury commodities as their income increases. Due to its extreme sensitivity to economic difficulties, consumer expenditure on luxury items is frequently influenced by the state of the economy. Consumer patterns, however,

frequently support the economy as well. Materials and Methods

II. MATERIALS AND METHODS

A. Description of data collection

The primary data for this study were collected through a self-administered online questionnaire conducted in the Kurunegala district. The Kurunegala district was selected due to its well-defined city planning and the clear demarcation of rural, semi-urban, and urban residential areas, which allowed for a comprehensive analysis of income level differences across these regions. The research design adopted a cross-sectional time horizon.

B. Sampling Method

This study employed a random sampling method to select participants from the Kurunegala district. The district's diverse residential areas, including urban, semi-urban, and rural regions, provided a comprehensive representation of varying income levels and household behaviors. Respondents were recruited through social media platforms such as Facebook, LinkedIn, and Twitter, ensuring broad accessibility.

The data collection process was executed through an online survey. The questionnaire, crafted using established scales adapted from previous literature, was initially prepared in English and then translated into Sinhala to ensure accessibility for all respondents. A back-translation process was employed to verify the accuracy of the translation, ensuring that all respondents could understand and accurately complete the survey. To ensure the reliability and validity of the questionnaire, it underwent a pre-testing phase. Feedback from this phase was utilized to refine the questionnaire, enhancing its clarity and understandability. The final sample consisted of 195 respondents, who provided detailed information on their household's socio-demographic characteristics, food expenditure, food-wasting behavior, and waste management practices.

Data collection occurred in October 2022, with respondents from the Kurunegala district recruited via social networks such as Facebook, LinkedIn, and Twitter. The questionnaire comprised four main sections: 1. Household Socio-Demographic Information, 2. Food Expenditure Information, 3.

Food-Wasting Behavior, and 4. Waste Management Practices and Attitudes. The final section delved into the waste management practices adopted by households and their attitudes towards reducing food waste.

Respondents were instructed to provide answers reflecting their household's behavior and practices. The questionnaire targeted ten specific food categories:

- Rice
- Other cereals
- Pulses
- Fruits
- Vegetables
- Meat (beef, chicken, and pork products)
- Fish and shellfish
- Dairy products (milk, yogurt, etc.)
- Eggs
- Miscellaneous food

Prices for each food category were obtained from the different markets located in respondents' areas. Respondents were asked to report their monthly expenditure on each food category and the corresponding percentage of food waste. This comprehensive data collection approach enabled a detailed analysis of household food waste patterns and behaviors.

C. Method of Data Analysis

1) Model Specification

In their influential work, Deaton and Muellbauer developed the Almost-Ideal Demand System (AIDS) to analyze consumer spending patterns. Banks et al. later refined this model by incorporating a quadratic term in log expenditure, addressing the limitations of the original log-linear specification, which did not fully capture consumer behavior for certain goods. This enhanced model is referred to as the Quadratic Almost-Ideal Demand System (QUAIDS). Banks et al. demonstrated that AIDS is a special case of QUAIDS, with the quadratic specification offering a more general and flexible framework.

For our analysis of food waste, we consider both the AIDS model by Deaton and Muellbauer and the QUAIDS model by Banks et al. However, the results presented in the following sections focus exclusively on the QUAIDS specification. The

demand function, as originally defined by Deaton and Muellbauer, takes the following form:

$$\omega_i = \alpha_i + \sum_j^k \gamma_{ij} \log p_j + \beta_i \log \left(\frac{m}{a(p)} \right)$$

Where α_i , γ_{ij} and β_i are vectors of parameters, w_i is the expenditure share for good i , m is the total expenditure, the price index $a(p)$ is defined as:

$$\log a(p) = a_0 + \sum_k a_k \log p_k + \frac{1}{2} \sum_j \sum_k \gamma_{jk} \log p_j \log p_k$$

Alternatively, the quadratic model proposed by Banks et al. [31] describes the indirect utility function as follows:

$$\ln V(p, m) = \left\{ \frac{\ln m - \ln a(p)}{b(p)} \right\}^{-1} + \lambda(p)^{-1}$$

Where $\ln a(p)$ denotes the transcendental logarithm function:

$$\ln a(p) = \alpha_0 + \sum_{i=1}^k \alpha_i \ln p_i + \left(\frac{1}{2} \right) \sum_{i=1}^k \sum_{j=1}^k \gamma_{ij} \ln p_i \ln p_j$$

Where p_i represents the price of good i for $i=1 \dots k$. Additionally, in the indirect utility function, $b(p)$ serves as the Cobb-Douglas price aggregator:

$$b(p) = \prod_{i=1}^k p_i^{\beta_i}$$

and

$$\lambda(p) = \sum_{i=1}^k \lambda_i \ln p_i$$

To adhere to economic theory, it is required to impose or test the conditions of aggregation, homogeneity, and symmetry, which leads to the following implications:

$$\sum_{i=1}^k \alpha_i = 1 \quad \sum_{i=1}^k \beta_i = 1 \quad \sum_{i=1}^k \gamma_{ij} = 0$$

$$0 \quad \gamma_{ij} = \gamma_{ji}$$

2) Elasticity

Since the estimated parameters themselves are not the main focus of our analysis, they are not

presented in the subsequent sections. Instead, we concentrate on discussing the estimated expenditure and uncompensated price elasticities, which provide the economic insights we aim to explore. The expenditure elasticities are calculated using the following equations:

$$\mu_i = 1 + \frac{1}{\omega_i} \left[\beta_i + \eta_i'z + \left(\frac{2\lambda_i}{b(p)c(p,z)} \right) \ln \frac{m}{m_0(z)a(p)} \right]$$

3) Interpretation and Insights

By analyzing the estimated elasticity values, we can derive insights into household food waste patterns:

Expenditure Elasticity: Indicates whether a good is considered a necessity ($E_i < 1$) or a luxury ($E_i > 1$). This helps in understanding how changes in total expenditure influence the demand for different goods, thereby shedding light on the economic behaviour underlying food consumption and waste patterns. This analysis contributes to economic theory and promotes sustainable consumption practices.

III. RESULTS

A. Descriptive results

The demographic distribution of the respondents shows that the majority, 39% (n=76), reside in urban areas. A further 37.4% (n=73) live in rural areas, and 23.6% (n=46) are from semi-urban areas. Among the surveyed households, 84.6% (n=165) of the household heads are aged between 56 and 70 years, indicating a significant representation of older individuals in leadership positions within these households. This demographic factor likely influences household decision-making processes. The survey also revealed that households with four members are the most common, constituting 41.1% (n=80) of the sample. Households with five members represent 21.0%, reflecting diversity in household sizes within the region (Table 01).

Table 01: Demographic characteristics

Demographic characters	Value (%)	Std. Err.	O bs.
Age of HH head (% of respondents)			
Below 20 years	2.1	0.01	04
25-40 years	21.0	0.29	41
41-55 years	31.3	0.03	61
56-70 years	43.1	0.03	84
Above 71 years	2.5	0.01	05
Household head			
Male (% of respondents)	84.6	0.02	5 16

Household size (% of respondents)			
1	2.1	0.01	04
2	10.3	0.02	20
3	13.3	0.02	26
4	41.1	0.03	80
5	21	0.02	41
6	8.2	0.01	16
7	1.5	0.00	03
8	1.5	0.00	03
9	1.0	0.00	02
Residence area (% of respondents)			
Rural	37.4	0.03	73
Semi-urban	23.6	0.03	46
Urban	39.0	0.03	76

Participants were asked about their monthly expenditure on groceries, which averaged 43,305.62 LKR per household (SD = 20937.51). In terms of food waste, the average monthly expenditure was 2,604.40 LKR per household (SD = 2,054.05). This indicates considerable variability in household spending on both groceries and food waste (Table 02). Monthly household incomes were categorized into three groups: low income ($\leq 35,000$ LKR), middle income (35,000 LKR - 100,000 LKR), and high income ($> 100,000$ LKR). Analysis revealed that 39% of respondents are in the high-income category, indicating a significant presence of economically affluent individuals. Additionally, 38% belong to middle-income households, suggesting a substantial middle-class presence, while 23% are categorized as low-income, highlighting economic challenges faced by a portion of the population. Examining the food purchasing habits, the highest food waste expenditure was reported by individuals who purchase raw food daily. Following this, those who buy raw food 3-5 days per week also exhibited high food waste expenditure. Households purchasing raw food monthly had lower food waste expenditure, with the lowest observed among those who buy raw food monthly. Food safety practices were also assessed. Among the 195 respondents, 93% consistently check the expiration dates when purchasing food, 5% do so sometimes, and 2% do not consider expiration dates at all. Furthermore, 83.59% (n=163) of respondents regularly freeze fruits and vegetables to minimize waste, while 16.41% (n=32) do not engage in this practice.

The impact of COVID-19 and the economic crisis on food waste behaviors was also examined. None of the respondents reported an increase in household food waste due to these conditions.

Conversely, 63.59% (n=124) indicated a reduction in food waste during this period, while 36.41% (n=71) reported no change in their household food waste practices. These findings provide valuable insights into the demographic and economic factors influencing household food waste and the practices employed to manage and reduce waste within the study population.

B. QUAIDS Estimation Findings

Rice emerges as the dominant category with the highest expenditure share among all households. Vegetables also exhibit a substantial expenditure share across all household food waste (FW) categories. In low-income households, higher expenditure shares are observed for rice, other cereals, pulses, fruits, and miscellaneous FW, with lower shares for meat, fish, eggs, and dairy products compared to high-income households. Conversely, high-income households show elevated expenditure shares for meat, fish, eggs, and dairy products, alongside lower shares for rice, cereals, pulses, fruits, and miscellaneous FW.

Urban households exhibit higher expenditure shares for vegetables, meat, fish, eggs, and dairy products, while displaying lower shares for rice, cereals, pulses, fruits, and miscellaneous FW. In contrast, rural households have elevated expenditure shares for rice, cereals, pulses, fruits, and miscellaneous FW, with lower shares for vegetables, meat, fish, eggs, and dairy products. The following table summarizes the QUAIDS estimation results along with their significance levels:

Table 02: Average monthly expenditure on food and FW at the household level

Expenditure share on FW	All households	Low-income	Middle-income	High-income	Rural	Semi-urban	Urban
Rice	0.250	0.257	0.227	0.210	0.258	0.260	0.237
Other kinds of cereals	0.059	0.075	0.065	0.047	0.083	0.064	0.031
Pulses	0.048	0.043	0.054	0.039	0.062	0.058	0.026
Fruits	0.153	0.229	0.164	0.130	0.198	0.178	0.095
Vegetables	0.198	0.153	0.175	0.238	0.148	0.187	0.253
Meat	0.090	0.034	0.068	0.129	0.048	0.059	0.150
Fish	0.044	0.016	0.037	0.057	0.044	0.030	0.052
Dairy products	0.023	0.004	0.019	0.031	0.018	0.016	0.032
Eggs	0.190	0.017	0.020	0.018	0.016	0.010	0.027
Miscellaneous food	0.114	0.170	0.120	0.099	0.122	0.133	0.095

***p < 0.01; **p < 0.05; *p < 0.1

Semi-urban households show the highest expenditure shares on rice waste and miscellaneous FW (Table 03).

Table 03: Expenditure shares on household food waste

Food category	Elasticity	Standard error	Significance level
Rice	0.942	0.061	***
Other cereals	0.928	0.104	**
Pulses	0.805	0.156	*
Fruits	0.712	0.082	**
Vegetables	1.001	0.069	***
Meat	1.658	0.082	***
Fish	1.312	0.116	**
Dairy products	1.297	0.125	**
Eggs	1.273	0.143	**
Miscellaneous foods	0.870	0.104	*

Elasticity values of Food Waste

The QUAIDS model was used to estimate expenditure elasticities for various household food waste categories. The results indicate that rice, cereals, pulses, fruits, and miscellaneous foods are considered necessities, with expenditure elasticity values below 1. Conversely, vegetables, meat, fish, dairy products, and eggs were classified as luxury goods, with elasticity values exceeding 1.

Table 04: Expenditure elasticity of household FW categories

FW categories	All households	Low-income	Middle-income	High-income	Rural	Semi-urban	Urban
Rice	0.942 (0.061)	1.070 (0.054)	0.958 (0.058)	0.825 (0.099)	1.008 (0.052)	1.006 (0.052)	0.831 (0.096)
Other cereal	0.928 (0.104)	1.197 (0.082)	0.985 (0.097)	0.607 (0.185)	1.075 (0.064)	1.075 (0.084)	0.371 (0.288)
Pulses	0.805 (0.156)	1.055 (0.123)	0.792 (0.148)	0.601 (0.267)	0.935 (0.104)	0.933 (0.112)	0.342 (0.413)
Fruits	0.712 (0.082)	0.564 (0.066)	0.662 (0.080)	0.892 (0.138)	0.653 (0.056)	0.641 (0.062)	0.903 (0.196)
Vegetables	1.001 (0.069)	1.057 (0.098)	1.032 (0.069)	0.975 (0.083)	1.055 (0.082)	1.029 (0.06)	0.975 (0.081)
Meat	1.658 (0.082)	2.468 (0.242)	1.645 (0.081)	1.555 (0.082)	2.085 (0.135)	1.876 (0.109)	1.473 (0.072)
Fish	1.312 (0.116)	1.479 (0.212)	1.339 (0.117)	1.250 (0.126)	1.292 (0.102)	1.425 (0.147)	1.286 (0.145)
Dairy products	1.297 (0.125)	1.442 (0.204)	1.310 (0.137)	1.249 (0.134)	1.348 (0.140)	1.404 (0.156)	1.237 (0.134)
Eggs	1.273 (0.143)	1.097 (0.224)	1.242 (0.110)	1.377 (0.212)	1.243 (0.152)	1.348 (0.236)	1.270 (0.147)
Miscellaneous	0.870 (0.104)	0.810 (0.094)	0.867 (0.095)	0.919 (0.173)	0.844 (0.086)	0.853 (0.079)	0.914 (0.186)

These findings suggest that households in the Kurunegala District tend to classify staple foods like rice and pulses as necessities, while luxury food items like meat and dairy products see higher food waste levels as income increases.

IV. DISCUSSION

Throughout this study, household food waste (FW) was estimated using a proxy value derived from multiplying waste amounts by monthly grocery expenditures. This approach introduced a total expenditure "proxy" in the QUAIDS model at the household level, providing a focused method for identifying meals that significantly contribute to the overall economic value of food waste.

Expenditure Share Analysis

The expenditure share analysis revealed that rice waste constituted the highest among household food waste categories across all households. This is particularly noteworthy in a sample where 98% of respondents were Sinhalese, as rice is a staple food in Sri Lankan households. Additionally, lower expenditure shares were identified for other cereals, pulses, meat, and fish, which might be influenced by elevated prices during an economic crisis, leading to reduced consumption of these categories. High-income households demonstrated higher expenditure shares on meat, fish, eggs, dairy products, and vegetables. This

trend can be attributed to inflationary effects on food prices, causing lower spending by low-income households in these categories.

Residential Area-Based Analysis

The analysis based on residential areas revealed higher expenditure shares for rice, cereals, pulses, fruits, and miscellaneous food in rural areas. This reflects the agrarian nature of the Kurunegala district, a major rice-producing region. In contrast, urban households exhibited higher expenditure shares for vegetables, meat, fish, eggs, and dairy products, indicating different consumption patterns influenced by urban living conditions.

Expenditure Elasticity values

Expenditure elasticity values were calculated using the QUAIDS model, revealing positive values for all food categories and confirming them as normal goods. By distinguishing between necessity and luxury goods based on elasticity values, the study identified rice, cereals, pulses, fruits, and miscellaneous foods as necessities. Conversely, vegetable, meat, fish, dairy products, and egg waste were classified as luxury goods. Fruit waste, despite being perishable, was considered a necessity due to lower consumption levels in Sri Lanka. The study highlighted the perishability and cultural factors contributing to vegetable, meat, fish, dairy products, and egg waste being categorized as luxury goods. Rural

areas exhibited higher wastage for all food categories except fruits and miscellaneous food, possibly due to factors such as limited space for disposal in urban areas and different separation habits in rural households. Urban households and those in high-income defiles allocated a higher percentage of their food budget to fruits, emphasizing higher expenditure elasticity for fruits in urban areas. Additionally, low-income households exhibited higher expenditure elasticity values for most categories except for fruit, dairy, eggs, and miscellaneous food, indicating higher consumption by wealthier individuals.

Food Waste Behavior

The study also considered food waste behavior, revealing that attitudes such as cooking skills and consciousness of expiration dates significantly influenced waste reduction. Moreover, responses indicated a reduction in household food waste during the COVID-19 period and the prevailing economic crisis. This finding aligns with similar observations in Mexico during the pandemic, underscoring the importance of individual and household-level factors in minimizing food waste during challenging economic conditions. These findings suggest a notable trend toward decreased household food waste among the surveyed population amidst the adversity of the COVID-19 pandemic and economic instability. This emphasizes the critical role of economic and cultural factors in shaping food waste patterns and highlights the potential for targeted interventions to reduce waste across different income levels and residential areas.

V. CONCLUSION

According to our findings, all categories of household food waste (FW) were classified as normal goods, as evidenced by positive elasticity values. Specifically, waste of rice, other cereals, pulses, fruits, and miscellaneous food items were identified as necessity goods, while waste of meat, fish, dairy products, eggs, and vegetables fell under luxury goods. The expenditure elasticity values of food waste varied across household income levels and residential areas. Notably, all FW categories exhibited higher expenditure elasticity values in rural areas, except for fruits. Low-income households generally showed higher expenditure elasticity values compared to other income groups, with exceptions noted for fruit, dairy products, and eggs. The study suggests that management practices, attitudes, and behaviors

towards reducing household FW can be discerned from these observations.

VI. LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

The primary limitation of this study was the absence of directly collected food waste data. Instead, household food waste (FW) was estimated using a proxy value derived from multiplying waste amounts by monthly grocery expenditures. While maintaining food diaries would have provided more precise results, time constraints rendered this approach impractical. The study relied on an online survey, thus analyzing self-reported data. Such methods introduce potential measurement errors due to respondents providing inaccurate information or opting out of participation. Data collection occurred exclusively in October 2022, which may limit the generalizability of findings since household FW can fluctuate seasonally, such as during holidays like Christmas or New Year, impacting waste patterns. Furthermore, the rapidly changing economic conditions posed challenges in maintaining consistent food prices throughout the study period.

Future research should consider integrating food diaries with online surveys to enhance data accuracy and account for seasonal variations in household FW. Additionally, investigations should explore how expenditure on food, price dynamics, and demographic factors influence variations in FW at the household level.

VII. IMPLICATION

Based on the analysis results, household food waste (FW) categories were classified as luxury goods and necessity goods solely based on expenditure elasticity values, without considering price elasticity values. Future research endeavors should focus on determining price elasticity values within the household food category.

This study was conducted exclusively in one district of Sri Lanka, suggesting a need for broader geographical representation across all districts for comprehensive insights. The findings are crucial for identifying which goods are considered luxury or necessity in Sri Lankan households, pivotal for developing effective strategies to minimize FW at the household level.

Understanding the dynamics of different FW categories across various income levels and expenditure patterns is essential for addressing household food waste effectively. Such insights are invaluable for policymakers and decision-makers seeking to implement targeted measures for FW reduction, particularly in the context of ongoing economic challenges.

Ultimately, this study provides vital information to ensure continuous fulfillment of food requirements amidst the current economic crisis, underscoring its relevance and potential impact on policy formulation and decision-making.

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Engagement in an Entrepreneurial School Garden Project: Impact of Gardening on Students' Environmental Attitudes

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Abstract

This study explores the impact of the “Entrepreneurial School Garden Program” on students’ environmental attitudes, using a mixed-methods research approach. This program integrates practical gardening activities with the school’s co-curriculum to enhance knowledge and skills in food and nutrition, agriculture, and entrepreneurship. Quantitative data were collected through a survey on a sample of 214 students in the Jaffna district, where 22 schools had completed the program. Qualitative data were gathered through interviews with 5 groups of teachers, observations, and document analysis. The results revealed significant improvement in environmental attitudes ($M=4.0494$, $SD=0.7538$). Students perceived improvements in their environmental awareness ($M=3.9745$), positive attitudes toward environmental sustainability ($M=3.9185$), and adaptability to environmental changes ($M=4.195$). The frequency of engagement in gardening activities influenced students’ attitudes, while female students exhibited greater improvements than male students. Qualitative data analysis revealed improvements in a sense of responsibility and achievement, enhanced social skills and teamwork, and increased environmental awareness and stewardship. The frequency and duration of engagement have an influence on motivation. Students are perceived to be more responsible and capable of dealing with environment-related problems through their improved problem-solving skills, goal-setting abilities, and self-awareness. They developed better communication skills, empathy, and teamwork to adapt themselves to the environment. The engagement in gardening resulted in an improved consciousness of sustainability and commitment to environmental stewardship.

Keywords: *Environmental well-being, Entrepreneurial school garden program, Behavioural attitudes, Food security, Experiential learning*

I. INTRODUCTION

In recent years, there has been a growing interest among the curriculum designers and educational researchers on the effectiveness of extracurricular activities for developing social and emotional competencies in school students. Thus, attention is focused on the role of school-based gardening programs as a means of enhancing students' educational experiences and personal development. These programs are increasingly recognized by educators for their potential to foster a range of positive outcomes, including improved academic performance, greater environmental awareness, and enhanced social and emotional well-being (Childs, 2011). The schools in Jaffna district, with their unique cultural and environmental contexts, provide an intriguing setting to explore these potential benefits.

Since January 2023, the Food and Agriculture Organization of the United Nations (FAO), Australian Aid, Sri Lanka (Common Wealth Union) have supported entrepreneurial school gardens for students in over 200 schools spread across three provinces in Sri Lanka: Uva, Central, and North, in honor of the International Day of Education. The goal of the project is to assist awareness of school-based nutritional health and food security during the post COVID-19 and economic crisis led malnutrition and food insecurity crisis that Sri Lanka was experiencing. As part of the program, to develop skills in food security, nutrition, agriculture, and entrepreneurship, 505 school teachers from the three provinces were selected and provided training in the discovery-based teaching and learning techniques in agriculture. In addition, an awareness program was organized for students through practical activities in the selected schools for three weeks.

Then, the Entrepreneurial School Garden Program was implemented for one year in selected schools, integrating practical gardening activities into the educational curriculum. It was implemented to

enhance the knowledge, and skills among students on basic concepts of food nutrition, agriculture and entrepreneurship to improve their resilience to the food shortage that have emerged with economic crisis in Sri Lanka, while motivating students to have interest in agricultural entrepreneurship. This initiative is further intended to teach students about agriculture and sustainability and to encourage the development of positive environmental attitudes. By engaging directly with nature, students can learn the values and various skills of taking responsibility, problem solving, goal setting, stress management, critical thinking, spirituality, relationship building, team work, empathy, and positive attitude toward the environment.

This study investigates how participation in the Entrepreneurial School Garden Program has influenced the development of the environmental attitudes of students who participated in the programme. Specifically, it investigated the changes perceived in the environmental wellbeing of the students by examining the three dimensions identified through the literature (Milfont, & Duckitt, 2010): environmental awareness, positive attitudes toward sustainability, and adaptability to environmental changes. The research is grounded in the belief that hands-on, experiential learning opportunities can significantly impact attitudinal growth and development of interpersonal skills of the students.

II. BACKGROUND OF THE STUDY

The role of co-curricular activities in developing positive attitudes in students has been a major area of focus in several research studies (Waliczek, Bradley, & Zajicek, 2001). School gardening is one of the co-curricular activities which develops students' knowledge, skills and attitudes (Waliczek, & Zajicek, 1999) In recent years, innovative searches in education are increasing on a daily basis. Especially with the emergence of the Covid-19 pandemic, it became evident that a change in the direction and form of education is a must.

Despite the recognized benefits of school-based gardening programs, there remains a gap in understanding how these initiatives specifically impact the environmental attitudes of school students, particularly in diverse cultural and environmental contexts (Dilip, Thomas, & Malik, 2020). In the Jaffna district of Sri Lanka, where

economic challenges and post-COVID-19 recovery efforts have heightened concerns about food security and nutritional health, the introduction of the Entrepreneurial School Garden Program presents a unique context to explore the impacts of the engagement in school gardening on students' attitudes.

While previous research has highlighted the potential of school gardening to improve academic performance and social and emotional well-being, there is limited empirical evidence on how such programs influence environmental attitudes in a comprehensive manner. Moreover, the specific context of the Jaffna district, with its unique socio-economic challenges, adds another layer of complexity that has not been thoroughly examined.

Therefore, this study seeks to investigate the participation of students in the Entrepreneurial School Garden Program and its impact on the environmental attitudes of students. It attempts to answer the overarching question: How does involvement in gardening activities of students enhance environmental awareness, positive attitudes toward environmental sustainability, and adaptability to environmental changes?

The study attempts to describe the behavioral impacts of school gardening programs, and offer valuable insights for educators, policymakers, and education leaders. This will help in making informed decisions regarding the implementation and expansion of such initiatives in future to maximize the benefits for holistic development of students, especially in regions facing economic and nutritional challenges.

The Objectives of the Study

1. To identify the impacts of school garden on students' attitudes in terms of their environmental well-being.
2. To identify the factors contribute to the attitude development through school gardening engagement of school.
3. To examine the significant differences in attitudinal development through engaging in school garden among different socio-demographic characteristics of students.

III. LITERATURE REVIEW

The relationship between school gardening programs and students' environmental attitudes has been extensively studied, reflecting the growing emphasis on experiential learning in

education. School gardens serve as practical platforms where students can connect with nature, learn about environmental sustainability, and develop a sense of responsibility towards the environment.

Research studies have consistently shown that participation in school gardening activities positively influences students' environmental attitudes. According to Skelly and Bradley (2007), gardening programs can significantly enhance students' awareness and appreciation of environmental issues. Similarly, studies by Dirks and Orvis (2005) have demonstrated that hands-on gardening experiences lead to improved environmental knowledge and a stronger commitment to sustainability. Previous research also suggests that female students often exhibit greater environmental concern and engagement compared to their male counterparts. This is supported by Li et al., (2022) who found that females are generally more inclined towards environmental protection and sustainability.

Beyond environmental attitudes, school gardening has been linked to the development of social skills, teamwork, and a sense of achievement. Klemmer, Waliczek, and Zajicek (2005) highlighted that gardening activities foster collaboration among students and improve their communication skills, empathy, and ability to work in teams. These findings align with the current study's results, where students reported enhanced social skills and teamwork through gardening.

The integration of gardening into the school curriculum, particularly in subjects like food and nutrition, agriculture, and entrepreneurship, has been shown to enhance students' motivation and engagement. A study by Blair (2009) found that students who participate in garden-based learning are more motivated and perform better academically. The connection between frequency of engagement and improved environmental attitudes observed in this study echoes this, emphasizing the importance of sustained involvement in such programs. This body of literature underscores the multifaceted benefits of school garden programs, supporting the idea that they not only foster environmental stewardship but also contribute to the holistic development of students.

IV. RESEARCH METHODOLOGY

This study employs a mixed-methods research design, integrating both quantitative and qualitative approaches to describe the impact of the Entrepreneurial School Garden Program on behavioral attitudes of students. This design allows for a robust analysis by combining numerical data with detailed personal insights, thus providing a holistic understanding of the program's effects.

The study was conducted in the Jaffna district where eleven schools had completed Entrepreneurial School Garden Program successfully from 2022 to 2023 after the pandemic of Covid-19. Five schools were purposively selected for this study considering the gender, number of students who participated from the schools and number of presently available teachers who participated in the Entrepreneurial School Garden Program. A questionnaire survey approach was used for collecting the quantitative primary data from 214 grade nine students. A purposive sampling approach was employed to ensure a representative sample across different socio-economic backgrounds and school types.

The review of the literature revealed few instruments for measuring student attitudes from the impact of a school garden on students' attitudes. After through contemplation a self – prepared and validated questionnaire was administered to students after the implementation of the programme, at its completion. These surveys measured the perceived changes in three areas of environmental well-being..

In-depth interviews were conducted with a subset of 10 students, and 5 teachers. These interviews provided qualitative data on experiences and perceptions of the Entrepreneurial School Garden Program. Group discussions were held with five groups of parents having 5 members in each group .Observational data was collected during gardening activities and related classroom sessions. Student Journals and Project Reports, Analysis of students' written reflections and project reports offered additional insights into their learning experiences and attitudinal changes

Quantitative data Analysis was conducted using the techniques of descriptive statistics: Basic statistical measures were employed to summarize the survey data. Qualitative thematic technique was used to analyze interview and focus group

transcripts, along with observational and document data. This helped in identifying common themes and patterns in the perceptions.

V. FINDINGS OF THE STUDY

The study found that engagement in school gardening significantly improved their overall environmental attitudes, with a mean score of ($M=4.0494$, $SD=0.7538$). Additionally, the number of days students engaged in school gardening had a positive impact on improving their attitudes ($\beta=0.082$). The most significant improvement was observed in environmental well-being. Students developed greater environmental awareness, positive attitudes towards the environment, and adaptability to environmental changes.

The study revealed significant differences in attitudinal development based on gender. Female students had a greater improvement in attitudes ($M=4.0396$, $SD=0.63558$) compared to male students ($M=3.8523$, $SD=0.68411$), with a notable improvement difference (0.1872). This suggests that female students were more positively influenced by participation in school gardening activities. Parent's occupation, family income, and religion of the participant were not found to have significant differences.

Several factors were identified as contributing to the development of attitudes through engagement in school garden program. The frequency of engagement in school gardening activities was a critical factor. Increased days of participation were positively correlated with improvements in attitudes. This highlights the importance of consistent involvement in gardening activities to foster attitudinal growth.

Students with more experience in gardening activities showed greater improvements in their attitudes. This aligns with previous findings by Williams, & Dixon, (2013), which indicated that increased experience in gardening enhances knowledge, attitudes, and overall experience.

As mentioned, female students exhibited more significant attitudinal improvements compared to male students.

Although the overall time spent on gardening activities in schools was limited, with 47.6% of students spending 30 minutes and 24.1% spending one hour, the consistent engagement played a crucial role in attitude development. Long-term involvement in school gardening activities

positively impact on active engagement, both at school and at home. The sustained interest and participation were key to the positive attitudinal changes observed.

The Entrepreneurial School Garden Program significantly enhances environmental well-being. The findings underscore the value of regular, hands-on gardening activities in fostering positive behavioral attitudes and highlight the importance of considering demographic factors such as gender in program implementation.

Through the qualitative analysis of interviews, discussions, observations, and document studies, several key themes emerged, providing a nuanced understanding of how engagement in school gardening influenced attitudes.

Sense of Responsibility and Achievement: Students developed a strong sense of responsibility and achievement. Interviews revealed that students felt proud and accomplished when they successfully nurtured plants. Teachers noted increased self-esteem and a proactive attitude in students, particularly when they solved gardening-related challenges. Students' journals frequently mentioned their sense of responsibility and pride in their gardening achievements.

Gardening activities significantly enhanced social skills and teamwork which indirectly improve the environmental attitudes. Discussions indicated that students learned to collaborate and appreciate mutual contributions. There was a visible improvement in teamwork and empathy among students. They were observed supporting each other during gardening tasks. Project reports highlighted collaborative efforts and the development of strong peer relationships.

Participation in gardening fostered a deep sense of environmental awareness and stewardship. Interviews showed that students became more environmentally conscious. Students took the initiative in promoting sustainable practices, such as recycling and composting, in the school garden. Reflective essays indicated a significant increase in understanding of environmental issues and their commitment to sustainability.

Female students exhibited greater engagement and attitudinal improvements compared to male students. Interviews with female students highlighted their sense of empowerment and confidence gained through gardening. Female students were more engaged and took on leadership roles in gardening activities.

Regular and frequent engagement in gardening activities was crucial for attitudinal development. Teachers and students emphasized the importance of consistent participation. Frequent participants demonstrated greater improvements in responsibility and teamwork. Journals and project reports supported the idea that regular engagement was key to positive attitudinal changes.

Long-term involvement in gardening activities sustained interest and motivation. Interviews revealed that many students continued gardening at home, showing sustained interest. Students remained motivated and enthusiastic about gardening activities throughout the program. Reflective essays and journals showed ongoing commitment and enthusiasm for gardening beyond the school environment.

The integration of regular, hands-on gardening activities fosters positive behavioral attitudes, emphasizing the importance of frequency, experience, and gender considerations in program implementation. These insights provide valuable guidance for educators, policymakers, and community leaders in expanding and refining school gardening initiatives. Being engaged in school gardening helps students to improve their behavioural attitudes positively in the three identified dimensions: personal wellbeing, social wellbeing and environmental wellbeing.

VI. IMPLICATIONS AND RECOMMENDATIONS

The findings of this study have important implications for educators, policymakers, and community leaders. The positive impacts of the Entrepreneurial School Garden Program on behavioral attitudes highlight the value of integrating experiential learning opportunities into the educational curriculum. School gardening programs can serve as a powerful tool for holistic development, addressing not only academic needs but also fostering personal growth, social skills, and environmental consciousness. To maximize the benefits of such programs, the study recommends increasing the frequency of engagement, tailoring programs for inclusivity, sustaining long-term involvement, and integrating environmental education into the curriculum.

In conclusion, the Entrepreneurial School Garden Program has demonstrated significant positive impacts on environmental well-being. By providing hands-on, experiential learning

opportunities, the program has cultivated a range of positive behavioral attitudes, equipping students with essential life skills and fostering a sense of responsibility towards themselves, their peers, and the environment. These findings underscore the importance of school gardening programs as a valuable component of holistic education, offering insights that can guide the implementation and enhancement of similar initiatives in diverse educational contexts.

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A Study of the Existing Knowledge and Practice of Small and Medium-scale Agricultural Entrepreneurs on the Export Market

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Abstract

As a developing country, it is important for Sri Lanka to consider the export sector in achieving the desired economic goals and still, Sri Lanka is a country that has prioritized the export of agricultural products. Entrepreneurship plays the most important role in achieving the economic development of a country, and considering Sri Lanka, small and medium-scale agricultural entrepreneurship makes a remarkable contribution to it. When considering the export sector, the contribution of small and medium-scale agricultural enterprises is at a very low level. Therefore, this research aimed to gain an understanding of the knowledge and practices of small and medium-scale agricultural enterprises about the export market and to assist in the development of the export market accordingly. Out of 1,376 small and medium-scale entrepreneurs registered in the Galgamuwa and Giribawa Divisional Secretariats of the Kurunegala District, 250 were selected as a sample using a simple random method. A principal component analysis was conducted to identify the main factors affecting it, in which the factors of literacy, financial ability, management ability, government policies and marketing capability were identified as internal factors that have a high impact on the export market and existing knowledge regarding the export market, and utilization of knowledge of the export market were identified as external factors. Accordingly, proper policies and practical programs are necessary to empower small and medium-scale agricultural enterprises. Further, entrepreneurs can be encouraged to remove the obstacles to access the export market and achieve the desired economic development goals for Sri Lanka.

Keywords: *Small-scale business, Medium-scale business, Export market, Agriculture, Entrepreneurs*

I. INTRODUCTION

The contribution of the export sector to the economy of a country is very special by dint of globally, every country is trying to increase its export revenue. For this, there is a strong competition between powerful states. Especially China, USA, Germany, Japan and South Korea are leading countries in the export sector respectively (world market figures, 2019).

Although this is the world market situation, Sri Lanka has earned 15.0 billion in export revenue in 2023 (Sri Lanka Central Bank report, 2023) and it ranks 86th in the world's export revenue ranking. When looking at Sri Lanka with domestic and global development, low growth in the export sector continues to be seen. Due to this, an exchange deficit has been created in the country for almost a decade.

In finding solutions for this, there are very few studies on the contribution of small and medium agricultural entrepreneurs to the export market and the knowledge and practice they have about the export market. Accordingly, it is important to study this as a matter that needs special attention. According to Mayneris & Poncet (2015), the nature of the knowledge of the business community regarding the demand in the foreign market related to their business affects the export process. Also, it has been confirmed in the investigations that the awareness and trust in the business community regarding the availability of related institutions and their services in the export process has an impact on the nature of knowledge for the export process (Filatotchev & et al, 2009). This study aims to identify the obstacles that prevent businesses from entering the export market and to highlight how addressing these challenges can contribute to uplifting Sri Lanka's economy. By examining the interest and attitudes of the current youth and business communities towards the export market, the study seeks to foster a greater inclination toward exporting. Furthermore, it explores the new market opportunities highlighted by the Export

Development Board, particularly those beyond Sri Lanka's traditional export products. The study also assesses the level of awareness, knowledge, and attitudes within the local business community regarding the procedures for becoming an exporter, as well as the challenges they face in utilizing these opportunities (Sri Lanka Export Development Board Annual Report, 2019).

Accordingly, the primary objective of this study is to gain an understanding of the existing knowledge and practices of the small and medium scale agricultural entrepreneurs about the export market.

II. METHODOLOGY

The main target of this research is to study the gain an understanding of the existing knowledge and practices of the small and medium scale agricultural entrepreneurs about the export market. When studying the contribution of them in the export market, considering the expansion of the small and medium scale agricultural entrepreneurs in Sri Lanka, the expansion of the small and medium scale agricultural entrepreneurs can be commonly identified in the districts of Colombo, Gampaha and the Kurunegala district of the North-West Province, with the Western Province leading. Thus, in the selection of the sample used in the study, small and medium scale agricultural entrepreneurs registered in the Galgamuwa and Giribawa Divisional Secretariat Divisions of Kurunegala District was used. 250 entrepreneurs were selected for this purpose from the registered small and medium scale business in Giribawa and Galgamuwa areas using simple random sampling method.

Both the primary and secondary data methods were used to collect data. Under these two methods, both quantitative and qualitative data were classified and in order to obtain data relevant to the two methods, primary and secondary technical methods inherent to that were used for the collection of data. o obtain primary data, questionnaire was used, and using it a principal component analysis (PCA) was conducted to identify the factors affecting the knowledge and practice of SMEs in export markets.

III. RESULTS AND DISCUSSION

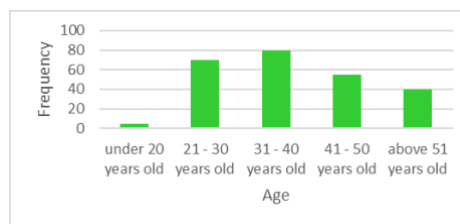


Figure 01: Responders Age level

Most of the respondents in the sample are people in the age group of 31-40 years. That is, when this group is expressed as a percentage of the entire sample, it is about 32%. Secondly, when classified according to the age structure of small and medium scale entrepreneurs, most people belong to the age group of 21-30 years. They are 28% when taken as an overall fixed percentage. In the sample, there are only five small entrepreneurs under 20 years of age, which is 2%.

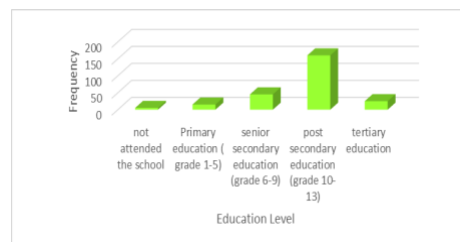


Figure 02: Responders Education level

Considering the educational level of the studied small and medium scale entrepreneurs, the highest percentage represents the post-secondary level of education. That is, the people who studied advanced level and ordinary level. It is a percentage of 64% in the entire sample. 18% percent had higher secondary education which is 45% of the total sample. The business community with college and university education as tertiary education constitutes 10% of the sample. Those with primary education represent 6% and the uneducated represent 2%.

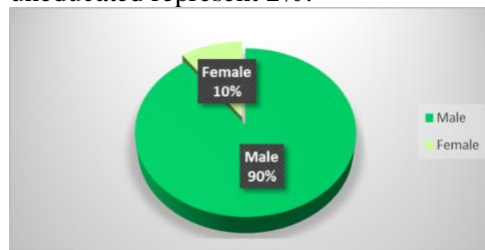


Figure 03: Gender Disparities

92% of the total respondents are represented by males which is 225 out of the total sample.

Females represent 10% which is 25% of the total sample.

Table 01: Component Score Coefficient Matrix

	Component	
	1	2
Literacy	.208	-.110
Utilization of Knowledge of Export Market	.092	.380
Financial Ability	.243	-.056
Management Ability	.242	-.003
Government Policies	.223	-.143
Marketing Capability	.182	.155
Knowledge of the Export Market	-.114	.844

Source: Authors generated using SPSS

Here, the contribution of variables to each component can be indicated through Score coefficients. The results presented are based on a Principal Component Analysis (PCA), which was employed to reduce the dimensionality of the data and identify the key factors (components) that contribute to the variability among the variables studied. The method used to extract these components was PCA with Varimax rotation to ensure that the components are orthogonal (uncorrelated).

The score coefficients represent the contribution of each variable to the respective components. These coefficients were calculated using the factor loadings obtained from PCA. The higher the absolute value of a score coefficient, the greater the contribution of the corresponding variable to that component. For the first component, variables such as Literacy, Financial Ability, Management Ability, Government Policies, and Marketing Capability showed the highest contributions, indicating that these factors are the most influential in this component. The second component is primarily influenced by the Knowledge of the Export Market and the Utilization of Knowledge of the Export Market.

The above factors could be identified as internal factors affecting the export market. Among the internal factors affecting export market access, financial ability can be identified as one of the most influential factors. According to the data obtained from the entrepreneurs, the problems of financing the working capital for internationalization, the lack of funds for investment for internationalization, the lack of

insurance for internationalization can be identified as internal barriers affecting export market access.

Management ability as an internal barrier to the export market can also be identified as the second influencing variable. Accordingly, strong management is required for export market performance. The study identified that there is insufficient knowledge in the small and medium scale entrepreneurs. Based on that, it was identified in the study that it is necessary to provide knowledge about the management process for management.

It was identified in the study that government policies affect export markets as internal barriers. Accordingly, it was recognized that market behavior is influenced by tax policies and government agreements followed by the government.

The second component has the highest contributions are, Utilization of Knowledge of Export Market and Knowledge of the Export Market.

According to the study, external factors affecting the export market can be identified as the second component. It was identified in the study that existing knowledge regarding the export market as a variable that has a strong impact on it. Analyzing the information of the entrepreneurs in the questionnaire, it appears that the information is inefficiently channeled into the businessmen.

Another factor affecting external factors was found in the study to be the problem in practical use of the export market. The second extracted component, the impact of the external factors affecting the export market, score is 0.388.

Thus, it can be concluded that internal factors have a greater impact on the export market and it is important to pay attention to external factors to maintain the performance of the export market. It can be concluded on the basis of the component score that the variable of small and medium scale entrepreneur's use of knowledge about the export market has a higher impact than all other variables. It was recorded as 0.844. Accordingly, the knowledge of small and medium scale entrepreneurs about the export market can be identified in the study as the variable that has the greatest impact on the export market.

IV. CONCLUSION

The study identifies several critical internal and external factors that influence the participation of small and medium-scale agricultural

entrepreneurs in Sri Lanka's export market. Internal factors such as financial ability, management capability, and literacy play a significant role in determining the success of these enterprises in the export market. Specifically, financial challenges, such as inadequate working capital, lack of investment funds, and insufficient insurance for international trade, are major barriers to market entry. Additionally, gaps in management skills highlight the need for enhanced training and knowledge transfer to strengthen the operational capacity of these businesses.

External factors, particularly the entrepreneurs' existing knowledge of the export market and their ability to utilize this knowledge, were found to be crucial for successful market participation. The study revealed that inadequate information flow between export development agencies and entrepreneurs significantly hampers their ability to navigate the export process effectively. To address this, there is a need for robust organizational programs that ensure consistent and accessible information dissemination, leveraging digital platforms, social media, and traditional media outlets.

Moreover, the study underscores the importance of a sustainable and supportive government policy framework. Policies that facilitate access to financial resources, provide tax incentives, and promote effective foreign agreements are essential for creating a conducive environment for export market growth. The findings suggest that empowering young entrepreneurs, particularly those between the ages of 21 and 30, through targeted education and support programs, could further enhance their participation in the export market.

In conclusion, a comprehensive approach involving the enhancement of internal capacities, improvement of external information channels, and the establishment of supportive government policies is essential for encouraging small and medium-scale agricultural entrepreneurs in Sri Lanka to engage more actively in the export market. These measures are vital for achieving the broader economic development goals of the country.

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Factors Influencing the Fast-food Consumption Frequency among Undergraduates of Faculty of Agriculture, Eastern University of Sri Lanka

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Abstract

Fast food has been revolutionized by modernization and globalization, and Sri Lankans, particularly young people with busy schedules, embrace it for its convenience. This could reduce their nutritional status and increase their risk of diet-related noncommunicable diseases. This study aims to relate the factors that influence the frequency of fast-food consumption among undergraduates of the Faculty of Agriculture, Eastern University, Sri Lanka (EUSL). A structured questionnaire was used to gather primary data from 100 randomly chosen students in five batches at the EUSL Faculty of Agriculture. The collected data were analyzed using the SPSS software package. Descriptive statistics were used to explain the study variables, and a chi-square analysis was done to find out the factors influencing fast-food consumption frequency. The results revealed that more than half of the students (82%) were female from various districts of Sri Lanka. When it came to choosing fast food items, the majority of students gave preference to taste. However, when it came to the diversity of the menu, they gave preference to taste when they consumed fast food on a weekly basis. Almost half of the students consume fast food 1-2 times per week. Additionally, the menu's variety and the time allotted for preparation, tasting, and dining with loved ones affected how frequently they consumed fast food each week. The study reveals that most students prefer fast food for snacks, which could be beneficial for undergraduate health care and promote healthier dietary choices.

Keywords: *Fast food, Food choice, Health impacts, Nutritional status*

I. INTRODUCTION

The fast-food industry has grown dramatically throughout the world (Jia et al., 2021; Lim et al., 2018; Mertens et al., 2022). Fast food is linked with restaurant chains that provide a bound menu

of standard choices such as pizza, hamburgers, sandwiches, chips, sodas, and other related foods that are made quickly and intended to be consumed immediately (Mazidi and Speakman, 2017; Thornton et al., 2009). These dishes are distinguished by their quick availability, simple preparation method, and emphasis on efficiency, allowing customers to receive their cuisine in minutes of placing an order (Fulkerson, 2018).

Fast food consumption has become a public health concern due to its association with a poor diet. (Jia et al., 2021). It ended up with the risk of certain chronic diseases such as diabetes, cardiovascular diseases (Elizabeth et al., 2020; Jardim et al., 2021), and obesity (Elizabeth et al., 2020; Jardim et al., 2021; Ipparraguirre et al., 2021).

Fast food consumption has grown significantly among higher education students. These amounts may vary from around three times per month. (Didarloo et al., 2022) to two or more times a week (Shaban and Alkazeme, 2021; Mwafi et al., 2021). Varied factors have shown significant impacts on continual fast-food consumption, including attributes like higher socioeconomic status, gender, age group (Didarloo et al., 2022; Saha et al., 2022), and high-rise body mass index (Hojjati et al., 2023). Further, factors like price, brand reputation, taste, accessibility, favourable location, Promotional incentives and rapid service play an important influence in increasing fast-food consumption among higher education students. (Saha et al., 2022). Undergraduates are an especially vulnerable group, as they are in a period of life marked by various changes, which include spending prolonged periods away from home and residing at university campuses. This change considerably influences eating habits, frequently resulting in unlikely weight gain (Shatwan et al., 2022). This may have significant consequences in the future, as weight increase during the young adulthood stage is identified as a significant risk factor for the development of obesity in the later periods of adulthood (Sparke et al., 2021). Because it is regarded as the young generation, its well-being is important to the country's future

economy. Due to their busy lifestyles and limited time for meal preparation, university students are frequently seen as a huge customer base for fast food. People in the adolescent and teenage years are the most regular consumers of fast food. (Lee, 2007). There is a lot of well-researched evidence that consuming fast food daily can be harmful to one's health. This is due to the elevated sugar, salt, saturated fat, trans fats, processed components, and calories in fast foods. It is also deficient in antioxidants, fibre, and a variety of other nutrients (Jerlyn Jones, 2023). University students who spend most of their time out of home usually consider factors like accessibility, comfort, and eating preference when determining how to meet their energy and dietary needs. This may lead to an unbalance in their dietary habits and increase their chance of getting diet-related non-communicable diseases (NCDs).

Few studies have been conducted on Sri Lankan undergraduates' fast-food consumption patterns. (Jayawickrama et al., 2020). Public knowledge of youngsters' fast-food eating is relatively low, and there are very few resources and studies accessible on the subject, particularly on undergraduates' food consumption patterns (Arya and Dubey, 2023). As a result, an empirical gap in fast-food consumption patterns and factors influencing the choice of fast-food among university students has been established. Based on this background, a study was conducted among undergraduates of the Faculty of Agriculture, Eastern University, Sri Lanka, to determine the factors influencing their fast-food intake. By having a better understanding of these variables, more efficient strategies for encouraging people to choose environmentally

friendly and healthier food choices can be developed.

II. METHODOLOGY

This study further attempted to identify the most preferred fast foods and their consumption patterns; ten fast food items were listed among the respondents, and preference level was asked. The ten fast-food items included were burger, pizza, cakes, short eats, biscuits, juices, energy drinks, fried chicken, kothu, and ice cream.

A. Location of study

The research was conducted among the students in the Faculty of Agriculture at the Eastern University, Sri Lanka. The study looked at the Agriculture faculty students of Eastern University, Sri Lanka. The study's sample size was limited to 100 students from the Faculty of Agriculture at Eastern University in Sri Lanka.

B. Sample selection

Undergraduates from the Faculty of Agriculture at Eastern University of Sri Lanka were the intended audience. There were five batches of students under the Faculty of Agriculture, EUSL, during the study period, and the total number of students was 318. The survey included 100 students randomly selected from the five batches. The number of students selected from each batch was proportional to the total number of students in that batch. For the study, students from each batch were picked by simple random sampling technique.

Table 01 gives the sample size of the study.

Table 01: Sample size of the study
(Source: Field Survey, 2023)

Batches	Total Students	Sample size
1 st year 1 st Semester	76	24
2 nd year 1 st Semester	69	22
2 nd year 2 nd Semester	73	23
3 rd year 2 nd Semester	54	17
4 th year 2 nd Semester	46	14
Total	318	100

C. Data collection

In this study, a questionnaire survey was the principal primary data collection method. A

structured questionnaire was used to measure the variables. The study also gathered secondary data from various sources, including textbooks, published sources, statistics handbooks, libraries, websites, and more. Additionally, data pertaining

to the current study were gathered from the literature through empirical proof, real-world instances, and other research findings.

D. Data Analysis

The data gathered were analyzed using the IBM SPSS Statistics software, version 23.0 (Statistical Package for the Social Sciences). In addition to the absolute (n) and relative (%) frequencies, the mean and standard deviation (SD) were calculated for the statistical description. The chi-square analysis was performed to test the association among different variables.

III. RESULTS AND DISCUSSION

This study consisted of 100 participants, most of them were females (82%) and from 20 different districts of Sri Lanka. Most of the students, nearly 63 per cent, live in urban areas. About 95% of Students reported eating fast food one or two times a week, and they preferred and had become used to it. This indicates a moderate frequency of consumption. However, a more recent study conducted among students from higher education in Portugal found that students consumed fast food one to six times per week, with a high frequency of fast-food consumption (Oliveira and Raposo, 2024). Usually, fast-food items are taken as breakfast, lunch, snacks, dinner, or other periods. From the study, it was found that most of the students (more than 50%) preferred to take fast food as snacks. According to their consumption time, they prefer to grab fast food between 2 pm and 6 pm. More than half of the students (63%) preferred to consume both restaurant-made and home-made fast foods, followed by restaurant-based (20%) and home-made (12%).

A. Factors considered by the students during the selection of fast foods

The respondents were asked to rank the key factors considered when selecting fast food at a restaurant or home. The factors mentioned include healthy food, taste, calories, price, quantity, satisfaction, and variety. The responses are discussed below.

Taste: 80% of the students considered taste to be an important factor when purchasing fast food. A similar result was also observed by Pinnagoda (2017) and Kaushik et al. (2011), indicating that taste was the primary factor (50.3%) in consuming

fast food. Most of the respondents in this study considered fast food tastes when making their selections.

Healthy food: Around 78% of the students considered healthy food a key factor when selecting a fast-food, indicating awareness of food and health choices. A likely result was observed by Oliveira and Raposo (2024) in their study among higher education students in Portugal, where students considered healthy food during the selection of fast-food and were concerned about their body weight management.

Calories: Almost 66 per cent of respondents considered calories to be an essential priority when selecting fast food.

Price: The results show that 70% of respondents considered price an essential priority when selecting fast foods, indicating the students considered cost as a significant factor when deciding what to eat.

Quantity: The results show that 50 per cent of respondents considered quantity of food as an essential priority while selecting fast foods.

Satisfaction: According to the results, 68 per cent of respondents considered consuming fast food for satisfaction.

Variety of menu: According to the results, 49 per cent of respondents highly prioritized the variety of fast-food items while selecting fast foods. Similarly, Harris et al. (2010) discovered that a diverse menu encouraged restaurant visits for specific eating occasions.

Among the factors such as health, calories, taste, price, quantity, satisfaction, and variety, students were asked to rank their important priorities when selecting fast foods. Most students preferred to consider taste as their foremost priority, followed by healthy food, price, satisfaction, the calorie content of fast food, quantity, and variety of food. The lowest number of students preferred to consider the variety of fast-food items. Table 02 gives the mean and standard deviation of the priority factors.

Table 02 : Mean and standard deviation values of factors considered during the selection of fast-food

Factors	Mean	Std. Deviation
Taste	6.0698	1.42903
Health	4.7473	1.94132
Price	4.2706	1.73472
Satisfaction	3.9176	1.96524
Calories	3.4125	1.91393
Quantity	3.2785	1.45828
Variety	2.8077	1.77323

(Source: Field Survey, 2023)

B. Factors associated with fast-food

Consumption frequency per week

A chi-square test was carried out with the variables: Advertisement, good taste (liking & enjoying the taste), limited time for cooking, cost, variety of menu, and eating with friends or family to identify their association with fast-food consumption frequency. Here, fast food consumption frequency was studied under four

categories: 0 times, 1-2 times, 3-4 times, and 5 times or more per week. Table 03 gives the c Chi-square analysis between fast-food consumption per week and selected variables.

Table 03 : Chi-square analysis between fast-food consumption per week and selected variables

Factors	Chi-square Value [X^2]	<i>p-value</i>
Advertisement	17.849 ^a	0.466
Good taste	29.980 ^a	0.038*
Limited time for cooking	25.683 ^a	0.041*
Cost/price	19.123 ^a	0.384
Variety of menu	32.377 ^a	0.020*
Eating with friends or family	29.384 ^a	0.044*

Means with different letters represent significant differences at $p < 0.05$

This chi-square test between the variety of menus and fast-food

frequency per week shows that the corresponding p -value is less than 0.05 ($p = 0.020$; $X^2 = 32.377$). This implies that the two variables have an association between them. When testing the good taste, it was shown that two variables are associated ($p < 0.05$; $X^2 = 29.980$). This highlights the importance of palatability in food consumption. The same was observed for the association between limited time for cooking and fast-food consumption frequency per week ($p < 0.05$; $X^2 = 25.683$). University students are generally loaded with study-related activities and find very little time for cooking. This situation results in obtaining fast food from restaurants or preparing it at home. In addition, a significant association ($p < 0.05$; $X^2 = 29.384$) was also

observed between the frequency of fast-food consumption per week and eating with friends or family. Advertisements on fast foods were found not to be associated with the fast-food consumption frequency per week ($p > 0.05$; $X^2 = 17.849$). Similarly, the study results reveal that fast-food consumption frequency per week was not influenced ($p > 0.05$; $X^2 = 19.123$) by the cost/price of fast-food. Accordingly, advertisement and cost were not influenced fast food consumption frequency, and the variety of menu, limited time for cooking, taste factor, and eating with friends or family were found to be influenced by the fast-food consumption frequency per week.

IV. CONCLUSION

It is concluded from the study that most of the students in the Faculty of Agriculture, Eastern University, Sri Lanka, preferred to consume fast food. Among the fast foods, most students preferred to consume short foods like samosa, rolls, and pastries, and their least preference was energy drinks. While selecting fast food, most students considered the taste of fast-food items an important factor, and the least considered factor is the variety of fast-food items. The study further concluded that there is a significant association between the frequency of fast-food consumption per week and the menu variety, limited cooking time, good taste, and eating with friends or family. Accordingly, these factors influence the fast-food consumption pattern of the Faculty of Agriculture, Eastern University, Sri Lanka undergraduates. The findings of this study have significant consequences for college students and offer guidance for creating stronger approaches to promote healthy eating choices.

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Physico-chemical and Consumer Preference Analysis of Novel Herbal Soap Enriched with Aloe vera (*Aloe barbadensis*)

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Abstract

Herbal soaps are popular products at a homemade scale worldwide, but innovative and commercialized local formulations are rare. Sri Lanka has a rich herbal diversity, and several plant extracts have been scientifically proven to show bioactivities such as anti-inflammatory, antibacterial, and antifungal properties. An instance of this is a herbal soap formulation that is useful for treating microbiological infections and regular use. The current study aimed to develop a novel herbal soap enriched with extracts of aloe vera (*Aloe barbadensis*), citronella oil (*Cymbopogon nardus*) and black tea (*Camellia sinensis*), evaluate the physico-chemical properties, and gauging consumer preference for the finished prototype while advancing the technology of the current saponification process. The soap base was produced by saponifying coconut oil with NaOH at 40°C, subsequently value added by incorporating 8% aloe vera gel, 4% citronella oil, and 4% black tea extract, and

allowed to age for 72 hours at 32°C. The physico-chemical properties were determined as follows: density was 0.95 mg/ml, NaOH ratio was 4.16, free alkali content was 0.028% (0.007 mol/dm³), and Total Fatty Matter (TFM) was 79.6%. These metrics comply with the SLS 34:2009 standards and align with previous research findings, thereby classifying the product as Grade 1. Consumer assessment considered colour, aroma, texture, washing quality, and overall acceptability, revealing a brownish-golden hue, pleasant fragrance, a soft, consistent texture and gentle hand impact. Consumer preference was assessed across diverse socio-economic groups, revealing a high overall acceptability rating of 8.65 out of 10. The study advances soap technology, emphasizing compatibility with existing standards and consumer satisfaction.

Keywords: Herbal soap, Aloe vera, Tea, Total fatty matters, Saponification

I. INTRODUCTION

Soap is a commodity that is commonly used for hygienic practices such as washing and cleaning. The soap is generated through a process known as Saponification. In this process, triglycerides, free fatty acids (FFA), and fatty acid methyl esters react with an alkaline (NaOH or KOH) to produce soap (Bahl and Arun, 2017). There are several fatty acids that have been involved in the production of soap such as lauric acid, myristic acid, palmitic acid, stearic acid, and oleic acid (Arasaretnam and Venujah, 2019). In commercialization, colourants and fragrances are added to soap as value addition (Rahman and Paramita, 2021; Nchimbi, 2020).

Different scientific studies have proven that aloe vera gel can be used as a moisturizer for hydrating the skin due to its antiviral, antibacterial, and

antioxidant properties (Mishra et al., 2023). Hence, the novel soap developed under this study was prepared with the incorporation of aloe gel. Moreover, the colour and fragrance of the novel soap were intended to be taken from natural ingredients. Citronella oil (*Cymbopogon nardus*) was used as the fragrance agent which imparts with addition of pleasant herbal smell to the developed soap and contributes to numerous actions such as antimicrobial, antioxidant, anticonvulsant and wound healing (Singh and Kumar, 2017) in addition to giving the fragrance for the developed aloe vera enriched soap. Hence, these properties have generated additional value for the developed soap further (Sharma et al., 2019).

Black tea (*Camellia sinensis*) was imparted for the addition of natural colour which has been

recognized as containing natural antioxidants such as catechin and has shown the antimicrobial, anticancer, and antifungal biological activities which generate more value to the developed soap product (Liczbiński, and Bukowska, 2022; Wang et al., 2022). Thus, when selecting the ingredients for the value addition, the aforementioned properties were considered (Pratama et al., 2021). This novel soap product was developed with enhancements to the technology of the existing saponification process to be easily adoptable in small and medium-scale enterprises. Nowadays, many novel herbal developments are carried out within the local university community, but the major drawback of these studies is the lack of commercial viability. In addressing this issue, the novel herbal soap enriched with aloe vera gel, citronella oil, and tea extract was assessed for compatible physico-chemical properties of a common soap product and acceptable consumer preference. In addition to the mere development of the product, in designing this study the concept of incorporation of aloe vera into several possible productions that could be carried out within the island is intended.

II. METHODOLOGY

A. Soap Production

Soap was made by saponification, filtering, and incorporation of herbs. For saponification, coconut oil and 20% NaOH were mixed and stirred in a beaker at 40°C for 40 minutes at 800 rpm, under controlled environmental conditions ($23 \pm 2^{\circ}\text{C}$). As the next step, saturated sodium chloride (NaCl) was added into the soap base in an ice bath. The NaCl-soap mixture was filtered through a muslin cloth. Then, the filtered soap base was washed with ice-cold water and 0.05 M Citric acid respectively until the washouts gave a pH below 8. The resulting soap base was weighed and then melted in a 90 °C water bath until the desired melted texture. Then, the soap was enriched with the herbal incorporations and herbal formulations were taken according to a scientific design based on the trial-and-error method. The product optimization was done to the selected final formulation with regard to the organoleptic properties. Then, the herbal soap mixture was set to the moulding and the final product was obtained after 72 hours of holding time.

B. Physico-Chemical Characterization

The physico-chemical characterization comprised visual observations on product quality, including

colour, texture, and aroma, alongside the mole ratio of coconut oil to NaOH (Rahman and Paramita, 2021), which were basically observed during its storing period and final stage of optimized soap at room temperature ($32 \pm 2^{\circ}\text{C}$).

Furthermore, density, pH, free alkali content (Betsy et al., 2013), and total fatty matter (TFM) (SLS 34:2009) were measured in triplicate to assess the formulation and quality of the novel herbal soap product.

C. Consumer Preference Evaluation

Consumer preference of the developed novel herbal soap was analyzed involving a 50-member consumer panel, recruited through careful screening from a pool of volunteers from the University staff to representing all defined social classes. In this consumer preference evaluation, the panelists were provided with a questionnaire and asked to rate the product regarding the attributes; colour, texture, odor, washing quality, and overall acceptability by using a ranking scale of 1 to 10, 10 being the highest value an attribute can obtain. Further, they were asked a few multiple-choice questions on their demographic details and preference perception.

D. Statistical Analysis

Data was analyzed using Microsoft Excel Professional plus 2016 and Minitab -17 statistical software to get the mean rank value and the standard deviation of each mean rank value for the consumer preference and each physico-chemical data regarding the newly developed herbal soap with the incorporation of aloe vera.

III. RESULTS AND DISCUSSION

As shown in Table 01, panelists have shown a higher preference, above the acceptable range in each attribute for the developed novel herbal soap. With the acceptance of 96% of consumer panelists, the developed herbal soap product has obtained overall consumer acceptability with 8.65/10 mean rank value. The panelists were specifically invited to represent a cross-section of the general public, encompassing a range of socio-economic backgrounds. Therefore, the received consumer preference score is comprehensive in defining the quality of the developed novel herbal soap.

Table 01 : Mean rank values of the evaluation of consumer preferences

Consumer Preference (n=48)	Mean rank value (out of 10)
Color	8.06±0.96
Texture	8.27±1.25
Odor	9.98±0.94
Washing Quality	9.31±0.97
Overall acceptability	8.65±0.92

The final aloe vera incorporated herbal soap has given the observations as shown in Figure 01. It was brownish gold in colour and found to have a soft consistency. The citronella aroma existed after the solidification and the smell remained throughout the storing time at room temperature. In herbal value addition to the novel soap, aloe vera was used as the major value-adding ingredient, due to its antimicrobial activities, antioxidant activities, wound healing, moisturizing and beauty care properties.

The high antioxidant content of aloe vera slows down the ageing process of the skin while stimulating proper blood saturation via the vitamin and minerals present in aloe fillets. Also, due to its Additionally, though the citronella oil was used for the fragrance, and the tea extract was intended for imparting color, the antioxidants, flavonoids, and polyphenols compositions had enhanced the medicinal properties (antimicrobial, insecticidal, antioxidant, and dermatotoxicity activities) of the soap (Wany, et al., 2013; Sharma et al., 2019).

The weight of the prepared trial samples was between 7.6 ± 0.5 g. As shown in Table 02, the physico-chemical properties of the final sample, pH value was measured as 7.03 which represented the neutralized chemical nature. Although the resulting pH value is less than the standard value

hydrating effect, aloe vera is beneficial in masking the dehydration that may be caused by the coconut oil-based soap. The most common oil used in soap production is coconut oil which is known to cause skin dryness evident in a wealth of previous studies (Ngan et al., 2020). Further, aloe gel has the ability to remove dead skin cells and has a good penetrating power, which aids in the transportation of healthy substances through the skin (Liang et al., 2021).



Figure 01 : Prototype of developed Aloe vera incorporated novel herbal soap

(pH 8.0 -10.0), the neutralized pH value represents that the developed herbal soap is ideal for the prevention of skin irritation due to the incorporation of aloe vera gel while advancing the soothing effect. Thus, it is suitable for body washing, and cleansing purposes further.

The density of the soap and the molar ratio between coconut oil and NaOH used in the saponification process were calculated as 0.95 ± 0.006 g/mL, and 1:4.16 respectively. Those values were proved to be compatible compared to the previous study of Rahman and Paramita, (2021).

Table 02: Results of determined physicochemical properties of the final porotype

Physico-chemical Property	Amount	Reference values	Reference
pH	7.03±0.01	8.0 – 10.0	Das et al., 2024
Density (g /mL)	0.95±0.006	1.02	Rahman and Paramita, 2021

Mole ratio (Coconut oil: NaOH)	1:4.16±0.006	1:5	Rahman and Paramita, 2021
Free caustic alkali content (Percent in mass)	0.028%±0.000	0.06% (max.)	SLS 34:2009
Total Fatty Matter (TFM) content	79.6% ±0.058	76.5 (min.)	SLS 34:2009

IV. CONCLUSION

The free alkali content of the sample was given a value of 0.028% (0.007 moldm⁻³) with standard 0.1 moldm⁻³ HCl solution under the phenolphthalein indicator. The alkalis used to make soap are KOH (potassium hydroxide) and NaOH (sodium hydroxide). The most popular toilet soaps are sodium carboxylates. The fatty acids that are bound to glycerol in the precursor triglycerides play a crucial role in determining the molecular makeup of soap. Specifically, the proportion and type of these fatty acids determine the resulting sodium or potassium carboxylates formed during saponification, and this relationship governs the physicochemical properties of the soap (Moody et al., 2004).

Total Fatty Matter (TFM) content was 79.6% which is higher than the estimated TFM content of the previous study of Ahmed et al., (2021) (Ahmed et al., 2021). TFM value denotes one of the most important factors in terms of the quality of soap. According to the TFM value, the soap is graded into three categories such as grade 1 (above 76%), grade 2 (above 60%), and grade 3 (above 50%) (Betsy et al., 2013). Further, the TFM value is a metric for calculating how much fatty matter is present in soaps and the quality of the soap improves with a higher TFM content. High moisture concentrations in soap are caused by TFM%. Other elements that may affect the TFM value include the forms and amounts of fatty materials employed, as well as potential variations in the saponification process. Additionally, the resulting TFM value of the novel soap represents the lack of the presence of unreacted NaOH. Hence, the determined result of the TFM value of the prepared organic soap belongs to grade 1. That is associated with high quality, less hardness, and increased moisturizing properties of the soap (Betsy et al., 2013).

The production of the aloe vera-enriched herbal soap, incorporating citronella as a fragrance agent and tea extract as a colouring agent, demonstrated compatible physico-chemical properties—such as pH, density, molar ratio between coconut oil and NaOH, free alkali content, and total fatty matter (TFM)—with commercial products. Additionally, the soap achieved favourable consumer acceptance, indicating a successful development at the laboratory scale.

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ABBREVIATIONS

Sodium hydroxide (NaOH), Potassium hydroxide (KOH), Sodium chloride (NaCl), Total fatty matter (TFM), Sri Lanka standard (SLS)